Wealth effect revisited:
Novel evidence on long term co-memories between real estate and stock markets

Apostolos Kiohos[1], Vassilios Babalos[2] and Athanasios Koulakiotis[3]

Abstract

Employing an innovative ECM-ARFIMA methodology we explore any dynamic interdependence of stock and securitized real estate markets for two developed western economies that exhibit different characteristics. The empirical analysis runs from 2/1/1990 through 13/06/2014. Our results provide support to the ‘wealth effect’ and the fractional integration process in both countries. It is clear that non-linear cointegration, co-memory, long-run and short-run adjustment dynamics are fundamental concepts in understanding market integration/segmentation. Our findings entail significant implications for policymakers,market regulators and investors.

1. Introduction

Real estate has long been recognized as an attractive investment vehicle offering diversification benefits as a part of a multi-asset portfolio (Worzala and Sirmans (2003)). However, this diversification process is more complicated than thought it would be. In particular, investors’ decisions are largely affected by the presence of fractional cointegration between real estate and stock market. Fractionally integrated series are characterized by long term co-memories and irregular long cycles that would affect long-term investors’allocation decisions.

As a result a voluminous strand of literature emerged seeking to map any long or/and short term interdependencies between the real estate market and traditional asset classes such as stocks or bonds (see inter alia Li et al., 2015). Despite the extensive coverage of the stock-real estate market causal nexus, evidence is still inconclusive.

In view of the growing importance of real estate investments at an international level this paper aims to investigate the ‘wealth effect’ mechanism in Germany and UK exploring the level of integration between stock and securitized real estate market. With respect to the two economies research on the UK by Apergis and Lambrinidis (2011), and Liow and Yang (2005) has delivered evidence in favor of a fractional integration between real estate and stock markets. Compared to UK, there is little empirical work on German real estate market and its interaction with capital markets. For example, Maurer et al. (2004) performed a correlation analysis and found that real estate returns exhibit zero or negative correlations with the stock and bond markets.

[1]Department of International and European Studies, University of Macedonia, Egnatia 156, 54006, Thessaloniki, Greece.
[2] Corresponding author, Research Associate, Department of Banking & Financial Management, University of Piraeus. Adjunct Assistant Professor, Technological Educational Institute of Peloponnese, Department of Accounting & Finance, Antikalamos, 24100, Kalamata, Greece vbabalos@teikal.gr.
[3] Department of International and European Studies, University of Macedonia, Egnatia 156, 54006, Thessaloniki, Greece.

Our selection of countries rests on key findings of a recent study prepared by IMF (IMF, 2014) and of course on recent events surrounding UK referendum regarding EU membership. Over the past 30 years UK real house prices have registered the largest increase among OECD economies. However, UK real house prices exhibit the largest variability compared to other OECD countries. Moreover, UK's real estate sector suffered the largest damage during the recent global financial crisis among the G7 economies. On the other hand, a boom in the real estate sector was observed shortly after the Great Recession in Germany. Finally it should be noted that Germany has a bank-based financial system whereas UK has a market-oriented financial system. In light of the above, UK and Germany are interesting cases to examine.

Prior literature cites two mechanisms in order to interpret the relationship between real estate and stock markets, namely the 'wealth effect' and the 'credit price effect'. The 'wealth effect' mechanism implies that a rise in stock prices boost real estate prices and the transmission flow from stock market to real estate market (Okunev and Wilson (1997), Okunev et al. (2000)). We investigate whether the 'wealth effect' is likely to exist in the two markets since both markets in the two countries experienced big boom and busts during the last few years. Using a novel econometric model, we attempt to unveil any unidirectional fractional integration in the presence of 'wealth effect' in the two markets.

Our paper is related to the study of Wilson and Okunev (1999) who examined the long term co-dependence between the securitized real estate and stock markets of the USA, UK and Australia and that of Liow and Yang (2005) who examined the existence of long-term co-memory accounting for the influence of macroeconomic factors and a wider range of cointegration, fractional cointegration and short term adjustment dynamics for Japan, Hong Kong, Singapore and Malaysia. However compared to the latter study on methodological grounds we set off to examine non-linear cointegration and then we proceed with an innovative ECM-ARFIMA model that captures both short and long-term dynamics.

Previewing our findings we report a fractional integration with 'wealth effect' between stock and real estate markets. Within this context, we develop an ARFIMA model that accounts for the fractional integration process with 'wealth effect' through an ECM-ARFIMA methodology. Our findings indicate that the error correction term is significant in Germany and the ARMA coefficients are important in both markets. Thus, through our novel methodology we managed to uncover the impact of error correction term and fractional integration terms in the two markets under investigation when the transmission mechanism of 'wealth effect' holds. A quite strong relationship between stock and real estate market is documented that could be attributed to the 'portfolio adjustment' effect (e.g. Kapopoulos and Siokis, 2005).

Against this background the rest of the paper is structured as follows, section 2 shortly describes the data and methodology employed and the main results whereas section 3 concludes and presents some interesting implications.

2. Data and methodology

2.1. Data

Daily prices of real estate and stock market indices for United Kingdom and Germany for the period from 2/1/1990 through 13/06/2014 were collected. Stock market returns were calculated using FTSE 100 for UK and DAX for Germany respectively. Real estate indices were sourced from FTSE EPRA/NAREIT, including securitized and listed companies that have their core business in real estate activities (REITs and non-REITS). Data for stock market indices were sourced from Thomson Reuters Datastream.

2.1Fractional Integration

As previously stated, we seek to establish whether a nonlinear relationship between the real estate and stock market exists. To this end we firstly employ the original model developed by Okunev and Wilson (1997).

The regression model is given by:

$$\log(\frac{RE_{t+1}}{RE_t}) = \beta_0 + \beta_1 \log(\frac{P_{t+1}}{P_t}) + \beta_2 \log(P_t) + \beta_3 \log(RE_t) + \varepsilon_t \quad (1)$$

where $\beta_3 = (\mathrm{e}^{-\lambda\Delta t} - 1)$, λ is the speed of adjustment' (2)

In order to have mean reversion, λ should be greater than zero (λ >0). If there is a divergence between the two markets, then they will converge at a rate of λ% per period. Thus, the real estate market returns are dependent on both the changes of equity market index and the values of the index itself.

The parameters of the univariate model are estimated by computing the log-likelihood function as:

$$L_t(\Theta) = -\frac{1}{2}\log(h_t) + \varepsilon_t * \varepsilon_t / h_t \quad (3)$$

$$h_t = \%SEESQ \quad (4)$$

Equation (3) is an estimation of the unconditional variance and is applied to the residuals in our case. This is used as an estimation of the initial conditional variance term, and helps the term to be represented by an average behaviour of the sample period. We firstly use the SIMPLEX algorithm to refine the initial values of all the parameters. Θ_S are all error estimated parameters. The numerical maximization of the log-likelihood function follows the BFGS algorithm which accounts for the maximum likelihood estimates and is associated with asymptotic standard errors.

There are four cases applied to our dataset, regarding co-integration. These are:

1) If $\beta_1 = 0$ then the two markets are segmented.
2) If β_1 is significantly different from zero, then the equity and real estate markets would be integrated.
3) If $\beta_1 = 1$, then there exists a linear relationship between the equity and real estate markets and the method of co-integration could be applied.
4) If 0< $\beta_1 < 1$, then the markets would be fractionally integrated.

The results from Table 1 indicate that there is a non-linear co-integration relationship between real estate and stock market returns for UK and Germany. This is reflected in β_1 coefficient, which normally lies between 0 and 1. Thus, we can examine for a common order of integration between real estate and stock market for the two countries under investigation. Moreover, there is a 'granted' preference to the 'wealth effect', which means that, when stock prices rise, then the real estate prices rise as well, as mentioned previously implying a strong relationship between the two markets due to the 'portfolio adjustment' effect (see Kapopoulos and Siokis, 2005).

Insert Table 1 about here

2.2. Extension of the ECM-ARFIMA model

We empirically examine, through an augmented ECM-ARFIMA model, the long memory of the absolute mean return of real estate series and the impact of error correction term on the same series, based on the 'wealth effect' transmission mechanism, as developed by Okunev and Wilson (1997). The estimates for the univariate ECM(1)-ARFIMA model in Germany and UK are reported in Table 2 and 3 respectively. The augmented ECM(1)-ARFIMA(p.d.q) model takes the following form:

$$EC = \log(\frac{RE_{t+1}}{RE_t}) - \beta_0 - \beta_1 \log(\frac{P_{t+1}}{P_t}) - \beta_2 \log(RE_t) - \beta_3 \log(P_t)_t \quad (5)$$

$$\alpha(L)(1-L)^d (\sqrt{y_t} - b_1 * \sqrt{EC_{t-1}}) = \vartheta(L)\varepsilon_t \quad (6)$$

where, EC stands for the Error Correction variable, RE stands for the real estate index, P stands for the stock price index, $\alpha(L) = 1 - \sum_{\pi=1}^{s} \alpha_j L^{\pi}$, $\vartheta(L) = 1 + \sum_{q=1}^{k} \vartheta_q L^q$, y_t is the return series of real estate term.

Our results reveal that the fractional difference between real estate and stock market returns is equal to 0.30 for Germany (Table 2 and Figures 1 and 2). In addition, accounting for the order of integration as indicated by Brunetti and Gilbert (2000)'s error correction model (ECM-FIGARCH), our error correction (ECM-ARFIMA) difference process |d-θ| = 0.058 was found to be almost equal to λ=0.054, based on the Okunev and Wilson (1997) model. The modified ECM-ARFIMA model can accurately capture the degree of divergence. In this case, there is also an indirect impact of the 'wealth effect' theory through the error correction variable which is incorporated in the ARFIMA model.

Similarly, we find that the fractional difference in UK is higher and equal to 0.51 (Table 3 and Figures 3 and 4). The order of integration difference between |d-($\vartheta_1 + \vartheta_2$)| =0.511 and the divergence is far away from the λ=0.11 speed of adjustment. While in Germany there is a significant long-term persistence and influence from the long-term error of co-integration, the effect of persistence in UK is not significant (see Table 3). In addition, the results show that the short-term effects (e.g. ARMA coefficients in Table 3) play a more significant role in UK than in Germany. Finally, the results show that there is no impact from the error correction term on the real estate returns in UK. However, in Germany, the direct impact from the error correction term is more prominent than in the UK.

The estimates of autocorrelation are reported in the lower part of Table 2 and 3. The standardized and squared standardized residuals are significant at the 1% level, which confirm the importance of examining the fractional integration between the real estate and stock markets in UK and Germany through an ARFIMA model. The moving average lag dependence is higher in UK compared to Germany. The above justifies the use of a higher moving average lag process in UK than in Germany.

Insert Table 2
Insert Table 3
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Insert Figure 2
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3. Conclusions and Implications

This paper seeks to uncover any long co-memory process between real estate and stock market returns, assuming that the 'wealth effect' mechanism is present in two developed markets. The results of the innovative ECM-ARFIMA model capture the fractional difference and the long-term error effect of the initial non-linear fractional integration model in Germany and the short–term effects (ARMA coefficients) in UK. A strong relationship between the two markets probably due to the 'portfolio adjustment' effect (see Kapopoulos and Siokis, 2005) is also documented.

These results entail significant implications for investors who wish to include real estate and stock market investments into a well-diversified portfolio. Long-term memory makes portfolio diversification especially for medium and long-term investors doubtful due to the long-term persistence of news.

Moreover, our results shed light on the performance patterns of the two assets enhancing predictability of future performance from one market to the other. The relationship between stock and real estate market is important for market regulators since regular or irregular portfolio rebalancing actions might give rise to market anomalies.

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Appendix

Table 1: Modeling the non-linear relationship between Real Estate and Equity Indexes when 0< $\beta_1 < 1$

$$\log(\frac{RE_{t+1}}{RE_t}) = \beta_0 + \beta_1 \log(\frac{P_{T+1}}{P_T}) + \beta_2 \log(P_t) + \beta_3 \log(RE_t) + \varepsilon_t$$

where, $\beta_3 = (\mathrm{e}^{-\lambda\Delta t} - 1)$, λ is the speed of adjustment'

Dependent Variable	β_0	0< $\beta_1 < 1$	β_2	β_3	λ	Log-likelihood
UK	-0.400 (0.449)	0.633 (0.015)*	0.117 (0.061)**	-0.083 (0.053)	**0.109**	-10207.83
Germany	0.996 (0.635)	0.389 (0.00)*	-0.017 (0.043)	-0.128 (0.070)**	**0.054**	-10751.61

Notes: (*)(**)(***) means significance at the (1%) (5%)(10%) level.

Table 2: Univariate EC(1)-ARFIMA(1,d,1) model's results for Germany

$$EC = \log(\frac{RE_{T+1}}{RE_T}) - \beta_0 - \beta_1 \log(\frac{P_{t+1}}{P_t}) - \beta_2 \log(RE_t) - \beta_3 \log(P_t)_t$$

$$\alpha(L)(1-L)^d(\sqrt{y_t} - b_1 * \sqrt{EC_{t-1}}) = \vartheta(L)\varepsilon_t$$

	Germany
d	0.299** (0.122)
ϑ	-0.348 (0.536)
α	0.166 (0.519)
EC $_{t-1}$	-0.335** (0.151)

Log-likelihood	-235.04
Diagnostic tests for Residuals	
Skewness	1.144
Kurtosis	5.307
LB(20)	105.134*
LB ^{2} (20)	225.464*

Notes: (*)(**)(***) means significance at the (1%) (5%)(10%) level.

Table 3: Univariate EC(1)-ARFIMA(1,d,2) model's results for the UK

$$EC = \log(\frac{RE_{T+1}}{RE_T}) - \beta_0 - \beta_1 \log(\frac{P_{t+1}}{P_t}) - \beta_2 \log(RE_t) - \beta_3 \log(P_t)_t$$

$$\alpha(L)(1-L)^d(\sqrt{y_t} - b_1 * \sqrt{EC_{t-1}}) = \vartheta(L)\varepsilon_t$$

	UK
d	0.510*
	(0.094)
ϑ_1	0.122
	(0.164)
ϑ_2	-0.899
	(0.036)*
α	0.647
	(0.094)*
EC $_{t-1}$	-0.320
	(0.228)
Log-likelihood	-167.66
Diagnostic tests for Residuals	
Skewness	0.009
Kurtosis	0.724
LB(20)	44467.841*
LB ^{2} (20)	24485.420*

Notes: (*)(**)(***) means significance at the (1%) (5%)(10%) level.

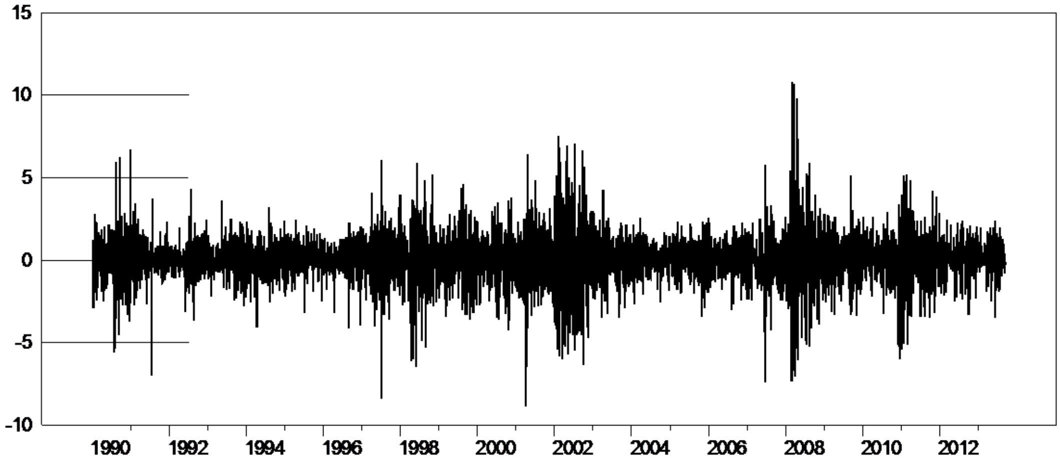

Figure 1: Time series plot for German stock market returns

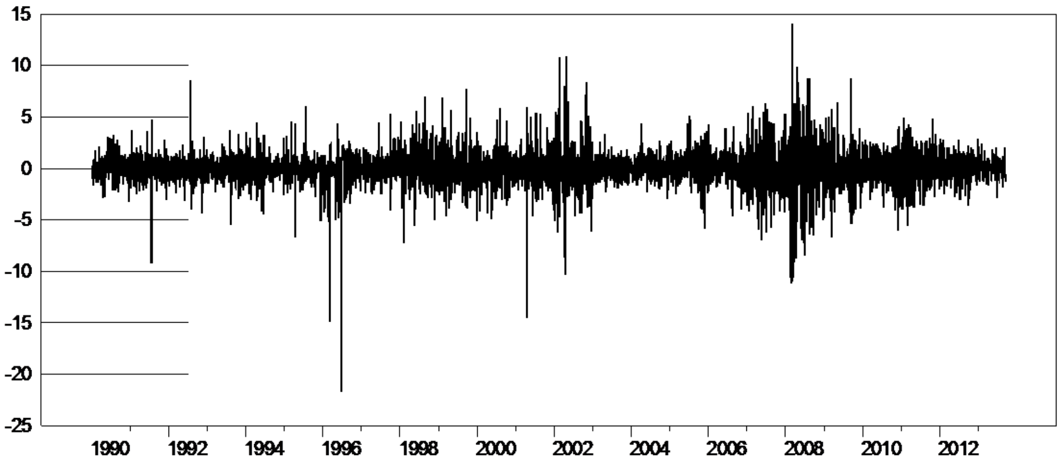

Figure 2: Time series plot for the German Real Estate returns

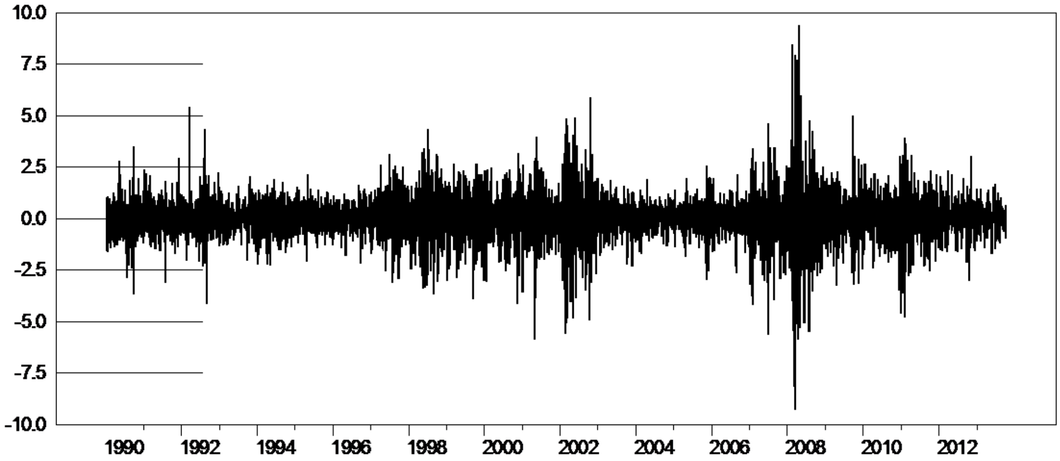

Figure 3: Time series plot for UK stock market returns

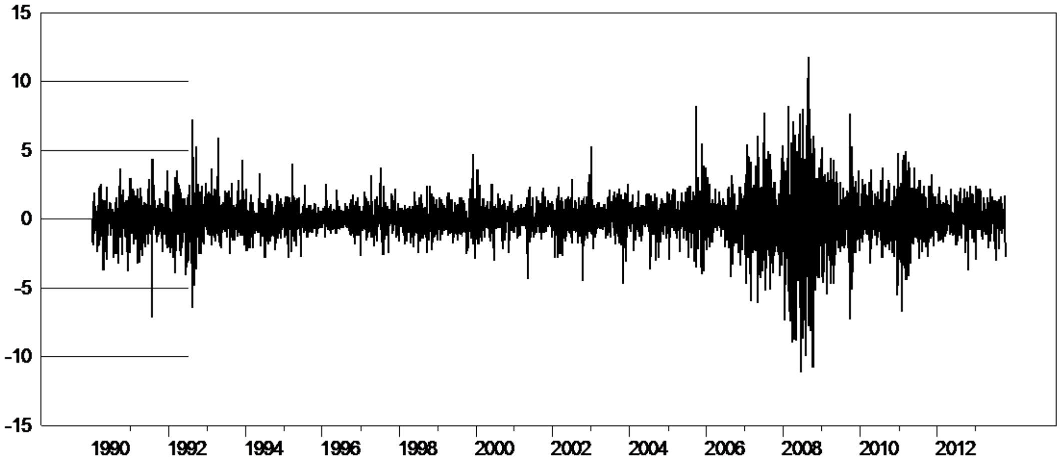

Figure 4: Time series plot for UK Real Estate returns