Feedback trading strategies and long-term volatility

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Abstract

The aim of the present study is to examine securitized real estate market efficiency under a new perspective. We begin by investigating the effect of feedback trading strategies on long-term market volatility of three hypothetical portfolios of securitized real estate markets. To this end, the original FIGARCH and an extended GJR-FIGARCH methodology are employed. Our results reveal that positive feedback trading occurs across the three portfolios casting doubt on real estate market efficiency. Moreover, evidence against effciency is amplified by the documented volatility asymmetry. During the recent global financial crisis, the European portfolio of Italy and Sweden favors negative (symmetric and asymmetric) strategies with volatility (symmetric and asymmetic) being present and affecting the autocorelation of portfolio returns. Our results entail significant implications for market regulators and investors.

Keywords: Feedback Trading; Long-Memory Volatility; Real Estate Markets; Financial Crisis; Market Risk Analysis

JEL Classification: G1, R2, C5

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1.Introduction

Efficient Market Hypothesis (EMH) since its inception by Fama (1970) remains a useful framework under which asset prices reflect timely all available information ruling out the possibility of consistent above-average returns for investors that employ mechanical trading rules. Stated differently, if the Efficient Market Hypothesis is valid in its weak form it is assumed that asset returns are generated from a normal distribution and returns are sequentially independent. In other words, asset returns should exhibit no long-term memory of the price series or in the volatility. Although the EMH has spurred a significant strand of theoretical and empirical literature towards the validity of EMH across asset markets evidence is mixed. It is widely known that early literature on market efficiency centered on the profitability of relative strength trading rules that buy past winners and sell past losers in the stock market. Contrarian or return reversal strategies (see inter alia Jegadeesh, 1990 and Lehmann, 1990) have also been famous in the academic literature of the early 1990s. Motivated by abundant evidence that contrarian relative strength trading rules can generate positive abnormal returns Jegadeesh and Titman (1993) set out to examine the profitability of a strategy that consists of buying stocks that have performed well in the past and sell stocks that have performed poorly. Their main strategy yielded a compounded excess return of 12.01% per year on average for the period from 1965 through 1989. The profitability of this and other similar trading rules was revisited by the same authors few years later (Jegadeesh and Titman, 2001). The main finding was that the momentum profits persist in the 90's eliminating any suspicion that the original result was driven by data manipulation. Most importantly the authors reached evidence in favor of the explanation that the momentum profits result from delayed overreaction that eventually after 4 to 5 years from formation results in return reversals. A different view expressed by Fama (1998) who claimed that the return anomalies documented in the literature are not inconsistent with the notion of market efficiency. His argument rests on the premise that irregularities are due to chance and that profits from trading strategies focusing on these anomalies are sensitive to the metric employed.

One would expect that informational inefficiency would be more prevalent in asset markets that exhibit several frictions. Therefore, an ideal setting to examine the above claim is the housing markets (see Ghysels, 2013 for an excellent review of relevant literature) that are characterized by the lack of an organized market that offers centralized information on real estate prices. As a result, gathering information is very costly and transactions costs are high. Furthermore, these markets are characterized by less trading activity as compared to stock markets. Moreover, it should be noted that real estate markets need more time to recover after a shock to the economy.

Real estate plays the role of wealth storage in the economy. Most importantly, real estate price dynamics and the boom and busts carry important implications for financial and banking crises. Households in US and in European continent tend to include real estate into their investment portfolio more frequently than they do with equities. A shift in real estate prices will probably affect households' wealth more severely than a change in other asset prices of equal magnitude. In addition, housing wealth is related to larger marginal propensity of consumption as opposed to financial wealth (Crowe et al., 2013). Moreover, the behavior of housing market entails significant implications for the macroeconomic environment. For example, the activity in the construction sector contributes substantially to the general economic activity and keeps a large portion of labor force occupied. Therefore real estate boom–busts and economic activity share common paths not only during economic crises, but during normal times. As mentioned in Igan et al. (2011) in most developed economies, investment in the housing sector and house price cycles tend to lead credit and business cycles. From the above it is evident that the volatility in residential investment and house prices is an unhealthy situation for the economy through their impact on consumption and credit while the reverse effect is not widely confirmed, reinforcing the belief that shocks originate from the real estate sector.

From the above it is easily inferred that feedback trading strategies and long memory property of returns and volatility are common empirical regularities that carry important implications for the efficient market hypothesis of the securities market under consideration. The further motivation of this study is that real estate portfolios are important for risk management purposes as they add risk to investors not only though trading but also through news transmission inefficiency. This means that not only feedback strategies are important in real estate markets, but also bad and good news play an important role in market inefficiency. In addition, real estate portfolios are important for investment opportunities when they are international and have been separated according to the size of the markets. In literature, the findings of long memory are important for the construction of portfolio for investors as they base their trading to the memory of the market or otherwise market's news persistence. For asset management process, it is important to look at real estate assets as they add value to the portfolio of investors.

In the context of this study and in the spirit of the study of Clapp and Tirtiroglu (1994) we focus on real estate market efficiency under a novel perspective. Therefore, in this study, we split feedback (buy-sell shortly) traders to two groups: risk averse utility maximizers, along the lines of CAPM, and positive or negative traders. On the one hand, risk averse utility maximizers respond rationally to expected returns subject to their wealth limitation. On the other hand, feedback (buy-sell shortly) traders base their decisions on the response to price changes, and on the historical past return trading, rather than on the expected fundamental return series. The reverse relationship between volatility and autocorrelation is due to (positive or negative) feedback trading strategies. This reversal sign in asset return autocorrelation is consistent with the fact that traders follow feedback (buy-sell) strategies. In particular, positive traders buy (sell) when prices rise (fall). Thus, positive feedback trading produces negative first order autocorrelation in real estate returns. This impact, in turn, increases proportional to the level of volatility. Furthermore, non-synchronous trading and negative first order feedback trading (NFT) cause positive autocorrelation in real estate returns.

Negative feedback trading might result from profits when the market raises accounting for wealth maximization (similar to 'constant-mix' strategies). In this case, negative feedback traders sell an asset following an increase in price and buy after a price drop. Following this behavior, both groups provide the rationale for autocorrelation in return series and the importance of volatility on this return autocorrelation of series. While negative feedback trading helps make markets less volatile, positive feedback trading is a source of market volatility. In particular, when a cycle of positive feedback continues for too long, it can create an asset bubble or a market crash as investors seem to speculate on the shorter term and avoid longer term investments.

In line with the findings of Sentana and Wadhwani (1992), positive feedback trading (PFT) is an important source of short-term variability in the US stock market. In this respect, Koutmos (1997) reports similar findings for the developed as well as for the emerging stock markets. In contrast, DeLong et al. (1990) find that positive feedback trading is associated with positive return autocorrelation, because traders move stock prices away from their fundamental values in the short run. Other studies, such as Shiller (1990) point out that positive feedback trading produces negative return autocorrelations which is corroborated by the findings of Sentana and Wadwhwani (1992) and Koutmos (1997).

The above findings support the notion that the return autocorrelation may vary over time and the impact of positive or negative feedback trading should be a function of return volatility. In order to introduce a volatility term in the mean return equation of (PFT or NFT), we use the original and an extended FIGARCH methodology which was initially proposed by Baillie et al. (1996). We use the original FIGARCH and an extended GJR-FIGARCH methodology as we wish to examine the relationship between long-term volatility and short-term feedback strategies in real estate markets, both symmetrically and asymmetrically. The focus of this investigation is the interaction between long-term volatility and autocorrelation of real estate returns which obviously carries implications for real estate market efficiency. In the context of the relevant literature, it is expected that during a low volatility period stock returns exhibit positive autocorrelation, while during a high volatility period stock returns turn negative. We opt for this effect, measuring the impact of positive and negative returns during the global financial crisis period of 2008-2009, on the relationship between long-term volatility and negative or positive feedback trading.

Therefore, the main objective of this paper is to investigate whether strategies encountered in stock markets are also prevalent in the real estate markets casting doubt on real estate market efficiency. Our main contribution stems from the link between short-term positive or negative feedback trading and long-term volatility in three portfolios accounting for both positive and negative returns. Particular attention has been given to the above link between short-term feedback trading and long-term volatility, through two fractionally integrated GARCH approaches.

Our motivation to examine the real estate markets stems from the fact that these investments are held by many investors as part of a multi-asset portfolio (see Kroencke and Schindler, 2012 and earlier discussion). Our goal is to reveal the short-term investing strategies that may arise from trading in real estate markets, when the fluctuation of volatility persists for a long period and thus it is easier-through our two approaches-to capture the short-term traders' symmetric or asymmetric behavior for the whole period under study and also during the 2008-2009 global financial crisis. Our study focus on long-term market volatility of three hypothetical portfolios of real estate markets-two European: the first one which consists of securitized real estate markets of UK, Germany and France and the second one which contains securitized real estate markets of Italy and Sweden, and an Asia-Pacific: it consists of securitized real estate assets of Japan, Australia and Hong-Kong. We also examine the long-term volatility for one of the two above European portfolios-this one which contains the Italian and Swedish assets-during the financial crisis period of 2008-2009, using both the original and an extended FIGARCH model. We have chosen this portfolio in order to test the theory of symmetric and asymmetric efficiency or inefficiency in feedback strategies and long-term volatility as this portfolio includes a country (Italy) which is affected much by the global financial crisis and a country (Sweden) which is not affected much by the current crisis. So, it is interesting to examine this portfolio characteristic during the global financial crisis and state their influence both in feedback strategies and long-term volatility. We have split the above European indexes into two portfolios of real estate assets as we want to compare the feedback trading strategies and the impact of negative news on the long-term volatility between larger and smaller markets of real estate assets.

Previewing our findings, we report mixed results concerning the link between returns autocorrelation and long-term volatility across the sample of securitized real estate markets. Thus, the two FIGARCH models show whether the shocks in real estate markets die away slowly in the long run. Furthermore, the results show whether the real estate markets are stationary or mean reverting through the degree of fractional integration metric, which captures the long memory features of volatility. A recent study of Cotter and Stevenson (2008) finds strong evidence of long memory in REITs volatility. Thus, there is evidence that REITs exhibit high persistence of volatility and the autocorrelation of residuals exists over long lags. In other words, evidence of volatility persistence in the real estate markets implies inefficiency. Following that, to the best of our knowledge, the impact of short-term (symmetric or asymmetric) feedback trading strategies on long-term (symmetric or asymmetric) volatility fluctuations in the real estate markets is examined for the first time.

The rest of the paper is organized as follows: Section 2 presents a brief literature review while section 3 describes the sample data and methodology. Section 4 discusses the empirical results. Section 5 presents an application of the two models during the crisis period of 2008-2009, and finally Section 6 summarizes the main findings of the empirical analysis and discusses any policy implications.

2.Brief Literature Review on Feedback Trading, Long Term Volatility and EMH in Real Estate Markets

Feedback trading strategies and long memory property of volatility are common empirical regularities that carry important implications on the efficiency market hypothesis (EMH) of the asset market under consideration. The degree of real estate market efficiency has been in the epicenter of numerous studies reaching mixed evidence. Researchers in real estate market employ either directly observed prices usually extracted from transactions or stock-market based indices. Therefore research on the predictability of real estate prices has paved its way into two different paths. On the one hand the early study of Gau (1985) for Vancouver commercial prices and Linneman (1986) on US residential real estate prices both rejected weak form efficiency of real estate prices. In an influential study, Case and Shiller (1989) document substantial predictability in real and excess returns to real estate for four US states. In a related study with ours Clapp and Tirtiroglu (1994) tested the positive feedback hypothesis using housing prices of 19 towns in US metropolitan area of Hartford Connecticut for the period from 1982 through 1988. Their results confirmed that there is a tendency of lagged house prices to predict current house prices only in neighboring towns which is consistent with the positive feedback hypothesis. Most recently, Hill et al. (1999) and Schindler (2011) reject the hypothesis of random walk in real estate prices. Studies on the topic conclude among other things that there exists a positive serial correlation of returns for short time intervals which turns negative if we consider longer time intervals. However, short term predictability in real estate prices is not exploitable by means of a trading strategy (see Ghyssels et al., 2013 for an excellent review of past literature). For securitized real estate markets since the study of Liu and Mei (1992) evidence are in favor of predictability that is market and time dependent. In particular, Serrano and Hoesli (2010) reported a greater degree of predictability in securitized real estate returns than stock returns in countries with mature and well established REIT regimes. The degree of efficiency of international securitized real estate markets was the focus of several studies including Schindler (2011) and Su et al. (2012). The former study examined the predictability of real estate returns in 4 developed and 12 emerging markets employing a battery of tests. The results provided significant evidence in favor of the weak form of efficiency hypothesis for 7 countries. Su et al. (2012) examined the degree of efficiency using a novel method for 14 international securitized real estate markets—Australia, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Sweden, Switzerland, United Kingdom and the United States. Their findings revealed that only six of these markets—Australia, Hong Kong, Italy, Japan, Sweden and the United States are efficient while the rest are inefficient. Finally, it appears that real estate markets, in line with Schindler (2011), are relatively less efficient as compared to stock and bond markets in general which could be a reflection of the nature of real estate. It should be also noted that the efficiency (inefficiency) of the real estate markets is time dependent.

Another significant strand of literature examines the degree of integration between real estate and stock markets. Okunev and Wilson (1997) examined the presence of mean reversion and fractional integration between the returns in public real estate and stock markets. They detected a fractional cointegration between the returns of the two assets but they also claimed that the mean reverting behavior of the two variables was quite slow implying that the two markets could behave differently for a long period. In a related study, Wilson and Okunev (1999) failed to reach evidence in favor of the integration hypothesis between the general stock and real estate stock market returns in the U.S. and the U.K. However, in Australia they documented tenuous evidence using the fractional co-integration technique. Moreover, they noted that international real estate securities markets may be non-linearly related in returns with slow mean reversion. Okunev et al. (2000) reported a nonlinear unidirectional causal relationship running from the stock market to public real estate market in the presence of structural breaks. Stevenson (2002) examines the predictability of eleven international real estate securities returns over short- and long-term horizon from a mean reversion perspective. The author employed variance ratio and augmented Dickey–Fuller (ADF) tests and reported limited evidence in favor of mean reverting behavior. Kleiman et al. (2002) employing ADF and Phillips–Perron (PP) unit root and variance ratio test to examine the random walk hypothesis for the real estate securities markets and associated broader stock markets of Europe, Asia and North America failed to reject the random walk hypothesis. Moreover, their non-parametric run test reveals that international real estate securities markets are weak-form efficient. Liow and Yang (2005) in an international context and using a fractional differencing test for long co-memory reported evidence of fractional co-integration between the securitized real estate price, stock market prices and important macroeconomic factors in some Asian and UK economies. Liow (2009) examined a series of international securitized real estate markets and detected substantial evidence of long memory in the volatility structure of most securitized real estate markets especially in Asia. Miles (2011) for a number of U.S. metropolitan areas, concluded that for housing prices with significant GARCH effects, more than 50% are characterized by the very high persistence found in other assets such as stocks.

The large literature on real estate price dynamics has documented the volatility characteristics of securitized real estate markets from different angles. The main findings for real estate market volatility are summarized in the following: volatility is both time-varying and predictable. However the literature in the real estate market ignores the asymmetric nature of volatility.

3. Data and Methodology

3.1. Data Analysis

Our dataset consists initially of daily returns of eight (UK, Germany, France, Italy, Sweden, Australia, Japan and Hong Kong) international real estate indexes, obtained from FTSE EPRA/NAREIT, which include securitized and listed companies that have their core business in real estate activities (REITs and non-REITS). The period covers 29 years, from 1-1-1990 to 7-2-2019, which spans the recent financial crisis and the consequences arising for the distribution of real estate returns[5].

Due to diversification reasons we constructed three new diversified real estate portfolios based on the aforementioned eight international real estate indexes. These portfolios named E_P_1, E_P_2 and AP_P. The E_P_1 real estate portfolio is constructed from Italian and Swedish indexes; the E_P_2 real estate portfolio is constructed from UK, German and French indexes and the AP_P real estate portfolio is constructed from Japan, Australia and Hong Kong indexes.

Table 1 gives the descriptive statistics for the three securitized real estate diversified portfolios. E_P_1 portfolio provides the lowest mean (0.000031) whereas E_P_2 portfolio the highest. Minima vary between -0.134 (E_P_1 portfolio) and -0.106 (E_P_2 portfolio). Maxima vary between 0.084 (E_P_2 portfolio) and 0.124 (E_P_1 portfolio). The historical standard deviations range between 0.012 percent for the real estate portfolios E_P_2 and AP_P to 0.015 percent for the real estate portfolio E_P_1. The

[5] KPSS test shows stationarity at first differences for all the series.

skewness is negative for all the portfolios. The three real estate portfolios are leptokurtic. The kurtosis appears to be the highest for the E_P_2 portfolio (10.20155).

Table 1: Descriptive Statistics

	Mean	St. Dev.	Minimum	Maximum	Skewness	Kurtosis
E_P_1	0.000031	0.015	-0.134	0.124	-0.28545	9.29006
E_P_2	0.00011	0.012	-0.106	0.084	-0.38218	10.20155
AP_P	0.000066	0.012	-0.108	0.098	-0.08336	8.32348

Notes: E_P_1 stands for the European portfolio of Italy and Sweden, E_P_2 stands for the European portfolio of UK, Germany and France, AP_P stands for the Asia Pacific portfolio of Japan, Australia and Hong-Kong.

The graphs of the real estate series support our methodology which is used below[6]. In addition, the autocorrelation values and graphs up to 20 lags show that the portfolios of real estate series are stationary[7].

3.2. Methodology

3.2.1. Positive and Negative Feedback Trading (PFT and NFT)

The FT (Feedback Trading) model proposed by Sentana and Wadhwani (1992) has the following form:

$$r_t = \beta_0 + \beta_1\sigma_t^2 + (\beta_2 + \beta_3\sigma_t^2)r_{t-1} + \varepsilon_t \qquad (1)$$

where, β_2 picks up the possibility that constant autocorrelation is present in the model, β_3 should be both negative and statistically significant for the presence of positive feedback trading, the term $\beta_1\sigma_t^2$ is equal to -$\beta_3\sigma_t^2$ and implies that there is positive feedback trading and negative autocorrelation in returns.

[6] The graphs are available upon request

[7] The results of the values and graphs are available upon request.

The advantage of this model is that it can accommodate not only the feedback trading strategies followed by two types of investors, but also the relation between autocorrelation and long-memory volatility. It should be noted that real estate markets are expected to exhibit high degree of integration.

At low volatility levels, negative feedback trading will dominate and induce positive serial correlation in real estate returns due to the relative strength of constant autocorrelation (β_2) compared to $\beta_1\sigma_t^2$. As risk levels increase, the larger impact of $\beta_1\sigma_t^2$ compared to β_2 implies negative autocorrelation in real estate returns due to the strength of positive feedback trading. Thus, negative feedback trading will account for the positive autocorrelation in daily real estate returns.

Structural breaks and regime switching found to play somehow a significant role in the real estate series and as a result we isolate the portfolio of Sweden and Italy during the global financial crisis in order to examine its patterns of efficiency or inefficiency with respect to feedback trading.

3.2.2. The original FIGARCH approach

The FIGARCH model best describes the volatility in the real estate markets as found by Cotter and Stevenson (2008). The conditional variance of the FIGARCH process may be written as:

$$\sigma_t^2 = c + \beta\sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - L)^d]\varepsilon_t^2 \qquad (2)$$

where, (1-L) is the first difference operator, $(1-L)^d$ is the fractional first difference operator.

The FIGARCH model nests the covariance-stationary GARCH model for d=0 and the IGARCH model for d=1. We should allow for values of d between 1 and 0 when modeling long-term dependence in the conditional variance. If 0<d<0.5, the series are stationary, and if 0.5<d<1, the series are no longer stationary but they are long-term reverting, with the effect of shocks dying away slowly in the long-run. For the FIGARCH approach, all series can be estimated in terms of I(d) parameter, with d lower than 1 and higher than 0. Thus, series are either long-term or mean reverting.

This paper fits a long memory volatility model, the Fractional Integrated GARCH (FIGARCH), developed by Baillie et al. (1996) who reported that the FIGACRH model can capture the long memory of financial volatility for daily equity returns through the fractional differencing parameter (d). As shown in Baillie et al. (1996), for 0<d<1, the conditional volatility $-\sigma_t^2$ will decay at a slow hyperbolic rate, which is a characteristic of long memory[8]. Numerous studies (see Stevenson (2002), Liow (2009)) have shown that the long-run dependence in real estate market volatility is described well by a long term-reverting fractionally heteroskedastic (FIGARCH) process.

Our primary purpose is to reveal a more solid and persistent relationship, if possible, between real estate volatility and autocorrelation of returns. Taylor (1986) supports the use of absolute values of stock returns as they have slowly decaying autocorrelations, and Ding et al. (1993) note the same fact for daily stock returns.

[8] Alternative models and the student distribution indicate the importance of long-memory.

3.2.3. The novel GJR-FIGARCH approach

We develop the GJR-FIGARCH model[9], following Glosten et al. (1993), as it best describes the asymmetric impact of negative shocks on volatility in the real estate markets. The conditional variance of the GJR-FIGARCH process may be written as:

$$\sigma_t^2 = c + \beta\sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - fI_{t-1}L)(1 - L)^d]\varepsilon_t^2 \tag{3}$$

where,

$$I_{t-1} = \begin{cases} 1, \text{if } \varepsilon_{t-1} < 0 \\ 0, \text{if } \varepsilon_{t-1} \geq 0 \end{cases} \tag{4}$$

The GJR-FIGARCH model nests the FIGARCH model for f=0. This could be clarified by a test, which will examine the null hypothesis, that f=0. If we reject the null hypothesis, then volatility responds asymmetrically to positive and negative innovations. The long-term variance[10] is conditional to a common factor of last period's long-term conditional volatility and last period's squared innovations. The difference in this factor is estimated by the fractional integration coefficient (d).

In the above model, we allow for positive and negative long-term innovations to influence the long-term conditional volatility. In particular, the sum of ($\beta + e$) measures the impact of positive innovations on long-term volatility of real estate markets, while the sum of ($\beta + e$+f) measures the impact of negative innovations on volatility. In addition, we can capture the whole asymmetric volatility by the fraction of ($\frac{(\beta + e + f)}{(\beta + e)}$), whereas the volatility persistence at time t-1 is measured by the sum of the coefficients of (β+e+d). This sum of values occurs because the integration coefficient is common between volatility and error terms.

[9]Asymmetry is important in the series undertaken and our asymmetric GJR-FIGARCH methodology makes sense.

[10] Long memory is present in the series as the G-P-H technique shows.

Thus, volatility could influence last period's squared innovations with past negative innovations to increase it more than positive innovations of the same magnitude. Hence, if the above fraction is significantly positive, volatility rises more after a negative shock than a positive one.

4. Feedback Trading and the GJR-FIGARCH model's results for International portfolios of securitized real estate indexes

4.1. Positive Feedback Trading and the GJR-FIGARCH results

4.1.1. The European portfolio of real estate markets

Table 2 shows that when the impact of negative innovations is introduced in the variance equation of the GJR-FIGARCH model, then investors overreact as far as the risk is undertaken by them is concerned. In particular, European portfolio's investors trade on the real estate markets of Italy and Sweden in order to take advantage of riskiness. We have estimated the total asymmetry as being equal to 1.006, which means that bad news, affects long-term volatility slightly more than good news. This means that these markets are somehow asymmetric. The markets of Italy and Sweden contain real estate stocks which are risky for positive feedback traders when markets are inefficient, who base their strategies on the negative autocorrelation of real estate returns and make them riskier and the diversification benefits that might arise are dubious for investors. In that case, investors face difficulties of how to construct their portfolios as real estate markets are inefficient and trading is slightly risky.

As far as the similar impact of bad and good news is concerned for the European portfolio of Italy and Sweden, there is a slightly higher impact of bad news, by 0.313, than of good news, which is equal to 0.311. This means that the above two markets remain asymmetric during the investigated period and thus inefficient. Thus, risk undertaken by investors is quite high for these real estate markets as asymmetry found to be important. In addition, volatility persistence is equal to 0.642 for this period. This indicates that the persistence of news is important, and the long-term volatility is present in these two markets. Furthermore, the diagnostic tests indicate the importance of serial correlation in the standardized residuals, but not in the squared standardized residuals. There is also negative skewness and kurtosis less than 3, which makes the normal distribution feasible in this portfolio. The inefficiency is present in this portfolio for these two markets with risk uncertainty to be present in investors. Investors could diversify their portfolio based on this risk asymmetry as it seems to play significant role in real estate markets of Italy and Sweden.

Table 2: FT-GJR-FIGARCH results for the European Portfolio of real estate markets of Italy and Sweden

$$r_t = \beta_0 + \beta_1\sigma_t^2 + (\beta_2 + \beta_3\sigma_t^2)r_{t-1} + \varepsilon_t$$

$$\sigma_t^2 = c + \beta\sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - fI_{t-1}L)(1 - L)^d]\varepsilon_t^2$$

Variables	European
β_0	-0.001 (0.001)**
β_1	0.001 (0.001)*
β_2	0.034 (0.001)*
β_3	-0.539 (0.001)*
c	-0.001 (0.001)*
β	0.244 (0.001)*
e	0.067 (0.001)*
f	0.001 (0.001)*
d	0.331 (0.001)*
Log-likelihood	21993.460
Skewness	-0.369
Kurtosis	2.673
LB(20)	29.386***
LB^2 (20)	24.394

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

In Table 3, asymmetry and thus inefficiency is slightly less pronounced in comparison to the previous portfolio of European real estate indexes, and in particular is equal to 1.004. This means that the impact of negative news is slightly larger by 1.004 times more than positive ones with bad news having an impact equal to 0.374, while good news has an impact of 0.372. Their difference is equal to 0.004, which indicates just only a small significant impact. This means that this portfolio is not riskier than the previous one which explained in the previous Table 2 as asymmetry affects investors' decisions slightly different here as well; uncertainty plays an important role in the portfolio construction here as well. Volatility persistence is equal to 0.725, which means that the impact of long-term volatility news from the previous days to the next one is not minimal, but in contrast has a strong effect. News persists for a long period and affects investors' decisions when they consider their portfolios' construction.

For the real estate markets of UK, Germany and France, investors' strategies are influenced by positive autocorrelation as the coefficient of $\beta 1$ is negative and statistically significant. This indicates that risky trading is only slightly present in these markets for investors who want to diversify their portfolio. The coefficient of β_3 is negative and statistically significant, supporting the presence of positive trading strategies (PTS). PTS could be developed by investors in order to take advantage by the slightly small asymmetric opportunities arising in these three real estate markets[11]. These real estate markets remain inefficient under the prism of trading and thus diversification benefits might arise to traders and investors.

Diagnostic tests indicate that serial correlation is not present in the standardized and squared standardized residuals, while normal distribution is present in the residual series with negative skewness. This means that small asymmetric effects are present in the three European real estate markets, affecting investors' preferences with regard to their strategies.

[11] Our robustness tests in the indexes and the feedback trading behavior in individual assets are consistent with the main findings in the aggregate indexes of the European hypothetical portfolio of UK, German and French real estate assets.

Table 3: FT-GJR-FIGARCH results for the European Portfolio of real estate markets of UK, Germany and France

$$r_t = \beta_0 + \beta_1 \sigma_t^2 + (\beta_2 + \beta_3 \sigma_t^2) r_{t-1} + \varepsilon_t$$

$$\sigma_t^2 = c + \beta \sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - f I_{t-1} L)(1 - L)^d] \varepsilon_t^2$$

Variables	European
β_0	0.001 (0.001)*
β_1	-0.060 (0.001)*
β_2	0.064 (0.001)*
β_3	-0.038 (0.001)*
C	0.001 (0.001)
B	0.285 (0.017)*
E	0.087 (0.001)*
f	0.001 (0.001)*
d	0.353 (0.010)*
Log-likelihood	24013.451
Skewness	-0.283
Kurtosis	2.075
LB(20)	21.058
LB ^{2} (20)	17.297

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

4.2. Positive Feedback Trading and the GJR-FIGARCH results

4.2.1. The Asia-Pacific portfolio of real estate markets

It is obvious from Table 4 and the other two tables (Tables 2-3), that investors, when speculating due to market segmentation or inefficiency, follow positive strategies minimizing the risk of their position. For the real estate markets of Japan, Australia and Hong-Kong, asymmetry has similar impact on the long-term volatility of the Asia-Pacific portfolio. In particular, bad news has an impact of 1.006 times larger than good news, bad news increases long-term volatility by 0.371 points and good news increases long-term volatility by 0.369 points. This portfolio is not far more risky than the previous two European portfolios that have been analyzed in the previous section, indicating the similar asymmetric nature of assets in the Asia markets and the slight risk exposure for investors when they consider trading in the

Asia-Pacific region for real estate assets. Volatility persistence is quite high here, and is equal to 0.729, which means that the impact of news on long-term-volatility decays quite slowly. Long-term volatility remains important for a couple of days and this indicates that negative news persist more in comparison to positive news and inefficiency is present in real estate Asia-Pacific markets.

Diagnostic test results for normality and autocorrelation of standardized and squared standardized residuals confirm the presence of normality and the absence of serial correlation in the standardized and squared standardized series of residuals. This means that these markets behave similarly to the European markets and integration tests may be good to arise for investment purposes. Skewness is negative, and kurtosis indicates the presence of normal distribution meaning less riskiness in the trading behavior of investors for real estate markets in comparison to equity markets.

Table 4: FT-GJR-FIGARCH results for the Asia Pacific Portfolio of real estate markets of Japan, Australia and Hong-Kong

$$r_t = \beta_0 + \beta_1 \sigma_t^2 + (\beta_2 + \beta_3 \sigma_t^2) r_{t-1} + \varepsilon_t$$

$$\sigma_t^2 = c + \beta \sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - f I_{t-1} L)(1 - L)^d] \varepsilon_t^2$$

Variables	**Asia-Pacific**
β_0	-0.001 (0.001)
β_1	0.356 (0.001)*
β_2	0.096 (0.001)*
β_3	-0.053 (0.001)*
C	0.001 (0.001)*
B	0.312 (0.001)*
E	0.057 (0.001)*
f	0.001 (0.001)*
d	0.360 (0.001)*
Log-likelihood	23270.209
Skewness	-0.021
Kurtosis	1.459
LB(20)	16.276
LB ^{2} (20)	20.093

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

4.3. Ratio test results: Is asymmetric volatility significant for the three portfolios?

Table 5 results indicate that volatility asymmetry, namely negative news, affects slightly more next day's volatility than good news in the GJR-FIGARCH model and consequently there is an impact on autocorrelation of real estate returns. This means that the GJR-FIGARCH model captures real estate returns slightly differently for the three portfolios. Thus, in the European portfolio of Italy, Sweden, and of UK, Germany and France and in the Asia-Pacific portfolio of Japan, Australia and Hong-Kong it is asymmetric news that affects positive feedback trading. Thus, the above markets remain inefficient, and this is attributed to the different impact of good and bad news on volatility of real estate assets.

Table 5: Testing for Asymmetric Volatility significance

	f=0
E_P_1	222.770*
E_P_2	81.519*
AP_P	301.595*

Notes: (1) E_P_1 stands for the European portfolio of Italy and Sweden, E_P_2 stands for the European portfolio of UK, Germany and France, AP_P stands for the Asia Pacific portfolio of Japan, Australia and Hong-Kong. (2) The Ratio test results are based on a Chi-squared distribution. (3) (*)(**)(***) indicate significance at the (1%)(5%)(10%) level.

4.4. A comparison of the impact of Bad and Good news on long-term volatility

Table 6 presents a summary of the results in order to gain a complete picture of the impact of asymmetries on long-term volatility for the real estate portfolios under study. A smaller impact of bad news on volatility is observed in the European portfolio of the real estate indexes of Italy and Sweden and also in the other two portfolios, the European (E_P_2) and the Asia-Pacific (AP_P), the impact of bad news on volatility is slightly larger to that of good news. This is clear from the values of 1.006, 1.004 and 1.006 of the portfolios, which are practically almost unequal and reveal a slightly heterogeneous impact of the bad news in relation to the good news on volatility. This means that all three portfolios react asymmetrically to news of other markets and they remain inefficient in the long-term. So, investors trade differently in these markets and update their portfolios based on the inefficient nature that affects their decisions in a different manner in the long-term. Moreover, volatility persistence is large in magnitude, which means that any impulse responses from volatility's previous day to the next one persist for a quite long period.

Table 6: Comparison of the impact of asymmetric news on long-term volatility

	Good News	Bad News	Total Asymmetry	Volatility Persistence
E_P_1	0.311	0.313	1.006	0.642
E_P_2	0.372	0.374	1.004	0.725
AP_P	0.369	0.371	1.006	0.729

Notes: E_P_1 stands for the European portfolio of Italy and Sweden, E_P_2 stands for the European portfolio of UK, Germany and France, AP_P stands for the Asia Pacific portfolio of Japan, Australia and Hong-Kong.

5. An application during the global financial crisis of 2008-2009

5.1. The impact of (symmetric or asymmetric) long-term volatility on (symmetric or asymmetric) investor strategies during the global financial crisis of 2008-2009: An application on the European Portfolio of Sweden and Italy

We measure the degree of feedback trading asymmetry during the crisis period in order to examine whether the crisis has an effect on investors' strategies and their rationale trading stating the degree of market efficiency or inefficiency. Following Koutmos (1997), the estimation of Sentana and Wadhwani (1992) model is modified as follows in order to account for the presence of feedback asymmetry:

$$r_t = \beta_0 + \beta_1 \sigma_t^2 + (\beta_2 + \beta_3 \sigma_t^2) r_{t-1} + \beta_4 * |\, dummy1 \,| + \varepsilon_t \tag{5}$$

and

$$r_t = \beta_0 + \beta_1 \sigma_t^2 + (\beta_2 + \beta_3 \sigma_t^2) r_{t-1} + \beta_4 * |\, dummy2 \,| + \varepsilon_t \tag{6}$$

In contrast to Koutmos (1997), we examine the presence of asymmetry on feedback strategies separately. In particular, dummy1 and dummy2 take the following values:

Where

dummy1 = -r $_{t-1}$ and (7)

dummy2 = + r $_{t-1}$ (8)

Thus, if the coefficient β_4 is positive in equation (8) for the absolute negative returns, this means that negative returns are larger than positive returns, with dummy1 capturing this difference. If, dummy2 is positive for the absolute positive returns, this means that positive returns are more important than negative returns (see Koutmos, 1997 and Antoniou et al., 1998).

Under the premise that the asymmetric feedback trading of investors is influenced by the fluctuation of returns, we link the autocorrelation and (symmetric or asymmetric) volatility of returns with the different (symmetric or asymmetric) investors' feedback strategies. We link these two factors using two models, the original FIGARCH and the GJR-FIGARCH models. The first one contributes on the impact of the symmetric and asymmetric investors' feedback strategies on the symmetric long-term volatility. The second one measures the impact of symmetric and asymmetric investors' feedback strategies on the asymmetric long-term volatility. The equations of FIGARCH and GJR-FIGARCH models are provided in sections 3.2.2 and 3.2.3.

Table 7 shows that the coefficient β_4 is positive and significant for the first model. This means that negative trading is more pronounced than positive trading. This is also confirmed by the sign of coefficient β_3. It could be inferred that during the crisis period, investors based their strategies on negative feedback trading, rather than positive feedback trading for the European portfolio of Italy and Sweden.

Turning our attention to the results of the modified model, we infer that asymmetric volatility does not change the strategy of investors, as investors still base their trading on negative feedback. Still, negative feedback trading is superior to positive.

Thus, we found here that for both models, the inclusion of absolute negative returns does not have an effect on the strategy of investors regardless of the nature of volatility. The asymmetric strategy of investors states that negative feedback is preferable to positive feedback during the financial crisis, when the autocorrelation of returns are related negatively to previous levels of returns.

Diagnostic tests indicate significant serial correlation in squared residuals, and negative skewness. The kurtosis value is quite small, which means that normality could be applied on the return series. This means that this portfolio index for the two European markets remains the same during the crisis period as previously mentioned, with negative feedback trading to arise and remain stable in the two models under investigation. The symmetric and the asymmetric models indicate the same behavior for investors as negative feedback trading still remains an important indicator in these models.

Table 7: FT-GJR-FIGARCH results for the European Portfolio of real estate markets of Italy and Sweden for negative returns

$r_t = \beta_0 + \beta_1\sigma_t^2 + (\beta_2 + \beta_3\sigma_t^2)r_{t-1} + \beta_4 * | dummy1 | + \varepsilon_t$, **dummy1 = -r** $_{t-1}$

$\sigma_t^2 = c + \beta\sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - fI_{t-1}L)(1 - L)^d]\varepsilon_t^2$

Variables	Original	Modified
β_0	-0.110 (0.01)*	-0.099 (0.001)*
β_1	0.013 (0.001)*	0.012 (0.001)*
β_2	0.057 (0.001)*	-0.090 (0.001)*
β_3	0.005 (0.001)*	0.015 (0.001)
β_4	0.011 (0.001)*	0.050 (0.001)*
c	0.068 (0.001)*	0.543 (0.001)*
β	0.530	0.285

	(0.016)*	(0.001)*
e	0.014	0.009
	(0.001)	(0.001)*
d	0.565	0.475
	(0.015)*	(0.001)*
f		0.165
		(0.001)*
Log-likelihood	-1178.693	-1190.868
Skewness	-0.125	-0.092
Kurtosis	0.335	0.566
LB(20)	24.031	25.109
LB^2 (20)	28.498***	39.385*

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

Table 8 indicates that the coefficient of β_4 is positive and statistically significant at the 1% level for the positive return series for the portfolio of European real estate markets of Italy and Sweden with the FIGACRH model. This means that positive feedback trading is superior to negative due to the positive sign. This is not confirmed, however, by the modified model of Table 8, in which the coefficient of β_4 is negative**,** meaning that there is a disagreement with the results of Table 8 (original model). There is a difference to investors' preferences, putting emphasis on the positive feedback trading rather than on the negative feedback. This means that investors react positively to price decreases and negatively to price increases. As thus, the real estate markets in this case, are inefficient and risky trading is obvious.

Diagnostic tests indicate quite significant serial correlation in squared residuals, and negative skewness in both models. Kurtosis is quite small (less than the value of 3), which means that normality could be applied on the return series of the European portfolio of Sweden and Italy. This indicates that asymmetry plays an important role to investors, however its impact is not very significant for investing purposes as the trading risk is minimal in that case.

Table 8: FT-GJR-FIGARCH results for the European Portfolio of real estate markets of Italy and Sweden for positive returns

$r_t = \beta_0 + \beta_1\sigma_t^2 + (\beta_2 + \beta_3\sigma_t^2)r_{t-1} + \beta_4 * | dummy2 | + \varepsilon_t$, **dummy2 = + r** $_{t-1}$

$\sigma_t^2 = c + \beta\sigma_{t-1}^2 + [1 - \beta L - (1 - eL)(1 - fI_{t-1}L)(1 - L)^d]\varepsilon_t^2$

Variables	Original	Modified
β_0	-0.072 (0.003)*	-0.008 (0.001)*
β_1	0.012 (0.003)*	-0.010 (0.001)*
β_2	-0.005 (0.003)	-0.009 (0.001)*
β_3	0.008 (0.002)*	-0.001 (0.001)***
β_4	0.015 (0.003)*	-0.022 (0.001)*
c	0.013 (0.003)*	-1.124 (0.001)*
β	0.468 (0.003)*	0.342 (0.001)*
e	0.019 (0.003)*	0.002 (0.001)*
d	0.497 (0.003)*	0.308 (0.001)*
f		-0.143 (0.001)*
Log-likelihood	-1180.900	-1179.442
Skewness	-0.131	-0.179
Kurtosis	0.261	0.387
LB(20)	21.697	24.399
LB^2 (20)	31.268**	44.352*

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

5.2. Ratio test results for the European portfolio of Italy and Sweden in the crisis period of 2008-2009 for both FIGARCH models

The results of Table 9 reveal the significance of both symmetric and asymmetric feedback strategies and symmetric and asymmetric long-term volatility in the European portfolio of Italy and Sweden. These findings result from the two methodologies, the FIGARCH and the GJR-FIGARCH. These models have been augmented by the series of positive and negative absolute returns in the mean return equation of the positive feedback trading strategy, separately. In addition, the GJR-FIGARCH model has been modified to capture the impact of negative news on long-term volatility linkage with the autocorrelation of the European portfolio of real estate series. The results indicate that in the context of the GJR-FIGARCH model, there is an indication of rationale trading especially when the negative returns affect the portfolio of real estate assets during the crisis period. This further implies that negative feedback asymmetry indicates a good investment in this portfolio of assets during the crisis. In addition, we found that for this case, long-term volatility and volatility asymmetry play a significant role in the trading behavior of investors.

Table 9: Asymmetric linkages between feedback strategies and long-term volatility

	$\beta_4 = 0$	**f=0**
O_P_R	17.673*	NA
M_P_R	66960.580*	1180495.585*
O_N_R	37837.890*	NA
M_N_R	270465.025*	2895113.129*

Notes: (1) O_P_R stands for the original model with the dummy variable of positive returns, M_P_R stands for the Modified model with the dummy variable of positive returns, O_N_R stands for the original model with the dummy variable of negative returns, and M_N_R stands for the modified model with the dummy variable of negative returns (2) The Ratio test results are based on a Chi-squared distribution. (3) (*)(**)(***) indicate significance at the (1%)(5%)(10%) level.

6. Conclusions and Implications

Literature on market efficiency has been mainly concerned with the existence of predictability in asset returns, patterns in financial volatility and with profitability of simple mechanical trading rules. Positive feedback trading belongs to trading patterns that if present could cast doubt on the efficiency of the asset market under study. To this end, in the context of the present study we set off to investigate the existence of positive or negative feedback trading strategies in global real estate markets and their interaction with market volatility.

Constructing a hypothetical portfolio of real estate investments in a European level, we document that markets become more inefficient, as positive feedback strategies arise for the cases of Italy and Sweden. A similar result is found for the portfolio of the UK, German and French real estate markets. In addition, the results for the portfolio of Japan, Australia and Hong-Kong indicate a similar relationship. In particular, in the first European portfolio and in the Asia-Pacific portfolio, the relationship between volatility and autocorrelation is positive, while in the second

European portfolio is negative. Also, negative shocks seem to be slightly superior to their positive counterparts in the three portfolios of real estate assets, namely in the first European portfolio of Italy and Sweden, in the second one of UK, Germany and France and in the Asia-Pacific portfolio of Japan, Australia and Hong-Kong.

The global financial crisis period of 2008-2009 clearly reveals a preference to asymmetric negative feedback trading strategy from investors or risk managers, with negative news being superior to positive news considering both the negative and positive returns in the return equations. These results indicate that negative news affect more feedback trading than good news. In addition, we found that long-term volatility asymmetry is present in the augmented GJR-FIGARCH model, regardless of the sign of the return series. This is partly consistent with the European portfolio of Italy and Sweden, where there is a separate effect of positive or negative returns on trading. Nevertheless, the findings of fractional integration show that volatility is mainly stationary, with an exception of the original FIGARCH model when it accounts for negative returns only.

Our results entail implications for portfolio investing. In particular, investors and risk managers should update their portfolios based on profitable feedback strategies available in real estate markets. In particular, when there is a negative (or positive) serial correlation between portfolio volatility and real estate return, the decision whether this asset should be included in an investor's portfolio depends on the feedback trading strategy that investors wish to follow. Thus, investors should account for these preferences in their decision making if they want to outperform the market and realize profits. The available opportunities are few for investors or risk managers still with careful consideration. They will be able to diversify their portfolio with real estate assets and take advantage of the information available in real estate returns. These results imply that asymmetry in returns and volatility affects the investors' trading and markets or portfolios of indexes remain inefficient. Persistence of news is important in the long-term and may influence investors' preferences among different assets however different news or noise may also affect both, the two European and the one Asia-Pacific portfolio of real estate assets significantly in all the markets under investigation. Our augmented model has captured well the impact of volatility asymmetry on investors' trading preferences, supporting that the three European portfolios are slightly inefficient for real estate assets. Thus, investors' risk is larger in the two European and one Asia-Pacific real estate markets.

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