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FROM PROPERTY COMPANIES TO REAL ESTATE INVESTMENT TRUSTS: THE IMPACT OF ECONOMIC AND PROPERTY FACTORS IN THE UK COMMERCIAL PROPERTY RETURNS

Vitor Leone

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Dr Juan Carlos Cuestas
Division of Economics
Nottingham Trent University
Burton Street
Nottingham, NG1 4BU
UNITED KINGDOM
Email: juan.cuestas@ntu.ac.uk

From Property Companies to Real Estate Investment Trusts: The Impact of Economic and Property Factors in the UK Commercial Property Returns

Vitor Leone

Economics Division

Nottingham Trent University

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Abstract: This study investigates cross-sectionally the impact of economic and property factors on the returns of UK property companies and real estate investment trusts. By applying structural time-series modelling and the Kalman Filter to obtain unexpected changes or innovations in selected economic and property variables it was found for the sample period analysed that economic and property variables influence commercial property returns in the UK. It was also found that by converting into REITS property companies quickly acquired hybrid features of securitised and property backed assets.

Keywords: REITS, commercial, property returns, innovations, Kalman Filter, cross-section, panel data, innovations, unexpected changes.

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Corresponding author: vitor.leone@ntu.ac.uk

1. Introduction

In recent years, interest in the performance of real estate markets and securitised real estate investments represented, for example, by real estate investment trusts (REITS) and general securitised real estate indices has become increasingly popular.

Traditional research on investigating commercial real estate returns has put emphasis on economic and financial factors which influence those returns since the impact that macroeconomic variables have on real estate markets and REITS plays an important role in the risk management of property investors. As such, previous studies attempt to find exogenous influences which will help determine the risk structure of commercial real estate returns through time.

Studies aiming to find the links between real estate returns, economic and financial factors have been overwhelmingly carried out using US data. Chan et al. (1990) showed that changes in the default risk and the term structure of interest rates within a multifactor arbitrage pricing model helped to explain real estate returns movements proxied by returns on REITS. McCue and Kling (1994) applied an unrestricted VAR model to explore the linkages between the macroeconomy and real estate returns through time. The aim was to determine the extent to which the macroeconomic variables explain real estate returns and how these returns react to shocks in those variables. The macroeconomic variables used on by McCue and Kling were based on a model of firm investment behaviour by Lawrence and Siow (1985) which includes prices proxied by the consumer price index, short term nominal rates proxied by the three-month treasury bill-rate, output proxied by the Federal Reserve' Industrial Production Index, and for investment the McGraw Hill Construction Contract Index. The results showed that the macroeconomic variables explained approximately 60% of the variation in real estate returns proxied the National Association of Real Estate Investment Trust (NAREIT) equity REIT index, with nominal interest rates explaining the greatest percentage of the variation in the real estate series (36%).

Ling and Naranjo (1997) looked into the links between economic risk factors and commercial real estate returns in the US market and found that the growth rate in real per capita consumption, the real treasury-bill were consistently priced on a APT asset pricing model test framework with fixed coefficients and the term structure of interest rates and unexpected inflation were significant when sensitivities and risk premia were allowed to vary over time.

Chen, Hsieh, Vines and Chiou (1998) investigated the cross-sectional variation in equity real estate investment trusts using a pooled cross-sectional time-series approach as an alternative to the two-step Fama-MacBeth regression. Four pricing models were used to explain real estate returns, the CAPM, a firm-specific model based on Fama and French (1992) three-factor model where firm-specific attributes are presumed pricing factors, a macroeconomic variable model where the chosen economic time-series based on Chen, Roll and Ross (1986) are assumed to be pricing factors, and a combined model including all the variables associated with the other three models. The results rejected the CAPM explanation with the beta coefficient not being different from zero but found size as significantly priced among REITS in the firm-specific model and the term structure of interest rates in the macroeconomic model. The combined model showed only size as significant variable. The authors concluded that the size factor appear to be the dominant factor in explaining real estate returns.

Chen, Hsieh and Jordan (1997) applied the arbitrage pricing theory (APT) on monthly returns of equity real estate investment trusts using two empirical models a factor loading model constructed by factor analytical approach and a macroeconomic model using the same economic factors of Chen, Roll and Ross. The aim of the study was to find the priced macroeconomic variables and to compare the performance of the two empirical versions of the APT. Using three sample periods they found that unanticipated inflation and a market residual factor, unanticipated change in the term structure and the unanticipated change in the risk premium as significant variables and the macroeconomic model being in general superior than the factor loading model in explaining real estate returns in two of the three analysed sample periods.

Payne (2003) investigated the effects that shocks to macroeconomic variables would have on the excess returns of three broad classifications of REITS (equity, mortgage and hybrid) by using an unrestricted vector autoregressive model (VAR) and general impulse response analysis which did not impose the ordering of the variables in the VAR. The results showed that unexpected changes in the broad stock market index was positively significant to all three types of REITS, unexpected changes to the growth of industrial production was negatively significant for hybrid and mortgage REITS, unexpected changes to inflation and default risk insignificant for all three types, unexpected changes to the term structure negatively related to equity and

hybrid REITS and unexpected changes to federal funds rates adversely affect mortgage and hybrid mortgages.

Using a multifactor asset pricing model (MAP) Sing (2004) examined the effects of systematic risk factors and common risk factors on the fluctuations in excess returns of direct and securitised real estate investments using the seemingly unrelated regression (SUR) technique and the Fama-MacBeth (1973) two stages regression to estimate the risk premia in the MAP models. They found that macroeconomic risk factors are priced quite distinctly in direct and securitised real estate markets.

Ewing and Pane (2005) using an unrestricted VAR and generalised impulse response analysis on the NAREIT index for all-public traded REITS in the United States found that unanticipated changes or innovations to monetary policy, economic growth, and inflation are all associated with a fall in REITS returns, while innovations to the default risk premium is associated with raises in REITS returns. Bredin, O'Reilly and Stevenson (2007) applying a GARCH model to focus on the impact of innovations in the US monetary policy on returns and the volatility of equity REITS found indications of strong responses in both returns and volatility to the innovations, although the volatility trend remained unchanged. The importance of monetary policy for REITS returns is also the focus of the research by Simpson, Ramchander and Webb (2008) who found a significant response of equity returns to inflation and highlight a dependence on the predominant monetary policy environment, during expansionary periods, equity REITS are influenced by both raising and reducing inflation.

In the UK, the links between economic, financial variables and commercial real estate returns have attracted much less research interest. Lizieri and Satchell (1997) using a threshold autoregressive model (TAR) investigated the relationship between real interest rates and property prices and concluded that property company share prices proxied by the DataStream UK property price index are sensitive to real interest rates in the UK. Specifically the price effects of high relative interest rates are much sharper than those of lower interest rates. In other words, where there were high rates property prices fell very sharply with low volatility and with lower rates the increase in prices were less pronounced.

Brooks and Tsolacos (1999) employed a VAR model to investigate the impact of macroeconomic and financial variables on a UK real estate return series represented by the FTSE Property Total Return Index and a set of economic variables which are

commonly used in studies of stock returns predictability. That is, by stating that the same assumptions linking movements in stock returns to macroeconomic and business conditions apply to real estate returns, changing trends in the economic and business environment were examined by the following variables: the rate of unemployment, nominal interest rates, the term structure of interest rates, unanticipated inflation and the dividend yield. Authors concluded that the UK real estate returns cannot in general be explained by the set of variables used on the study, however there were suggestions that the term structure, unexpected inflation have some effect on property returns.

Hoskins, Higgins and Cardew (2004) compared the relationships of macroeconomic variables on the commercial property markets in Australia, Canada, the UK and the US to find that GDP, unemployment and inflation as main determinant factors. Wang (2006) using the functional linkages between real estate returns and economic activities in the UK proposed a multivariate approach to unsmoothing appraised based real estate indices (IPD and the JLW real estate indices) to infer how much those appraised indices were smoothed and concluded that the method enabled for the correction of appraisal-smoothing suggesting a reasonable volatility in direct real estate investment that was closed to the real equity market volatility.

Schatz and Sebastian (2009) looked into empirical evidence on the dynamic interactions between the property markets in Germany and the UK and their country-specific macroeconomic environment. Deviating from traditional research this study was focused on appraisal-based property indices (The UK IPD and the German IMMEX). Applying a vector error correction model (VECM) the authors examined the development of real estate prices while considering the influences of a wide range of macroeconomic risk factors on both markets to find that property markets in Germany and the UK for long-term equilibria showed comparable results in terms of significance, order, magnitude and sign. Specifically they found a negative relationship between the property indices and unemployment rates, and a positive link with both property markets and the respective consumer price index and government bond yields.

The objective of this paper is to address the lack of research linking commercial real estate returns (represented cross-sectionally by real estate investment trusts) and unanticipated changes in economic and property variables in the UK real estate market; and second explore the idea that these links between unanticipated changes or

innovations and real estate returns are likely to change when a sample of UK listed property companies opted to be transformed into REITS with the introduction of the UK REITS legislation in January 2007. In other words, the major objective is to find whether the impact of economic and property factors are useful in explaining cross-sectional property returns represented by a sample UK REITS also if these factors have changed when these REITS previously to 2007 were listed and traded as ordinary property company shares. To analyze these changes we focus this research on three sample periods which cover the period before REITS (2001 to 2006), after (2007 to 2009) and the whole sample (2001 to 2009).

In order to achieve those aims we applied traditional panel data analysis in a sample of listed property companies before and after they turned into REITS. Unexpected changes or innovations on the selected economic and property variables were obtained by using the residuals generated from structural time-series models or unobserved components time-series models and the application of the Kalman Filter to fit these unobserved component models. For the sample period (2001-2009) we not only found that real estate returns are sensitive to macroeconomic and property variables cross-sectionally and through time but also by opting to become REITS the listed property companies kept and acquired both the features of stocks and real estate assets when related to exogenous influences. We also found distinguished patterns of economic and property factors related to real estate returns for the period before the advent of REITS (2001-2006) and after its introduction (2007-2009).

The remainder of this paper is organised as follows. Section two discusses the selection of data and the generation of unanticipated changes or innovations in the economic and property variables. Section three provides empirical evidence. Section four presents the conclusion remarks.

2. Data and Methodology

2.1. Real Estate Returns

The starting point for the data used in this study is all property companies who turned into REITS traded on the London Stock Exchange (LSE). It can pin pointed that: i) one of the advantages for these property companies to enter into the REIT regime are low tax burden. That is, the income generated through the rental business and gains arising on the sales of rental properties are generally outside the scope of tax; ii) in

line with the US, UK REITS are required to distribute at least 90% of its tax-exempt profits to its shareholders, and consequently there may be greater value in REITS over property company.

The current UK REITS MARKET according to UK REITA consists of 21 companies. From these 21 companies three were ruled out due to thin or almost inexistent trade and additional two because they did not exist as property companies before 2007. Therefore 16 of the 21 currently listed REITS were included in the study. It is important to highlight that since the introduction of the UK REITS legislation, according to the European Public Real Estate Association (EPRA) the estimated UK REITS market already represents 6.5% of the global REIT market and had a market capitalisation of 18.7 billion Euros (June, 2009). Time series monthly returns on the 16 selected listed property companies that turned into REITS from January 2007 were collected for the 2001-2009 period from DataStream Thompson Financial and listed on table 1 below:

Table1

LISTED UK REITS		
COMPANY	**SECTOR**	**SAMPLE DATA**
BIG YELLOW	SELF STORAGE	2001M1-2009M12
BRITISH LAND	DIVERSIFIED	2001M1-2009M12
DERWENT LONDON	OFFICES	2001M1-2009M12
GREAT PORTLAND ESTATES	OFFICES	2001M1-2009M12
HAMMERSON	DIVERSIFIED	2001M1-2009M12
HANSTEEN	INDUSTRIAL	2004M12-2009M12
HIGHCROFT INVESTMENTS	DIVERSIFIED	2001M1-2009M12
LAND SECURITIES	INDUSTRIAL	2002M10-2009M12
LIBERTY INTERNATIONAL	RETAIL	2001M1-2009M12
MCKAY SECURITIES	OFFICES	2001M1-2009M12
MUCLOW (A&J) GROUP	INDUSTRIAL & OFFICES	2003M2-2009M12
PRIMARY HEALTH PROPERTIES	HEALTHCARE	2001M1-2009M12
SHAFTESBURY	RETAIL	2003M2-2009M12
TOW CENTRE SECURITIES	RETAIL	2003M2-2009M12
WARNER ESTATE HOLDINGS	RETAIL	2003M2-2009M12
WORKSPACE GROUP	INDUSTRIAL & OFFICES	2003M2-2009M12

Source: Reita

2.2. Economic and Property Variables

In choosing the economic factors to include in our analysis we borrow from the literature that investigated the relationship between stock market returns as well as real estate returns and economic factors Here we follow both traditional practice and

published empirical findings (Chen *et al.*, 1986; Chan *et al*., 1990, McCue and Kling 1994; Clare and Thomas, 1994; Priestley, 1996; Ling and Naranjo, 1997; Brooks and Tsolacos, 1999; Payne, 2003; Ewing and Payne, 2005; Lawrence and Leone, 2008; Schatz and Sebastian, 2009) to select macroeconomic variables thought to influence either expected dividends $E(D_t)$ or the discount rate *R* of the stock valuation model:

$$P_0 = \sum_{t=1}^{\infty} \frac{E(D_t)}{(1+R)^t} . \quad (1)$$

As Brooks and Tsolacos (1999) highlight securitised real estate returns are likely to behave in similar way as stock returns which are assumed to be related to macroeconomic and business conditions. Therefore any economic or property variable related to changing trends in the economic and business outlook likely to affect equation (1) will have an impact on prices and observed returns and therefore potential candidates to be used on this type of research.

The selected economic variables are shown in Table 2. In addition to the variables commonly selected in other studies, we included the following property variables: the UK IPD All property index return which is an appraised-based commercial property index, UK All property rental growth and UK All property equivalent yield. By using these property variables as explanatory variables we deviated from the majority of academic literature linking commercial real estate returns to economic factors that usually do not use direct property appraised measures to explain equity based commercial property returns. We think they would be relevant to capture the transition of property companies returns to REITS returns especially rental growth and equivalent yields as they are likely to help to explain REITS returns but not property companies returns. The later should have features of equities and the former both the features of equities and direct real estate. The choice of including the UK FTA All Share index and its Dividend Yield is explained by the fact that the market index return is a generally powerful explanatory variable and its exclusion could lead to an omitted variables bias. While the variables are expected to have an impact on the valuation of cash flows they are also intended to capture economic growth, and the impact in the demand and supply for commercial property (Industrial production and unemployment respectively), portfolio balance (exchange rate between sterling and the US dollar), and risk premium (term structure of interest rates calculated as the difference in yields between UK 20 years Government Bond and the UK three-month

treasury bill). Monthly data for these variables are drawn from The UK Investment Property Database (IPD), Office of National Statistics (ONS), DataStream Thompson Financial and from the Bank of England (BOE) and collected from 1998M1 to 2009M12 as information previous to 2001 were needed to apply the Kalman Filter to fit the unobserved components models and obtain the innovations in the economic and property variables for the investigation period considered on this study (2001M1-2009M12).

Table 2

SELECTED ECONOMICS AND PROPERTY VARIBLES	
VARIABLE	**SOURCE**
UK FTSE ALL SHARE INDEX RETURNS(FTSE)	DATASTREAM
UK FTSE ALL SHARE DIVIDEND YIELD (DIV)	DATASTREAM
UK CONSUMER PRICE INDEX (CPI)	ONS
UK IPD ALL PROPERTY RETURNS (IPD)	IPD
UK INDUSTRIAL PRODCUTION (INDP)	ONS
UK ALL PROPERTY RENTAL GROWTH (RENT)	IPD
UK MONTHLY AVERAGE YIELDS ON 20 YEARS GOVERNMENT BONDS(LTB)	BOE
UK 3MONTH TREASURY BILL RATE (3MTB)	BOE
TERM STRUCTURE OF INTEREST RATES (TERM)	LTB-3MTB
UK UNEMPLOYMENT RATE (UNEMP)	ONS
UK ALL PROPERTY EQUIVALENT YIELD (EQY)	IPD
STERLING US DOLLAR EXCHANGE RATE (EXRATE)	BOE

2.3. Generating Innovations in the Economic and Property Variables

Research on the relationship between stock and or commercial property returns and economic variables, are often focused on the idea that the way these returns are valuated is underpinned by real economic and business outlook.

As Chen *et al.* (1986) have argued on their paper, it is only the unexpected component of economic news or 'innovations' that should have any impact on asset prices in efficient markets. It is therefore of considerable importance to use an appropriate method of estimating the unexpected changes or innovations in any econometric investigation of the relationship between commercial property returns and economic variables since this may have a strong bearing on the results. Innovations should qualify as genuine shocks and should therefore be zero-mean, serially-uncorrelated white-noise processes. The most common approach is to calculate the first differences

in order to render the variable under investigation as stationary. However, Priestley (1996), Garrett and Priestley (1997), Antoniou *et al*. (1998) Cauchie *et al.* (2004), Lawrence and Leone (2008), and Leone and Lawrence (2008b) have shown that first differences usually fail to produce serially-uncorrelated white-noise processes and by using structural time-series analysis with the Kalman Filter algorithm embodies an updating process whereby investors can change their expectations in response to economic news. That is, economic agents learn and update their expectations recursively each period as more information becomes available such that the problem of estimating an expectation series and generating the unanticipated component becomes, in the simplest case, one of signal extraction which can be achieved through the use of the Kalman Filter.

Structural time series or unobserved components modelling using the Kalman Filter is a state-space approach to time-series modelling that involves the decomposition of the series under investigation into unobserved components which are the presence or absence of the level, trend seasonality, cyclicity, autoregressiveness, or irregularity inherent in the series.

The model can be written as

(2) $y_t = \mu_t + \gamma_t + \nu_t + \varepsilon_t$ and ε_t is NID (0, σ_ε^2), $t = 1,\ldots,T$

Where μ_t is the trend, γ_t is the seasonal, ν_t is a first order autoregressive component, and ε_t is the irregular. The stochastic trend component is specified as

(3) $\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t$ and η_t is NID (0, σ_η^2);

(4) $\beta_t = \beta_{t-1} + \zeta_t$ and ζ_t is NID (0, σ_ζ^2), where β_t is the slope of the trend μ_t. The irregular ε_t, the level of disturbance η_t and the slope disturbance ζ_t are mutually uncorrelated.

In the investment context it permits optimal updating of economic information and could therefore be a useful way to model innovations in economic variables (economic ‘news’). Durbin and Koopman (2002) note that structural time-series

models built using state space format are very general (subsuming ARIMA models) and allow for an underlying structure that changes over time. The 'Structural Time Series Analyser, Modeller and Predictor' software (STAMP) of Koopman, *et al.* (1999) was used to apply the Kalman Filter, specifying stochastic level, stochastic slope, stochastic trigonometric seasonal and irregular components and lags of the dependent variable included if necessary. Estimation was performed by maximum likelihood.[1] Unlike the Box-Jenkins ARIMA models, none of the variables are adjusted by first differencing (Durbin and Koopman 2002; Schatz and Sebastian, 2009; argue that using first differences may lead to loss of information and to distortions of the results). Table 3 gives the final models, showing the number of iterations necessary to achieve convergence and the strength of convergence. 'VERY STRONG' convergence signalled by the STAMP programme indicates that successful maximum likelihood estimation has been carried out by numerical optimisation. Failure to achieve convergence may be an indication of a poorly specified model. The residuals from the final models constitute the unexpected changes or innovations in selected economic and property variables used on this paper. Tables 4 shows the Ljung-Box test results for serial correlation and the Augmented Dickey-Fuller (ADF) and Phillips-Peron stationarity tests for both the first differences and the residuals of the final selected unobserved components models.

[1](Detailed description of unobserved components modelling and the Kalman Filter can be found at Cuthbertson, 1988; Harvey, 1989; Durbin and Koopman, 2002, Harvey et al. 2004; Harvey and Proietti, 2005; Commandeur and Koopman, 2007)

Table 3

STRUCTURAL TIME-SERIES MODELS OF THE ECONOMICS AND PROPERTY VARIABLES (KALMAN FILTER)	
VARIABLE	**SELECTED MODEL**
UK FTSE ALL SHARE INDEX RETURNS(FTSE)	LEVEL+SLOPE+IRREGULAR.(VERY STRONG CONVERGENCE AFTER 8 ITERATIONS)
UK FTSE ALL SHARE DIVIDEND YIELD (DIV)	LEVEL+SLOPE+LAGS(1,2,4,10)+IRREGULAR (VERY STRONG CONVERGENCE AFTER 6 ITERATIONS)
UK CONSUMER PRICE INDEX (CPI)	LEVEL+SLOPE+TRIG SEASONAL+IRREGULAR (VERY STRONG CONVERGENCE AFTER 10 ITERATIONS)
UK IPD ALL PROPERTY RETURNS (IPD)	LEVEL+SLOPE+LAGS(2,3,4,7,9,12)+IRREGULAR (VERY STRONG CONVERGENCE AFTER 13 ITERATIONS)
UK INDUSTRIAL PRODUCTION (INDP)	LEVEL+SLOPE+IRREGULAR (VERY STRONG CONVERGENCE AFTER 4 ITERATONS)
UK ALL PROPERTY RENTAL GROWTH (RENT)	SLOPE+LEVEL+LAGS(1,3,4,9)+IREEGULAR (VERY STRONG CONVERGENCE AFTER 48 ITERATIONS)
TERM STRUCTURE OF INTEREST RATES (LTB-3MTB)	SLOPE+LEVEL+LAGS(1,3,10)+IREEGULAR (VERY STRONG CONVERGENCE AFTER 11 ITERATIONS)
UK UNEMPLOYMENT RATE (UNEMP)	LEVEL+SLOPE+IRREGULAR (VERY STRONG CONVERGENCE AFTER 17 ITERATONS)
UK ALL PROPERTY EQUIVALENT YIELD (EQY)	LEVEL+SLOPE+IRREGULAR (VERY STRONG CONVERGENCE AFTER 6 ITERATONS)
STERLING US DOLLAR EXCHANGE RATE(EXRATE)	SLOPE+LEVEL+LAGS(1,2,3,5,7)+IREEGULAR (VERY STRONG CONVERGENCE AFTER 4 ITERATIONS)

Table 4

ECONOMICS AND PROPERTY VARIABLES INNOVATIONS SERIAL CORRELATION AND STATIONARITY DIAGNOSTICS							
VARIABLE	**FLAG**	**FIRST DIFFERENCE INNOVATIONS**			**STRUCTURAL MODEL-KALMAN FILTER INNOVATIONS**		
VARIABLE	**FLAG**	**LJUNG-BOX (LAG 24)**	**ADF**	**PP**	**LJUNG-BOX (LAG 24)**	**ADF**	**PP**
UK FTSE ALL SHARE INDEX RETURNS(FTSE)	FTSE	***50.289 (0.001)***	(-12.213)***	(-22.692)***	24.803(0417)	(-8.857)***	(-8.998)***
UK FTSE ALL SHARE DIVIDEND YIELD (DIV)	DIV	***45.942(0.004)***	(-3.425)**	(-8.996)***	9.433(0.997)	(-9.733)***	(-9.719)***
UK CONSUMER PRICE INDEX (CPI)	CPI	***283.29(.0000)***	(-5.071)***	(-57.822)***	29.108(0.216)	(-8.877)***	(-8.845)***
UK IPD ALL PROPERTY RETURNS (IPD)	IPD	***34.708(0.073)***	(-9.235)***	(-9.223)***	19.336(0.734)	(-9.394)***	(-9.400)***
UK INDUSTRIAL PRODCUTION (INDP)	INDP	***19.103(0.751)***	(-11.927)***	(-11.813)***	19.777(0.709)	(-9.706)***	(-9.730)***
UK ALL PROPERTY RENTAL GROWTH (RENT)	RENT	***113.16(0.000)***	(-4.436)***	(-13.772)***	***47.538(0.003)***	(-4.796)***	(-8.8467)***
TERM STRUCTURE OF INTEREST RATES (LTB-3MTB)	TERM	***38.979(0.027)***	(-6.194)***	(-6.148)***	9.517(0.996)	(-9.512)***	(-9.473)***
UK UNEMPLOYMENT RATE (UNEMP)	UNEMP	***107.88(0.000)***	(-4.048)***	(-6.829)***	21.181(0.628)	(-9.868)***	(-9.866)***
UK ALL PROPERTY EQUIVALENT YIELD (EQY)	EQY	***234.0(0.000)***	(-2.808)*	(-2.681)*	14.024(0.946)	(-8.401)***	(-8.423)***
STERLING US DOLLAR EXCHANGE RATE (EXRATE)	EXRATE	***41.405(0.015)***	(-6.867)***	(-6.929)***	23.323(0.501)	(-10.380)***	(-10.527)***

Note: Values in bold and italics with attached probabilities indicate significant presence of serial correlation. ***; **; * indicates the rejection of unit root at 1%, 5%, and 10% significance levels.

Table 3 shows that first differencing although succeeds in creating stationary innovations, dramatically fails to generate serially uncorrelated series with all variables unexpected changes having strong presence of serial correlation.

2.4. The Linear Panel Data Model

Traditional panel data analysis was the method of choice since it provides regression analysis with both spatial and temporal dimensions and the sample size can be increased considerably. The spatial dimension pertains to a set of cross-sectional units of observation. In the case of this research the returns on 16 UK REITS. The temporal dimension pertains to periodic observations of a set of variables characterizing these cross-sectional units over a particular time span which are the unexpected changes or innovations on the selected economic and property variables. The basic model using pooled data (Greene, 2008) is

(5) $Y_{i,t} = \alpha_i + \beta X_{i,t} + \varepsilon_{i,t}$.

The panel data have multiple observations, viz., t = 1,…,T (time periods) of each i =1,…, N cross-sectional observation unit (UK REITS) in the sample. There are k regressors in $X_{i,t}$ (explanatory variables), not including the constant term. α_i is the individual effect, which is assumed as constant over time and specific to the individual cross-sectional unit (UK REITS) in the one-way fixed firm effects model. $\varepsilon_{i,t}$ is a stochastic error term assumed to have mean zero and constant variance. For two of three sample periods (2001M1 to 2009M12 and 2001M1 to 2006M12) analysed due to missing observations of some of the cross-sectional units, unbalanced panels were applied. To define whether a fixed effects model which allows for different constants for each cross-section was preferred to a simple pooled regression the standard F-test (Likelihood Ratio test results were reported on table 5) was used. The tests indicated being the Fixed Effects Model appropriate for the 2001M1-2009M12 and 2007M1-2009M12. As our explanatory variables are the same for all UK REITS the random effects estimate of the cross-section variance term is likely to be zero and therefore there is no evidence of individual effects in the data what was confirmed by the Hausman test for random effects. (Hausman test results available on request).

Table 5

TEST CROSS-SECTION FIXED EFFECTS (LIKELIHOOD RATIO TEST)				
Sample Period	**Effects Test**		**Statistic**	**Prob.**
2001M1-2009M12	Cross-section F		**2.048279**	**0.0101**
	Cross-section Chi-square		**30.941355**	**0.0089**
2001M1-2006M12	Cross-section F		1.162204	0.296
	Cross-section Chi-square		17.757664	0.2756
2007M1-2009M12	Cross-section F		**1.476962**	**0.1085**
	Cross-section Chi-square		**22.746626**	**0.0897**

Note: Values in bold indicate the rejection of the common constant model in favour of the fixed effects model.

3. Empirical Evidence and Analysis

The regression results for each of the three sample periods are reported on table 6 below:

Table 6

PANEL DATA MULTIPLE REGRESSION RESULTS

SAMPLE PERIOD 2001M1-2009M12				SAMPLE PERIOD 2001M1-2006M12			SAMPLE PERIOD 2007M1-2009M12		
Variable	**Coefficient**	**t-Statistic**	**Prob.**	**Coefficient**	**t-Statistic**	**Prob.**	**Coefficient**	**t-Statistic**	**Prob.**
C	0.000319	0.108838	0.9133	0.013142	3.930343	0.0001	-0.022653	-4.003159	0.0001
DIV	-0.001173	-0.256054	0.7979	0.004088	0.467772	0.6401	-0.001446	-0.225942	0.8213
FSTE	**0.033455**	**6.907358**	**0**	**0.030499**	**3.830878**	**0.0001**	**0.035817**	**4.702446**	**0**
CPI	0.002167	0.602321	0.5471	0.005159	0.989865	0.3225	0.002787	0.485014	0.6279
IPD	**0.007635**	**2.594484**	**0.0096**	**0.011482**	**2.691139**	**0.0072**	**0.020135**	**3.779414**	**0.0002**
INDP	**0.011253**	**3.787901**	**0.0002**	**0.007113**	**2.197119**	**0.0283**	**0.021096**	**3.708068**	**0.0002**
EXRATE	**-0.00562**	**-1.93015**	**0.0538**	-0.0018	-0.51017	0.6101	**-0.01914**	**-3.77416**	**0.0002**
RENT	**0.012097**	**3.399529**	**0.0007**	-0.00028	-0.05747	0.9542	**0.024486**	**4.168841**	**0**
EQY	**0.006935**	**1.836954**	**0.0664**	-0.00078	-0.16021	0.8727	**0.030255**	**3.822324**	**0.0001**
TERM	**-0.01644**	**-5.43282**	**0**	**-0.0198**	**-3.73776**	**0.0002**	**-0.01129**	**-2.65561**	**0.0081**
UNEMP	0.00347	1.13683	0.2558	0.003763	1.059706	0.2896	0.002824	0.528373	0.5975
R-squared	0.190488			R-squared	0.095248		R-squared	0.286831	
Adjusted R-squared	0.176969			Adjusted R-squared	0.085582		Adjusted R-squared	0.254415	

Note: This table gives the cross-sectional slope coefficients, t-statistics and probabilities derived from running a fixed pooled cross-sectional time-series regression for 2001m1-2009m12 and 2007m1-2009m12 and a general pooled regression (no fixed effects) for 2001m1-2006m12 of individual UK REITS returns against unexpected changes or innovations on selected economic and property variables which are the residuals obtained from using the Kalman Filter to fit unobserved components time-series models to those variables. UK FTSE ALL SHARE INDEX RETURNS(FTSE), UK FTSE ALL SHARE DIVIDEND YIELD (DIV), UK CONSUMER PRICE INDEX (CPI), UK IPD ALL PROPERTY RETURNS (IPD), UK INDUSTRIAL PRODCUTION (INDP), UK ALL PROPERTY RENTAL GROWTH (RENT), TERM STRUCTURE OF INTEREST RATES (TERM), UK UNEMPLOYMENT RATE (UNEMP), UK ALL PROPERTY EQUIVALENT YIELD (EQY), STERLING US DOLLAR EXCHANGE RATE (EXRATE).

Preliminary analysis of table 6 indicates that UK REITS returns are sensitive to macroeconomic and property variables on the sample periods investigated. This result contradicts the findings of Brooks and Tsolacos (1999) who found for the 1985M12 to 1999M1 that the variation in UK property returns, net of stock market influences could not be explained by any of the main macroeconomic or financial variables used on their research. The authors highlighted and we endorse that one likely explanation for their results were possibly the choice of variables for the sample period analysed which did not convey the information about macroeconomy and business conditions assumed to determine the inter-temporal behaviour of property returns. They also support some of our findings related to the relevance of appraised property factors such as rent and yields by conjecturing that they were likely to influence property returns and unfortunately were omitted from their research.

Although the R-squares of the panel regressions were not high this did not come as a surprise due to volatile events embraced in the sample period such as 09/11 and recent financial crisis. As a matter of fact, we would not be surprise if none of the selected variables were relevant since during periods of extreme volatility asset prices tend not to follow economic fundamentals.

Unexpected changes or innovations in the FTSE All Share Index returns (FTSE), the UK IPD All Property returns (IPD), Industrial Production (INDP) and the Term structure of interest rates (TERM) have all influences ,cross-sectionally and through time, related to the UK commercial property returns before and after property companies converted into REITS. As expected returns on a broad market index (FTSE) are positively related to commercial property returns since both property companies shares and subsequently REITS are compulsory traded on the London Stock Exchange we would expect their variation to positively track the variations in the market. The same can be said in relation to the IPD being positively related to commercial property returns since positive returns on an appraised real estate index imply on property capital values appreciation what would drive investors and property developers to potentially increase their investments into real estate directly or indirectly. Industrial Production (INDP) here used as a proxy for economic growth was also found to be positively related to property returns. As has been frequently observed in real estate research, it is expected a positive link between both property prices and rents with economic growth as the later is likely to stimulate the demand for real estate investments and in this way boosts property prices. In addition higher

cash flows expectations ensure relaxed credit standards and facilitate the increase in profit margins of property companies. As for the term structure (TERM) the negative relation with property returns indicates an inverse relation to increases in the long rates of interest over the short rates of interest. That is, as TERM measures a change in the log-term rate of interest, decreases would imply a subsequent lower return on any form of capital driving investors to look for protection against this possibility and consequently likely to put a relatively higher value on assets whose price increases when the long rate declines.

The revealing results came when looking at the emergence of a different pattern of economic and property variables being sensitive to UK property returns after property companies converted into REITS. Specifically the unexpected changes or innovations on UK IPD All property rental growth (RENT), the UK IPD All Property Equivalent Yield (EQY) and the Sterling US dollars exchange rate were all significant for the 2007M1 to 2009M12 period characterised by the REITS period and the 2001M1 to 2009M12 period which incorporated both the pre and post REITS returns.

REITS are assumed to be an attractive investment vehicle for investors who want exposure to property investment but do not want to purchase property directly. REITS also provide features of equity investments not available in direct property such as liquidity, lower transaction costs, and lower cost of entry for investors and access to a diversified portfolio. Therefore this could explain similar economic and property variables being sensitive to both returns on property companies and REITS. Nevertheless, what explain the addition of other variables when these property companies turned into REITS?

A REIT is a publicly listed company which purchases and manages property in order to deliver income and capital growth for investors. In the UK a REIT has to split itself into a ring-fenced REIT business and a non ring-fenced business and the ring-fenced business must have at least 75% of its income and assets held within a property letting business (Finance Act, 2006). The positive and significant relationship between property returns and rental growth suggest that investors put greater emphasis on rental increases since it will increase the income generated and subsequently the price and return of a REIT. The interesting thing to emphasise here is the quick incorporation of this variable as an important factor to measure REIT returns as it also appears as significant factor for the whole sample which includes the returns before and after the introduction of REITS.

The same principle can be used to explain the sensitiveness of equivalent yields to property returns. Equivalent yield is defined as a weighted average of the initial yield[2] and the reversionary yield[3] and represents the return a property will produce based upon the timing and income received. It can be calculated as a form of Internal Rate of Return (IRR) but where the Present Value (PV) of future rental income is set to equal the current market value of the property. Therefore, if property prices increases, rents are likely to increase and equivalent yields decrease and if property prices decrease, rents are likely to decrease and equivalent yields increase. As price and returns are positively related the same positive relationship is observed between equivalent yields and returns.

Again it is worth highlight the quick incorporation of this property variable in explaining property returns in the UK with the introduction of REITS which quickly appear to show its hybrid features of both securitised and non-securitised real estate asset by having both RENT and EQY plus the other economic variables as significant factors to explain cross-sectionally and through time UK property returns. The significance of the exchange rate as relevant factor on explaining property returns in the whole sample (2001-2009) and the after REITS sample (2007-2009) might be attributed to the high number of international private and institutional investors diversifying or balancing their real estate portfolios by investing in both direct and indirect real estate in the UK.

[2] Which is the annualised net rent generated by the portfolio expressed as a percentage of the portfolio valuation, excluding development properties.

[3] It is defined as the anticipated yield, which the initial yield will rise to once the rent reaches the estimated rental value.

4. Concluding Remarks

This paper employed traditional panel data analysis to investigate the impact of economic and property variables on commercial property returns in the UK. The main motivation for focusing in the UK market was the lack of research covering the largest European real estate market as the majority of studies investigating the linkages between real estate returns and macroeconomic and financial variables are focused in the US.

Commercial property returns in the UK following the bulk of research in the US were proxied by property companies' returns which turned into REITS from January 2007 generating a cross-section sample of 16 UK REITS.

The selection of economic and property variables were based on previous studies investigating the relationship between stock market and property market returns and the economic and financial outlook. As only unexpected changes or innovations on economic and property variables were likely to affect returns, structural time-series modelling was applied to obtain these innovations. That is, we applied unobserved components time-series models and the Kalman Filter to fit the models to our selected economic and property variables and used the residuals of these models as our innovations. These residuals differently from unexpected changes generated by first differences contained an important property, they were serially uncorrelated white-noise processes giving our economic and property factors the real feature of being unexpected economic news.

The results showed that for the 2001M1-2009M12 and 2007M1-2009M12 periods economic and property variables had helped to cross-sectionally and through time explain commercial property returns in the UK. Specifically unexpected changes in the FTSE All Share Index returns, the UK IPD All property returns, Industrial Production, the UK IPD All property rental growth, and the UK All property equivalent yield, have a positive impact on property returns. While the term structure of interest rates and the sterling US dollar exchange rate a negative impact.

The revealing results came when comparing the results for the period 2001M1-2006M12 which covers the period before introduction of REITS in relation the whole sample and the after REITS period. Specifically innovations on rental growth and equivalent yield did not show any power to explain property companies' returns. Also revealing was the quick incorporation of direct property factors (rental growth and

equivalent yield) in explaining REITS returns after the introduction of the REITS legislation and throughout the whole sample showing the hybrid features of the UK REITS as both securitised and a property backed assets.
While this research showed that unexpected changes in economic and property variables had an impact on the UK commercial property returns it would be relevant to revisit this investigation once the UK REITS market has longer period of existence. Another future avenue for research is perhaps the investigation of the UK IPD index and economic and financial variables on an asset pricing type of testing.

5. References

Bredin, D., O'Reilly, G. , and Stevenson, S. (2007) 'Monetary shocks and REITS returns', Journal of Real Estate Finance and Economics,35, 315-331.

Brooks, C. and Tsolacos, S. (1999) 'The impact of economic and financial factors on the UK property performance', Journal of Property Research, 16(2), 139-152.

Chan, K.C., Hendershoot, P.H., and Sanders, A.B. (1990) 'Risk and Return on Real Estate: Evidence from Equity REITS', AREUEA Journal, Vol.18, No. 4, 431-52.

Chen, N.F., Roll, R., and Ross, S.A. (1986) 'Economic forces and the stock market', Journal of Business, 59, 383-403.

Chen, S.J., Hsieh, C., and Jordan, B.D. (1997) ,Real estate and the arbitrage pricing theory: macrovariables vs. derived factors', Journal of Real Estate Economics, 25(3) 505-23.

Chen, S.J., Hsieh, C., Vines, T.W., and Chiou, S.N. (1998) 'Macroeconomic variables, firm-specific variables and returns to REITS', Journal of Real Estate Research 16(3), 269-77.

Clare, A.D. and Thomas, S.H. (1994). "Macroeconomic Factors, the APT, and the UK Stock Market", Journal of Business Finance and Accounting, 21, 309-330

Commandeur, J.J.F. and Koopman, S.J. (2007) 'An introduction to time series analysis', Oxford University Press.

Cuthbertson, Keith (1988). 'Expectations, Learning and the Kalman Filter', The Manchester School, Vol. LVI, 3, 223-246.

Durbin J. , and Koopman S. J. (2002). 'Time Series Analysis by State Space Models', 2nd Edition, Oxford University Press

Ewing, B.T., and Payne J.E. (2005) 'The response of real estate investment trust returns to macroeconomic shocks', Journal of Business Research, 58, 293-300.

Fama, E.F., and French, K.R. (1992) 'The cross-section of expected returns', Journal of Finance, 47, 427-65.

Fama, E. and MacBeth, J. (1973) 'Risk return and equilibrium: empirical tests', Journal of Political Economy, 81, 607-636.

Greene, W.H. (2008) 'Econometric Analysis', 6th Edition, Pearson International.

Harvey, A. (1989). 'Forecasting Structural Time-Series Models and The Kalman Filter', Cambridge University Press.

Harvey A, S.J. Koopman, and N. Shephard (2004) 'State space and unobserved components models: theory and applications', Cambridge University Press

Harvey A., and Proietti T. (2005) 'Readings in unobserved components models', Oxford University Press.

Hoskins, N. Higgins, D. and Cardew, R. (2004) 'Macroeconomic variables and real estate returns. An international comparison', The Appraisal Journal, Spring, 164.170.

Koopman, S. J., Harvey, A. C., Doornik J. A., and Shephard N. (1999). 'Structural Time Series Analyser, Modeller and Predictor: Stamp', 2nd Edition, Timberlake Consultants Press

Lawrence, L. and Leone V. (2008) 'Changes in the risk structure of stock returns: Consumer confidence and the dotcom bubble', Review of Financial Economics, 17, 228-244.

Lawrence, C. and Siow, A. (1985) 'Interest rate and investment spending: some empirical evidence for post-war US producer equipment, 1947-1980', Journal of Business 58(4), 359-375.

Ling, D. and Naranjo, A. (1997) 'Economic risk factors and commercial real estate returns', Journal of Real Estate Finance and Economics 14(3), 283-307.

Lizieri, C. and Satchell, S. (1997) 'Interactions between property and equity markets: an investigation of linkages in the UK 1972-1992', Journal of Real Estate Finance and Economics, 15(1), 11-26.

McCue, T.E, and Kling, J.L. (1994) 'Real estate returns and the macroeconomy: some empirical evidence from real estate investment trust data, 1972-1991', Journal of Real Estate Research 9(3), 277-287.

Payne, J.E. (2003) 'Shocks to macroeconomic state variables and the risk premium of REITS', Applied Economics Letters, 10, 671-677.

Priestley, R. (1996) 'The arbitrage pricing theory, macroeconomic and financial factors, and expectations generating process', Journal of Banking and Finance, 20, 869-890

Schatz, A. and Sebastian S. (2009) 'The links between property and the economy: evidence from British and German markets', Journal of Property Research, 26(2), June, 197-191.

Simpson, M.W., Ramchander, S. and Webb, J.R. (2008) ‘The asymmetric response of equity REIT returns to inflation’, Journal of Real Estate Finance and Economics,34, 513-529.

Sing, T.F. (2004) ‘Common risk factors and risk premia in direct and securitized real estate markets’, Journal of Property Research,21, 189-207.

Wang, P. (2006) ‘Errors in variables, links between variables and recovery of volatility information in appraised=based real estate return indexes’, Real Estate Economics, 34, 497-518.

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