Option Pricing of U.S. REITs M&A under Stochastic Volatility

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[Original Draft: March 2010]
[Current Draft: December 2011]

Abstract

Real estate investment trusts (REITs) represent a unique laboratory for their institutional settings which lead to industry homogeneity and information availability. Between 1994 and 2009 the US market recorded a wave of mergers and acquisitions (M&A) due to a change in legislation. To illustrate and price exchange options, we extend the Margrabe (1978) model by looking at the impact of internal and external funding and the effect of stochastic volatilities and jumps in M&A pricing. Finally, we find option pricing models to represent actual values better than other valuation methods such as dividend discount models.

Keywords: Exchange Options, M&A, REITs, Internal vs External Funding

JEL: C4, C5, G1 and G3

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1 Introduction

In REITs markets, three valuation tools dominate the analysts' approach for the pricing of such vehicles: dividend discount model (DDM) and multiples, using a cash flow rather than accounting figure specifically designed for these vehicles (funds from operations, i.e. FFO); net asset value (NAV), obtained as the difference between the market value of assets and debt; and more common discounted cash flows, i.e. DCFs (which are also the basis of market values computed in the NAV approach) – Cheah and Garvin (2004), Fernandez (2007), Michel and Oded (2007). More specifically, the FFO technique is widely regarded as being a robust technique, although subjective in terms of parameters that should be included in the calculation of FFO figures – Higgins et al. (2006) – while the NAV offer insightful valuations among similar items in the long run – Gemmill and Thomas (2002). Moreover, since FFO methodologies have been agreed only in the US and, as such, homogeneity among different markets and REITs is not captured accurately when using earnings based valuations. Despite the fact that three valuations techniques are widely used, they do have their own limitations, among which we find the inability to account for flexibility and optionality, Fernandez (2007). One area where the above valuation techniques do not offer insightful value of "assets" is represented by mergers and acquisitions (M&A), where the optionality aspect plays a major role. During an M&A, in fact, an extra value is normally generated through the emergence of compound or exchange options and the extra value is not captured by traditional pricing mechanisms – Margrabe (1978).

We use M&A of real estate investments trusts (REITs) as a laboratory to explore the pricing discrepancies between traditional valuation techniques and compound option values. Firstly we decided to analyse the REIT sector because it represents unique institutional setting with a very codified and transparent corporate governance. More importantly, REITs publish, along with external funding activities, internal funding figures beyond accounting rules. As highlighted above, this industry has specifically developed a measure – called funds from operations (i.e. FFO) – which wants to retrieve and represent a cash flow dimension from accounting numbers, so that the real amount of internal cash flows generated by each vehicle is available. We will then use it to study the impact of internal vs. external funding on option values. Finally, it is also possible to obtain fundamental value figures (i.e. NAVs) for REITs and this allows us to study the difference between option values computed on underlying trading prices vs. fundamental values.

The paper is structured as follows: firstly, we illustrate the relevant literature (section 2) and present the Margrabe (1978) model to illustrate that one can grow REITs' organic structures without "changing" anything operationally (section 3); we then introduce an extension to the Margrabe (1978) model embedding internal and external funding opportunities; in section 4 we use various mathematical and numerical techniques to obtain option-based strategies and to illustrate similarities between logarithm functions, sub-martingale and resulting numerical and mathematical techniques; in section 5 we introduce stochastic volatility; the dataset and empirical findings are discussed respectively in sections 6 and 7. Finally, in the last section we present the main conclusions.

2 Literature Review

U.S. REITs experienced a steady growth in market values also due to M&A activities that took place from mid-1990s to mid-2000s. Most empirical studies that explored M&A of U.S. REITs during similar period cited a number of reasons for growth in size and liquidity of these firms, including the establishment of Umbrella Partnership REIT (UPREIT) in 1994 – Ling and Petrova (2011). Basically, the idea behind UPREIT was the establishment of operating partnership (OP) where actual shares in REIT are placed in OP without altering the existing structures of REITs. In principle, the OP “mimicked” existing structures of REIT firms. Although the growth in size of U.S. REITs brought advantages such as more information spill over to the U.S REITs market and greater liquidity – Marcato and Ward (2007) –, similarly there were challenges linked to the existence or lack of appropriate valuations of those transactions. Prior to the marathon growth period of M&As, information on various U.S. REITs was inward looking and kept by the management of those vehicles – Sahin (2005), Daniels and Phillips (2007). One of the exciting points making REIT M&As unique if compared with M&A activities in other industries is the mutual benefit brought to both acquiring and target shareholders – Womack (2010). Furthermore, Womack (2010) also suggests that hostile M&As in REIT markets are uncommon. In order to understand the broader terms of this empirical study, we first explore the main literature on valuation techniques in REIT M&As, their relationship with achieved returns and, lastly, the presence of strategic options in such activities and their pricing.

2.1 Valuations in M&A of REITs

Given the rigidness and complexity of REIT firms, to base benefits of M&A activities solely on financial gains in the short term is hard; therefore, the dynamism of valuations and other benefits offer an insight on the reasons why M&As have developed so much in the REIT industry. Of course in the long run we would expect financial gains to be stronger as strategic options are unveiled and become public information. Among benefits cited but not directly determining higher profits, we find an increased leverage ability that allows REITs to augment the expansion capacity. According to Li et al. (2010), the leverage size gives REITs an advantage to "time the market", i.e. a firm decides the best time to announce and execute acquisitions. Furthermore, Daniels and Phillips (2007) explore benefits of REIT M&As underpinned by the service of financial advisor. Their empirical study illustrates that, by choosing a "appropriate" advisors, REITs will benefit from services provided by them. *"The results indicate that financial advisor monitoring, possibly be reducing information asymmetries, has significant positive effects on the value of REIT acquisitions"*.

On the broader topic of pricing of corporations, Fernandez (2007) discusses various valuation techniques that are applicable to both financial and real assets, and consequent differences which depend upon the correct use of different parameters in correct formulae. An example is represented by equity cash flows which tend to be different from debt cash flows as debt finance implies taxes advantages to be embedded in the appropriate discount rate; therefore, debt should be treated differently to equity in valuations. One interesting point the author makes is that most valuations are based on book values; however, investors tend to focus on market values to decide their trading activities. Since REITs are at times a highly leveraged investment vehicle, one can infer that there is a high chance that the overall asset cash flows may show a high impact from debt cash flows.

Finally, One of the most used techniques in valuations is represented by the Dividend Discount Model (i.e. DDM) and one of the reasons for its broad application is its grounding on financial theory and its simple application – Lee and Jiang (2005). However, the DDM has its own limitations such as the need to determine a constant growth of dividends over time and, mostly, a poor modelling power. For example, *"They found, based on a simple dividend discount model (DDM) with a constant discount rate, that stock market volatility was far greater than could be justified by subsequent changes in dividends"*, Lee and Jiang (2005). Goetzmann and Jorion (1995) also show that the predictive power of dividend yields is poor, especially when the prediction of values is projected in the long run; however in the "short" run the DDM does have some predictive capacity, although very rare.

2.2 Returns and General Valuations in M&A of REITs

Most empirical studies on REIT M&As exemplify benefits accruing to both bidding and target firms finding mixed results. Campbell et al. 2009 state abnormal benefits accruing to a bidding firm are normally non-existent in the long-run and, if they do exist, they are insignificant. Following on, Sahin (2005) finds that benefits accruing to a target firm might be significant only for a short period, i.e. three days after the announcement date.

Ling and Petrova's (2011) empirically explore most reasons contributing to these gains. Their empirical study groups deals into public-to-public and private-to-public M&As. Although, our empirical study is on public-to-public deals (because we need a return series for our estimation both before and after the merger or acquisition), we note that their study finds "abnormal returns" for private-to-public M&As, whose main reason is the fact that there is no limit to debt levels. Therefore, a merged entity can use extra debt finance to expand the business and high premiums then tend to be associated with private-to-public deals as opposed to public-to-public ones. The other factor leading to "lower" returns in public-to-public M&As is the transparency of these transactions and the fact that most mergers are financed through cash while private-to-public are financed through "hybrid" financing mechanisms. A variety of models, including one illustrating the probability of abnormal returns, were used by Ling and Petrova (2011), and results illustrate "limited" abnormal returns. The rigid and complex structures of REITs were cited among the reasons that minimised abnormal returns of both bidding and target REITs.

Campbell et al. 2005 explore the value creation of M&A activities. Like most empirical studies on U.S. REITs, their sample is based on M&A transactions between 1994 and 2005. Prior to this investigation, a "similar" study by Campbell et al. (2001) puts emphasis on the information content of M&A deals. According to Campbell et al. 2005, the main sources of value creation within the REIT industry were selling equity units within REITs, while most REOCs went public. Despite the benefits resulting from M&A activities, however, there were contentious issues such as managing REITs and corporate control. Campbell et al. 2001 illustrate the influence of available information on listed REITs, *ceteris paribus*: the share price of target firms tends to decline after the M&A announcement because financial markets interpret target REITs being acquired due to their inefficiencies. The fundamental idea behind the UPREIT structure (one of the main factors behind the M&A wave in the U.S.) is that REIT shares are placed into an operating partnership (i.e. OP), without altering existing REIT shareholding structures, but allowing other activities in the OP, such as development. As the conversion into OP happens after a specified time, this leads to the emergence of optionalities according to option pricing theory (OPT). Campbell et al. (2005) find that proper re-structuring of REITs improved efficiency that led to higher returns – see also Anderson et al. 2002. Their sample includes fifty-three public-private merges in which a private held REIT is being taken over by a public trading REIT (REITs acquired for $50 million or less were excluded from the sample). In general, transactions generate good returns; however, most benefits emerge when target REITs' management did not participate in the "new" entity.

Finally, mergers' benefits spilled over to the entire REIT industry as more information was then available. Along with others, *ex post* benefits shown in the literature include the effectiveness of company structures. Campbell et al. 2001, just like Campbell et al. 2005, confirm that in case of public-private mergers, returns are significantly positive especially those emerging from public-to-public mergers in the long run.

2.3 Strategic Growth Opportunities in M&A Activities

Although, we have not come across any literature on strategic growth on M&A activities for REITs, a lot of empirical studies illustrate that growth in M&A deals is largely due to management seeking strategic growth opportunities which should lead to the maximisation of shareholders' returns. Most investors "insure" against the effects on timing of M&A in order to maximise their returns resulting from M&A – Morellec and Zhdanov (2005). Smith and Triantis (1995) illustrate that there are some growth options embedded in M&A besides the flexibility of "projects". Fisher (1978) and Margrabe (1978) explore growth options when two firms merged and they obtain exchange options formulae, which price a long call option when one asset is exchanged for another. Although, the two models are invariably similar, however, there is a slight difference: while in Fisher (1978) the exercise price is "determined" by the option appraiser, in Margrabe (1978) the exercise is "chosen" by the option holder. In our empirical study, which is restricted to listed equities from a single sector, i.e. REITS, we have decided to adopt a modified Margrabe (1978) model to value emerging exchange option. The model will be explored further in detail in the next section.

One of the major challenges in volatile markets such as equities is the ability to properly "account" for idiosyncratic risk. Cao et al. 2008 state that accounting of growth options leads to mitigating idiosyncratic risks of assets. Therefore, growth options offer one competitive advantages in uncertain business environments. *"It is well accepted by now that the value of many strategic investments does not derive so much from direct cash inflows, as it does from the options to invest in future"*, Smit and Trigeorgis (2006).

3 Margrabe (1978) Model

The pricing of exchange options using closed-form solutions on two securities without barriers within the same industry when exercise prices are uncertain can be traced back to Fisher (1978) and Margrabe (1978). Later Sebehela (2008) explored emerging long call option values within the REIT industry looking at M&A deals in South Africa. Besides calculating exchange options, the Margrabe (1978) model illustrates indexing, whereby the target firm is priced against its acquiring firm and an "index" which helps building forward strategies of investment portfolios – see also McDaniel and Schnusenberg

(2000). If one takes the Margrabe (1978) model as the representation of acquirer's share price in relation to target's share price (raised to the power of one), then Margrabe(1978) model illustrates the pricing of 'power options' which, in the context of indexing, allow efficient indexing, flexibility and proper parameterisation – see Blenman and Clark (2005).

The long call option as from the Margrabe (1978) model is given by the following formula:

$$C[S_1, S_2, (T-t)] = S_1 e^{-y_1(T-t)} N(d_1) - S_2 e^{-y_2(T-t)} N(d_2) \tag{3.1.1}$$

Where

$$d_1 = \frac{ln\left(\frac{S_1}{S_2}\right) + \left(y_1 - y_2 + \frac{\sigma_p^2}{2}\right) * (T-t)}{\sigma_p \sqrt{T-t}} \tag{3.1.2}$$

$$d_2 = \frac{ln\left(\frac{S_1}{S_2}\right) + \left(y_1 - y_2 - \frac{\sigma_p^2}{2}\right) * (T-t)}{\sigma_p \sqrt{T-t}} \tag{3.1.3}$$

or

$$d_2 = d_1 - \sigma_p \sqrt{T-t}$$

C is the long call option, S_1 is the acquiring asset, S_2 is the target asset, $(T-t)$ is time to expiration (in this case time to expiration starts when the merger is announced until when the deal is closed), y_1 and y_2 are cost of carries for assets one and two respectively, σ_1 and σ_2 are stochastic volatilities of assets one and two respectively, σ_p is the combined stochastic volatility of two assets, $\rho_{1,2}$ is the correlation coefficient between the two assets, d_1 and d_2 are probabilities of being in-the-money and d_1 is specifically probability of being in-the-money when the risk-free rate is a numeraire; $N(d_1)$ and $N(d_2)$ are univariate cumulative normal density functions with upper integral limits d_1 and d_2 respectively. The positive and negative sign before S_1 and S_2 illustrate that S_1 and S_2 sold and bought respectively. Option values tend to be "higher" than normal because the model assumes that inputs are stochastic, Lint and Pennings (2000). One of the "hidden" feature of the Margrabe (1978) model is the fact that option values are linearly homogenous in relation to stock and exercise prices – Johnson (1987) and Merton (1973). The income generated by underlying assets is treated as dividends as this leads to option fair values to avoid overestimation, Whaley (1982).

Furthermore, during a merger or acquisition between REITs, (either external or/and internal) funding is frequently used. In order to consider the impact of funding in M&A activities, we have decided to add funds to the acquirer's share price. Davis et al. 2004 illustrate that when funds are used to expand existing project, they are treated as "extra values" to the existing project's value and the extra "values" will be represented by *lambdas* (λs); where λ_1 and λ_2 represent FFOs (internal funds) and debt (external funds) respectively. In order for the “extra” value, λs to be consistent with the share price lambdas represent the nominal value divided by the number of outstanding ordinary shares. Moreover, in M&A activities, the amount of debt injected in the deal is conditional upon the amount of FFO available (i.e. λ_2 is conditional on λ_1). The extra funds will be added only to the acquirer’s share price as the acquirer is the agent using the injected funds – for a more detailed numerical illustration of the relationship between spot prices and added funds, please refer to appendix A. Therefore, accounting for FFOs in a Margrabe (1978) framework changes the option price as follows:

$$C[(S_1+\lambda_1),S_2,(T-t)]=(S_1+\lambda_1)e^{-y_1(T-t)}N(d_1)-S_2e^{-y_2(T-t)}N(d_2) \quad (3.1.5)$$

where

$$d_1=\frac{ln\left(\frac{S_1+\lambda_1}{S_2}\right)+\left(y_1-y_2+\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.6)$$

$$d_2=\frac{ln\left(\frac{S_1+\lambda_1}{S_2}\right)+\left(y_1-y_2-\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.7)$$

When only debt funding is taken into account, the call option price becomes:

$$C[(S_1+\lambda_2),S_2,(T-t)]=(S_1+\lambda_2)e^{-y_1(T-t)}N(d_1)-S_2e^{-y_2(T-t)}N(d_2) \quad (3.1.8)$$

Where

$$d_1=\frac{ln\left(\frac{S_1+\lambda_2}{S_2}\right)+\left(y_1-y_2+\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.9)$$

$$d_2=\frac{ln\left(\frac{S_1+\lambda_2}{S_2}\right)+\left(y_1-y_2-\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.10)$$

However, in most cases, the funding of REIT M&As is obtained through a combination of internal and external sources; therefore, the fully modified Margrabe (1978) model expands into:

$$C[(S_1+\lambda_1+\lambda_2),S_2,(T-t)]=(S_1+\lambda_1+\lambda_2)e^{-y_1(T-t)}N(d_1)-S_2e^{-y_2(T-t)}N(d_2) \quad (3.1.11)$$

Where

$$d_1=\frac{ln\left(\frac{S_1+\lambda_1+\lambda_2}{S_2}\right)+\left(y_1-y_2+\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.12)$$

$$d_2=\frac{ln\left(\frac{S_1+\lambda_1+\lambda_2}{S_2}\right)+\left(y_1-y_2-\frac{\sigma_p^2}{2}\right)*(T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.13)$$

Capozza and Israelsen (2007), and Crosby et al. 1998 show that share prices for REITs hardly trade at their NAVs. The literature trying to explain the reasons (including smoothing and valuation accuracy) for a premium or discount to NAV is extensive, but not covered in this paper as it is outside its scope. However, for the pricing of exchange options in M&A deals, we have decided to incorporate this feature in our model substituting the share price to NAV plus (or minus) a premium (or discount). The premium is represented by α, where α_1 and α_2 are the premiums for the acquiring and target REIT respectively. The NAV-based model then becomes:

$$C[(NAV_1 \pm \alpha_1 + \lambda_1 + \lambda_2), (NAV_2 \pm \alpha_2), (T-t)] =$$
$$= (NAV_1 \pm \alpha_1 + \lambda_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) - (NAV_2 \pm \alpha_2)e^{-y_2(T-t)}N(d_2) \quad (3.1.14)$$

Where
$$d_1 = \frac{ln\left(\frac{NAV_1 \pm \alpha_1 + \lambda_1 + \lambda_2}{NAV_2 \pm \alpha_2}\right) + \left(y_1 - y_2 + \frac{\sigma_p^2}{2}\right) * (T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.15)$$

$$d_2 = \frac{ln\left(\frac{NAV_1 \pm \alpha_1 + \lambda_1 + \lambda_2}{NAV_2 \pm \alpha_2}\right) + \left(y_1 - y_2 - \frac{\sigma_p^2}{2}\right) * (T-t)}{\sigma_p\sqrt{T-t}} \quad (3.1.16)$$

Although the concept of scale-invariance is beyond the scope of this paper, one of the strength of the Margrabe (1978) model is that it is scale-invariant and these models are appropriate for pricing tradable securities such as equities. Interestingly, when injected funds are incorporated into the original model, their treatment is line with Pecking Order Theory (POT) – Majluf and Myers (1984). The negative α_2 has the advantage of decreasing the denominator ($NAV_2 \pm \alpha_2$) which, in turn, increases the probabilities of being in-the-money, leading to higher univariate cumulative normal density functions. If univariate cumulative normal density functions are "higher", then resulting long call option prices tend to be greater. Lastly, equations (3.1.8), (3.1.11) and (3.1.14) illustrate exchange options priced using a specific number of underlying parameters and can be classified as compound exchange options – Carr (1998). At same time, equations (3.1.11) and (3.1.14) are conditional compound exchange options because debt is conditional upon the amount of internal funds available for the M&A deal. These options have two strike prices (one from debt and one from equity) and separate "time to expiration" (respectively for debt and equity).

3.1 Analysis of Main Parameters

In this section, we mathematically explore whether changes in model parameters lead to a decrease or increase of the option value. Firstly, we verify the impact of internal funds (λ_1) on the long call option as represented in (3.1.11):

$$\frac{\partial C}{\partial \lambda_1} = 1 * (S_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) - 0 \quad (3.1.17)$$

$$\frac{\partial C}{\partial \lambda_1} = (S_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) \quad (3.1.18)$$

In principle, the derivative of a long call option with respect to λ_1 is a positive "function", implying that the injection of FFOs in M&A deals should increase the total option value as shown in (3.1.18). Secondly, we verify the impact of λ_2 on the long call option as illustrated by equation (3.1.11). Note that λ_2 is conditional on λ_1; therefore, the derivative with respect to λ_2 is computed as a conditional derivative. Given that

$$\frac{\partial C}{\partial \lambda_1} > 0;$$

therefore, we may write

$$\partial C_{\lambda_2} |_{\lambda_1}(\lambda_1, \lambda_2) := \frac{\frac{\partial C}{\partial \lambda_2}}{\frac{\partial C}{\partial \lambda_1}} \quad (3.1.19)$$

and the full derivative with respect to λ_2 can be written as follows;

$$\frac{\partial C}{\partial \lambda_2} = 1 * (S_1 + \lambda_1)e^{-y_1(T-t)}N(d_1) - 0 \quad (3.1.20)$$

$$\frac{\partial C}{\partial \lambda_2} = (S_1 + \lambda_1)e^{-y_1(T-t)}N(d_1) \quad (3.1.21)$$

Therefore, equation (3.1.19) can be re-written as follows;

$$\partial C_{\lambda_2} |_{\lambda_1}(\lambda_1, \lambda_2) := \frac{(S_1+\lambda_2)e^{-y_1(T-t)}N(d_1)}{(S_1+\lambda_1)e^{-y_1(T-t)}N(d_1)} \quad (3.1.22)$$

$$:= \frac{S_1+\lambda_2}{S_1+\lambda_1} \quad (3.1.22)$$

In principle, the derivative of a long call option with respect to λ_2 is a positive "function", implying that the injection of debt finance in M&A deals should increase the total option value. Since the derivative with respect to λ_2 is the conditional on λ_1, it can be assumed to be a Radon-Nikodym derivative. Hansen and Sargent (2001) show that a Radon-Nikodym derivate represents the new value of an asset in relation to its prior value. As λ_2 tends to be higher than λ_1 in most REIT M&As, the Radon-Nikodym derivate is at least equal to one when written as a ratio of (4.2.5) to (3.1.18). Furthermore, equation (4.2.7) can be decomposed into:

$$\frac{S_1+\lambda_2}{S_1+\lambda_1} := \frac{S_1}{S_1+\lambda_1} + \frac{\lambda_2}{S_1+\lambda_1} \quad (3.1.23)$$

If one were to assume that the components of the denominator (S_1 and λ_2) are fixed, then part of the numerator is fixed as well. Intuitively, for the first part of (3.1.23), changes in S_1 are conditional only to changes in λ_1 (FFOs). This phenomenon – where S_1 changes when FFOs change – is reflected in equity markets: when a company has "more" money, normally the stock market interprets this information as a positive signal. The second part of equation (3.1.23) illustrates that changes in λ_2 are underpinned by changes in λ_1. This concepts ties up with our earlier statement that debt finance is conditional on what happens in FFOs when one expands the original Margrabe (1978) model to include both internal and external funding.

Thirdly, we verify the impact of NAV_s on the long call option as illustrated by equation (3.1.14) and the derivative of long call option with respect to NAV_1 and NAV_2 are listed below;

$$\frac{\partial C}{\partial NAV_1} = 1 * (\pm\alpha_1 + \lambda_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) \quad (3.1.24)$$

$$= (\lambda_1 \pm \alpha_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) \quad (3.1.25)$$

$$\frac{\partial C}{\partial NAV_2} = -1 * (\pm\alpha_1)e^{-y_2(T-t)}N(2) \quad (3.1.26)$$

$$= \pm\alpha_1 e^{-y_2(T-t)}N(d_2) \quad (3.1.27)$$

Equation (3.1.24) illustrates that the change of the acquirer's NAV should add value to the overall M&A option value as the premium due to the acquirer can never be greater than the amount of FFOs and debt in the M&A deal, while the change in the target NAV can either add or subtract value depending upon the initial premium in relation the REIT share price.

Lastly, we verify the impact of α_s on the long call option as illustrated by equations (3.1.14) and (3.1.16), and the derivative of long call option with respect to α_1 and α_2 are listed below:

$$\frac{\partial C}{\partial \alpha_1} = \pm 1 * (NAV_1 + \lambda_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) \quad (3.1.28)$$

$$= \pm(NAV_1 + \lambda_1 + \lambda_2)e^{-y_1(T-t)}N(d_1) \quad (3.1.29)$$

$$\frac{\partial C}{\partial \alpha_2} = \pm 1 * (NAV_2)e^{-y_2(T-t)}N(2) \quad (3.1.30)$$

$$= \pm(NAV_2)e^{-y_2(T-t)}N(2) \quad (3.1.31)$$

Share price premiums can either add or subtract value to the option. In the context of option values, the discount in share prices represents a cost to the acquirer as the acquiring firm has to increase the target firm value to "appropriate" levels. On the contrary, premiums represent benefits as the acquirer decreases prices to "appropriate" levels. As a further explanation and using the argument that prices converge to their long term averages in the long run - from Alexander (2008) -, the management of a company should spend money to increase prices to their long term averages when share prices are trading at discounts while it should not "cost" anything to decrease share prices to their long term averages when they are trading at premium.

4 Mathematical and Numerical Analysis

In this section we use various mathematical and numerical techniques to explore if there are any new "emerging concepts" through mathematical and numerical techniques explaining the option nature of our model: Conze and Viswanathan (1991) option technique and Radon-Nikydom derivatives.

4.1 Conze and Viswanathan (1991) Option Techniques

Conze and Viswanathan (1991) find that if the payoff of the option at time T is denoted by V and the value of the option at time t is denoted by Π_t, the formula of that function can be written as follows:

$$\Pi_t = e^{-r(T-t)} \mathrm{E}_{p*} \left[V \mid \mathcal{F}_t \right] \tag{4.1.1}$$

Where $\mathrm{E}_{p*}[\quad]$ is the expectation under risk neutral measure p^*. In the original Margabe (1978) model, the value of the long call option is given by equation (3.1.1). It should be noted that the payoff of the option is calculated from the option formula and it can be either a call or a put, even if in our case it is a long call option. As the option value according to Conze and Viswanathan (1991) is at time T, we suggest to use V_t instead of V with respect to some prior filtration process, $\mathcal{F}_t$. Therefore equation (5.1.1) becomes:

$$\Pi_t = e^{-r(T-t)} \mathrm{E}_{p*} \left[V_t \mid \mathcal{F}_t \right] \tag{4.1.2}$$

Given that V_t is the payoff in relation to its prior known process, $\mathcal{F}_t$, then equation (4.1.2) becomes:

$$\Pi_t = e^{-r(T-t)} [V_t] \tag{4.1.3}$$

Futhermore, V_t can be replaced by the payoff of the long call option in equation (4.1.1), so we find:

$$\Pi_t = e^{-r(T-t)}\left[S_1 e^{-y_1(T-t)} N(d_1) - S_2 e^{-y_2(T-t)} N(d_2)\right] \quad (4.1.4)$$

$$\Pi_t = e^{(T-t)^2}[S_1 e^{-r-y_1} N(d_1) - S_2 e^{-r-y_2} N(d_2)] \quad (4.1.5)$$

The exponential factor part, i.e. $(T-t)^2$ or τ^2, has a "double" minimisation attribute. The resulting number when the exponent is raised to the power zero is similar to the "minimum" value of a logarithm function. This means that, when one applies the Conze and Viswanathan's option technique to our model, the value of a long call option has logarithmic attributes. In fact, although equation (4.1.5) is different to a logarithm function in the sense that it decreases (instead of increasing) with time, the curvature factor of a logarithm functions holds in our model. Interestingly, most of the value is realised before the option time approaches its expiry date, contrary to logarithm functions where most value is "generated" when they approach maturity.

Comparing an American long call option paying dividends with a European one, the latter should be more valuable than the former. They key reason why we choose a European long call over an American one is that it has a higher ratio of risk-free interest rate plus dividend yields, i.e. $-(r+y_1)$ or $-(r+y_2)$, but the exponent raised to "lower" negative number is higher than the exponent raised to "higher" negative number. On the other hand, equation (4.1.5) deals with expectations and, if one compares expectations at time t versus time T considering the logarithmic features of equation (4.1.5), clearly the expectation at time t is lower than the one at time T. The phenomenon where the "initial" expectation is higher than the "future" expectation is representing a sub-martingale process; however, the returns of a logarithmic function illustrate a super-martingale process. In principle, equation (4.1.5) exhibits the properties of a sub-martingale process and extrema effects in American options when the time to expiration approaches maturity. Conze and Viswanathan (1991) stated that American options with extrema exhibit a sub-martingale process. If one were to combine the logarithmic function and equation (4.1.5) in designing an arbitrage strategy, the resulting option strategy would be such that the option writer earns "massive" profits at the beginning and similarly when the time to expiration approaches maturity. Figure 1 illustrates an option strategy resulting from a combination of sub and super martingale processes. The minimum amount that the option's writer earns is "always" along the curve for the entire time to expiration. The min/max point is the point where "maximum" returns are earned as per equation (4.1.5) while it is the starting point of earning "minimum" returns as per the logarithm function.

[Insert Figure 1 here]

4.2 Radon-Nikodym Derivatives

Given that equation (4.1.1) is an "initial" value of some security, we assume that equation (4.1.5) is a "future" value of the same security; therefore, we can illustrate the Radon-Nikodym derivative of the same security, which is a conditional expectation that illustrates whether the asset has grown in value when its new value has been compared to its original one – Hansen and Sargent (2001). Hence the Radon-Nikodym derivative of equation (4.1.3), $\mathcal{F}_{RND}$, can be written as follows:

$$\mathcal{F}_{RND} = \frac{Equation\ (5.1.5)}{Initial\ Option\ "Value"} \tag{4.2.1}$$

The payoff of option V_t can be used to illustrate the "initial" option value at a specific "time". Thus equation (4.2.1) becomes;

$$\mathcal{F}_{RND} = \frac{e^{(T-t)^2}[S_1 e^{-r-y_1} N(d_1) - S_2 e^{-r-y_2} N(d_2)]}{V_t} \tag{4.2.2}$$

Above we showed that the option payoff V_t is calculated from an option formula (call in our case). Therefore, we replace V_t with the call option formula for the payoff $S_1 e^{-y_1(T-t)} N(d_1) - S_2 e^{-y_2(T-t)} N(d_2)$ and equation (4.2.2) becomes:

$$\mathcal{F}_{RND} = \frac{e^{(T-t)^2}[S_1 e^{-r-y_1} N(d_1) - S_2 e^{-r-y_2} N(d_2)]}{S_1 e^{-y_1(T-t)} N(d_1) - S_2 e^{-y_2(T-t)} N(d_2)} \tag{4.2.3}$$

$$= \frac{e^{(T-t)^2-r}[S_1 e^{-y_1} N(d_1) - S_2 e^{-y_2} N(d_2)]}{e^{(T-t)}[S_1 e^{-y_1} N(d_1) - S_2 e^{-y_2} N(d_2)]} \tag{4.2.4}$$

$$= e^{(T-t)-r} \tag{4.2.5}$$

Since $(T-t) = \tau$, we then find that:

$$\mathcal{F}_{RND} = e^{\tau - r} \tag{4.2.6}$$

The Radon-Nikodym derivative of our model then implies that F_{RND} is a decreasing function of the option time to expiration less risk-free rate, i.e. the factor driving "growth" in our model is the exponential factor of tau less risk-free rate. Therefore, using Conze and Viswanathan (1991) option techniques and Radon-Nikodym derivatives, one can illustrate that the Margrabe (1978) model has similar characteristics to a logarithmic function, showing a concave shape. Since concave options are more lucrative than linearly shaped options – Alexander (2008) – equation (4.2.6) illustrates a sub-martingale process. Just like the logarithm function, exponential parts of equations (4.1.5) and (4.2.6) have minimum values because logarithms can never have the value zero. Moreover, the returns of equation

(4.2.6) should be log normally distributed as the returns of logarithmic functions are so – Jamshidian (1989).

[Insert Figure 2 here]

Therefore, an option trader is "guaranteed" "super" initial profits by taking a position in the stock market and she is offered an opportunity to generate extra value over time until the option reaches the "maturity" point, with a "guaranteed" minimum value.

5 Stochastic Volatility

The spot volatility will be based on the share prices of the acquirer as prior to the actual M&A taking place until the M&A transactions are closed. The acquirer is an independent variable driving the whole merger (or acquisition) process and most information known about the possible M&A deal is mainly driven by the acquirer; however, there will always be a speculation about possible targets. Hunter and Jagtiani (2003) implicitly illustrated that in M&A deals, the acquirer influences the pending transaction, and therefore, acquirers are 'market makers' of M&A transactions. Baker and Savasoglu (2002), Fuller et al. 2002, Hamich (2004) and Mitchell et al. (2004) show that days ranging from twenty (20) to fifty three (53) prior to the merger announcement give a good insight of unfolding events and likely state of the merged entity (i.e. event window prior to the M&A deal). Prior studies on volatility of stock markets – Alexander and Lazar (2009) – find that volatility is stochastic in the long run and deterministic in the short term (although deterministic volatility is stochastic in relation to its stock price). As this empirical study is on tradable assets, then the stochastic volatility model used to estimated volatility should be scale-invariant and such a model is represented by a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. As suggested by Alexander and Lazar (2009) the estimation of GARCH parameters is done using 500 observations, with a backdrop in that our sample size is then restricted to the deals where enough recorded data is available. We also acknowledge that there may be a bias against the presence of M&A deals where a relatively new REIT is involved (because 500 previous daily returns may not be available to estimate the volatility parameter.

6 Data

The original data sample is taken from SNL Financials and it includes of 178 completed M&A deals of U.S. REITs, REOCs and other types of real estate "companies" (i.e. more precisely 69 were on REOCs, 94 on REITs and 15 on companies recorded with unknown status). After filtering all deals on the basis of the availability of all information needed to compute the parameters and the option price (debt, FFO, long time series, etc.), the final data sample is reduced to 37 deals which took place in the United States between 1994 and 2009 period. Poor recording includes REITs or REOCs recorded over short period (i.e. less than a year), no recorded dividends and missing data in between when the company was first recorded and last recorded periods. Most of M&A between acquirers and targets were in the same or similar line of business at different times. REITs firms' M&A were as follows; ten M&A were in between REITs firms focused on regional malls or shopping centres business, eleven M&A were in between REITs firms focused on multi-family or student housing business, five M&A were in between REITs firms focused on offices business, two M&A were in between REITs firms focused on industrial business, two M&A were in between REITs firms focused on health care business, one M&A was in between REITs firms focused on self-storage business, one M&A was in between REITs firms focused on diversified business and five M&A were in between REITs firms specialising in different business areas. Market NAVs used in this empirical study were provided by SNL Financials. In some cases where the acquirer REIT firm merged with more than one REIT firms at different times; therefore, all different transactions per one acquirers and different target firms will be analysed.

Even if the data sample is small, we feel confident it is significant enough for two main reasons: other previously published papers use similar sample sizes; at the same time, we our filtering process is even stronger as the computational part of our studies is much more requiring than for any other study on REIT M&As published before.

As SNL Financials provides dates only from the merger announcement to the conclusion of the deal, we assumed that emerging exchange options are of European nature. Ammann et al. 2003 prove that when a trigger feature is present, the callability of an option is "provisional" or "soft", and in absence of callability, the call is then "absolute" or "unconditional". Therefore emerging exchange options in this empirical study are provisional as M&As of U.S. REITs were triggered mainly by legislation. All U.S. REITs used in this empirical study are of equity REITS (i.e. vehicles investing directly in real estate and not in debt-like instruments) and they are self-managed. According to the National Association of Real Estate Investment Trusts (i.e NAREIT) most of U.S. REITs are sector focused. In this empirical study, 70 out of 74 U.S. REITs (in the 37 U.S. REITs M&As) used in our analysis invest in one sector only (e.g. office, or shopping centre, or hotels, etc.), with the remaining 4 being diversified.

7 Empirical Results

7.1 GARCH (1; 1) Parameters

[Insert Exhibit 3 here]

Exhibit 3 shows that most estimated GARCH (1;1) model parameters are statistically significant, which makes the parameters reliable in this empirical study; however, some parameters are statistically insignificant for reasons stated earlier about data "quality". Moreover, the sum of alpha (α) and beta (β) is at most one. Stochastic volatilities (σ_t) versus their long-term average volatilities $(\bar{\sigma})$ confirm that during the M&A period, stochastic volatilities of all different deals are higher than their long-term average volatilities. The phenomenon where stochastic volatilities converge to the long-term average volatilities from above indicates the presence of volatile financial markets.

[Insert Exhibit 4 here]

The model selection criteria for the GARCH estimations are reported in Exhibit 4. Asemota and Shittu (2009) show that, with a minimum sample of fifty data points, irrespective the level of the process used to simulate the statistical model, the Bayesian Information Criterion (BIC) works best on small sample, while the Hannan-Quinn criterion works best on large samples. In this empirical study the Durbin-Watson statics is around 2, indicating that there is no autocorrelation in the data used. Most empirical studies on stochastic volatilities illustrating a bull market phenomenon, REITs' volatilities illustrate that spot volatilities of REITs are more prone to shocks than forward REITs volatilities because of information lags in the REIT industry – Chau et al. 2007. The authors, however, also find that phenomena represented in forward volatilities of REIT market also occur in spot volatilities. Despite, the fact REIT volatilities have their own unique features such as stock market shocks absorbed only by spot volatilities, they are in line with most behavioural expectations on volatilities of more general equity markets – Stevenson (2002).

7.2 Option Values

[Insert Exhibit 5 here]

Exhibit 5 reports the option values from out models and shows a pattern where option values increase with an increment in injected funds. This result is consistent with the fact that a direct positive relationship exists between the values of underlying assets option values. During the 1994-2009 period, the U.S. economy was growing and, in rising markets, asset values and prices tend to increase in relative terms. One of the factors driving asset values in rising markets is represented by demand. Therefore, taking our conceptual view on similarities between REIT share prices and their NAVs, and Alexander's (2008) convergence theory on share prices, we can assume that NAVs should converge to their long term average. Furthermore, Capozza and Israelsen (2007) show that REIT NAVs mean revert; however, NAVs take longer to mean-revert when the capital structure includes debt. Intuitively, the NAV structure is most likely to be of a convex shape and these types of derivative products, such as variance swaps, are much more lucrative than linear ones – Alexander (2008). On the other hand, prices are mainly driven by financial market sentiment about specific stocks; therefore, share prices long term averages should be relatively smaller as share prices move up and down quite frequently. Hence, call values from share prices are smaller than call values from NAVs.

Moreover, values of long call options increase with fund injections. If funds used in acquisitions are taken as an underlying of the deal, the relationship makes sense because fund injections increase the value of the underlying. Some call option values are equal to zero because their normal cumulative probabilities are significantly out-of-money. Therefore, those deals should not have taken place at that time. Interestingly, when call options are deep in-the-money and the underlying asset increases due to the funding availability, the resulting total option value is slightly "eroded". This is due to the fact that funding (especially external funding) creates a "burden" to REIT owners who have to pay the borrowed amount back. In other words, the debt has a dilutive effect on company values due to the periodical debt and interest repayments made until the principal is fully paid – Merton (1992). The phenomenon of total option value "erosion" is prevalent in all calculated call option prices, notwithstanding whether they are long or short. It does not make sense to change a "highly profitable" strategy for another strategy whose benefits are unknown by taking extra costs – Kogut and Kulatilaka (2001). However, for option values based on NAV, we argue that stock markets in bullish phases and high demand for consolidation within the REIT industry led to convex shaped NAVs, with a resulting extra value from the curvature structure of NAVs.

Interestingly we also find some negative call option prices, which imply the exercise of short call options. Normally, when there is a short call option, the investor wants to finance her position, and this implies that more money was needed to finance those M&A transactions. SNL Financials does not have information on whether investors had to obtain extra money to conclude the M&A transactions or not. After, making several direct enquiries with REITs who call options are short, some acquiring REITs responded that they never used extra funds to finance M&A deals. Therefore, short call options, especially for these REITs are misleading as no extra funds were used in the transaction. However, the “misleading” long call values give rise to arbitrage opportunities for intraday investors depending on their initial investment “positions” in the stock market.

An advantage of any value-based measure when used in option pricing is that the value-based measure increases the correlation between the calculated error term and option parameters; therefore, one can easily “hedge” any risks resulting from the error term. *“The approximation obtained by substituting the stock price net of the present value of the escrowed dividends into the Black-Scholes model is shown to induce spurious correlation between the prediction error and (1) the standard deviation of stock return, (2) the degree to which the option is in-the-money or out-of-the-money, (3) the probability of early exercise, (4) the time to expiration, and (5) the dividend yield of the stock”* – Whaley (1982). In principle, NAVs eliminate risk associated with REIT mispricing.

[Insert Figure 3 here]

As illustrated by Figure 3, most valuable call options were in hotel, apartment and retail sectors, which were the better performing sectors during the analysed M&A period.

7.3 Poisson REITs’ Share Prices’ Option Values

Ikenberry and Vermaelen (1996), and Mitchell et al. 2004 show that when a merger is announced, the share price of target firms tends to increase due to the demands for “excess” compensation from their shareholders. On the other hand, Mitchell et al. 2004 also find that when M&A deals are about to be closed, share prices of target firms tend to be fairly priced. Therefore, although there are jumps in share prices of target REITs, these prices represent the fair value of those firms according to market participants. Finally, share prices of acquiring REITs are most likely to be higher after an M&A than before it. We propose using a Poisson distribution to see if share price jumps have any effect on option values in M&A activities. The advantage of using jumps is that jumps lead to higher volatilities especially at higher levels – Bates (2003) – and therefore, option values should increase “substantially” when jumps are taken into account. The general assumption of a Poisson distribution is that, if the expected number of occurrences in this interval is Λ, then the probability of having exactly k occurrences (k being a non-negative integer, k=0, 1, 2 ...) is equal to:

$$f(k,\Lambda) = \frac{\Lambda^k e^{-\Lambda}}{k!}$$

where

- e is the base of the natural logarithm;
- k is the number of occurrences of an event, the probability of which is given by the function;
- $k!$ is the factorial of k.

In our empirical study we assume that REIT share prices will only jump once, when the M&A deals are announced as there will be no incentive to increase share prices further since M&A deals in the REIT industry are beneficial to all stakeholders – Womack (2010). Furthermore the stock price follows a Levy process can be represented as:

$$S(t + \Delta t) = S(t)e^{x},\ -\infty < x < \infty,$$

where x is the size of the movement in log price over a small time interval (Δt) – Khanna and Madam (2004).

[Insert Exhibit 6 here]

Exhibit 6 shows that, when the effect of jumps is considered, option values tend to be higher than when excluded. In this empirical analysis, changes in option values vary from 0% to over 2000%. This is consistent with the notion that jumps add extra value to calculated option prices – Chiara et al. (2007). The presence of a Levy process, as illustrated by a Poisson distribution, demonstrates that option prices are quite bigger than in a world with no jumps. On other hand, the exchange options valued in this empirical study are compound options (call on call) – Gukhal (2004) – and we argue that REIT share prices with jumps can be viewed as "second spot prices" of compound options. Since the second spot price is found "arbitrarily", there should be uncertainty to find the spot price which should intuitively lead to a higher option value than the "first spot price". Therefore, we recommend that investment appraisers consider all variables affecting the total possible value of M&A deals for all concerned stakeholders to obtain full benefit from their investments.

[Insert Figure 4 here]

Figure 4 illustrates average consolidated REIT share prices in relation to their call option prices. Moreover, average consolidated REIT prices are less spiky than call option ones. If one were to flip the graph, when jumps are considered, call option prices are higher than call option prices with no jumps. Therefore, jumps in REIT prices illustrate a phenomenon similar to scale-invariance. Still on the "flipped" graph, all call option prices are higher than average consolidated REIT prices, either with or without jumps. This supports the view that option prices are "extra" prices on existing prices – Fisher (1978) and

Gastineau (1993). Moreover, we think that the clustering effect of REIT volatilities induces options to be higher in value than when only examining the issue of REIT prices' jumps. Although Chau et al. (2007) and Stevenson (2007) did not explicitly say that REIT volatility clustering increases option values, we argue that clustering increases option prices further as the resulting volatility should be lower than individual volatilities. In principle, the resulting volatility is a multiplication of individual volatilities and hence should be much smaller than individual volatilities due the multiplication effect (i.e. minimisation effect of conditional variance). Lastly, jumps in REIT prices present a scale-invariant effect on option values, in relation to the case where no jumps were considered.

7.4 Margrabe (1978) Model vs. DDM

In order to verify the predictive power and strength of our option pricing model, we compare the results of our modified Margrabe (1978) model and the ones from a DDM. Farell, Jr. (1985) and Nagorniak (1985) show that DDM is widely used in academia and practice because the model is grounded on financial theory, despite its limitations. A DDM price of a stock is computed as follows:

$$Value\ of\ Stock\ (VS) = \frac{D_0(1+g)}{r-g}$$

where D_0 is the current dividend yield, r is the return of the stock and g is the growth rate. The growth rate g is estimated from the dividend yield growth over time prior to the M&A. To compare the real option values (ROV) with the DDM values, we use REIT prices 60 days prior each merger announcement – Fuller et al. 2002 and Mitchell et al. 2004.

[Insert Exhibit 7 here]

Exhibit 7 reports real option values (ROV) based on share prices (SPs), ROVs based on SP and acquisition funds and ROVs in relation to DDM values. Columns ROV on SPs reached reports the price, reached sometime after the M&A deal. Most ROVs predicted by Margrabe (1978) were reached sometime after the deal, while most DDM values were never reached. In calculating DDM values, the dividend *(D)* refers to one period prior the announcement of the merger. Interestingly, ROVs on SPs and funds were either reached or REIT prices traded closely to ROVs. Therefore, the option pricing technique has a better predictive power and strength than DDM. Goetzmann and Jorion (1995, 1993) show that if the predictive power of dividend yields is poor in the long run, the DDM does have some predictive capacity, although very rare. Reasons cited for poor predictive power include constant assumption of dividend yields and dividend growth over a given period. In practice, dividend yields change continuously as organisations' strategies change. Although Goetzmann and Jorion (1995) empirical study covered a different period in relation to our empirical study, their empirical study demonstrates that during both bear and bull markets, dividend models displayed poor predictive poor.

Consolidated REIT share prices immediately after the merger are different to consolidated share prices 60 days prior to the announcement. We argue that, when share prices after the merger are higher (smaller) than prices 60 days prior to the announcement, the target firm was acquired at a premium (discount). Since M&As between REITs always include equity, they are bound to be "successful". *"Bidder announcement period abnormal returns are positively and significantly related to the amount of ex ante equity financing"* – Schlingemann (2004). Furthermore, Schlingemann (2004) shows that the amount of debt used in M&As has no bearing of returns that accrue to the bidding firm. On the other hand, we think the inside superior information that REIT managers have causes REITs to seek new growth opportunities as REIT markets are semi-strongly efficient in the "short-run", giving managers opportunities to exploit new opportunities before information on REITs spill over to other market participants.

If we compare the DDM values with ROVs, the differences demonstrate that DDM values are lower than ROVs when one takes absolute values. Despite the fact that the standard deviation (SD) of option values is away from its mean more than DDM ones; however, on average when absolute values are considered, mean and median of option values tend to be closer than DDM values. Therefore, the distributions of option values are more leptokurtic for option values than for DDM ones. Goetzmann and Jorion (1995, 1993) demonstrate that this is due to the fact that the latter assume that dividend yields and the dividend growth rate grow in perpetuity (and this is not true); moreover, companies do experience both growth and "erosion" at some point in their "life" span. Since share prices change continuously in the "short-run" while NAVs change in the "longer-term", there is likely to be both short and long term smile effects. In the short, leptokurtosis in "price" density declines rapidly with maturity while in the long-run it can increase – Alexander (2008). On the other hand, OPT is forward looking for a specified period, making OPT's prediction probably more reliable. In special cases, ROVs are higher than DDM values and the phenomenon is not sector specific. This is due to the fact that target REITs were acquired at a significant premium; and that makes DDM values to be less than ROVs.

7.5 Robustness of Margrabe (1978) Model's NAVs

[Insert Exhibit 8 here]

Exhibit 8 illustrates that options based on NAV predicted most M&A deals in our sample. Interestingly, some predicted NAV options were observed at least twice from the data provided by SNL Financials. Moreover, as time gets "older", there are more NAVs option values closer to the share price. We think that why Margrabe (1978) model predicts prices better using NAVs than share prices is because REIT share prices are generally "noisy" as compared to their corresponding NAVs. Furthermore, as REITs' share prices have higher real estate spreads in relation to their "true values", we argue this is one of the reasons why our modified model predicts REITs' NAVs better than related share prices. Although, NAVs are not robust, Exhibit 8 has implications for other investment variables, such as capitalisation rates (cap rates). Therefore, assuming that exit NAVs based on OPT, cap rates can be either calculated or extrapolated from OPT NAVs. In principle, besides OPT being able to predict REIT NAVs, OPT can help one to indirectly "forecast" other related investment values such as cap rates.

[Insert Exhibit 9 here]

Exhibit 9 reports cap rates invariably extrapolated from NAVs predicted by our model. When two NAVs of the same REIT are compared, the common trend is that a higher NAV will be associated with a lower cap rate. This is phenomenon which is prevalent when exit values of REITs or REOCs are calculated, based on different cap rates – Netzell (2009).

7.6 Statistically Significant Difference of Means

With t-tests for statistically significance, we try to ascertain whether the pricing error (measured as price minus valuation) is significantly different from zero (i.e. the comparison is made between a specific grouping and the remaining deals). Particularly, we performed one tail t-tests assuming unequal sample size and unequal variance. To determine the significance in the differences, we choose a significance level of 10%.

[Insert Exhibit 10 here]

Exhibit 10 shows that most means are different, implying that most sub-groups are independent of one another. Some exceptions are the 'industrial' sector, small to medium size, small portion of internal funds, big portion of external funds and A rating class. We believe these exceptions reflect the average nature of deals in the market.

8 Conclusion

In this empirical study, we illustrate that when an M&A deal between REITs happens, extra value is generated from the M&A deal due to the emerging exchange option. Moreover, the computation of exchange options in the REIT industry performs best when it uses NAVs rather than share prices as underlying asset and exercise price. In principle, NAVs have a “smoothing” effect that leads to “true” long-term values of REITs. We also showed that funds used in acquisitions add extra value to the overall merged entity, although this is not always the case. Furthermore, we tested that OPT has more predictive power and strength than DDM and should then be preferred as a pricing tool for mergers and acquisitions. Finally we have reported the implied cap rates corresponding to REIT NAVs. In conclusion, M&A deals of U.S. REITs period generated extra values in the context of exchange options, increased liquidity in the market through increment of funds’ sizes and increased quest for more investment information by generating investors’ investment interests and increased the completeness of stock markets by introducing possible financial products that can “written” on existing REITs and resulting merged REITs.

We are grateful for valuable comments from ERES 2010 conference participants, especially Martin Hoesli and the positive criticism from REP seminar participants on the 9th February 2011 at The University of Reading, UK. The rest of errors are solely authors and usual disclaimer applies.

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Appendix A

Let's say that S_0= X and λ_T= Y, the returns of the two parameters are given by the following equations:

$$dX_t = \alpha X dt - \upsilon Y dz \quad (1)$$

and

$$dY_t = \alpha Y dt + \upsilon X dz \quad (2)$$

where α and υ are same constants in both equations (1) and (2) (i.e. both α and υ are equal to one). One of the reasons why the Weiner processes of equations (1) and (2) are negative and positive respectively is that we do not want to influence the Brownian motion of the two parameters. Therefore, the combined Weiner process of the two parameters X and Y is still natural despite it is driven by two parameters, X and Y. Furthermore, we assume that $R_t = S_t + \lambda_T$, where R_t represents the full option returns underpinned by the share price and total funds.

Now we use Stochastic Differential Equations as illustrated by the Ito Lemma:

$$R_t = f(S_t, \lambda_T)$$

with

$f(S_t, \lambda_T) = S_t + \lambda_T$, $\frac{\partial f(S_t,\lambda_T)}{\partial x} = 1$, $\frac{\partial f(S_t,\lambda_T)}{\partial y} = 1$, $\frac{\partial f(S_t,\lambda_T)}{\partial x \partial x} = 0$, $\frac{\partial f(S_t,\lambda_T)}{\partial y \partial y} = 0$ and $\frac{\partial f(S_t,\lambda_T)}{\partial x \partial y} = 0$

Then:

$$dR_t = \frac{\partial f(X_t,Y_t)}{\partial x} dX_t + \frac{\partial f(X_t,Y_t)}{\partial y} dY_t + \frac{1}{2}\frac{\partial^2 f(X_t,Y_t)}{\partial x^2}(dX_t)^2 + \frac{\partial^2 f(X_t,Y_t)}{\partial x \partial y} dX_t dY_t + \frac{1}{2}\frac{\partial f(X_t,Y_t)}{\partial y}(dY_t)^2 \quad (3)$$

$$= 1dX_t + 1dY_t + \frac{1}{2}(0)(dX_t)^2 + 0 + \frac{1}{2}(0)(dY_t)^2 \quad (4)$$

$$= 1dX_t + 1dY_t \quad (5)$$

$$= S_0 + \lambda_T \quad (6)$$

Equation (6) illustrates that when funds are injected in M&A, the option value id driven by the sum of share price total injected funds.

Exhibits

Exhibit 1 (a): Conditional Expectations of Acquiring U.S. REITs Firms

U.S. REIT's Name	NAV(0)	NAV (1)	Expected Conditional Return
American Campus Communities, Inc	26.97	27.03	0.06
Apartment Investment & Management Company	47.6	47.1	-0.5
Bay Apartment Communities, Inc	122.57	122.56	-0.01
Brandywine Realty Trust	28.67	28.67	0
Camden Realty Trust	69.44	67.44	-2
Colonial Property Trust	36.24	36.24	0
Developers Diversified Realty Corporation	57.22	57.12	-0.1
Duke Realty Investments, Inc	30.46	30.36	-0.1
Equity One, Inc	28.01	27.99	-0.02
Equity Residential Properties Trust	47.32	47.32	0
General Growth Properties, Inc	54.53	54.53	0
Health Care Property Investors, Inc	27.28	27.28	0
Kimco Realty Corporation	40.67	40.67	0

Source: SNL Financials

Exhibit 1 (b): Conditional Expectations of Target U.S. REITs Firms

U.S. REIT's Name	NAV(0)	NAV (1)	Expected Conditional Return
IRT Property Fund	11.77	11.76	-0.01
Crown American Realty Trust	8.05	8.00	-0.05
JP Realty, Inc	24.52	24.48	-0.04
Chelsea Property Group, Inc	22.40	22.41	0.01
Summit Properties Inc	23.98	24.07	0.09
Shurgard Storage Centers, Inc	31.74	31.74	0.00
Reckson Associates Realty Corporation	24.80	24.95	0.15
Cornerstone Realty Income Trust Inc	13.51	13.51	0.00
Prentiss Properties Trust	29.38	29.38	0.00
Pan Pacific Retail Properties, Inc	31.08	31.08	0.00
Catellus Development Corporation	21.25	21.25	0.00
GMH Communities Trust	11.93	11.94	0.01
Republic Property Trust	13.23	13.24	0.01

Source: SNL Financials

Exhibit 2: Normality Test Results

Acquirer	Skewness	Kurtosis	Jarque-Berra	Probability
American Campus Communities, Inc.	-0.137	10.554	2583.26	0.000
Apartment Investment & Management Company	0.310	5.221	191.94	0.000
Bay Apartment Communities, Inc.	0.449	4.959	194.67	0.000
Brandywine Realty Trust	1.844	23.804	78583.21	0.000
Camden Property Trust	-0.033	5.823	937.62	0.000
Colonial Properties Trust	-0.198	7.823	2725.56	0.000
Developers Diversified Realty Corporation	0.080	6.368	926.05	0.000
Developers Diversified Realty Corporation	-0.140	5.801	1140.40	0.000
Duke Realty Investments, Inc.	-0.539	20.710	33657.75	0.000
Equity Office Properties Trust	0.293	7.726	1833.87	0.000
Equity Office Properties Trust	0.304	7.998	2348.59	0.000
Equity One, Inc.	0.342	7.509	970.00	0.000
Equity One, Inc.	0.268	7.358	616.04	0.000
Equity Residential Properties Trust	0.748	9.343	1806.70	0.000
Equity Residential Properties Trust	0.825	9.750	3516.70	0.000
Equity Residential Properties Trust	0.850	9.731	2980.01	0.000
Equity Residential Properties Trust	0.766	9.289	1693.53	0.000
General Growth Properties, Inc.	0.837	10.150	5034.51	0.000
Health Care Property Investors, Inc.	-0.268	7.088	1046.99	0.000
Health Care Property Investors, Inc.	-0.412	6.848	2048.52	0.000
Highwoods Properties, Inc.	0.930	8.608	660.40	0.000
Kimco Realty Corporation	0.222	6.241	1299.13	0.000
Kimco Realty Corporation	0.035	6.340	1732.02	0.000
Lexington Corporate Properties Trust	0.228	12.671	12565.31	0.000
Liberty Property Trust	-0.104	5.312	740.14	0.000
Mid-America Apartment Communities, Inc.	1.884	11.166	835.65	0.000
Pennsylvania Real Estate Investment Trust	-0.057	5.957	1321.95	0.000
Post Properties, Inc.	-0.219	6.821	541.20	0.000
ProLogis	2.003	40.977	169830.20	0.000
ProLogis	3.464	56.849	143576.80	0.000
Public Storage, Inc.	-0.194	11.766	14095.06	0.000
Simon Property Group, Inc.	0.096	9.857	5230.25	0.000
Simon Property Group Inc.	0.183	4.583	63.36	0.000
Simon Property Group Inc.	-0.278	4.076	7.58	0.000
SL Green Realty Corp.	0.039	9.168	4882.46	0.000
United Dominion Realty Trust, Inc.	2.650	25.216	6759.66	0.000
Vornado Realty Trust	7.228	119.537	1672582.00	0.000

Source: SNL Financials
Note: Results were simulated using Eviews

Exhibit 3: GARCH (1;1) Parameters

Acquirer	$\bar{\sigma}$	σ_i	ω	$P(\omega)$	α	$P(\alpha)$	ε	$P(\varepsilon)$	λ	$P(\lambda)$	β	$P(\beta)$	$\alpha+\beta$
American Campus Communities, Inc.	0.0091	0.094	0.000	0.00	0.06	0.00	0.001	0.58	0.08	0.00	0.88	0.00	0.94
Apartment Investment and Management Company	0.0025	0.002	0.000	0.00	0.04	0.00	0.001	0.09	0.04	0.82	0.06	0.00	0.09
Bay Apartment Communities, Inc.	0.0099	0.029	0.000	0.00	0.09	0.00	0.001	0.47	0.05	0.08	0.83	0.00	0.92
Brandywine Realty Trust	0.0097	0.569	0.000	0.00	0.05	0.00	0.000	0.30	0.04	0.00	0.93	0.00	0.99
Camden Property Trust	0.0087	0.026	0.000	0.00	0.07	0.00	0.000	0.87	0.09	0.00	0.84	0.00	0.91
Colonial Properties Trust	0.0100	0.022	0.000	0.00	0.12	0.00	0.000	0.80	0.10	0.00	0.57	0.00	0.69
Developers Diversified Realty Corporation	0.0087	0.042	0.000	0.00	0.05	0.00	0.000	0.89	0.04	0.00	0.92	0.00	0.97
Developers Diversified Realty Corporation	0.0111	0.038	0.000	0.00	0.09	0.00	0.000	0.31	0.04	0.00	0.85	0.00	0.94
Duke Realty Investments, Inc.	0.0124	0.123	0.000	0.00	0.06	0.00	0.001	0.06	0.02	0.06	0.93	0.00	0.99
Equity Office Properties Trust	0.0146	0.050	0.000	0.00	0.07	0.00	0.000	0.24	0.01	0.43	0.90	0.00	0.97
Equity Office Properties Trust	0.0131	0.046	0.000	0.00	0.07	0.00	0.000	0.73	0.02	0.04	0.89	0.00	0.96
Equity One, Inc.	0.0158	0.047	0.000	0.00	0.18	0.00	0.000	0.74	0.06	0.08	0.67	0.00	0.85
Equity One, Inc.	0.0215	0.052	0.000	0.00	0.25	0.00	0.001	0.64	-0.04	0.43	0.67	0.00	0.92
Equity Residential Properties Trust	0.0088	0.047	0.000	0.00	0.02	0.02	0.001	0.29	0.03	0.01	0.95	0.00	0.97
Equity Residential Properties Trust	0.0095	0.039	0.000	0.00	0.04	0.00	0.000	0.75	0.03	0.00	0.93	0.00	0.96
Equity Residential Properties Trust	0.0096	0.042	0.000	0.00	0.04	0.00	0.000	0.76	0.03	0.01	0.93	0.00	0.97
Equity Residential Properties Trust	0.0091	0.048	0.000	0.00	0.02	0.01	0.001	0.37	0.03	0.02	0.95	0.00	0.97
General Growth Properties, Inc.	0.0101	0.029	0.000	0.00	0.08	0.00	0.000	0.21	0.09	0.00	0.78	0.00	0.86
Health Care Property Investors, Inc.	0.0122	0.038	0.000	0.00	0.08	0.00	0.000	0.69	0.06	0.05	0.79	0.00	0.87
Health Care Property Investors, Inc.	0.0139	0.027	0.000	0.00	0.17	0.00	0.001	0.44	0.02	0.35	0.53	0.00	0.69
Highwoods Properties, Inc.	0.0060	0.033	0.000	0.04	0.02	0.09	-0.001	0.33	0.14	0.00	0.90	0.00	0.93
Kimco Realty Corporation	0.0097	0.020	0.000	0.00	0.11	0.00	0.000	0.42	0.03	0.06	0.77	0.00	0.88
Kimco Realty Corporation	0.0098	0.024	0.000	0.00	0.09	0.00	0.000	0.60	0.04	0.01	0.81	0.00	0.90
Lexington Corporate Properties Trust	0.0133	0.057	0.000	0.00	0.06	0.00	0.000	0.81	0.04	0.00	0.87	0.00	0.92
Liberty Property Trust	0.0101	0.030	0.000	0.00	0.05	0.00	0.000	0.46	0.04	0.00	0.86	0.00	0.91
Mid-America Apartment Communities, Inc.	0.0106	0.048	0.000	0.00	-0.04	0.00	0.000	0.70	0.14	0.07	0.89	0.00	0.85
Pennsylvania Real Estate Investment Trust	0.0112	0.034	0.000	0.01	0.06	0.00	-0.001	0.01	0.04	0.00	0.84	0.00	0.90
Post Properties, Inc.	0.0089	0.014	0.000	0.00	0.14	0.00	0.000	0.82	0.11	0.01	0.51	0.00	0.66
ProLogis	0.0112	0.040	0.000	0.00	0.04	0.00	0.000	0.96	0.08	0.00	0.80	0.00	0.84
ProLogis	0.0123	0.048	0.000	0.00	0.06	0.00	0.000	0.87	0.09	0.01	0.76	0.00	0.82
Public Storage, Inc.	0.0131	0.043	0.000	0.00	0.09	0.00	0.001	0.12	0.07	0.00	0.78	0.00	0.87
Simon Property Group, Inc.	0.0127	0.018	0.000	0.00	0.20	0.00	-0.001	0.06	0.00	0.96	0.44	0.00	0.64
Simon Property Group Inc.	0.0204	0.029	0.000	0.02	0.08	0.00	-0.040	0.78	-0.04	0.17	0.91	0.00	0.99
Simon Property Group Inc.	0.0080	0.036	0.000	0.48	0.13	0.14	0.003	0.17	-0.10	0.31	0.92	0.00	1.00
SL Green Realty Corp.	0.0124	0.018	0.000	0.00	0.17	0.00	-0.001	0.11	0.02	0.39	0.43	0.00	0.60
United Dominion Realty Trust, Inc.	0.0132	0.078	0.000	0.00	0.10	0.01	-0.001	0.68	0.31	0.01	0.61	0.00	0.71
Vornado Realty Trust	0.0159	0.038	0.000	0.00	0.27	0.00	0.000	1.00	-0.14	0.00	0.56	0.00	0.83

Source: SNL Financials
Note: GARCH (1;1) parameters were simulated using Eviews

Exhibit 4: Model Selection Criteria

Acquirer	Durbin-Watson stat	Akaike info criterion	Schwartz criterion	Hannan-Quinn criterion
American Campus Communities, Inc.	2.0323	-5.2957	-5.2682	-5.2853
Apartment Investment & Management Company	1.9394	-6.1052	-6.0722	-6.0926
Bay Apartment Communities, Inc.	1.9595	-6.1451	-6.1158	-6.1339
Brandywine Realty Trust	2.3430	-4.4697	-4.4607	-4.4665
Camden Property Trust	1.9402	-6.2620	-6.2494	-6.2575
Colonial Properties Trust	2.2378	-6.1801	-6.1674	-6.1755
Developers Diversified Realty Corporation	2.0449	-5.9515	-5.9344	-5.9453
Developers Diversified Realty Corporation	1.9775	-5.9517	-5.9411	-5.9479
Duke Realty Investments, Inc.	2.4231	-5.1857	-5.1720	-5.1807
Equity Office Properties Trust	1.9675	-5.6637	-5.6493	-5.6584
Equity Office Properties Trust	1.9755	-5.7525	-5.7372	-5.7469
Equity One, Inc.	2.3072	-5.4582	-5.4312	-5.4480
Equity One, Inc.	2.3039	-5.3522	-5.3159	-5.3383
Equity Residential Properties Trust	1.9042	-5.8287	-5.7997	-5.8177
Equity Residential Properties Trust	1.8120	-5.9976	-5.9788	-5.9907
Equity Residential Properties Trust	1.8053	-5.9366	-5.9152	-5.9286
Equity Residential Properties Trust	1.9102	-5.7972	-5.7671	-5.7857
General Growth Properties, Inc.	1.9015	-6.1024	-6.0897	-6.0978
Health Care Property Investors, Inc.	2.1315	-5.8013	-5.7798	-5.7933
Health Care Property Investors, Inc.	2.0415	-5.7424	-5.7309	-5.7383
Highwoods Properties, Inc.	2.1532	-6.1204	-6.0659	-6.0989
Kimco Realty Corporation	1.9559	-6.4069	-6.3946	-6.4025
Kimco Realty Corporation	1.9169	-6.3185	-6.3085	-6.3150
Lexington Corporate Properties Trust	2.3572	-5.5407	-5.5293	-5.5366
Liberty Property Trust	2.0064	-6.1335	-6.1224	-6.1296
Mid-America Apartment Communities, Inc.	1.8570	-5.7912	-5.7203	-5.7627
Pennsylvania Real Estate Investment Trust	2.0538	-5.9663	-5.9560	-5.9626
Post Properties, Inc.	1.9762	-6.5266	-6.4939	-6.5141
ProLogis	1.9795	-5.8626	-5.8499	-5.8580
ProLogis	1.9411	-5.7197	-5.6937	-5.7099
Public Storage, Inc.	2.1227	-5.6731	-5.6644	-5.6700
Simon Property Group, Inc.	1.9813	-5.9819	-5.9687	-5.9771
Simon Property Group Inc.	2.0712	-6.1737	-6.1283	-6.1560
Simon Property Group Inc.	2.1458	-5.9914	-5.8550	-5.9360
SL Green Realty Corp.	1.9513	-5.9761	-5.9644	-5.9719
United Dominion Realty Trust, Inc.	1.7741	-5.2640	-5.1918	-5.2351
Vornado Realty Trust	1.7186	-6.0069	-5.9946	-6.0025

Source: SNL Financials
Note: Results were simulated using Eviews

Exhibit 5: Call Option Values

Acquirer	Target	Date of announcement of merger	Completion date	Prices Options	Equity & Prices Options	Debt & Prices Options	Equity, Debt & Prices Options	Equity, Debt, NAVs & Premiums Options
American Campus Communities, Inc.	GMH Communities Trust	02/11/2008	06/11/2008	21.94	39.94	64.40	82.09	82.09
Apartment Investment & Management Company	Ambassador Apartments, Inc.	23/12/1997	05/08/1998	0.00	13.13	0.93	26.04	26.04
Bay Apartment Communities, Inc.	Avalon Properties, Inc.	09/03/1998	06/04/1998	4.90	55.82	31.63	83.37	83.37
Brandywine Realty Trust	Prentiss Properties Trust	03/10/2005	01/04/2006	-2.36	21.16	-4.56	43.00	43.00
Camden Property Trust	Summit Properties Inc.	04/10/2004	28/02/2005	12.64	46.51	18.67	66.97	66.97
Colonial Properties Trust	Cornerstone Realty Income Trust Inc.	25/10/2004	04/01/2005	29.93	59.14	46.78	90.08	90.08
Developers Diversified Realty Corporation	American Industrial Properties REIT	01/11/2000	14/05/2001	-2.88	-0.76	-5.35	3.55	3.55
Developers Diversified Realty Corporation	Inland Retail Real Estate Trust, Inc.	20/10/2006	27/02/2007	42.61	73.23	45.71	91.87	91.87
Duke Realty Investments, Inc.	Weeks Corporation	28/02/1999	02/07/1999	-1.95	4.15	-2.92	14.57	14.57
Equity Office Properties Trust	Cornerstone Properties, Inc.	02/11/2000	19/06/2000	8.12	19.43	7.12	25.41	25.41
Equity Office Properties Trust	Spieker Properties, Inc.	22/02/2001	07/02/2001	-6.37	-8.02	-15.99	0.06	0.06
Equity One, Inc.	IRT Property Company	28/10/2002	02/12/2003	1.55	13.28	-3.56	21.30	21.30
Equity One, Inc.	United Investors Realty Trust	31/05/2001	21/09/2001	4.92	10.98	7.77	17.50	17.50
Equity Residential Properties Trust	Evans Withycombe Residential, Inc.	27/08/1997	23/12/1997	2.74	8.58	-0.91	11.50	11.50
Equity Residential Properties Trust	Grove Property Trust	17/07/2000	31/10/2000	5.24	8.10	-2.60	8.97	8.97
Equity Residential Properties Trust	Lexford Residential Trust	30/06/1999	01/10/1999	0.77	2.30	-1.25	4.44	4.44
Equity Residential Properties Trust	Wellsford Residential Property Trust	16/01/1997	30/05/1997	-2.26	1.02	-6.37	6.23	6.23
General Growth Properties, Inc.	JP Realty, Inc.	03/03/2002	07/10/2002	-10.72	-8.73	-14.06	-6.01	-6.01
Health Care Property Investors, Inc.	American Health Properties, Inc.	08/04/1999	11/04/1999	-1.88	2.77	0.74	8.71	8.71
Health Care Property Investors, Inc.	CNL Retirement Properties, Inc.	05/01/2006	10/05/2006	10.93	38.99	14.96	50.88	50.88
Highwoods Properties, Inc.	Crocker Realty Trust, Inc.	29/04/1996	20/09/1996	17.32	34.16	19.06	46.19	46.19
Kimco Realty Corporation	Mid-Atlantic Realty Trust	18/06/2003	10/01/2003	-0.26	3.49	-5.03	5.65	5.65
Kimco Realty Corporation	Pan Pacific Retail Properties, Inc.	07/09/2006	30/10/2006	-8.80	-21.00	-33.38	-16.54	-16.54
Lexington Corporate Properties Trust	Newkirk Realty Trust, Inc.	23/07/2006	31/12/2006	2.66	23.24	7.73	38.80	38.80
Liberty Property Trust	Republic Property Trust	23/07/2007	04/10/2007	29.54	36.66	28.53	41.17	41.17
Mid-America Apartment Communities, Inc.	America First REIT, Inc.	24/02/1995	29/06/1995	7.07	15.93	6.30	20.70	20.70
Pennsylvania Real Estate Investment Trust	Crown American Realty Trust	13/05/2003	20/11/2003	15.35	36.74	38.28	86.99	86.99
Post Properties, Inc.	Columbus Realty Trust	08/01/1997	24/10/1997	13.64	31.55	0.15	40.51	40.51
ProLogis	Catellus Development Corporation	06/05/2005	25/09/2005	8.28	27.72	4.95	34.24	34.24
ProLogis	Meridian Industrial Trust, Inc.	16/11/1998	30/03/1999	-0.56	5.32	-2.99	9.32	9.32
Public Storage, Inc.	Shurgard Storage Centers, Inc.	03/06/2006	22/08/2006	9.70	40.21	20.52	55.65	55.65
Simon Property Group, Inc.	Chelsea Property Group, Inc.	20/06/2004	14/10/2004	-1.64	12.07	-12.25	18.26	18.26
Simon Property Group Inc.	DeBartolo Realty Corporation	26/03/1996	08/09/1996	7.27	32.41	21.29	58.59	58.59
Simon Property Group Inc.	MSA Realty Corporation	13/05/1994	09/01/1994	19.39	21.64	13.93	21.64	21.64
SL Green Realty Corp.	Reckson Associates Realty Corporation	08/03/2006	25/01/2007	54.13	140.17	31.07	183.29	183.29
United Dominion Realty Trust, Inc.	American Apartment Communities II, Inc.	09/11/1998	12/07/1998	-1.89	-2.50	-4.99	2.20	2.20
Vornado Realty Trust	Arbor Property Trust	22/08/1997	16/12/1997	23.75	26.95	0.00	29.25	29.25

Source: SNL Financials

Exhibit 6: Option Values when there are Jumps in REITs' Share Prices

Acquirer	Target	Date of announcement of merger	Completion date	Prices Options	Equity & Prices Options	Debt & Prices Options	Equity, Debt & Prices Options
American Campus Communities, Inc.	GMH Communities Trust	02/11/2008	06/11/2008	44.00	63.10	88.44	105.24
Apartment Investment & Management Company	Ambassador Apartments, Inc.	23/12/1997	05/08/1998	4.11	16.80	20.23	29.71
Bay Apartment Communities, Inc.	Avalon Properties, Inc.	09/03/1998	06/04/1998	9.77	63.94	43.78	91.49
Brandywine Realty Trust	Prentiss Properties Trust	03/10/2005	01/04/2006	-5.94	8.54	-3.40	30.38
Camden Property Trust	Summit Properties Inc.	04/10/2004	28/02/2005	28.46	66.63	60.69	87.09
Colonial Properties Trust	Cornerstone Realty Income Trust Inc.	25/10/2004	04/01/2005	58.92	91.02	94.69	121.96
Developers Diversified Realty Corporation	American Industrial Properties REIT	01/11/2000	14/05/2001	-2.42	-3.65	-1.43	0.67
Developers Diversified Realty Corporation	Inland Retail Real Estate Trust, Inc.	20/10/2006	27/02/2007	82.19	115.92	104.03	134.57
Duke Realty Investments, Inc.	Weeks Corporation	28/02/1999	02/07/1999	-3.48	-0.97	0.17	9.45
Equity Office Properties Trust	Cornerstone Properties, Inc.	02/11/2000	19/06/2000	14.90	29.82	26.74	35.80
Equity Office Properties Trust	Spieker Properties, Inc.	22/02/2001	07/02/2001	-12.74	-30.79	-37.46	-22.71
Equity One, Inc.	IRT Property Company	28/10/2002	02/12/2003	2.21	14.86	11.14	22.90
Equity One, Inc.	United Investors Realty Trust	31/05/2001	21/09/2001	8.90	16.82	18.10	23.35
Equity Residential Properties Trust	Evans Withycombe Residential, Inc.	27/08/1997	23/12/1997	5.15	12.83	11.40	15.75
Equity Residential Properties Trust	Grove Property Trust	17/07/2000	31/10/2000	9.81	15.45	15.55	16.32
Equity Residential Properties Trust	Lexford Residential Trust	30/06/1999	01/10/1999	1.69	3.78	5.09	5.92
Equity Residential Properties Trust	Wellsford Residential Property Trust	16/01/1997	30/05/1997	-3.31	-3.11	-3.06	2.10
General Growth Properties, Inc.	JP Realty, Inc.	03/03/2002	07/10/2002	-6.31	-20.03	-19.79	-17.30
Health Care Property Investors, Inc.	American Health Properties, Inc.	08/04/1999	11/04/1999	-3.79	-2.30	-4.20	3.66
Health Care Property Investors, Inc.	CNL Retirement Properties, Inc.	05/01/2006	10/05/2006	20.77	52.59	39.05	64.47
Highwoods Properties, Inc.	Crocker Realty Trust, Inc.	29/04/1996	20/09/1996	33.49	53.24	50.18	65.27
Kimco Realty Corporation	Mid-Atlantic Realty Trust	18/06/2003	10/01/2003	-0.45	2.90	0.97	5.06
Kimco Realty Corporation	Pan Pacific Retail Properties, Inc.	07/09/2006	30/10/2006	-16.97	-53.81	-61.16	-49.36
Lexington Corporate Properties Trust	Newkirk Realty Trust, Inc.	23/07/2006	31/12/2006	4.63	26.94	22.94	42.51
Liberty Property Trust	Republic Property Trust	23/07/2007	04/10/2007	58.25	68.62	68.43	73.13
Mid-America Apartment Communities, Inc.	America First REIT, Inc.	24/02/1995	29/06/1995	13.23	25.45	23.79	30.22
Pennsylvania Real Estate Investment Trust	Crown American Realty Trust	13/05/2003	20/11/2003	25.93	52.23	81.20	102.48
Post Properties, Inc.	Columbus Realty Trust	08/01/1997	24/10/1997	21.61	46.89	39.62	55.84
ProLogis	Catellus Development Corporation	06/05/2005	25/09/2005	13.00	37.66	26.40	44.18
ProLogis	Meridian Industrial Trust, Inc.	16/11/1998	30/03/1999	-0.77	4.26	1.86	8.26
Public Storage, Inc.	Shurgard Storage Centers, Inc.	03/06/2006	22/08/2006	19.36	56.40	47.80	71.84
Simon Property Group, Inc.	Chelsea Property Group, Inc.	20/06/2004	14/10/2004	-4.06	7.35	-3.24	13.55
Simon Property Group Inc.	DeBartolo Realty Corporation	26/03/1996	08/09/1996	11.81	40.89	43.11	67.08
Simon Property Group Inc.	MSA Realty Corporation	13/05/1994	09/01/1994	38.84	42.34	41.39	42.34
SL Green Realty Corp.	Reckson Associates Realty Corporation	08/03/2006	25/01/2007	102.82	202.29	167.36	245.41
United Dominion Realty Trust, Inc.	American Apartment Communities II, Inc.	09/11/1998	12/07/1998	-3.44	-7.93	-6.08	-3.20
Vornado Realty Trust	Arbor Property Trust	22/08/1997	16/12/1997	46.44	52.07	52.53	54.37

Source: SNL Financials

Exhibit 7: Predictive Power and Strength of Margrabe (1978) versus DDM

Acquirer	Target	[DDM_Values]_Calculated	[OV_Prices]_Calculated	Price Reached in 60 days	Price reached in 100 days	Price reached in 150 days	Price reached in 200 days	Priced reached in a year
American Campus Communities, Inc.	GMH Communities Trust	277.05	21.94	21.37	16.10	22.29	25.18	28.29
Apartment Investment & Management Company	Ambassador Apartments, Inc.	34.02	0.00	36.62	37.49	38.00	31.87	42.50
Bay Apartment Communities, Inc.	Avalon Properties, Inc.	14.55	4.90	38.88	36.00	31.81	33.75	34.94
Brandywine Realty Trust	Prentiss Properties Trust	6.23	-2.36	28.44	29.95	29.25	31.50	34.20
Camden Property Trust	Summit Properties Inc.	38.82	12.64	27.73	47.03	54.45	50.39	60.04
Colonial Properties Trust	Cornerstone Realty Income Trust Inc.	131.00	29.93	26.76	30.30	26.65	28.69	38.13
Developers Diversified Realty Corporation	American Industrial Properties REIT	7.45	-2.88	13.70	14.62	17.09	19.05	20.80
Developers Diversified Realty Corporation	Inland Retail Real Estate Trust, Inc.	5.18	42.61	64.47	68.78	64.64	51.32	39.33
Duke Realty Investments, Inc.	Weeks Corporation	13.57	-1.95	38.00	21.50	18.56	17.81	21.50
Equity Office Properties Trust	Cornerstone Properties, Inc.	21.69	8.12	27.56	26.85	27.45	30.05	33.97
Equity Office Properties Trust	Spieker Properties, Inc.	22.35	-6.37	27.27	28.32	30.12	31.00	32.88
Equity One, Inc.	IRT Property Company	27.51	1.55	12.96	14.78	16.53	16.84	18.00
Equity One, Inc.	United Investors Realty Trust	57.89	4.92	11.11	11.97	13.74	13.50	12.84
Equity Residential Properties Trust	Evans Withycombe Residential, Inc.	132.32	2.74	21.06	20.88	20.50	23.56	20.94
Equity Residential Properties Trust	Grove Property Trust	20.09	5.24	22.69	26.38	25.78	25.70	28.75
Equity Residential Properties Trust	Lexford Residential Trust	20.31	0.77	21.31	19.88	20.97	22.06	26.31
Equity Residential Properties Trust	Wellsford Residential Property Trust	16.04	-2.26	22.19	22.94	26.06	25.19	22.78
General Growth Properties, Inc.	JP Realty, Inc.	3.88	-10.72	16.12	14.67	16.13	16.83	22.09
Health Care Property Investors, Inc.	American Health Properties, Inc.	29.04	-1.88	22.47	19.63	18.25	17.75	20.06
Health Care Property Investors, Inc.	CNL Retirement Properties, Inc.	36.14	10.93	36.60	31.90	34.94	38.63	28.70
Highwoods Properties, Inc.	Crocker Realty Trust, Inc.	24.85	17.32	27.25	29.75	30.75	35.38	35.44
Kimco Realty Corporation	Mid-Atlantic Realty Trust	14.86	-0.26	24.65	26.63	27.49	26.45	38.57
Kimco Realty Corporation	Pan Pacific Retail Properties, Inc.	12.61	-8.80	46.19	50.01	48.45	37.73	33.22
Lexington Corporate Properties Trust	Newkirk Realty Trust, Inc.	15.86	2.66	21.58	21.93	20.25	21.29	13.47
Liberty Property Trust	Republic Property Trust	40.42	29.54	40.54	29.96	30.82	35.38	22.83
Mid-America Apartment Communities, Inc.	America First REIT, Inc.	18.73	7.07	25.50	25.13	24.75	23.50	25.00
Pennsylvania Real Estate Investment Trust	Crown American Realty Trust	15.48	15.35	30.87	34.34	34.44	36.45	40.16
Post Properties, Inc.	Columbus Realty Trust	58.00	13.64	28.25	26.50	39.31	38.75	39.63
ProLogis	Catellus Development Corporation	6.84	8.28	45.59	43.02	46.00	53.14	58.89
ProLogis	Meridian Industrial Trust, Inc.	5.07	-0.56	19.63	19.38	20.19	19.63	19.69
Public Storage, Inc.	Shurgard Storage Centers, Inc.	29.64	9.70	85.63	95.07	111.70	95.62	76.95
Simon Property Group, Inc.	Chelsea Property Group, Inc.	17.67	-1.64	53.75	58.92	61.15	59.95	77.38
Simon Property Group Inc.	DeBartolo Realty Corporation	16.21	7.27	24.13	25.00	26.75	30.63	31.75
Simon Property Group Inc.	MSA Realty Corporation	19.56	19.39	27.25	26.50	25.13	24.38	24.75
SL Green Realty Corp.	Reckson Associates Realty Corporation	18.96	54.13	101.80	114.30	116.19	132.19	108.69
United Dominion Realty Trust, Inc.	American Apartment Communities II, Inc.	45.25	-1.89	10.00	10.06	11.19	11.19	9.88
Vornado Realty Trust	Arbor Property Trust	17.71	23.75	44.63	47.00	43.63	37.50	35.56

Source: SNL Financials

Exhibit 8: Predictive Power and Strength of Margrabe (1978) Model's NAVs

Acquirer	Target	[OV_Prices]_Calculated	[OV_NAVs, Premium, Equity & Debt]_calculated	Price Reached in 60 dys	Price reached in 100 dys	Price reached in 150 dys	Price reached in 200 dys	Priced reached in a year
American Campus Communities, Inc.	GMH Communities Trust	21.94	82.09	21.37	16.10	22.29	25.18	28.29
Apartment Investment & Management Company	Ambassador Apartments, Inc.	0.00	26.04	36.62	37.49	38.00	31.87	42.50
Bay Apartment Communities, Inc.	Avalon Properties, Inc.	4.90	83.37	38.88	36.00	31.81	33.75	34.94
Brandywine Realty Trust	Prentiss Properties Trust	-2.36	43.00	28.44	29.95	29.25	31.50	34.20
Camden Property Trust	Summit Properties Inc.	12.64	66.97	27.73	47.03	54.45	50.39	60.04
Colonial Properties Trust	Cornerstone Realty Income Trust Inc.	29.93	90.08	26.76	30.30	26.65	28.69	38.13
Developers Diversified Realty Corporation	American Industrial Properties REIT	-2.88	3.55	13.70	14.62	17.09	19.05	20.80
Developers Diversified Realty Corporation	Inland Retail Real Estate Trust, Inc.	42.61	91.87	64.47	68.78	64.64	51.32	39.33
Duke Realty Investments, Inc.	Weeks Corporation	-1.95	14.57	38.00	21.50	18.56	17.81	21.50
Equity Office Properties Trust	Cornerstone Properties, Inc.	8.12	25.41	27.56	26.85	27.45	30.05	33.97
Equity Office Properties Trust	Spieker Properties, Inc.	-6.37	0.06	27.27	28.32	30.12	31.00	32.88
Equity One, Inc.	IRT Property Company	1.55	21.30	12.96	14.78	16.53	16.84	18.00
Equity One, Inc.	United Investors Realty Trust	4.92	17.50	11.11	11.97	13.74	13.50	12.84
Equity Residential Properties Trust	Evans Withycombe Residential, Inc.	2.74	11.50	21.06	20.88	20.50	23.56	20.94
Equity Residential Properties Trust	Grove Property Trust	5.24	8.97	22.69	26.38	25.78	25.70	28.75
Equity Residential Properties Trust	Lexford Residential Trust	0.77	4.44	21.31	19.88	20.97	22.06	26.31
Equity Residential Properties Trust	Wellsford Residential Property Trust	-2.26	6.23	22.19	22.94	26.06	25.19	22.78
General Growth Properties, Inc.	JP Realty, Inc.	-10.72	-6.01	16.12	14.67	16.13	16.83	22.09
Health Care Property Investors, Inc.	American Health Properties, Inc.	-1.88	8.71	22.47	19.63	18.25	17.75	20.06
Health Care Property Investors, Inc.	CNL Retirement Properties, Inc.	10.93	50.88	36.60	31.90	34.94	38.63	28.70
Highwoods Properties, Inc.	Crocker Realty Trust, Inc.	17.32	46.19	27.25	29.75	30.75	35.38	35.44
Kimco Realty Corporation	Mid-Atlantic Realty Trust	-0.26	5.65	24.65	26.63	27.49	26.45	38.57
Kimco Realty Corporation	Pan Pacific Retail Properties, Inc.	-8.80	-16.54	46.19	50.01	48.45	37.73	33.22
Lexington Corporate Properties Trust	Newkirk Realty Trust, Inc.	2.66	38.80	21.58	21.93	20.25	21.29	13.47
Liberty Property Trust	Republic Property Trust	29.54	41.17	40.54	29.96	30.82	35.38	22.83
Mid-America Apartment Communities, Inc.	America First REIT, Inc.	7.07	20.70	25.50	25.13	24.75	23.50	25.00
Pennsylvania Real Estate Investment Trust	Crown American Realty Trust	15.35	86.99	30.87	34.34	34.44	36.45	40.16
Post Properties, Inc.	Columbus Realty Trust	13.64	40.51	28.25	26.50	39.31	38.75	39.63
ProLogis	Catellus Development Corporation	8.28	34.24	45.59	43.02	46.00	53.14	58.89
ProLogis	Meridian Industrial Trust, Inc.	-0.56	9.32	19.63	19.38	20.19	19.63	19.69
Public Storage, Inc.	Shurgard Storage Centers, Inc.	9.70	55.65	85.63	95.07	111.70	95.62	76.95
Simon Property Group, Inc.	Chelsea Property Group, Inc.	-1.64	18.26	53.75	58.92	61.15	59.95	77.38
Simon Property Group Inc.	DeBartolo Realty Corporation	7.27	58.59	24.13	25.00	26.75	30.63	31.75
Simon Property Group Inc.	MSA Realty Corporation	19.39	21.64	27.25	26.50	25.13	24.38	24.75
SL Green Realty Corp.	Reckson Associates Realty Corporation	54.13	183.29	101.80	114.30	116.19	132.19	108.69
United Dominion Realty Trust, Inc.	American Apartment Communities II, Inc.	-1.89	2.20	10.00	10.06	11.19	11.19	9.88
Vornado Realty Trust	Arbor Property Trust	23.75	29.25	44.63	47.00	43.63	37.50	35.56

Source: SNL Financials

Exhibit 9: Cap Rates Invariably Predicted by Margrabe (1978) Model

Acquirer	Target	NAVs Options	Predicted SNL cap rate (in %) at a given NAVs Options	Funds & NAVs Options	Predicted SNL cap rate (in %) at a given Funds & NAVs Options
American Campus Communities, Inc.	GMH Communities Trust	21.88	7.41	22.78	4.90
Apartment Investment & Management Company	Ambassador Apartments, Inc.	0.00	NA	0.00	NA
Bay Apartment Communities, Inc.	Avalon Properties, Inc.	267.40	NA	274.14	NA
Brandywine Realty Trust	Prentiss Properties Trust	45.01	NA	46.52	NA
Camden Property Trust	Summit Properties Inc.	28.33	9.37	29.15	8.25
Colonial Properties Trust	Cornerstone Realty Income Trust Inc.	5.25	7.04	5.40	11.42
Developers Diversified Realty Corporation	American Industrial Properties REIT	55.59	5.92	55.94	5.92
Developers Diversified Realty Corporation	Inland Retail Real Estate Trust, Inc.	257.11	NA	263.07	NA
Duke Realty Investments, Inc.	Weeks Corporation	11.05	Not given	11.21	Not given
Equity Office Properties Trust	Cornerstone Properties, Inc.	17.79	NA	17.92	NA
Equity Office Properties Trust	Spieker Properties, Inc.	15.55	NA	15.72	NA
Equity One, Inc.	IRT Property Company	90.83	NA	92.75	NA
Equity One, Inc.	United Investors Realty Trust	27.94	6.28	28.36	6.84
Equity Residential Properties Trust	Evans Withycombe Residential, Inc.	16.23	NA	16.31	NA
Equity Residential Properties Trust	Grove Property Trust	20.32	6.67	20.33	7.99
Equity Residential Properties Trust	Lexford Residential Trust	19.11	7.99	19.14	7.99
Equity Residential Properties Trust	Wellsford Residential Property Trust	4.55	NA	4.60	NA
General Growth Properties, Inc.	JP Realty, Inc.	0.81	8.22	0.83	8.22
Health Care Property Investors, Inc.	American Health Properties, Inc.	37.94	7.51	38.51	7.51
Health Care Property Investors, Inc.	CNL Retirement Properties, Inc.	21.16	6.90	21.98	6.32
Highwoods Properties, Inc.	Crocker Realty Trust, Inc.	8.76	NA	8.90	NA
Kimco Realty Corporation	Mid-Atlantic Realty Trust	76.56	NA	76.83	NA
Kimco Realty Corporation	Pan Pacific Retail Properties, Inc.	47.94	5.11	48.64	3.71
Lexington Corporate Properties Trust	Newkirk Realty Trust, Inc.	14.25	8.47	14.58	7.72
Liberty Property Trust	Republic Property Trust	42.80	8.07	43.00	8.00
Mid-America Apartment Communities, Inc.	America First REIT, Inc.	32.80	Not given	33.20	Not given
Pennsylvania Real Estate Investment Trust	Crown American Realty Trust	9.68	9.35	10.36	9.35
Post Properties, Inc.	Columbus Realty Trust	5.69	NA	5.80	NA
ProLogis	Catellus Development Corporation	50.73	6.85	51.55	6.87
ProLogis	Meridian Industrial Trust, Inc.	40.27	7.46	40.52	7.46
Public Storage, Inc.	Shurgard Storage Centers, Inc.	2004.97	NA	2026.23	NA
Simon Property Group, Inc.	Chelsea Property Group, Inc.	0.30	NA	0.34	NA
Simon Property Group Inc.	DeBartolo Realty Corporation	72.00	5.76	72.80	6.50
Simon Property Group Inc.	MSA Realty Corporation	0.54	NA	0.54	NA
SL Green Realty Corp.	Reckson Associates Realty Corporation	50.90	6.02	74.80	4.91
United Dominion Realty Trust, Inc.	American Apartment Communities II, Inc.	8.43	7.96	8.82	8.28
Vornado Realty Trust	Arbor Property Trust	11.43	NA	11.47	NA

Source: SNL Financials

Exhibit 10: Statistically Significant Difference of Means of Various U.S. REITs Parameters

REITs Groups	Sub-Groups	Critical Value t_value @ alpha of 10%	d.f.	Calculated t_value	Decision
Sectors	Diversified	1.68	35	-0.42	Different
	Health care	1.68	35	-9.50	Different
	Industrial	1.68	35	6.44	Indifferent
	Multi-family	1.68	35	1.35	Different
	Office	1.68	35	0.53	Different
	Self-Storage	1.68	35	-0.49	Different
	Shopping Centre	1.68	35	-0.20	Different
	Other	1.68	35	-1.40	Different
Sizes	0 -$500mn	1.68	35	-1.91	Different
	$501- $1000mn	1.68	35	4.55	Indifferent
	$1001-$4000mn	1.68	35	-0.09	Different
	>$4000mn	1.68	35	-4.49	Different
Internal Funds	0 -$500mn	1.68	35	2.70	Indifferent
	$501- $1000mn	1.68	35	-2.61	Different
	$1001-$4000mn	1.68	35	0.24	Different
	>$4000mn	1.68	35	0.38	Different
External Funds	0 -$500mn	1.68	35	-5.01	Different
	$501- $1000mn	1.68	35	10.40	Indifferent
	$1001-$4000mn	1.68	35	4.45	Indifferent
Success Period	None	1.68	35	2.92	Indifferent
Leverage	None	1.68	35	0.64	Different
R_Squared	None	1.68	35	1.11	Different
Rapid vs Slow Growth Phase	None	1.68	35	0.28	Different
Board	None	1.68	35	4.78	Indifferent
Audit Fees	None	1.68	35	-4.17	Different
Ownership	None	1.68	35	-4.50	Different
Agency Rating	All As	1.68	35	6.04	Indifferent
	All BBs	1.68	35	-2.21	Different
	All BBBs	1.68	35	-1.07	Different
	None Rated	1.68	35	-2.89	Different

Source: SNL Financials

Figures

Figure 1: Equation (5.1.5) and Logarithm Functions Option Strategy

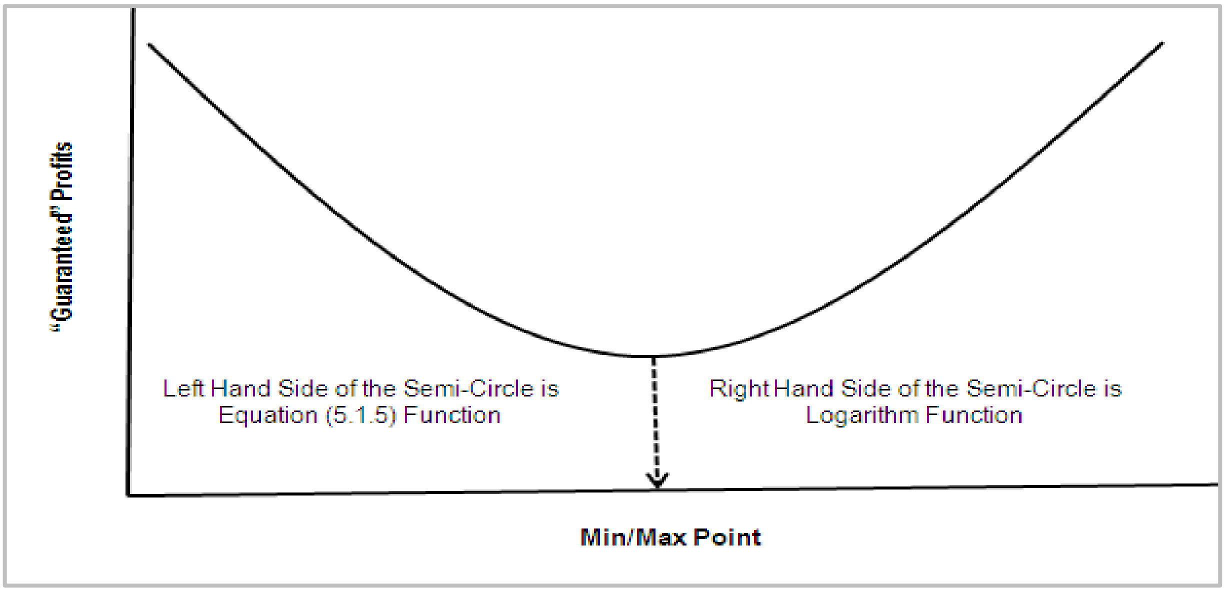


Figure 2: Sub-Martingale Processes as Illustrated by Equation (5.2.6)

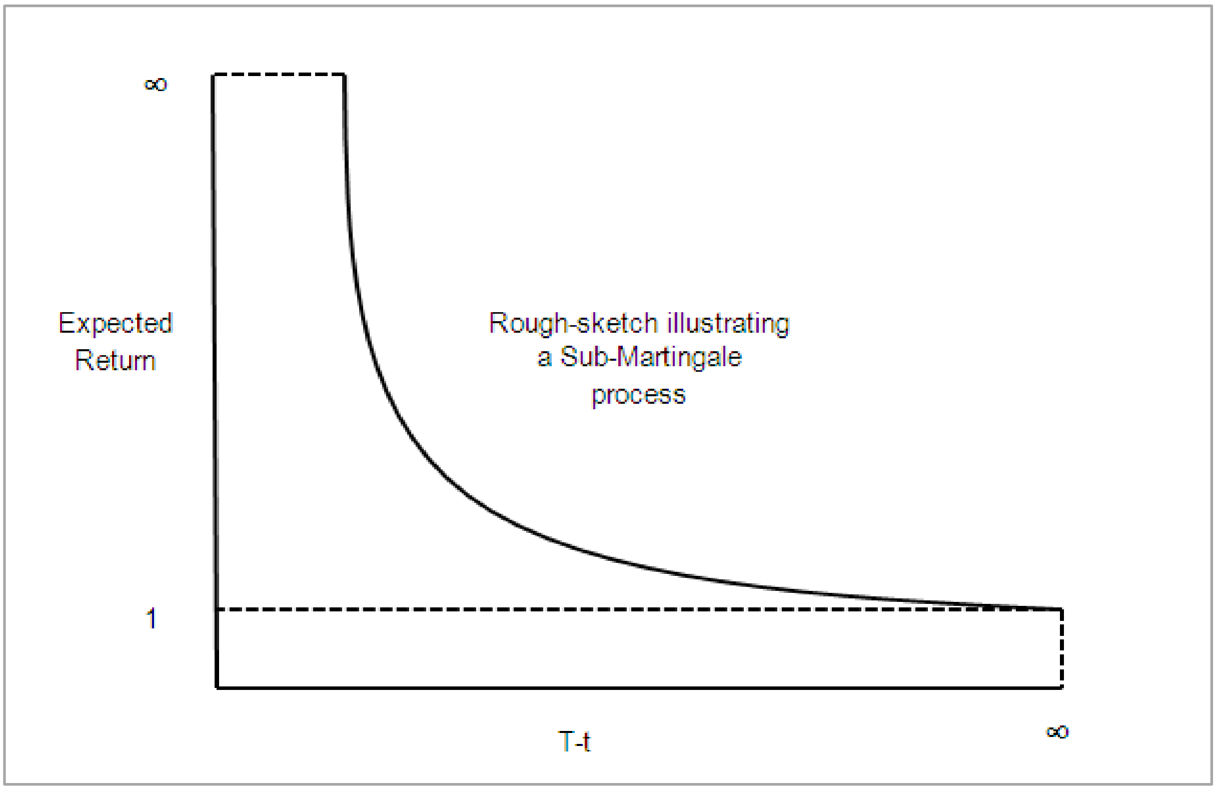
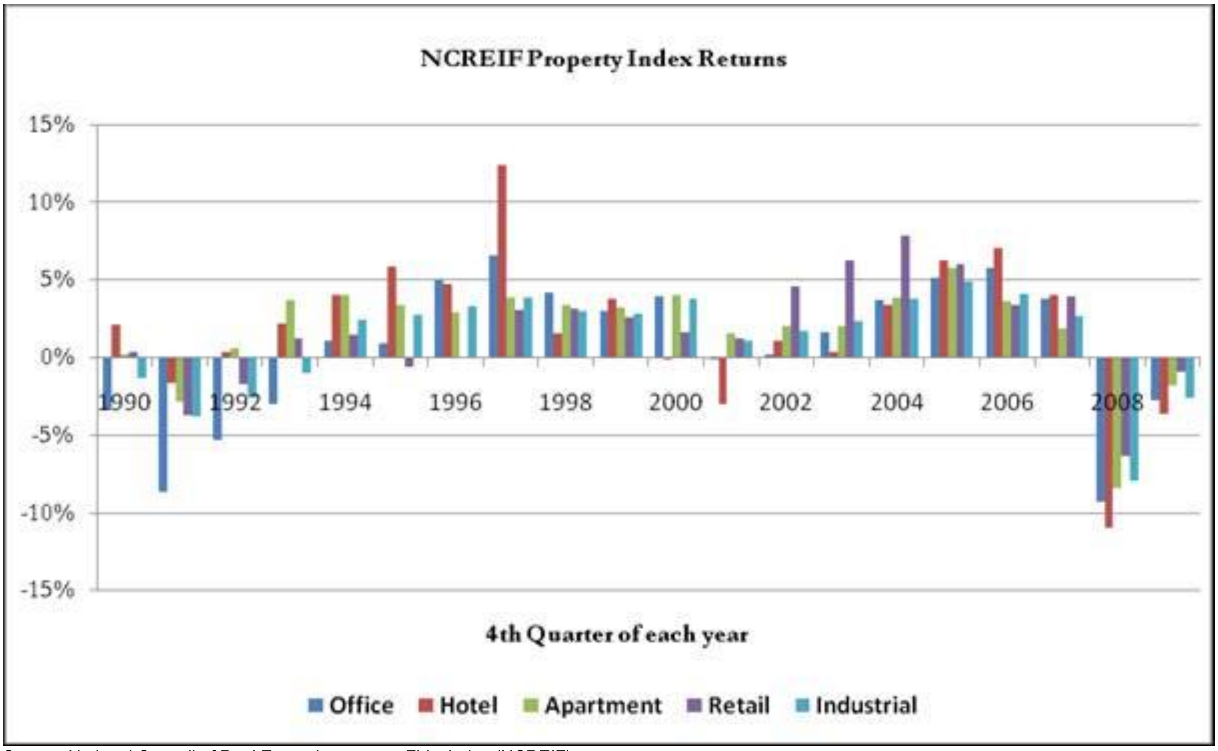
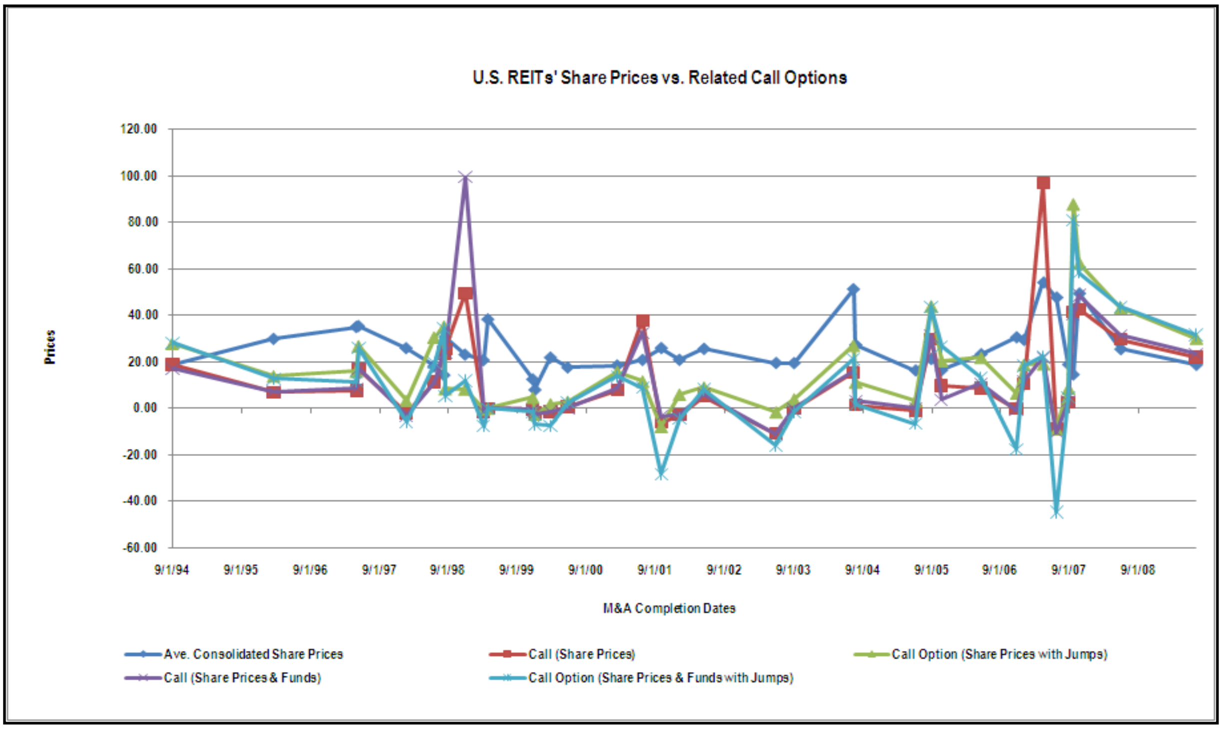


Figure 3: Performance of U.S. Real Estate Sectors during 1990-2008 period



Source: National Council of Real Estate Investment Fiduciaries (NCREIF)

Figure 4: U.S. REITs' Share Prices vs. Related Call Options



Source: SNL Financials