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PAPER FUTURES TRADING, SPOT PRICE VOLATILITY AND MARKET EFFICIENCY: EVIDENCE FROM EUROPEAN REAL ESTATE SECURITIES FUTURES TITLE

CHYI LIN LEE, University of Western Sydney

SIMON STEVENSON, University of Reading

MING-LONG LEE, National Dong Hwa University

ABSTRACT

In 2007 futures contracts were introduced based upon the listed real estate market in Europe. Following their launch they have received increasing attention from property investors, however, few studies have considered the impact their introduction has had. This study considers two key elements. Firstly, a GARCH model is used to examine the impact of futures trading on the European real estate securities market. The results show that futures trading did not destabilize the underlying listed market. Importantly, the results also reveal that the introduction of a futures market has improved the speed and quality of information flowing to the spot market. Secondly, we assess the hedging effectiveness of the contracts using two alternative strategies (naïve and OLS models). The empirical results also show that the contracts are effective hedging instruments, leading to a reduction in risk of 64%.

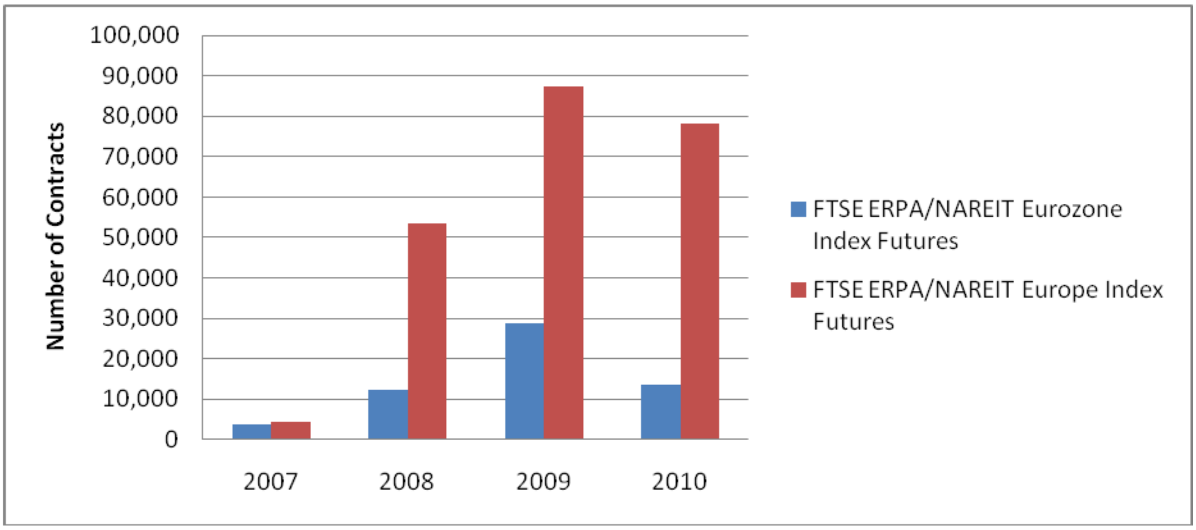
Keywords: Real estate securities futures, GARCH, volatility, hedging effectiveness and Europe

INTRODUCTION

The introduction of dedicated index derivative contracts has only been a relatively recent phenomenon in the listed real estate market. This is despite their long history and trading in the broader equity markets, other financial assets and in some markets the provision of stock option contracts for real estate firms. Furthermore, the importance of index futures contracts based on real estate securities has long been highlighted (e.g. Oppenheimer, 1996; Liang et al., 1998; Newell & Tan, 2004; Clayton, 2007; Ong & Ng, 2009). In principle, an index futures contact would offer an opportunity for institutional investors to reduce the risk of their portfolios, provide an alternative means of gaining exposure to the real estate security sector and to enhance the liquidity of listed real estate investment. Despite these factors it was only in 2002 when the first index futures contract specifically concerned with the real estate equity sector was launched. This first contract was introduced by the Australian Securities Exchange and based on the S&P/ASX 200 A-REIT Index. This was followed by contracts being developed by the Chicago Board of Trade in 2007 (Dow Jones US Real Estate Index Futures) and the Tokyo Stock Exchange in 2008 when J-REIT futures were launched. In October 2007, NYSE LIFFE Euronext introduced two futures contracts specifically concerned with the European market. Importantly, the listed real estate sector in Europe has expanded considerably over the course of the last decade, as of June 2011, there were a total 830 real estate stocks with a total market capitalization of €321.1bn. This equates to 24% of the global listed property market (EPRA, 2011).

Europe does provide an interesting case study in the examination of the introduction of index futures for real estate security markets. Unlike the contracts launched in Australia, U.S. and Japan, they are not country specific. Rather, they are based on the FTSE ERPA/NAREIT Europe and FTSE EPRA/NAREIT Eurozone indices. This raises a number of issues, in particular, whether the pan-European nature leads to differences in terms of the impact upon the underlying market and also the hedging effectiveness of them. After the initial establishment period in 2007-2008, the market has received increasing attention from investors, as can be seen from the increase in trading volume illustrated in Figure 1. By 2010 total trading volume in the contracts had increased to €692million and €130million for the Europe and Eurozone contracts respectively (NYSE, 2011). This reflects the significance of futures as an important tool for institutional investors in their portfolio management.

Figure 1: Transaction Volume of the FTSE ERPA/NAREIT Europe and Eurozone Futures Contracts



Source: NYSE (2011)

Although the European real estate securities futures market has received increasing attention from institutional investors, virtually no empirical work has been undertaken. This study aims to fill in this gap in the literature by examining a number of key elements concerning the introduction of index futures in the European listed real estate market. Specifically, it investigates whether the introduction of the futures market had a destabilizing impact upon the underlying listed real estate sector. The impact of introducing a futures market on the volatility of the underlying spot market has been of great interest to policy makers, practitioners and academics. This study therefore, aims to provide empirical evidence concerning the linkage between futures-trading and the volatility of the spot market. In addition, the study also investigates the hedging effectiveness of the futures contracts. This issue is obviously of enhanced importance in light of the negative impact of the recent financial crisis on global real estate securities. Thus, an investigation of the hedging effectiveness will enable more informed investment decision-making regarding the role of such contracts from a fund management perspective. This is particularly important in the case of Europe due to the use of continental, rather than national, indices.

The contributions of this study are therefore threefold. Firstly, it is one of the first papers to consider the impact on the underlying sector resulting from the introduction of index derivatives. The findings are important and are expected to offer insights to investors and financial regulatory authorities in relation to whether or not the establishment of futures market would facilitate the development of listed property markets. Secondly, the relationship between volatility and the level of futures trading, including trading volume and open interest, are also investigated for the first time. The results are expected to offer insights to institutional investors whether futures-trading contains important information regarding the spot market. Thirdly, the paper is the first attempt to assess the extent of risk reduction using European futures to hedge the return of European real estate securities. The results and their implications will help assess the economic usefulness of the derivatives market.

The remainder of this paper is organized as follows. The following section provides a brief literature review on real estate security futures. The impact of index futures trading on the volatility of the underlying market is also reviewed. Section 3 details the data used and the methodological framework adopted. Section 4 reports and discusses the empirical findings, whilst the final section provides concluding comments.

LITERATURE REVIEW

The impact of futures trading on the volatility of the underlying spot market has been intensely debated in the finance literature. This literature extends back to early papers that pre-date the widespread introduction of financial futures in the early seventies. These early studies primarily centered their arguments around two key positions. On one hand, there was a belief among market participants and policy makers that speculators in a futures market would lead to a destabilization of spot prices. Kaldor (1939) posited that speculators could destabilize prices by ignoring market fundamentals and speculating mainly based on other players' behavior. He therefore argued in favor of extensive regulation for futures markets. In contrast, other early studies argued that futures markets would have a stabilizing effect on the underlying spot market. This stance was based upon the argument that futures markets would attract additional traders to the cash/spot market and therefore improve the price discovery process, leading to enhanced liquidity and reduced volatility (Working, 1953; Cox, 1976).

Numerous empirical studies have assessed the impact of index futures trading in various markets. Some seminal empirical studies, such as Figlewski (1981), reported that futures trading in GNMA futures securities led to an increase in monthly price volatility. Stein (1987) also reported higher spot market volatility in post-futures periods. However, Santoni (1987) found little change in the S&P 500 index following the introduction of futures contracts. Comparable evidence is also reported by Edwards (1988a, 1988b). Whilst Aggarwal (1988) noted that the post-futures period displays greater volatility, the author also found that volatility in all markets, whether futures contracts were present or not, had increased. Hence the increase in volatility could not necessarily be attributed to the introduction of derivatives and the resulting futures trading. Harris (1989) also supported this hypothesis in that the increase in volatility could be linked to other index-phenomenon. Interestingly, Stoll & Whaley (1988) found that the introduction of futures contracts reduced the volatility of the underlying spot market. More recently, Pericli & Koutmos (1997) argued that calls for a tightening in the regulation of index futures are unwarranted as no further structural changes, apart from the impact of the October 1987 crash, are found in terms of the volatility of the S&P 500 index.

In the U.K., Antoniou & Holmes (1995) found an increase in the volatility of the FTSE 100 index in the post-futures period they considered. Importantly, they also illustrated that the increase in volatility is a direct result of an increase in the flow of information into the market. They therefore argue that the increased volatility should not necessarily, or immediately, be interpreted in a negative sense. This argument is also supported by Lee & Ohk (1992). They demonstrate that significant increased volatility is evident soon after index futures were launched in Japan, the U.K. and the U.S. Their empirical findings also showed that the creation of a futures contract makes the stock market relatively more efficient, as volatility shocks are more quickly assimilated into the underlying market. Moreover, Darrat & Rahman (1995) demonstrate that futures trading is not a significant factor in stock market volatility.

Interestingly, Chang et al. (1999) showed that whilst the onset of Nikkei 225 futures trading on the Osaka Securities Exchange slightly increased the volatility of the spot market, this was not the case with their introduction on the Singapore International Monetary Exchange. Gulen & Mayhew (2000) examined stock market volatility before and after the introduction of stock index futures trading in 25 developed and emerging countries. Interestingly, they only found a noticeable increase in conditional volatility in the U.S. and Japan. In the remaining 23 markets there was either a negligible effect or the conditional volatility actually fell. Bae et al. (2004) found that futures trading in Korea increased spot price volatility but also market efficiency. The results do however point to a reduction in the effect over time. Indeed, the impact appeared to vanish following the addition of options trading. More recently, Bohl et al. (2011) utilized a Markov-switching GARCH model in the context of the Polish market and showed that the introduction of index futures does not seem to influence the volatility of the underlying equity market. In addition, several studies have investigated the volatility-volume relation in futures markets (e.g. Bessembinder & Seguin, 1992, 1993; Daigler & Wiley, 1999; Watanabe, 2001). In general, linkages between volatility and not only volume but also open interest are reported.

In contrast to the large number of studies to have considered index futures generally, the specific literature concerning real estate has been limited. In large part this has been due to their recent introduction and to the small number of markets in which such contracts are traded. The majority of the real estate literature has either considered the introduction of derivatives on the direct market (e.g. Lecomte & McIntosh, 2006; Wong et al., 2006; Hoesli & Lekander, 2008; Lizieri et al., 2011) or considered how to produced so-called hedged REIT indices (e.g. Giliberto, 1993; Stevenson, 2000). Studies such as Oppenheimer (1996) and Liang et al. (1998) demonstrated the importance of introducing specific real estate related contracts as futures contracts written on stocks, interest rates, commodities and metals offer very weak hedging performance in a real estate stock context. Comparable evidence is also reported by Chaudhry et al. (2010), although this study did find that contracts based on energy-related products can provide some hedging benefits.

Newell & Tan (2004) is one of the first empirical studies to consider specific real estate security futures contracts. Utilizing data following the introduction of index futures in Australia in 2002, they showed that Australian institutional investors can use such futures contracts to protect in the context of hedging their REIT (Listed Property Trust) portfolios. More recently, Lee & Lee (2012) find that A-REIT and J-REIT futures are effective hedging instruments in which a risk reduction level of 59% and 45% is reported for Australian and Japanese REITs respectively. Their results also reveal that REIT futures offer superior hedging results compared to futures contracts based on stocks, interest rates and foreign exchange rates. Finally, Lee (2009) documents a strong volatility spillover effect between A-REITs and A-REIT futures, arguing that futures trading enhances the price discovery process of A-REITs. Newell (2010) notes that the role of futures contracts in Australia increased during the recent financial crisis. As can be seen, there have been relatively few studies on real estate stock specific futures, and no papers have as of yet considered the European case.

DATA AND METHODOLOGICAL FRAMEWORK

Data

To assess the impact of futures trading on volatility, daily closing prices from the spot market are collected for the period October 2004 to September 2010. The two indices on which the contracts are based, namely the FTSE ERPA/NAREIT Europe and Eurozone indices, are used to represent the performance of the underlying market. The time period available for the futures markets spans from October 2007 to September 2010. All data was obtained from Thompson Reuters Datastream. The returns of both the underlying indices and the futures contracts were defined as the first difference in the natural logarithm of the indices. In addition, the volume and open interest of both futures contracts were extracted from Thompson Reuters Datastream. Table 1 presents the specifications of the two futures contracts. The contracts are traded on NYSE LIFFE Euronext in Paris. Both contracts have a similar trading cycle, with expiry dates in March, June, September and December. As can be observed, the contract multiplier of both is only €10 per index point, and therefore both can be considered as mini-futures. These principal features and specifications are similar to those in place in Australia and Japan (Lee & Lee, 2012).

Table 1: FTSE ERPA/NAREIT Europe and Eurozone Index Futures Contracts

Contract	**FTSE ERPA/NAREIT Europe Index Futures**	**FTSE ERPA/NAREIT Eurozone Index Futures**
Exchange	NYSE Liffe Euronext Paris	NYSE Liffe Euronext Paris
Currency	Euro (€)	Euro (€)
Introduced Year	2007	2007
Underlying Index	FTSE ERPA/NAREIT Europe Index	FTSE ERPA/NAREIT Euro Zone Index
Contract Size	€10 per index point	€10 per index point
Trading Months	Nearest three quarterly maturities (March, June, September and December)	Nearest three quarterly maturities (March, June, September and December)
Last Trading Day	The third Friday of the expiration month at 5.45pm CET	The third Friday of the expiration month at 5.45pm CET

Source: NYSE Liffe Euronext (2011)

Table 2: Descriptive Statistics

Market	**Europe**	**Eurozone**
Panel A: Descriptive Summary		
Average (%)	0.000	0.026
Standard Deviation (%)	1.545	1.499
Skewness	-0.301	-0.220
Kurtosis	6.447	7.359
Jarque-Bera	791.504***	1240.577***
Count	1551	1551
Panel B: LM Tests		
ARCH(6)	262.846	318.457
	(0.000)***	(0.000)***
ARCH(12)	283.078	342.840
	(0.000)***	(0.000)***
ARCH(24)	312.273	366.478
	(0.000)***	(0.000)***

Notes: The first two moments (mean and standard deviations) are expressed in percentage form. The skewness and kurtosis statistics have a value of 0 for a normal distribution and these statistics give a preliminary indication of the normality of these series. Panel B reports the estimated results Engle (1982) LM tests. ARCH(q) exhibits the LM test on the returns up to q-order. Figures in parentheses are the p-values. * denotes significance at the 10% level; ** represents significance at the 5% level and *** denotes significance at the 1% level

The summary statistics are reported in Table 2. Panel A of Table 2 shows that the return and risk levels of real estate securities in Europe and in the Eurozone are very comparable. This is not unsurprising as the primary difference in the composition of the two indices is the exclusion markets such as the U.K. in the Eurozone index. The normality tests (skewness, kurtosis and Jarque-Bera statistics) reveal that the return distributions of the two indices are not normally distributed. These findings also imply the presence of ARCH effects, which is confirmed by the LM tests in Panel B. The ARCH(6), ARCH(12) and ARCH(24) statistics are statistically significant for both indices, confirming the presence of volatility clustering effects. Given that daily data is used in this study, the presence of volatility clustering is to be expected. This is not only a common finding in capital market assets generally, but in listed real estate markets specifically (see Cotter & Stevenson, 2006, 2008; Jirasakuldech et al, 2009; Liow, 2009)[i].

The Impact of Futures Trading on Spot Volatility

The empirical analysis consists of two key components. The first examines the impact of futures trading on the volatility of the underlying spot market. The second is concerned with the hedging effectiveness of the futures contracts. To assess the impact of futures trading two alternative models were utilized, namely a GARCH (1,1) specification and secondly the model proposed by Bessembinder & Seguin (1992). The GARCH(1,1) model was estimated in order to examine whether the introduction of a futures market has a significant impact on the spot market. It is specified as follows:

$$R_t = a_0 + a_1 R_{t-1} + a_2 GFC + \mu_t \tag{1}$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 D_F \tag{2}$$

where R_t represents the returns on the respective index, *GFC* is a dummy variable taking on the value 1 for the period around the recent financial crisis, and zero otherwise. D_F is a dummy that takes the value zero in the pre-futures period and unity following October 2007 and the introduction of the contracts. The coefficient for the *GFC* dummy is expected to be negative, given that the crisis had a strong negative impact on the listed real estate sector. There is however, no a priori sign for D_F. This is due to the alternative theoretical viewpoints concerning the possible impact of futures trading on the volatility of spot prices. The analysis was also carried out using two sub-periods. This was undertaken in order to examine the relationship between information and volatility following the onset of futures trading. We follow the methodology of Antoniou & Holmes (1995), with entire sample period partitioned into two, denoting the pre and post futures periods. The sample is therefore split as of October 1st 2007. The behaviors of the parameters in the GARCH equations for the two sub-periods are then subsequently compared.

The approach of Bessembinder & Seguin (1992) was also generalized in order to investigate the relationship between the volatility of the underlying index and the level of futures trading activity. An Autoregressive Integrated Moving Average (ARIMA) model was employed to decompose the time series of both trading volume and open interest in the futures contracts into expected and unexpected components. According to Bessembinder & Seguin (1992) the unexpected component can be interpreted as the daily shock, whereas the expected component should reflect the forecastable level of futures trading. This model has been widely used in the finance literature in papers such as Daigler & Wiley (1999), Gulen & Mayhew (2000) and Watanabe (2001). We then consider how these components affect the volatility of the spot market by including them as additional explanatory variables in the variance equation of the GARCH model. This approach is consistent with Gulen & Mayhew (2000). The augmented variance equation can be represented as follows:

$$\begin{aligned} h_t = {} & \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 ExpVol + \alpha_4 Un\exp Vol + \alpha_5 ExpOI + \alpha_6 Un\exp OI + \\ & \alpha_7 Mon + \alpha_8 Tue + \alpha_9 Wed + \alpha_{10} Thu \end{aligned} \tag{3}$$

where $ExpVol$ and $Un\exp Vol$ represents the expected and unexpected components of volume, $ExpOI$ and $Un\exp OI$ are the expected and unexpected components of open interest and Mon, Tue, Wed and Thu are daily dummies. It is hypothesized that the expected components of volume and open interest have a negative impact on volatility, whereas market volatility is positively related to the unexpected components of volatility and open interest. Furthermore, insignificant coefficients on daily dummies would be expected if the market efficiency of European real estate stocks has been enhanced following the onset of futures trading.

Hedging Effectiveness

The second part of the empirical analysis examines the economic significance of European listed real estate futures by assessing their hedging effectiveness using two alternative hedging strategies. The first is a naïve hedging strategy, assuming a hedge ratio of 1. In the second Ordinary Least Square (OLS) is used to estimate the optimal hedge ratio. Following Figlewski (1984), the OLS hedge can be estimated as follows:

$$RES_{i,t} = \alpha_i + \beta_i F_t + \varepsilon_{i,t} \quad (4)$$

where RES_i (=1,2) represents the returns of the FTSE ERPA/NAREIT Europe and Eurozone indices; *F* is the futures returns and α_i and β_i are the constant and coefficient to be estimated. The coefficients β_i represents the hedge ratio to be used. Following Andani et al. (2009), we decompose the data into two periods. The in-sample period was utilized to estimate the optimal hedge ratio and extended from October 2007 to July 2008. The second period, July 2008 to September 2010, was used for the out-of-sample testing. A 20-day window was employed, in which the OLS model was re-estimated every 20 days. The estimated hedge ratios were also used in the out-of-sample period in a 20-day trading window. The hedging effectiveness of a hedge was measured by the reduction in volatility obtained by applying the two alternative hedging strategies. This can be represented as follows:

$$\text{Risk reduction} = \frac{\sigma_u - \sigma_h}{\sigma_u} \times 100 \quad (5)$$

where σ_u is the standard deviation of returns on the unhedged position; σ_h is the standard deviation of returns on the hedged position.

EMPIRICAL RESULTS AND DISCUSSION

Impact of Futures Trading on Volatility

Table 3 reports the impact of futures trading on the volatility of the spot market through the estimation of the GARCH(1,1) model detailed previously. Panel A reports the results relating to the mean equation of the model, whilst the coefficients from the variance equation are detailed in Panel B. Panel A shows that the financial crisis had an inverse impact upon the FTSE EPRA/NAREIT Europe and Eurozone Indices. Specifically, the coefficients of the dummy variable are negative and statistically significant, indicating that the crisis had a significant negative impact upon the listed real estate market in Europe. The results from the variance equation, shown in Panel B, reveal that futures trading did not significantly increase the volatility of the wider overall Europe index. The positive, but statistically insignificant, coefficient for the dummy variable representing the introduction of the futures contracts (α_3) suggests that whilst volatility did increased following October 2007, it did not do so to a statistically significant extent. This would support the hypothesis that the introduction of futures trading did not have a discernible impact on underlying spot price volatility. These results are consistent previous mainstream finance work such as Edwards (1988a, 1988b) and Darrat & Rahman (1995). This finding can be interpreted as supporting the notion that introduction of the contracts did not destabilize the spot market. In contrast, when the Eurozone index is considered, the results show that in the post-futures period underlying volatility is not only higher but is so to a statistically significant extent. However, it does need to be emphasized that the onset of futures trading may not be either the sole nor primary cause of this increase in volatility. Indeed, given the timing of the inception of futures trading, in late 2007, it is perfectly natural to attribute at least some of the increase to the events surrounding the financial crisis. Although a dummy variable representing the financial crisis is included in the mean equation, the second dummy may be also capturing information from the financial crisis.

Table 3: Effect of Futures on Real Estate Security Market Volatility

Market	Europe	Eurozone
Panel A: Mean Equation		
Constant (a_0)	0.001 (5.450)***	0.001 (5.976)***
Lag Return (a_1)	0.052 (1.818)***	0.061 (2.062)**
GFC (a_2)	-0.003 (-3.014)***	-0.002 (-2.560)**
Panel B: Variance Equation		
Constant (α_0)	1.17 x 10^{-6} (2.470)***	1.94 x 10^{-6} (2.812)***
ARCH (α_1)	0.052 (5.748)***	0.153 (5.945)***
GARCH(α_2)	0.891 (49.377)***	0.837 (35.277)***
D_F (α_3)	1.23 x 10^{-6} (0.901)	4.35 x 10^{-6} (1.976)**

Notes: This table reports estimated coefficients for mean and variance equations of GARCH(1,1). The model is estimated by:

Mean Equation:

$$R_t = a_0 + a_1 R_{t-1} + a_2 GFC + \mu_t$$

Variance Equation:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 D_F$$

where GFC is a dummy taking on the value 1 for the period around the global financial crisis, and zero otherwise, D_F is a dummy variable taking on the value zero pre-futures and 1 for post-futures. Figures in parentheses are the standard errors. *, **, *** denotes significance at the 10%, 5% and 1% level respectively.

Therefore, to further differentiate the impact of the two events, the onset of futures trading and the financial crisis, a time dummy was used to gauge the influences of these two events separately. Specifically, we use two time dummies to disaggregate the sample into three periods. These are; the pre-futures period, the primary financial crisis period and a final period following this. The first dummy used takes the value of unity during the period of October 2007 to December 2008 and zero otherwise, thereby capturing the impact of events during the height of the crisis[ii]. The second dummy takes on a value of unity in the period after January 2009[iii]. Similar time dummies were also utilized by Bae et al. (2004) and Wong et al. (2006) to study the impacts of futures and forwards trading on the Korean stock market and the Hong Kong housing market respectively. The results from this expanded model are represented in Table 4.

Table 4: Augmented Model of Real Estate Security Market Volatility

Market	Europe	Eurozone
Panel A: Mean Equation		
Constant (a_0)	0.001 (4.727)***	0.001 (5.567)***
Lag Return (a_1)	0.061 (2.108)**	0.067 (2.276)**
Panel B: Variance Equation		
Constant (α_0)	1.30 x 10^{-6} (2.614)***	1.98 x 10^{-6} (2.904)***
ARCH (α_1)	0.101 (5.289)***	0.149 (5.856)***
GARCH(α_2)	0.892 (45.214)***	0.838 (35.052)***
$D1_F$ (α_3)	5.87 x 10^{-6} (1.500)	7.18 x 10^{-6} (1.974)**
$D2_F$ (α_4)	8.23 x 10^{-6} (0.618)	3.72 x 10^{-6} (1.590)

Notes: This table reports estimated coefficients for mean and variance equations of GARCH(1,1). The model is estimated by:
Mean Equation:
$R_t = a_0 + a_1 R_{t-1} + \mu_t$
Variance Equation:
$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 D1_F + \alpha_4 D2_F$

where GFC is a dummy taking on the value 1 for the period around the global financial crisis, and zero otherwise, $D1_F$ is a dummy variable taking on the value 1 for the period of Oct 2007-Dec 2008 and zero otherwise, $D2_F$ is a dummy variable taking on the value 1 for the period of Jan 2009-September 2010 and zero otherwise. Figures in parentheses are the standard errors. *, **, *** denotes significance at the 10%, 5% and 1% level respectively.

In the case of the overall Europe Index, the estimated coefficients of $D1_F$ and $D2_F$ are positive, indicating that higher volatility is evident in Periods 2 and 3 compared with the level observed in the pre-futures/pre-crisis period. However, as with original findings, estimated coefficients are not significant at conventional levels. This would therefore suggest that the introduction of futures did not result in a significant increase in the volatility of the European property securities market and therefore, there is little evidence to support the hypothesis that futures markets provide an instrument for destabilizing speculation (Kaldor, 1939). The implications from these findings are wide ranging, particularly for regulators in there is no evidence that would suggest financial authorities should impose additional regulation on the listed real estate futures market.

The results for the Eurozone index and contracts do however maintain their differences. The dummy variable for Period 2 (α_3) is not only positive but also statistically significant. This would suggest that listed real estate exhibit significantly higher volatility in the October 2007-December 2008 in comparison with the pre-October 2007 period. However, the results for the final period are not significant, implying that volatility in 2009 and 2010 are not higher than pre-October 2007. These results do make strong intuitive sense in a number of respects. Firstly, they imply that the initial increase in volatility was not due to introduction of derivatives trading, but rather can be attributed to the financial crisis and the large scale uncertainty that characterized capital markets during late 2007 and 2008. This reinforces the earlier argument that the increase in spot price volatility in the Eurozone was not necessarily caused by the start of futures trading. This view is given additional weight in that the results for the post 2008 period are insignificant. Therefore, even if futures trading had contributed to an immediate increase in volatility term, this impact was short lived and dissipated very quickly. The results also make intuitive sense when one considers the differences in the composition of the two indices. As noted previously the Europe wide index adds markets outside the Eurozone, the prime example being the U.K. This is important in that the British market is not only of the most established and largest real estate security markets in Europe but it is also one of the most heavily traded. In contrast, many of the Eurozone markets are smaller and less heavily traded. The impact of the financial crisis may therefore have been more clearly evident in those markets within the single currency zone. The results would appear to support this notion as the findings do indicate that the financial crisis of 2007/8 had a more significant and strong impact within the Eurozone than across Europe generally. Overall the results are consistent with many previous empirical studies in the stock market that have reported no significant increase in volatility that attributed to introduction of futures trading[iv].

Sub-Period Analysis and the Transmission of Information

Given that our empirical findings indicate the introduction of futures trading did not increase spot price volatility, the next concern is whether there is any associated gain with the onset of futures trading. To address this issue, the sub-period analysis detailed in Section 3 is undertaken, with the results reported in Tables 5 and 6. A comparison of the results before and after the establishment of futures trading shows interesting findings in the case of the FTSE ERPA/NAREIT Europe index. It can be seen from Table 5 that the value of α_0 has increased slightly in the post-futures period, signifying a minor increase in the unconditional variance. This further supports the results from Table 3, in which the volatility of the overall European real estate securities market is higher in the post-futures period than prior to the contracts being launched. Moreover, an increase in α_1 post-futures also suggests an increase in volatility. Importantly, the increase implies that the introduction of the contracts has facilitated the information transmission process, in that "*recent news*" is incorporated into spot prices more rapidly. It should be noted that the coefficient of α_1 relates to the lagged squared error term. Thus it links the impact of "*recent news*", in terms of the arrival of information yesterday, on price changes. Given that futures trading would offer more information to market participants, it would be reasonable to expect that the impact of "*recent news*" would increase with the onset of real estate security index futures.

Importantly, the increase of the coefficient α_1 further confirms this hypothesis in that the efficiency of the European listed property market has improved.

Table 5: FTSE EPRA/NAREIT Europe Index: Pre- and Post-Futures

Period	Pre-Futures	Post-Futures
Panel A: Mean Equation		
Constant (a_0)	0.001	0.001
	(4.786)***	(2.357)***
Lag Return (a_1)	0.051	0.054
	(1.209)	(1.412)
GFC (a_2)	-0.004	-0.003
	(-0.794)	(-2.616)***
Panel B: Variance Equation		
Constant (α_0)	7.47 x 10^{-7}	3.35 x 10^{-6}
	(2.092)**	(1.776)*
ARCH (α_1)	0.083	0.132
	(4.230)***	(4.806)***
GARCH(α_2)	0.917	0.868
	(53.504)***	(34.214)***

Notes: This table reports estimated coefficients for mean and variance equations of GARCH(1,1). The model is estimated by:

Mean Equation:

$$R_t = a_0 + a_1 R_{t-1} + a_2 GFC + \mu_t$$

Variance Equation:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1}$$

where GFC is a dummy taking on the value 1 for the period around the global financial crisis, and zero otherwise. Figures in parentheses are the standard errors. *, **, *** denotes significance at the 10%, 5% and 1% level respectively.

Table 6: FTSE EPRA/NAREIT Eurozone Index: Pre- and Post-Futures

Period	Pre-Futures	Post-Futures
Panel A: Mean Equation		
Constant (a_0)	0.001	0.002
	(5.150)***	(2.670)***
Lag Return (a_1)	0.073	0.054
	(1.704)*	(1.322)
GFC (a_2)	-0.003	-0.002
	(-0.444)	(-2.306)***
Panel B: Variance Equation		
Constant (α_0)	1.30 x 10^{-6}	6.28 x 10^{-6}
	(1.992)**	(2.476)**
ARCH (α_1)	0.122	0.153
	(3.577)***	(4.757)***
GARCH(α_2)	0.874	0.837
	(29.211)***	(27.740)***

Notes: This table reports estimated coefficients for mean and variance equations of GARCH(1,1). The model is estimated by:

Mean Equation:

$$R_t = a_0 + a_1 R_{t-1} + a_2 GFC + \mu_t$$

Variance Equation:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1}$$

where GFC is a dummy taking on the value 1 for the period around the global financial crisis, and zero otherwise. Figures in parentheses are the standard errors. *, **, *** denotes significance at the 10%, 5% and 1% level respectively.

The enhancement of market efficiency is further supported by the reduction of the coefficient of α_2. The coefficient of α_2 can be viewed as acting a gauge for "*old news*" in the sense that it relates to the lagged variance term. A fall in the value of α_2 is found by comparing α_2 before (0.917) and after (0.868) futures trading, demonstrating that "*old news*" would have less impact on today's price changes. This can be explained by the enhancement of market efficiency in which the arrival process of new information in the cash market has been improved. More specifically, the increased rate of information flow, shown through an increase in α_1, is expected to decrease the uncertainty about previous news (α_2). Therefore, in the presence of futures trading, "*old news*" has less impact in determining the volatility of the real estate securities market.

Comparable results are also documented in Table 6 for the FTSE EPRA/NAREIT Eurozone index. It can be noted that the values of α_0 and α_1 have both risen from the pre-futures figures, whereas α_2 has fallen slightly from 0.874 to 0.837. The results imply that, although the introduction of futures does seem to increase spot market volatility in the Eurozone, the increase in α_1 coupled with a drop in α_2 suggest that "*recent news*" is being incorporated into prices more quickly. The increased rate of information flow in recent news has also diminished the role of "*old news*" that is captured by α_2. This implies that futures trading has increased the efficiency of the listed real estate market in the Eurozone. In other words, establishing a real estate futures market has had a stabilizing effect on the spot market. All of these findings would imply that the introduction of real estate specific futures contracts have increased the flow of information and enhanced the spot market efficiency. The findings are similar to those reported in previous studies on the broader equity markets (Antoniou & Holmes, 1995; Lee & Ohk, 1995; Bohl et al., 2011). In effect, introducing of futures trading has led to increased efficiency in terms of the transmission of information to the underlying real estate equity market. Furthermore, this finding offers some support for the presence of a stabilizing effect in which futures trading provides more information on expected prices.

Volatility and Futures Trading Activity

The previous section provided some indication that the introduction futures trading in European listed real estate markets has improved the flow of information in real estate equities. To extend this analysis we test whether there appears to be a relationship between the volatility of the underlying index and the level of futures-trading activity, as proxied by both trading volume itself and also open interest. The results from this analysis are presented in Table 7 and reveal a significant negative coefficient with respect to expected futures volume for both Europe and Eurozone indices. This would imply that higher expected futures trading volume provides more price expectation information, thus leading to a reduction in the volatility of spot prices. This is a similar finding to that reported by Bessembinder & Seguin (1992) who argue that higher futures trading enhances the rate of information flow and therefore reduces the volatility of the underlying market[v]. It should however by noted, that the expected volume coefficient for the Eurozone index is not significant at conventional levels. This could be explained through the low trading volume evident in the futures contracts for the Eurozone index, as reported in Figure 1. This reduced volume not only implies reduced market depth in comparison to the Europe wide index and contract, but it may also have implications in terms of information flows. Turning our attention to the unexpected component of volume, the coefficients are positive, even both are statistically insignificant. The documented positive relation between unexpected volume and volatility is intuitively appealing in that information shocks are expected to move prices and generate trading in both markets. Therefore, it is would be expected to see a positive link between unexpected volume and spot volatility, as found in papers such as Bessembinder & Seguin (1992) and Watanabe (2001) in the U.S. and Japanese stock index futures markets respectively.

Table 7: Volatility and Expected & Unexpected Futures Trading Activity		
Market	**Europe**	**Euro Zone**
Panel A: Mean Equation		
Constant (a_0)	-0.001	-2.94 x 10^{-5}
	(-0.658)	(-0.010)
Lag Return (a_1)	0.053	0.040
	(0.883)	(1.031)
Panel B: Variance Equation		
Constant (α_0)	2.81 x 10^{-4}	9.40 x 10^{-5}
	(2.082)**	(3.006)***
ARCH (α_1)	0.150	0.097
	(2.038)**	(4.334)***
GARCH(α_2)	0.600	0.873
	(3.660)***	(31.390)***
Expected Volume	-7.90 x 10^{-8}	-2.70 x 10^{-7}
	(-2.135)**	(-1.878)*
Unexpected Volume	4.00 x 10^{-8}	2.02 x 10^{-7}
	(0.720)	(2.375)
Expected Open Interest	-1.08 x 10^{-8}	-4.10 x 10^{-9}
	(-2.075)**	(-1.138)
Unexpected Open Interest	4.32 x 10^{-9}	-4.76 x 10^{-8}
	(0.128)	(-1.369)
Monday	-6.61 x 10^{-5}	-8.86 x 10^{-5}
	(-0.480)	(-1.741)*
Tuesday	-5.11 x 10^{-5}	-6.24 x 10^{-5}
	(-0.454)	(-1.582)
Wednesday	-4.00 x 10^{-5}	-7.27 x 10^{-5}
	(-0.342)	(-1.689)*
Thursday	-2.07 x 10^{-5}	-6.48 x 10^{-5}
	(-0.143)	(-1.328)

Notes: This table reports estimated coefficients from a GARCH(1,1) model with expected and unexpected futures-trading activity. The model is estimated by:

Mean Equation:

$$R_t = a_0 + a_1 R_{t-1} + \mu_t$$

Variance Equation:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 ExpVol + \alpha_4 Un\exp Vol + \alpha_5 ExpOI + \alpha_6 Un\exp OI + \alpha_7 Mon + \alpha_8 Tue + \alpha_9 Wed + \alpha_{10} Thu$$

Figures in parentheses are the standard errors. *, **, *** denotes significance at the 10%, 5% and 1% level respectively.

With respect to expected open interest, we find, like Bessembinder & Seguin (1992) and Gulen & Mayhew (2000), that it has a negative impact on volatility, suggesting that futures markets improve market depth and thus have an underlying stabilizing influence. This finding also offers some indirect support to Bessembinder & Seguin (1992) in which the expected open interest component is an appropriate proxy for market depth in that it can be viewed as a measure of the number of traders or the amount of capital dedicated to a market at the beginning of a trading session. Again the insignificance of the coefficients in the Eurozone case may be attributed to its low trading activity. In addition, an insignificant coefficient with respect to unexpected open interest is evident in both markets. This means that the unexpected component of open interest has little impact on spot price volatility. The minor role of this variable is also documented by Bessembinder & Seguin (1992). In brief, our results would indicate that the volatility of real estate securities is mitigated when the background level of futures activity is high. This further reinforces the role of futures trading in market volatility. Indeed, the findings support the view that the introduction of the futures markets can improve liquidity and depth in the underlying market.

Another result worth noting is that the coefficients for the daily dummies are statistically insignificant, reflecting that there is no significant calendar anomaly in the European listed property market. The results are contrary to findings from stocks (Bessembinder & Seguin, 1992) and previous results from the European real estate securities markets

(Lenkkeri et al., 2006; Brounen & Ben-Hamo, 2009). This may be related to the improved efficiency over time. Lee & Lee (2003), Kohers et al. (2004) and Chan et al. (2005) all document that calendar effects in various international stock markets, and specifically the U.S. REIT market appears to have dissipated over time. Whilst this is a possible cause, particularly given the evidence provided earlier in this paper with respect to improved flow of information, the results may just be specific to our sample. Lenkkeri et al. (2006) considered data from 1990 to 2003, whilst Brounen & Ben-Hamo (2009) examined data from 1990 to 2007. In this study, we use a far shorter and more recent period, namely 2007-2010. Therefore, the difference in the results may simply be due to our use of a more specific and very short sample.

Hedging Effectiveness

Whilst the preceding sections have considered the impact of futures on the underlying spot market, our attention now turns to the ability of the contracts to act as effective hedges, with is one of the key characteristics of stock index futures generally (Darrat & Rahman, 1995). Specifically, there is the question of whether such contracts can act as effective risk management tools. This is a key issue for investors and one that will enable more informed investment decision making. The initial results from this analysis are reported in Table 8 and the findings for the entire sample period, as shown in Panel A, demonstrate that the pan-Europe contracts are effective hedging instruments, with a level of risk reduction of 65%. This equates to a reduction in the daily standard deviation from 2% to 0.7%, indicating that the contracts are effective hedging instruments. Another important observation is that both hedging strategies (naïve and OLS) offer very comparable hedging results, signifying that the hedging efficiency of the contracts is robust to different hedging strategies. Similar results are were reported by Lee & Lee (2012) with respect to the REIT markets in Australia and Japan. The strong hedging results indicate that the introduction of futures contracts specifically written on real estate security indices can add substantially to investors' opportunity sets through the enhancement of performance. In addition, the findings also support the arguments of Liang et al. (1998) and Lee & Lee (2012) with respect to the importance of establishing dedicated real estate security futures contracts.

The results with respect to the Eurozone specific index and contract are broadly similar. Both hedging strategies produce results that imply a level of risk reduction of 60% over the period July 2008-September 2010. However, the Eurozone contracts did provide somewhat weaker results compared to the overall European case. One possible explanation relates to the differences in the volatility of the underlying market. As noted by Lee and Lee (2012), a volatile spot market can lead to enhanced hedging results. Earlier in the paper the differences in composition between the two indices was noted with respect to trading. This is also a factor in their volatility. Over the sample period the standard deviation of the FTSE EPRA/NAREIT Europe index (2.02%) was slightly higher than that of the FTSE EPRA/NAREIT Eurozone index (1.98%). This possible explanation is further highlighted by considering the hedging effectiveness across two sub-periods, the results for displayed in Panels B and C of Table 8.

Table 8: Hedging Effectiveness of Europe Real Estate Securities Futures: Sub-Period Analysis

	Europe Index		Eurozone Index	
	Risk (%)	**Hedging Effectiveness (%)**	**Risk (%)**	**Hedging Effectiveness (%)**
Panel A: July 2008-September 2010				
Unhedged portfolio	2.021		1.979	
Hedged portfolio				
Naive hedge	0.714	64.685	0.788	60.199
OLS	0.705	65.116	0.788	60.179
Panel B: July 2008-May 2009				
Unhedged portfolio	2.720		2.642	
Hedged portfolio				
Naive hedge	0.706	74.041	0.767	70.985
OLS	0.709	73.952	0.780	70.473
Panel C: June 2009-September 2010				
Unhedged portfolio	1.349		1.353	
Hedged portfolio				
Naive hedge	0.720	46.651	0.803	40.675
OLS	0.703	47.852	0.795	41.278

Notes: Hedging effectiveness is measured as: $\frac{\sigma_u - \sigma_h}{\sigma_u} \times 100$

It is noticeable that the hedging effectiveness of the FTSE EPRA/NAREIT Europe futures contract increased markedly during the financial crisis, in that the reduction in risk, 74%, was of a larger magnitude than observed over the entire sample. In the second sub-period the level of risk reduction fell to 47%. This can in part be explained by the less volatile market conditions in this second period. Similar results are also found with respect to the Eurozone index and contracts with an initial risk reduction figure of 70% declining to 41%. This would again imply that the contracts achieved better hedging results in the more volatile period. The results are also consistent with Newell (2010) who found that A-REIT futures were widely used by institutional investors during the financial crisis. Importantly, the finding also indicates that European investors should more seriously consider the use of futures contracts during periods of high uncertainty and volatility. This provides additional evidence with respect to the economic usefulness of the contracts. In addition, the strong hedging results also provide some indirect support to the notion of a stabilizing effect brought about by the introduction of a futures market on listed real estate. As highlighted by McKenzie et al. (2001), a futures market can facilitate investors' hedging strategy in that it offers opportunities for investors, reducing therefore their reliance on spot hedging strategies.

The final issue to be considered in the current paper concerns the pan European nature of the indices used. As noted in the introduction this does provide the European market with unique characteristics. Unlike the majority of stock index futures, and specifically the REIT contracts available in the U.S., Australia and Japan, the European market is not centered on domestic indices. As a number of the results have indicated that this issue can come to the fore in other respects in that one of the largest and most heavily traded European markets, namely the U.K., is the primary difference in terms of the composition of the two indices used due to the U.K.'s exclusion from the Eurozone. Given the U.K. real estate equity market was ranked as the 2nd largest market in Europe (EPRA, 2011), it is reasonable to expect the U.K. investors would have a greater demand to hedge the risk of their portfolios. In addition, its size would mean that any pan European investor would be unlikely to hold negligible holdings in the U.K. sector. These elements may help to explain the difference in trading volumes in the two contracts, with substantially higher trading seen in the wider Europe contract. However, there are further implications. The Eurozone Index is largely centered on a small number of large markets, the biggest being France. In contrast, the Europe Index was large weightings in both these markets and the U.K. This naturally raises the possibility that U.K. investors have a disincentive in using the contracts to hedge their portfolios, particularly if those portfolios are predominantly U.K. in focus. In order to consider this we assess the effectiveness of using the Europe contracts in hedging the U.K. market, as proxied by the equivalent British FTSE EPRA/NAREIT index. The results from these tests are reported in Table 9.

Table 9: Hedging Effectiveness of the FTSE EPRA/NAREIT Europe Index Futures for UK Investors

	Risk (%)	Hedging Effectiveness (%)
Panel A: July 2008 – September 2010		
Unhedged portfolio	2.686	
Hedged portfolio		
Naive hedge	1.353	49.644
OLS	1.326	50.654
Panel B: July 2008 – May 2009		
Unhedged portfolio	3.672	
Hedged portfolio		
Naive hedge	1.692	53.905
OLS	1.600	56.423
Panel B: June 2009 – September 2010		
Unhedged portfolio	1.720	
Hedged portfolio		
Naive hedge	1.066	38.018
OLS	1.105	35.748

Notes: Hedging effectiveness is measured as: $\frac{\sigma_u - \sigma_h}{\sigma_u} \times 100$

The risk of the unhedged portfolio for UK investors is measured by the FTSE ERPA/NAREIT UK Index in Euro's.

The results reported in Panels A to C reveal that hedging U.K. exposure through the use of the pan-European contract does result in substantial benefits in terms of risk reduction. Risk reduction figures to the order of 36% to 56%, reflecting that U.K. investors can obtain benefits from their use. The fact that hedging benefits do occur would support the explanation is to why trading volumes are substantially larger with the Europe contracts in comparison to those concentrating solely on the Eurozone. However, the results also reveal that the hedging effectiveness is noticeably weaker compared to the preceding results reported in Table 8. This suggests that a dedicated U.K. investor would achieve lower hedging benefits by using the FTSE ERPA/NAREIT Europe index futures compared with pan-European investors. It does need to be made clear that this is probably true in the case of every single individual country and domestic investors within them. The situation is however extenuated in a U.K. case due to the relative size of its listed market. The largest European market, in terms of market capitalization if not trading volume, is France. However, domestic French investors would possibly see less of an impact due to the high weighting placed upon the French market in the Eurozone index. Furthermore, it should also be noted that we ignore the foreign exchange risk present in when considering a U.K. investors, and therefore assumedly Sterling denominated. This finding does raise questions over the choice of launching contracts on an international basis and the possibility of latent demand for a U.K. specific contract.

CONCLUDING COMMENTS

Since the launch of real estate security futures contracts in Europe in 2007 there has been increasing interest on the part of investors. However, there have been no academic pieces of work dedicated to the impact of their introduction on the listed real estate sector in Europe. The current study provides a number of important insights. Firstly, an investigation of the returns in the FTSE ERPA/NAREIT Europe and Eurozone indices find little evidence to support the view that the introduction of index futures contracts had a destabilizing impact on the underlying market. In particular, no evidence is found that would imply that the introduction of futures contracts have led to an increase in underlying volatility. Rather, the empirical results imply that futures trading has led to an improvement in the information flow in the European listed real estate sector. It also appears that the volatility of real estate equities is negatively associated with the expected futures trading volume and open interest, confirming the stabilizing role of futures trading. These findings support the view that futures markets can improve liquidity provision and depth in an underlying spot market. Secondly, the hedging effectiveness analysis further illustrates the economic significance of European listed real estate futures. The results confirm that both contracts can be used as effective hedging instruments. In addition, the sub-period analysis shows that enhanced hedging results are documented during more volatile periods. The one caveat that does however need to be noted with respect to the contracts use in a hedging context relates to the cross-border nature of the indices used. This does lead, as the evidence with respect to the U.K. illustrates, to a reduction in hedging effectiveness in the case of a purely domestic investor.

Email contact: chyilin.lee@uws.edu.au

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ENDNOTES:

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[i] Results from Augmented Dickey-Fuller and Phillips-Perron unit root tests show that all of the data is stationary. These results are available from the authors on request.

[ii] Different GFC periods (October 2007 to May 2009) were also employed in order to examine the robustness of our GFC period selection since the European listed real estate markets recovered at different speeds. However, no significant variation is found, suggesting that our baseline results are robust.

[iii] Naturally, a third time dummy representing the pre-crisis period cannot be introduced as it would lead to perfect multicollinearity.

[iv] Gulen & Mayhen (2000) do highlight the importance of accounting for movements in the world index in the consideration of changes in underlying volatility. To further control for the effect of other determinants of volatility, the FTSE Eurofirst 300 index, the FTSE Eurofirst 300 Eurozone Index as well as the S&P Global Property Index were introduced into our baseline models. Interestingly, the inclusions of these indices had little impact on our baseline results. In particular, there is no evidence to support the view that the introduction of futures trading has increased the volatility of European listed real estate. As with the main results none of the relevant coefficients were significant in the case of the FTSE ERPA/NAREIT Europe Index. Similar results are also found with respect to the Eurozone index. Although though some increase in volatility was observed in the post-futures period, this would appear to be due to the impact of the financial crisis and not the introduction of futures. The results also suggest that our results are robust to these alternative specifications. The full set of results from these specifications is available from the authors on request.

[v] Interestingly, a negative relationship is observed between the forward and spot housing markets in Hong Kong by Wong et al. (2006), confirming that futures/forwards trading may enhance the information flows and reduce spot volatility.