Erasmus School of Economics

The Inflation-Hedging Characteristics of Real Estate Investment Trusts

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Abstract

This study investigates the relationship between inflation and returns on US Real Estate Investment Trusts (REITs). The actual inflation rate is broken down to an expected and unexpected component. Two different measures of anticipated inflation were used, short-term bill rates and a survey. I will employ a combination of regression equations and cointegration tests. A cointegration test on this matter is a method more used by modern day literature. The results reveal that REITs generally tend to behave like equities with respect to their hedging characteristics, regardless of the chosen anticipated inflation measure.

Preface

This Master thesis finishes my graduate education at the Erasmus School of Economics in Rotterdam. My interest was triggered during the seminar “Pension Funds” where I was introduced to real estate finance. Also the current economic crisis which started on the American real estate market narrowed my interests.

I want to thank my thesis supervisor professor W. F. C. Verschoor for his advice and pleasant cooperation. Also I want to thank my parents for their support.

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1. Introduction

The subprime mortgage crisis is a current economic event which started in the United States. It began with the bursting of the US housing bubble and high default rates on subprime and adjustable rate mortgages. Due to the increasing housing prices and loan incentives (based on easy initial terms) encouraged borrowers to engage in complicated mortgages. Borrowers and investors believed they could refinance quickly at more favourable terms. Against expectations the housing prices started to decline in 2006-2007 in the United States and refinancing became more difficult. Due to the fact that house prices didn't go up as expected, default on loans increased dramatically and adjustable rate mortgages interest rates reset higher. As a result foreclosures became more common in the United States late 2006, and in 2007-2008 it had lead to a global financial crisis. The crisis is worldwide characterized by limited liquidity in the global credit markets and banking system. During 2007 nearly 1.3 million houses were subject to foreclosure, this is an increase of 79% from 2006 (RealtyTrac, n.d.). The mortgage lenders who carried the credit risk were the first victims, as borrowers became unable and unwilling to fulfil their payments. Mayor banks and other financial institutions around the world have reported losses of approximately US $435 billion as of July 17, 2008 (Finneman & Keoun, 2008). Institutions and corporations became victims of the crisis due to the fact that mortgage lenders had passed the credit/default risk to third-party investors through mortgage-backed securities (MBS) and collateralized debt obligations (CDO). Corporate and individual investors who held MBS and CDO suffered significant losses, because the value of the underlying mortgages declined. The effect of this crisis was worldwide visible through the declining stock markets across the globe. Well known institutions such as Merrill Lynch, Lehman Brothers, Bear Stearns and Citigroup had made huge losses through securitized mortgage-linked assets. For some banks it was too late and no acquisition by another bank or financial institution took place, Lehman Brothers and Bear Stearns went bankrupt due to the crisis. In September 2008, the Secretary of Finance Henry Paulson announced the US government will temporarily take over the control of mortgage banks Fannie Mae

and Freddie Mac. The two mortgage banks will be supervised by the Federal Housing Finance Agency (FHFA). Due to the crisis the two mortgage lenders had severe problems and a collapse would have caused a huge negative impact on the American and global economy. Also in Europe the effects of the crisis are visible, in the Benelux Fortis had to be saved by the affiliated governments in order to prevent a collapse and guarantee peoples saving amounts. In Germany and Great Britain mortgage banks had severe liquidity problems. Hypo Real Estate, the second largest mortgage bank of Germany was saved by a consortium of banks. Governments in Europe guaranteed the saving amounts to a certain degree in order to preserve faith in the banking system.

The link between returns on financial assets and inflation has been the subject of much research in recent years (Park, Mullineaux, & Chew, 1990, p. 91). According to Fisher's (1930) theory, expected nominal return on an asset is equal to its expected real return plus expected rate of inflation. If the real return is constant then higher inflation requires higher nominal return (Glascock, Lu, & So, 2002). To maintain the same level of real returns or purchasing power, investors will demand higher nominal returns in periods of high inflation (Glascock et al., 2002). Investors hold investments for numerous reasons, one objective is to protect wealth against inflation (Yobaccio, Rubens, & Ketcham, 1995). Inflation-hedging is a major concern for real estate investors, such as insurance companies or pension fund managers, who usually have long-term investment holding periods (Glascock et al., 2002, p. 302). During periods of high inflation, it has been observed that certain financial instruments not only do not protect the investor against changes in the price level, but actually perform as perverse hedges (Yobaccio et al., 1995, p. 279). They decrease in value as inflation increases. Nelson, Jaffe and Mandelker, and Stulz, among others, have revealed that common stocks serve as a perverse hedge in the United States. Others, such as Gultekin, Mandelker and Tandon, and Peel and Pope have noted such a relationship between stocks and inflation on an international basis (Rubens, Bond, & Webb, 1989, p. 45). Most studies on the relationship between real estate investment trusts (REIT) and inflation arrive at similar conclusions (Murphy and

Kleinman, 1989; Chan, Hendershott and Sanders, 1990; Park, Mullineaux and Chew, 1990; and Yobaccio, Rubens and Ketcham, 1995). To the contrary studies by Gyourko and Linneman (1988) and Chen and Tzang (1988) concluded that REITs are a partial hedge against inflation. The evidence from unsecuritized real estate has been far more favourable (Chatrath & Liang, 1998). Studies done by Fama and Schwert (1977) suggested that direct real estate was a complete hedge against expected as well as unexpected inflation. A more recently study by Rubens, Bond and Webb (1989) concluded that residential, commercial and farmland real estate provide at least partial hedges against inflation. There are separate conclusions about the hedging capabilities of securitized and unsecuritized real estate, although most of the studies concerning real estate focus solely on physical real estate. Former research has shown positive inflation-hedging characteristics for direct real estate, on the contrary securitized real estate (REITs) has mixed conclusions. There is evidence found of perverse inflation-hedging characteristics of REITs, but some authors concluded that REITs are a partial hedge against inflation.

Some authors make a distinction between three types of REITs; Equity REIT, Mortgage REIT and Hybrid REIT. An Equity REIT takes ownership position in its real estate investments and a Mortgage REIT invests in mortgages and mortgage related products, some also borrow money from the bank and relend it at higher interest rates. A hybrid REIT combines both activities, it generates income from rent and capital gains. The underlying value of the REITs can lead to different findings concerning inflation-hedging effectiveness. On the one hand, REITs should not be able to hedge inflation due to their common stock characteristics. On the other, they should be inflation hedges due to their operation in real estate (Lu & So, 2001, p. 103). The studies performed included data before the 21st century. A research performed by Simpson, Ramchander and Webb contained a dataset of Equity REIT return performances from August 1981 till November 2002. This is the most relevant recent study on inflation-hedging characteristics of REITs, however it does not include the period of the subprime mortgage crisis and the two other types of REITs. The purpose of this paper is to examine the inflation-hedging capabilities of US REITs

over the 1990 – 2008 interval. This way the most recent time period is used, which includes the subprime crisis and the beginning of the global financial crisis. Also a distinction will be made between Equity REITs, Mortgage REITs and Hybrid REITs. The actual inflation rate will be divided in an expected and unexpected component.

The paper is build up as follows, chapter 2 discusses the most relevant literature on REITs regarding inflation-hedging. Chapter 3 continues with underlying the importance of inflation risk, also the relationship between inflation and various asset classes will be discussed. Chapter 4 introduces the REIT industry based on history, financial performance and legal boundaries. In chapter 5 the data and used models are explained. The empirical results are presented in chapter 6. This paper ends with the conclusions made in chapter 7.

2. Review of Literature

Consistent with the results for stocks, studies which investigate REITs show similar results, even though the underlying value is real estate (Liu, Hartzell, & Hoesli, 1997). Like other stocks which trade on organized exchanges, REITs do not hedge against inflation. This is quite remarkable since studies show that direct investment in real estate (residential, commercial and farmland) is at least a partial hedge against inflation. Evidence of a positive correlation between inflation and real estate returns is somewhat proven by studies from Brueggeman, Chen and Thibodeau (1984), Ibbotson and Seigel (1984), Rubens, Bond and Webb (1989), and Miles and Mahoney (1997). These studies conclude that real estate investments are at least a partial hedge against unexpected- and expected inflation. Also the hedging effectiveness of mixed-asset portfolios improves once real estate is included (Simpson, Ramchander & Webb, 2007, p. 514). However the opinion about the inflation effectiveness of REITs is diverse.

Gyourko and Linneman (1988) conclude that REITs are a partial hedge against actual inflation and expected inflation, but not against the unexpected component of inflation. These results are opposite to the study done by Park, Mullineaux and Chew (1990), they revealed that REITs are negatively correlated to both unexpected and expected inflation. They used two different measures of expected inflation, the Treasury bill rate over the relevant investment horizon and the Livingston Price Expectations (LPE) series. When using the LPE series, REITs appear to be a partial hedge against expected inflation. The study by Chen and Tzang (1988) found some hedging ability for Equity and Mortgage REITs against expected inflation. Murphy and Kleiman (1989) investigated the inflation-hedging effectiveness of Equity REITs, they found that Equity REITs are a perverse hedge against both expected and unexpected inflation. Chan, Henderscott and Saunders (1990) note this perverse relationship only against unexpected inflation. Larsen and Mcqueen (1995) investigate the inflation effectiveness of stocks, gold and Equity REITs. Their results confirm that Equity REIT investors have not been compensated, on average, for

losses in purchasing power that arise from either expected or unexpected inflation. Simpson, Ramchander and Webb (2007) investigated the inflation-hedging capabilities of Equity REITs in the period 1981-2002. They reject the notion of a negative relationship between Equity REIT returns and inflation. The study notes an asymmetry in the response of Equity REITs to inflation. Equity REITs show a negative relationship with inflation when inflation itself goes down. When inflation increases the returns of Equity REITs are rising, and also when inflation decreases a rising return is noted.

Yobaccio, Rubens & Ketcham (1995) studied the hedging effectiveness of four types of REITs (equity, mortgage, hybrid and a composite index) over the period 1972:2-1992:12. The period was divided in two sub-periods (1972:2-1981:12 and 1982:1-1992:12), testing the performance of REITs in a high (1972:2-1981:12) and low inflation (1982:1-1992:12) period. This way the bull market of the 1980s is reflected. This led to different performance of the types of REITs, Equity REITs performed better in the low inflation period and Mortgage and Hybrid REITs were more effective in the high inflation period. This was based on REIT performances against actual inflation. Regressing the REIT performances against expected inflation, all four types of REITs revealed positive coefficients and near 1, especially the Mortgage REITs. This indicates that REITs have some hedging capability against expected inflation. On the other hand REITs do not posses any hedging capability against unexpected inflation, seeing that the coefficients are negative in all cases. Chatrath and Liang (1998) studied the relationship between inflation and REITs over the period 1972:1-1995:12. They used the CPI and Treasury bill rate as proxies for inflation, following prior research [see Park, Mullineaux & Chew, 1990; and Yobaccio, Rubens & Ketcham, 1995]. The authors employ regression analysis and tests for cointegration between REIT indices and the proxies. Regression estimators provided no evidence of effective inflation hedges. In the long-run some evidence was found for a relationship between the CPI and REIT indices, when a cointegration test is used. Very weak evidence of cointegration was noted between REIT indices and the T-bill rate.

Liu, Hartzell and Hoesli (1997) investigated the inflation-hedging capabilities of securitized real estate on an international scale. They used monthly returns on property unit trusts and capital market indices were obtained for Australia, France, Japan, South Africa, Switzerland, UK and the US. Past research has shown that common stocks do not hedge inflation effectively, there is a negative correlation between stock returns and inflation. When the inflation-hedging characteristics of the property trusts in the mentioned countries were investigated, no evidence was found that real estate securities in other countries are able to hedge inflation better than common stocks. In some countries property trusts are a more perverse hedge compared to common stocks. The only exception is the French "Societes Immobilieres pour le Commerce et l'Industrie" (SICOMIs), when the short term yield is used as a proxy for the expected inflation. SICOMIs are funds that lease and rent commercial and industrial properties.

Lu and So (2001) studied the perverse inflation-hedging characteristics of REITs, which was concluded in previous studies. They investigated the relationship among REIT returns, real activities, monetary policy and inflation. The authors concluded that REITs are not perverse inflation hedges, they do not deviate from the real estate sector. In addition, REIT returns provide information on future movements of inflation. Information is first discovered in the REITs market and then transmits to inflation (Lu & So, 2001, p. 113). The real estate returns are affected by macroeconomic events. In 2002, Glascock, Lu and So continued on the previous study to investigate the perverse relationship between REIT returns and inflation. They tested the linkages between REIT returns, expected inflation, unexpected inflation and other macroeconomic variables. The authors concluded again that REITs do not behave as perverse inflation hedges. The negative relationship is partially derived from monetary policy and its relationship with inflation. REIT returns anticipate changes in expected and unexpected inflation. Information appears to be first discovered in the REIT market and later in inflation rates (Glascock, Lu & So, 2002, p. 316).

Table 1. Summary of main used literature.

Title	Author	Year	Type of REIT	Inflation Measure	Time Interval	Conclusion
Owner-Occupied Homes, Income-Producing Properties, and REITs as Inflation Hedges: Empirical Findings	Gyourko and Linneman	1988	All REITs, Equity, Mortgage and Hybrid	CPI for actual inflation, the expected inflation is forecasted via an ARMA model and the difference between the two measures reflects the unexpected inflation.	January 1973 through March 1986	REITs are a partial hedge against actual and expected inflation, not against unexpected inflation
Are REITs Inflation Hedges?	Park, Mullineaux and Chew	1990	All REITs, Equity, Mortgage and Hybrid	Actual inflation is measured as the rate of change in the CPI index over the relevant investment horizon. Two different proxy measures are used for expected inflation: the Treasury bill rate and the average inflation rate calculated from the Livingston survey. Unexpected inflation is measured by the difference between actual and expected inflation.	January 1972 through December 1986	REITs like stocks are perverse inflation hedges. When the Livingston data was used, some evidence was found that REITs are at least partial hedges against anticipated inflation. The strongest finding is that REITs are indistinguishable from stocks in term of inflation-hedging capabilities.
REITs, Real Estate, and Inflation: Lessons from the Gold Market	Larsen and Mcqueen	1995	Equity	CPI for actual inflation and the Treasury bill for expected inflation. Unexpected inflation is obtained by the difference between the two measures.	January 1972 through August 1992	The investors of equity REITs have not been compensated for losses in purchase power resulting from expected and unexpected inflation.
The Inflation-Hedging Properties of Risk Assets: The Case of REITs	Yobaccio, Rubens and Ketcham	1995	All REITs, Equity, Mortgage and Hybrid	The CPI is used as a measure of actual inflation. Several different series are used as measures of expected inflation: Livingston forecasts, an AR model and Treasury bill rates. Unexpected inflation is merely the difference between actual and expected on an ex post basis.	February 1972 through December 1992	The different types of REITs were tested in two sub periods, a high inflation period (1972:2-1981:12) and a low inflation period (1982:1-1992:12). This way the bull market of the 80's was reflected. This led to different results for the different type of REITs. Equity REITs performed better in the low inflation period and mortgage and hybrid REITs were more effective in the high inflation period, this was based on actual inflation. When regressing against expected inflation all type of REITs show positive coefficients, which indicate partial hedge effectiveness. On the contrary against unexpected inflation there was no evidence of hedging capabilities for all the type of REITs.
International Evidence On Real Estate Securities as an Inflation Hedge	Liu, Hartzell and Hoesli	1997	Equity	The three proxies used for expected inflation are short term government yields, the Fama and Gibbons (1982) measure of anticipated inflation and a proxy for expected inflation generated by an ARIMA process. The difference between actual and expected inflation is the unexpected inflation component. In the article no disclosure is given on the used measure for actual inflation.	February 1980 through March 1991	No evidence is found that securitized real estate is able to hedge inflation better than common stocks, in some countries real estate is even a more perverse hedge then common stocks.
REITs and Inflation: A Long-Run Perspective	Chatrath and Liang	1998	All REITs, Equity, Mortgage and Hybrid	CPI for actual inflation, for the expected inflation the Treasury Bill rates is used and the difference between the two measures reflects the unexpected inflation.	January 1972 through December 1995	The regression analysis provided no evidence of effective inflation hedges, but in the long run some evidence of inflation was found when the Johansen cointegration test was employed between the CPI and REIT indices. Very weak evidence of cointegration was measured between T-bill rates and REITs.

Title	Author	Year	Type of REIT	Inflation Measure	Time Interval	Conclusion
The Relationship Between REITs Returns and Inflation: A Vector Error Correction Approach	Lu and So	2001	All REITs	The consumer price index (CPI) was used as a proxy for inflation.	January 1972 through December 1995	REITs are not perverse inflation hedges. In addition, REITs returns provide information on future movements of inflation. Information is first discovered by the REIT market and then transmits to inflation. The negative relationship observed is the result of excluding macro-economic variables in the analysis.
REIT Returns and Inflation: Perverse or Reverse Causality Effects?	Glascock, Lu and So	2002	All REITs	CPI for actual inflation and the One Month Treasury Bill Rate for expected inflation. The unexpected inflation rate is defined by the difference between CPI and the T-bill rate.	January 1972 through December 1995	The authors investigated the relationship between REIT returns, expected inflation, unexpected inflation and various macroeconomic variables. They concluded that REITs do not behave as perverse inflation hedges, the negative relationship is partially derived from monetary policy and its relationship with inflation. It seems that information appears to be adapted first into the REIT markets before the inflation rates make an adjustment to it.
The Asymmetric Response of Equity REIT Returns to Inflation	Simpson, Ramchander and Webb	2007	Equity	For actual inflation the consumer price index is used. The expected inflation component is provided by Money Market Services (MMS), which provides forecasts of CPI releases. The unexpected inflation is measured by the difference between the actual CPI at time t minus the MMS forecast of CPI at time t. The second method for decomposing inflation into expected and unexpected components is the ARIMA model. The fitted observations and the error terms from the ARIMA model are proxies for the expected and unexpected components of inflation, respectively.	August 1981 through November 2002	This study documents an asymmetry in the response of Equity REITs returns to inflation. This means that Equity REITs do display a negative relationship with inflation, but this is the case when inflation is going down. Therefore Equity REITs returns are shown to rise when inflation rises and also when it decreases.

3. Inflation and Asset Returns

This chapter explains the importance of inflation-hedging for investors, and thereafter the relationship between inflation and various assets will be discussed based on existing literature. REITs will not be introduced in this section.

3.1. Inflation-Hedging

Inflation comprises expected and unexpected components (Ganesan & Chiang, 1998, p. 55). The recent episode of high inflation rates has focused interest on the question of which assets, if any, provide effective hedges against inflation (Fama & Schwert, 1977, p. 115). Numerous asset classes have been investigated for its possible inflation-hedging characteristics, such as stocks, bonds, commodities and real estate. An asset which is an inflation hedge would have the characteristic of nominal returns that note a positive relationship with inflation. An asset is considered to be a hedge against expected (or unexpected) inflation when its returns move on a one-for-one basis with expected (or unexpected) inflation (Ganesan & Chiang, 1998, p. 55). Assets which do not perform well as inflation hedges, will exhibit return patterns that are negatively correlated with inflation. The purpose of any hedge is to offset or nullify risk (Tarbert, 1996, p. 77). Therefore, the effectiveness of an asset class in providing inflation protection is measured by its ability to reduce or offset the loss in purchasing power resulting from inflation (Wurtzebach, Mueller & Machi, 1991, p. 154).

The ability of homeowner equity to hedge against inflation compared to other forms of individual wealth, notably stocks and bonds, has been a subject of ongoing interest in the finance and economics literature (Anari & Kolari, 2002, p. 67). This is not only of interest for the academic world but also for institutions and individuals. Institutions like pension funds invest in a wide range of asset classes to meet its future liabilities, increasing inflation means adapting ones investment mix in order to give indexation in the future when contributions are not raised. The impact of

inflation on the value of assets is considered one of the primary financial concerns of long-term investors such as pension funds and life insurance companies (Wurtzebach et al., 1991, p. 153). Since the mid-1970s, combating inflation and crucial political issues have been the most important goals of the Federal Reserve's monetary policy (Wurtzebach et al., 1991).

During periods of inflation, certain financial instruments not only do not protect the investor, but actually perform as a perverse hedge, the assets decrease in value as inflation increases (Rubens, Bond & Webb, 1989, p. 45). In order to manage inflation risk, various assets and/or combinations of assets can be purchased in an attempt to protect the long-term investor against the negative effects of inflation. Traditionally, commercial property has been perceived by investors as a hedge against inflation and a worthy diversification asset (Tarbert, 1996, p. 77). The reason for holding a diversified portfolio of assets is to decrease the volatility in returns when market factors change and to provide an investor with a positive real rate-of-return (Bond & Seiler, 1998, p. 327).

The basis for empirical tests on this proposition is founded on the work of Irving Fisher in 1930 (Tarbert, 1996, p. 77). Based on the postulate that the real and monetary sectors in the economy are causally independent, the Fisher hypothesis is that expected nominal interest rates should move one-for-one with expected inflation (Tarbert, 1996, p. 77). Irving Fisher (1930) noted that the nominal interest rate can be expressed as the sum of an expected real return and an expected inflation rate (Fama & Schwert, 1977, p. 115). Fama and Schwert (1977) demonstrated that the Fisher hypothesis could be used to test the inflation-hedging capabilities of various assets. The Fisher equation is:

$$E(\tilde{R}_{jt} \mid \phi_{t-1}) = E(i_{jt} \mid \phi_{t-1}) + E(\tilde{\Delta}_t \mid \phi_{t-1}) .$$

Where:

$E(\tilde{R}_{jt} \mid \phi_{t-1})$: nominal return on asset j from t - 1 to t;

$E(i_{jt} \mid \phi_{t-1})$: expected real return at t - 1;

$E(\tilde{\Delta}_t \mid \phi_{t-1})$: expected value of the inflation rate.

3.2. Common Stocks and Inflation

The inflation-hedging characteristics of common stocks have been investigated by numerous research papers. Results have indicated that stocks are negatively correlated with inflation. Stocks have been shown to be an asset class that does not provide inflation-hedging characteristics (Wurtzebach et al., 1991, p. 154). The evidence presented does not support the Fisher hypothesis but rather suggests that a negative relation between returns and both anticipated rates of inflation and unanticipated changes in the rate of inflation has prevailed over the post-war period (Nelson, 1976, p. 471). This also has been researched for a well diversified portfolio of common stocks over the period 1953 to 1972 by Bodie (1976). The regression results obtained in deriving the estimates seem to indicate that, contrary to a commonly held belief among economists, the real return on equity is negatively related to both anticipated and unanticipated inflation in the short run (Bodie, 1976, p. 469). Economists have long believed that common stocks are an adequate hedge against inflation, in the sense that stocks represent ownership of physical capital whose real value is assumed to be independent of the inflation rate (Bodie, 1976). Until the mid-1970s, many economists thought that real stock returns and inflation should be positively or at least non-negatively related (Khil & Lee, 2000, p. 458). This means that a change in the rate of inflation would lead to an equal change in the nominal rate of return on equity, which means there is a positive correlation.

Previous studies, such as Kaul (1987, 1990) document a weak positive relationship between stock returns and inflation in the US pre-war period. However, several studies since then have discovered that the real stock return-inflation relation in the post-war US and several European countries is significantly negative (Khil & Lee, 2000, p. 458). The negative relationship between stock returns and inflation was significantly noted over the 1960s and 1970s, for leading industrialized countries (Mandelker & Tandon, 1985). Also a consistent negative correlation is noted between stock returns and expected inflation (measured by short-term interest rates) over the

period 1966-1979 (Mandelker & Tandon, 1985). Table 2 presents the results of real common stock returns regressed against expected and unexpected inflation. The relationship between real returns of common stock and expected inflation is negative, except for Canada (insignificant). With unexpected inflation however, the results are not significant and the authors find mixed relationships. This could be due to impositions of price and wage controls during sub periods (Mandelker & Tandon, 1985).

Table 2. Real Stock Returns and Inflation (1966-1979).

$RS_t = a + b_1 TB_1 + b_2 (I_t - TB_t) + e_t$

Country	C	EIT_t	UIT_t	R^2	DW
United States	0.005	-4.03	-2.06	0.18	1.39
	[2.46]	[-3.19]	[-1.15]		
United Kingdom	0.07	-0.297	2.92	0.22	1.62
	[2.18]	[-2.47]	[3.00]		
France	0.06	-3.32	1.38	0.06	1.72
	[1.49]	[-1.72]	[0.69]		
Belgium	0.11	-8.51	-0.91	0.34	1.59
	[4.42]	[-5.04]	[-1.18]		
Canada	0.008	-0.63	-2.21	0.05	1.59
	[0.19]	[-0.25]	[-1.55]		
Japan	0.07	-3.32	-1.62	0.25	1.42
	[3.39]	[-3.23]	[-2.50]		

TB is treasury-bill rate, I_t is inflation rate, *EIT* is expected inflation measured by *TB* and *UIT* is unexpected inflation measured by $(I_t - TB_t)$ (t-ratios in parentheses)

Source: Mandelker, G. and K. Tandon, 1985, "Common Stock Returns, Real Activity, Money, and Inflation: Some International Evidence", *Journal of International Money and Finance* 4, 267-286.

Khil and Lee (2000) investigated the relationship of common stock returns with inflation for the United States and 10 other Asian countries (including Australia), they noted that besides the negative relationship in the US also a negative relationship for the Asian countries exists with the exception of Malaysia. This leads to the assumption that this negative stock return-inflation relation is not only preserved for the industrialized countries (Europe and the US), but also for the emerging markets.

According to Fama and Schwert (1977) there is no explanation for the negative relationship between common stock returns and the expected inflation component,

nonetheless they give two possibilities. Some as yet unidentified phenomenon might cause equilibrium expected real returns to stocks to be negatively related to expected inflation rates, or the market might be inefficient in impounding available information about future inflation into stock prices (Fama & Schwert, 1977, p. 135).

In conclusive, the literature on stock market returns and inflation has found that monthly, quarterly and annual comparisons do not produce the presumed positive relationship (Hartzell, Hekman & Miles, 1987, p. 618). This conclusion appears to be inconsistent with the predictions of the Fisher hypothesis and belief that common stocks can be used as an inflation hedge (Khil & Lee, 2000).

3.3. Bonds and Inflation

Short-term bills contain assessments of expected inflation rates which are updated within the longer holding period (Fama & Schwert, 1977). The strategy of rolling over short-term bills provides a hedge against changes in expected inflation rates during longer holding periods (Fama & Schwert, 1977, p. 134). According to Fama and Schwert (1977), rolling over short-term bills provides a moving hedge against changes in expected inflation rates, which is not the case when a longer-term bill is purchased and held to maturity. The assumption behind rolling over short-term bills is that the return to maturity of a bond is not able to adjust to intra-period changes when it comes to expectations about the inflation rate (Fama & Schwert, 1977). For example, the return to maturity on a three month bill cannot adjust to intra-quarter changes in expectations about inflation, whereas month to month reassessments of the expected inflation rate are built into the quarterly return on a sequence of one month bills (Fama & Schwert, 1977, p. 134).

Rubens, Bond and Webb (1989) concluded that Treasury bills have some hedging effectiveness against actual inflation for the period 1960-1986. Against expected inflation Treasury bills perform well, providing a complete positive hedge for the same period. On the other hand, against unexpected inflation the results were

indeterminant, meaning that the beta coefficient is not statistically (significant) different from zero (Rubens et al., 1989).

Ibbotson and Sinquefield (1976) investigated the historical returns of varies asset classes, including long-term US government bonds, long-term corporate bonds and US Treasury bills. For each asset the article presents total rates of return which reflect interest income as well as capital gains or losses. The article estimates real (inflation-adjusted) return series for different asset classes over the period 1926-1974, see table 3 for the results.

Table 3. Basic and Derived Series. Historical Highlights (1926-1974).

Series	Annual Geometric Mean Rate of Return	Arithmetic Mean of Annual Returns	Standard Deviation of Annual Returns	Numer of Years Returns are Positive	Numer of Years Returns are Negative	Highest Annual Return (and year)	Lowest Annual Return (and year)
Long-Term Government Bonds	3.2%	3.4%	5.4%	37	12	16.8% (1932)	-9,2% (1967)
Long-Term Corporate Bonds	3.6	3.7	5.1	39	10	18.4 (1970)	-8.1 (1969)
U.S. Treasury Bills	2.2	2.3	2.1	48	1	8.0 (1974)	0.0 (1940)
Consumer Price Index	2.2	2.3	4.8	39	10	18.2 (1946)	-10.3 (1932)
Maturity Premia on Long-Term Govt. Bonds	1.0	1.1	5.6	25	24	15.7 (1932)	-12.8 (1967)
Default Premia on Long-Term Corp. Bonds	0.3	0.4	3.2	28	21	10.5 (1933)	-7.2 (1974)
Long-Term Government Bonds-Inflation Adjusted	1.0	1.3	8.0	29	20	30.2 (1932)	-15.5 (1940)
Long-Term Corporate Bonds-Inflation Adjusted	1.4	1.7	7.7	31	18	23.5 (1932)	-13.9 (1946)
U.S. Treasury Bills-Inflation Adjusted	0.1	0.2	4.6	29	20	12.4 (1932)	-15.1 (1946)

Source: Ibbotson, R. G. and R. A. Sinquefield, 1976, "Stocks, Bonds, Bills, and Inflation: Year-by-Year Historical Returns (1926-1974)", *The Journal of Business* 49:1, 11-47.

Long-term US government bonds had an annually compounded return of 3.2 percent per year over the period 1926-1974. For the entire period the inflation-adjusted annual returns were 1 percent for long-term US government bonds. The annual returns are far less volatile than the common stock series, however the real returns are quite volatile relative to their historical means (Ibbotson & Sinquefield, 1976, p. 41). The arithmetic mean of the real returns from long-term government bonds is 1.3

percent. Long-term corporate bonds returned 3.6 percent per year compounded annually over the period 1926-1974, while the inflation-adjusted return was 1.4 percent per year. The arithmetic means of the annual nominal returns and real returns from long-term corporate bonds is 3.7 percent, and 1.7 percent, respectively. Long-term corporate bonds had 39 positive returns out of the 49 years. During the entire period, US Treasury bills returned 2.2 percent compounded annually, a rate which was approximately equal to the rate of inflation (Ibbotson & Sinquefield, 1976, p. 42). The inflation-adjusted bill return for the entire period was 0.1 percent, which is a measure of the "real rate of interest" (Ibbotson & Sinquefield, 1976).

3.4. Commodities and Inflation

Bird (1984) studied the inflation-hedging capabilities of commodities over the period 1959-1980. Commodities in the aggregate were compared with a spectrum of real and financial assets, from paintings to cash (Bird, 1984, p. 866). Also different types of commodities were examined, such as Tin, Copper, Lead, Zinc, Sugar, Cocoa and Coffee. These are the seven most important commodities traded in London (Bird, 1984). For the period 1959-1980 as a whole, commodities were ranked intermediately (Bird, 1984). According to this evidence, little can be said about the suitability relative to other assets of a commodities portfolio without arbitrarily specifying the trade-offs between return, risk and liquidity (Bird, 1984, p. 866). On the contrary, the performance of commodities was much better in the period between 1973 and 1980, than in the earlier years between 1959 and 1972 (Bird, 1984).

A conclusion about the individual commodities was obtained by comparing the measures of return and risk of the seven commodity classes. Of the seven individual commodities six showed a positive mean rate of return, copper constituting the exception. This is also true for the price level elasticity's. Both measures indicate that the six commodities each acted as an effective inflation hedge (Bird, 1984, p. 864). It also showed that tin dominated all other commodities with the exception only of cocoa (Bird, 1984, p. 866). Cocoa dominates only sugar. Tin has the lowest instability indices and is ranked second by return (Bird, 1984, p. 864). Cocoa has the highest

return, but has the second most undesirable aspect of instability (Bird, 1984). The price per tonne of tin in 1980 was five times that of any other commodity, implying that tin has the lowest storage costs in relation to the value of a physical holding. This confirms its status as the most attractive commodity for inflation hedge purposes (Bird, 1984, p. 866). Another explanation for this is the existence since 1956 of successive International Tin Agreements (Bird, 1984, p. 864). The agreements have ensured that the real price of the metal has risen substantially and more stable than other commodity prices (Bird, 1984).

3.5. Commodity Futures and Inflation

Bodie (1983) revealed that commodity futures can offer substantial hedging opportunities to the general investor as well as to the commodity specialist. Even though the existence of commodity futures is based on hedging risks of unanticipated changes in the prices of agricultural and industrial commodities, commodity futures contracts can be used as a supplement to more conventional investments (stocks, bonds and bills) that improve the risk-return trade-off in an inflationary environment.

The inflation-hedging capabilities of commodity futures were tested by Bodie, by creating a well-diversified portfolio of commodity futures contracts over the 1953-1981 period. The number of commodities included in the series varies by time and primarily depends on the availability of the price data. Futures contracts will yield a positive rate of return when there are unanticipated increases in spot prices, and it is this feature that makes them valuable as an inflation hedge (Bodie, 1983, p. 148). The results showed that the buy-and-hold investment strategy in commodity futures tended to do well in the years when the rate of inflation was high. The reason that commodity futures tend to do well during periods of unanticipated inflation, is due to the observation that commodity prices and consumer prices tend to move together (Bodie, 1983). The evidence of the period 1953 through 1981 seems to support this hypothesis (Bodie, 1983, p. 155).

In table 4 is noticeable that the real rates of return on bills, bonds and stocks are all negatively correlated with inflation and positively correlated with one another (Bodie, 1983). Commodity futures, on the other hand, are positively correlated with the rate of inflation and negatively correlated with the real rates of return of the other major asset categories. Therefore, they can serve to reduce the risk associated with any portfolio containing them (Bodie, 1983, p. 148-149).

Table 4. Correlation of returns and inflation (1953-1981).

Correlation Coefficients:	Bonds	Stocks	Commodity Futures	Inflation (CPI)
Bill	.430	0.252	-.312	-.673
Bonds		.187	-.230	-.579
Stocks			-.210	-.467
Commodity Futures				.247

Source: Bodie, Z., 1983, "Commodity Futures as a Hedge against Inflation", *The Handbook of Managed Futures*, 141-155.

3.6. Unsecuritized Real Estate and Inflation

Real estate has become a popular asset class for providing a new source of diversification in investors' portfolios. By the end of 1983, pension funds had placed over 20 billion of their nearly 1 trillion dollar aggregate portfolio in commercial real estate equities (Hartzell et al., 1987, p. 634). One of the main reasons has been the need to provide protection against expected and unexpected inflation. According to several literature pension funds should allocate somewhere between 20-30 percent of their assets to real estate. Instead, most pension plans allocate only a modest amount of their assets to real estate (Chun, Ciochetti & Shilling, 2000). According to Chun et al. pension funds can make a fair improvement on its portfolio return in mean-variance space by including real estate assets to a stock-bond portfolio. Nevertheless the authors make clear that the optimal allocation to real estate is seemingly high.

According to Hartzell et al. (1987) there is strong evidence that diversified portfolios of commercial real estate have been a complete hedge against both expected and unexpected inflation over the period 1973-1983. During this period the inflation rate

was 5% or greater (Hartzell et al., 1987). The portfolios contained different types of property, size and location. Returns by property type also reveal strong inflation protection with industrial properties holding an inconclusive edge. Larger properties performed better than smaller ones in this sample, which may have been due to the diversification which results from the positive relationship of size and number of tenants (Hartzell et al., 1987, p. 634).

Rubens, Bond and Webb (1989) investigated the inflation-hedging capabilities of unsecuritized real estate. The article examines residential real estate, farmland and business real estate as individual assets and in a portfolio context for the period 1960-1986. These three types of real estate were tested against actual, expected and unexpected inflation. The hedging results of the return measures against actual inflation yield differing levels of protection. Only residential real estate is a complete hedge against actual inflation (Rubens et al., 1989, p. 50). The other types of real estate lead to indeterminant hedges. As with the results for performance against actual inflation, the results measured against expected inflation vary across asset type. For farmland and residential real estate the hedging results are not solvable. On the other hand, business real estate provides a complete positive hedge against expected inflation. The results for hedging performance of the various assets against unexpected inflation are in direct contrast with respect to expected inflation. Only farmland and residential real estate provided complete positive hedges (Rubens et al., 1989, p. 51). Business real estate is an indeterminant hedge. Also the benefit of including real estate in a portfolio containing financial and real assets is studied. The benefits of including real estate in portfolios include not only lower risk per unit of return, but greater inflation protection (Rubens et al., 1989, p. 52).

Some authors have researched the inflation-hedging effectiveness of owner-occupied homes (residential real estate) for different regions, like Gyourko and Linneman (1988). Some regions, such as the West and Midwest in the US did not hedge expected inflation quite well. The Midwestern homes appear to perform worst against inflation (Gyourko & Linneman, 1988, p. 361). This could be the result of the

region's large industrial base which was particularly harmed by inflation, leading to a declining owner-occupied sector (Gyourko & Linneman, 1988). Nowadays the region is under severe attack by the worldwide economic crisis, leading to enormous problems for the American car manufacturers and its employees in the Midwest. On the other hand, southern homes are strongly positively correlated with overall and unexpected inflation since 1976. Overall there are no owner-occupied housing returns which are significantly negatively correlated with overall or unexpected inflation (Gyourko & Linneman, 1988).

Results have indicated that financial assets are not good inflation hedges during periods of high unexpected inflation. Therefore it should be obvious to include real estate in a portfolio, which would lead to a decreasing variance of the portfolio returns. Bond and Seiler (1998) have tested this assumption over the 1969-1994 period, by relating residential real estate returns to inflation (expected and unexpected). Both the expected and unexpected inflation coefficients are positive and highly significant, showing the inflation hedge ability of residential real estate. To estimate the returns on residential real estate, the percentage change in existing housing sale prices was used (Bond & Seiler, 1998, p. 336). The results indicate that both expected and unexpected inflation are significant components of residential real estate returns (Bond & Seiler, 1998, p. 336).

Not only in the United States the inflation-hedging performance of real estate has been researched, Tarbert (1996) investigated the inflation-hedging ability of commercial property in the United Kingdom. Tarbert considered different types of commercial property, such as shops, offices and industrial properties. The nominal returns of the three types of properties are separated in rental income and capital gain. When commercial property completely hedges inflation, the correlation coefficient between nominal returns and actual inflation should approach the value of one (Tarbert, 1996). The results of Tarbert indicate that equities and gilts have negative coefficients, which is similar to other research performed on this matter. Property results show positive coefficients. Although the coefficients are positive,

they are not close to one indicating a partial hedge. This counts for rental income of the different types of property, as well as capital gain. The author has used two measures of expected inflation, both methods produce evidence that rental values have fully hedged against expected inflation. This is not the case for capital values. Research has shown that there is no long-run stable relationship between commercial property and inflation, which means that the Fisher hypothesis is, rejected (Tarbert, 1996). These findings could be translated as evidence that property has not been a consistent hedge over the time periods examined. The short-run relationships probably depend critically on market conditions and expectations (Tarbert, 1996, p. 91).

Differences between property types regarding inflation-hedging has also been researched by Wurtzebach, Mueller and Machi in 1991. Office and industrial returns are compared, in a high and low inflation period. The office returns were an effective hedge against actual inflation and expected inflation in the high inflation period, but not a statistically hedge against unexpected inflation. For the low inflation period office returns were an effective hedge against expected inflation and not statistically significant for actual or unexpected inflation. Industrial returns exhibited inflation-hedging characteristics that are similar to office returns, an effective hedge against the total inflation period and an effective hedge against actual inflation and unexpected inflation during the high inflation period. On the contrary for the low inflation period, industrial portfolio returns showed no statistically significant hedging capabilities and even some negative betas. So it seems clear that the real estate market clearly provides an effective inflation hedge, but it does so primarily when the real estate market supply-demand equation is in balance (Wurtzebach et al., 1991). This means that the inflation-hedging effectiveness of real estate could be diminished during periods of market imbalance (Wurtzebach et al., 1991).

4. Real Estate Investment Trusts (REITs)

This section introduces the characteristics of REITs, based on past performance, investment benefits and its legal compliances. Furthermore a critical note on the REIT entity will be given, and a link with the current economic crisis will be made.

4.1. Introduction to REITs

Real estate investment trusts, known as REITs, are entities that invest in different kinds of real estate or real estate related assets, including shopping centers, office buildings, hotels, and mortgages secured by real estate (US Securities and Exchange Commission, n.d.). Like mentioned in the introduction there are three types of REITs. They are classified in the following categories (US Securities and Exchange Commission, n.d.):

- Equity REIT is the most common type of REIT, which owns/operates or invests in income-producing real estate and makes money for investors through the rents they collect. These entities seek capital gain opportunities in the real estate market;
- Mortgage REIT lends money to owners and developers or makes investments in financial instruments secured by mortgages on real estate, or anything else to with mortgages. It makes money by borrowing in the short-term and lending in the long-term. Short-term rates are typically lower than long-term rates, so these entities realize profits on this spread;
- The Hybrid REIT is a company that both own properties and make loans to owners and operators. They combine the activities of Equity and Mortgage REITs. Hybrid REITs only present a small percentage of total REITs, less than 2% in 2006 (Cook, 2007).

Many REITs are traded on national exchanges or in the over-the-counter market. The REITs that are publicly traded must file reports with the SEC, such as quarterly and

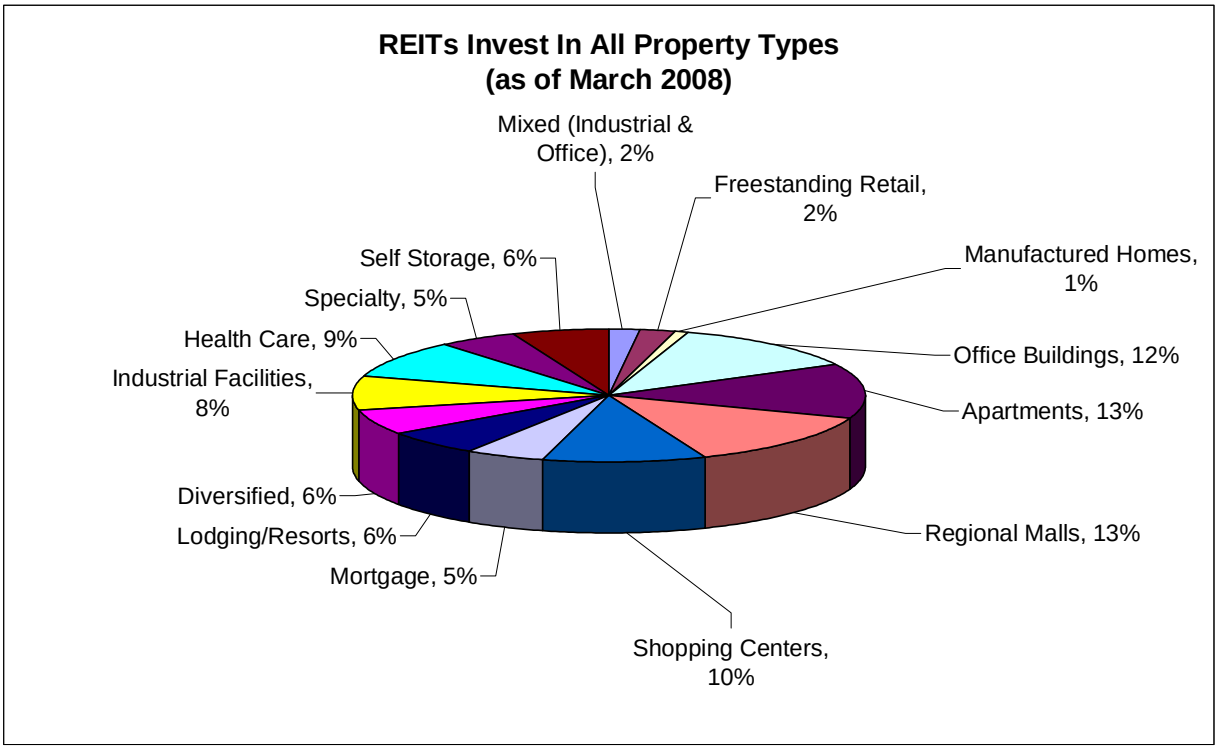
annual filings. In order to qualify as a “REIT”, the Internal Revenue Code lists conditions a company must meet. For example, the company must pay 90% of its taxable income to shareholders every year in the form of dividends. It must also invest at least 75% of its total assets in real estate and generate 75% or more of its gross income from investments in or mortgages on real property. No more than 50% of the shares can be held by 5 or fewer individuals during the last half of each taxable year, it’s called the 5/50 rule. It has to be structured as a corporation, trust or association, and managed by a board of trustees. The shares of the company must be transferable (US Securities and Exchange Commission, n.d.).

In 1960 congress created REITs in the US to broaden the investment market and make investments in real estate accessible to all investors in the same way as other financial securities, such as stocks and bonds. Before the introduction of listed real estate equities, access to the commercial real estate markets was only available for institutions or wealthy individuals who had the financial capability to undertake direct real estate investment. Now REITs have become a significant part of the US economy and investment market for nearly a half century (NAREIT, n.d.). Over the last 10 years US REITs have seen their equity market capitalization soar from $90 billion to more than $300 billion (NAREIT, n.d.). This growth has set stage for the introduction of securitized real estate through the REIT approach on a global scale (NAREIT, n.d.).

In the beginning the industry was dominated by Mortgage REITs, which provide debt financing for commercial or residential properties through their investments in mortgages and mortgage-backed securities (NAREIT, n.d.). Equity REITs at first had limited market interest, because ownership and management of assets were required to remain separate. In 1986 this restriction was abolished with the passage of the Tax Reform Act, this led to a secular wave of Equity REIT IPOs in the mid-1990s (NAREIT, n.d.). Currently, more than 90 percent of the nearly 200 publicly traded US REITs are Equity REITs that own and most often manage commercial real estate and derive most of their revenue and income from rents (NAREIT, n.d.). These REITs

own properties across different property sectors and in nearly every major metropolitan area across the US and in several international locations.

Figure 1. Different Property Sectors REITs Invest In.



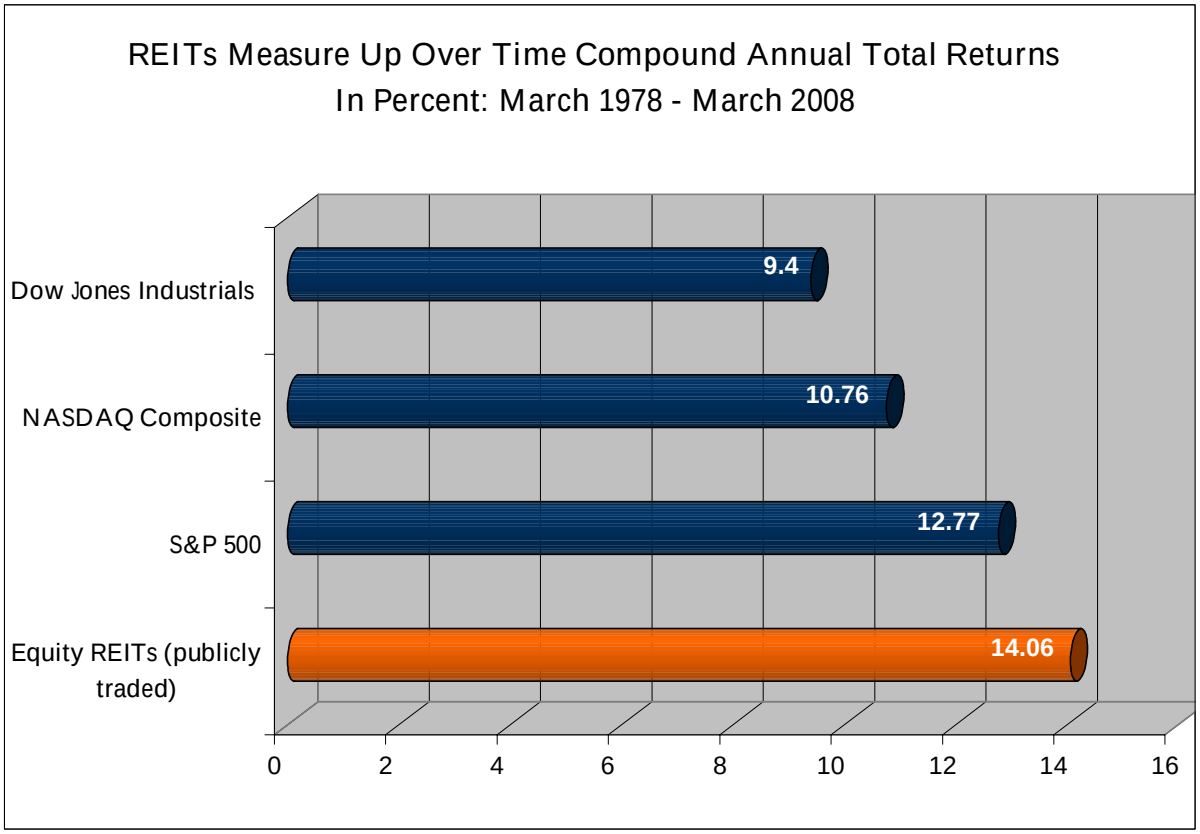
Source: NAREIT

4.2. Benefits of REITs

Most REITs have a small–to-medium equity market capitalization, therefore their returns are comparable to other small and mid-sized companies (NAREIT, n.d.). REITs are total return investments that provide high dividends and a potential for long-term capital appreciation. The benefit of investments in REITs is the fact that REITs are obliged to pay at least 90% of taxable income to shareholders in the form of dividends each year. Dividend growth rates have outpaced inflation over the last decade (NAREIT, n.d.). The dividend yields of the REITs industry generally produce a steady stream of income independent of the market conditions, in comparison to other equities on average (NAREIT, n.d.). Another noticeable benefit is the notion that the correlation of REIT returns to other stocks and bonds has declined significantly over the last 30 years. In conclusion, REITs provide a way to realize the

economic benefits of real estate, obtain stable, consistent income and long-term growth while increasing portfolio diversification beyond what other common stocks and fixed income securities can offer by themselves (NAREIT, n.d.).

Figure 2. Compound Annual Total Returns in Percent.



Source: NAREIT

Ibbotson Associates (well known authority on asset allocation) examined the historical investment performance of REITs.

Ibbotson concluded that (NAREIT, n.d.):

- REITs offer an attractive risk / reward trade-off;
- The correlation has declined over the last 30 years;
- Adding REITs to a portfolio reduces risk or boost returns.

4.3. Criticism on REITs

Investment corporations can generate long-term earnings per share (EPS) growth by investing in assets with growing earnings or by reinvestment of retained earnings

(Graff, 2001). Real estate debt and buildings are not growth assets, therefore REITs can only generate a growing EPS by reinvesting retained earnings in underlying real estate (Graff, 2001). It follows that REITs are required to pay out 90% of taxable income to its shareholders (NAREIT, n.d.).
Therefore REIT shares are not growth stocks, but cyclical income-producing assets which are comparable to the investment characteristics of the underlying real estate portfolios of REITs (Graff, 2001).

The 5/50 rule regarding REIT ownership provides REITs with nearly ironclad protection against hostile takeovers (Graff, 2001, p. 117). REITs deny access to investment information to everyone outside REIT management, therefore outside analysts have difficulties when it comes to asset valuation. The absence of public information about REIT investment portfolios provides REIT management with virtual immunity from lawsuits by disgruntled shareholders (Graff, 2001, p. 117). These facts have played a major key to REIT investment characteristics and historical REIT performance over the past four decades (Graff, 2001). Accordingly, it is reasonable to expect that REITs in general and larger-capitalization REITs in particular, will continue to be a great deal for management, but a risky proposition for outside investors (Graff, 2001, p. 117). For the larger-capitalization REITs, management concern for capital market approval is lessened (Graff, 2001). Once assets under management have grown to the point where REITs need not return to the equity markets for more investment capital, it follows that managers can operate the REITs according to the dictates of self interest, subject to compliance with REIT regulatory constraints and token deference to shareholder interests (Graff, 2001, p. 117).

4.4. REIT Type Characteristics

There are 3 types of REIT characteristics which are submitted to different rules and regulations.

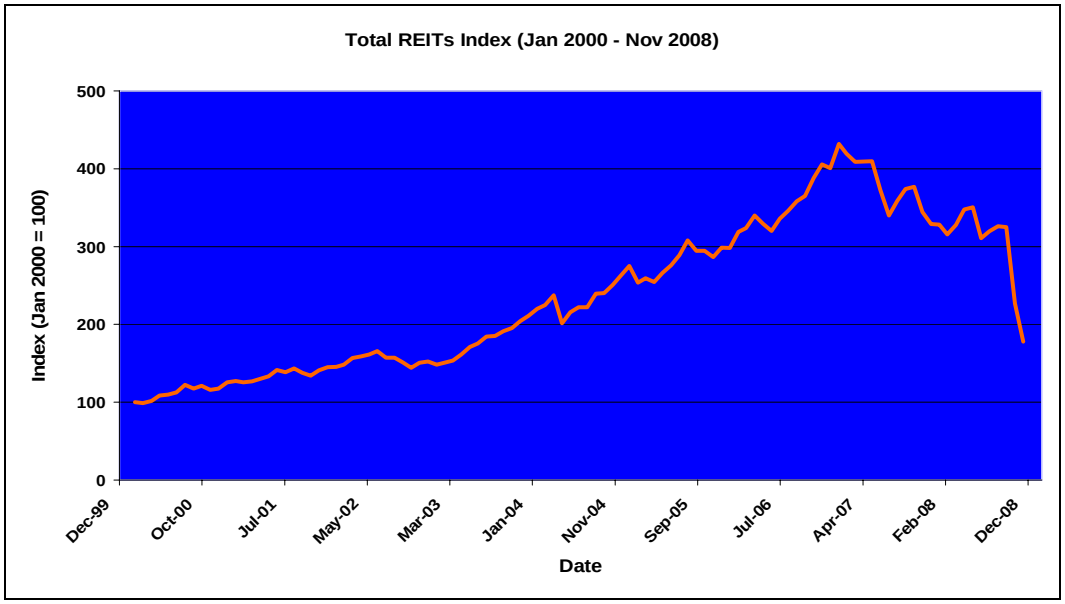
Table 5. Overview of REITs obliged to different rules.

	PUBLICLY TRADED REITS	NON-EXCHANGE TRADED REITS	PRIVATE REITS
Overview	REITs that file with the SEC and whose shares trade on national stock exchanges.	REITs that file with the SEC but whose shares do not trade on national stock exchanges.	REITs that are not registered with the SEC and whose shares do not traded on national stock exchanges.
Liquidity	Shares are listed and traded daily on stock exchanges with minimum liquidity standards.	Shares are not traded on public stock exchanges. Redemption programs for shares vary by company and are limited. Generally a minimum holding period for investment exists. Investor exit strategy generally linked to a required liquidation after some period of time (often 10 years) or, the listing of the stock on a national stock exchange at such time.	Shares are not traded on public stock exchanges.Redemption programs and the existence of it varies by company and are generally limited in nature.
Transaction costs	Broker commissions typically range between $20 and $150 per trade, depending on brokerage service. Investment banks receive a 2-7 percent fee to underwrite initial or follow-on offerings. Offering expenses vary based on deal size.	For each share purchased from the REIT, 10-15 percent of gross offering proceeds typically go to pay brokerdeal commissions, offering expenses and up-front acquisition or advisory fees (fees typically split between a related intermediary and third-party broker-dealer).	Varies by company.
Management	Self advised and self managed.	Externally advised and managed.	Externally advised and managed
Minimum Investment Amount	1 share.	Typically $1,000 - $2,500.	Typically $1,000 - $2,500. Private REITs that are designed for institutional investors require a much higher minimum.
Independent Directors	New stock exchange rules require a majority of directors to be independent of management. New NYSE and NASDAQ rules call for fully independent audit, nominating and compensation committees.	Subject to North American Securities Administrators Association (NASAA) regulations. NASAA rules require that boards consist of a majority of independent directors. NASSAA rules also require that a majority of each board committee consist of indepedent directors.	Not required.
Investor Control	Investors re-elect directors.	Investors re-elect directors.	Investors re-elect directors.
Corporate Governance	Specific stock exchange rules on corporate governance.	Subject to state and NASAA regulations.	Not required.
Disclosure Obligation	Required to make regular financial disclosures to the investment community, including quarterly and yearly audited financial results with accompanying filings to the SEC.	Required to make regular SEC disclosures, including quarterly and yearly financial reports.	Not required.
Performance Management	Numerous independent performance benchmarks available for tracking public REIT industry. Wide range of analyst reports available to the public.	No independent source of performance data available.	No public or independent source of performance data availavble.

Source: NAREIT

4.5. REITs Performance (Jan 2000 – Nov 2008)

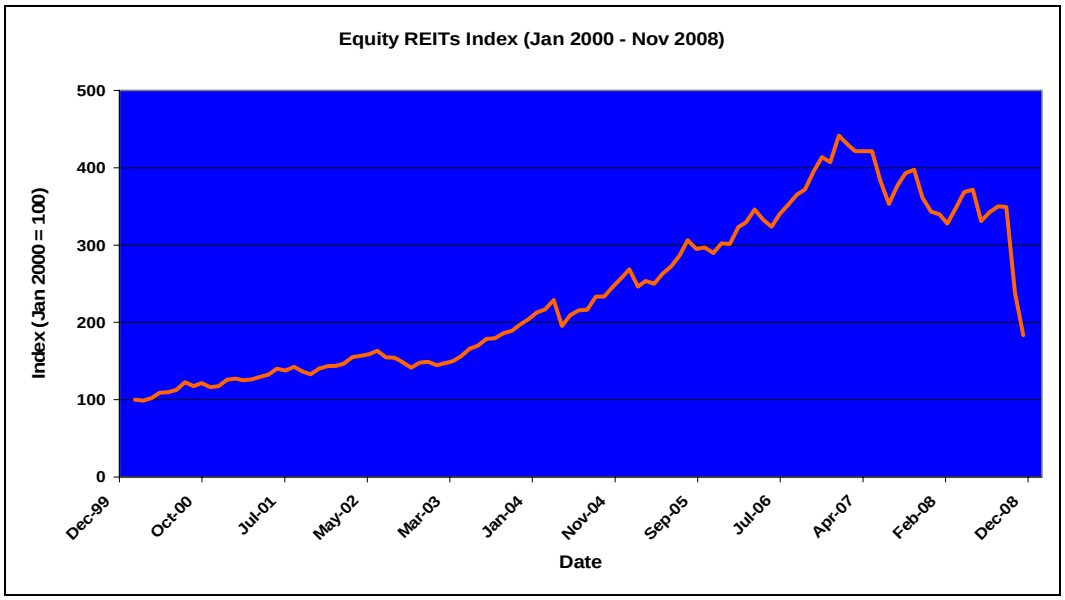
Figure 3A to D. Index of Total, Equity, Mortgage and Hybrid REITs.



A.

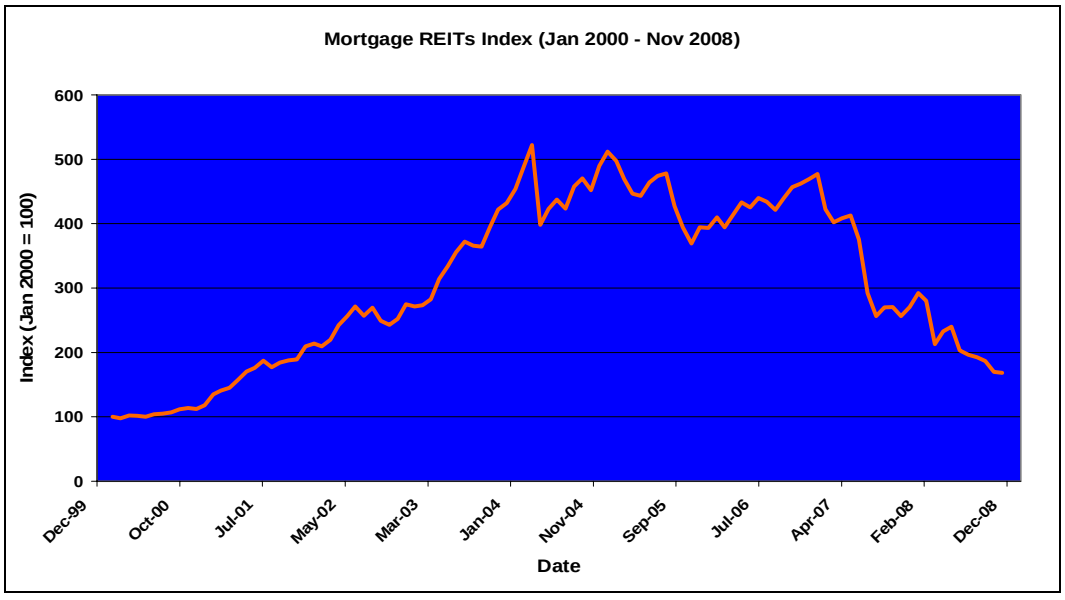
Figure 3A reveals clearly that the subprime mortgage crisis made its impact on the REIT market. REITs show a consistent growth till Feb-Mar 2007. From that point a negative growth has been realised, with a steep decline at the end of 2008. At the end of 2008 the subprime mortgage crisis struck the international financial markets, before the presidential election, leading to massive losses due to sharply declining stock prices worldwide. Figure 3A confirms the same impact on listed stocks with real estate as an underlying value.

The attack on the World Trade Center on 9/11 was followed by an increasing volatility of daily returns of the US stock market. Gheno and Lee (2006) investigated whether this increase in volatility was persistent or transitory. There research concluded that the impact of 9/11 on US REIT returns was financial and short lived. Figure 3A seems to confirm this as no long steep shocks are noted for the aftermath period. In the appendix a table regarding the outcome of Gheno and Lee's (2006) research is given with a short introduction to the article, see table 31.



B.

Figure 3B is almost the exact same graph as 3A, leading to the same conclusions. Investors in Equity REITs take ownership in its real estate investments, which realized heavy losses when real estate prices started to decline. As a result the real estate portfolios of Equity REITs decreased in value.

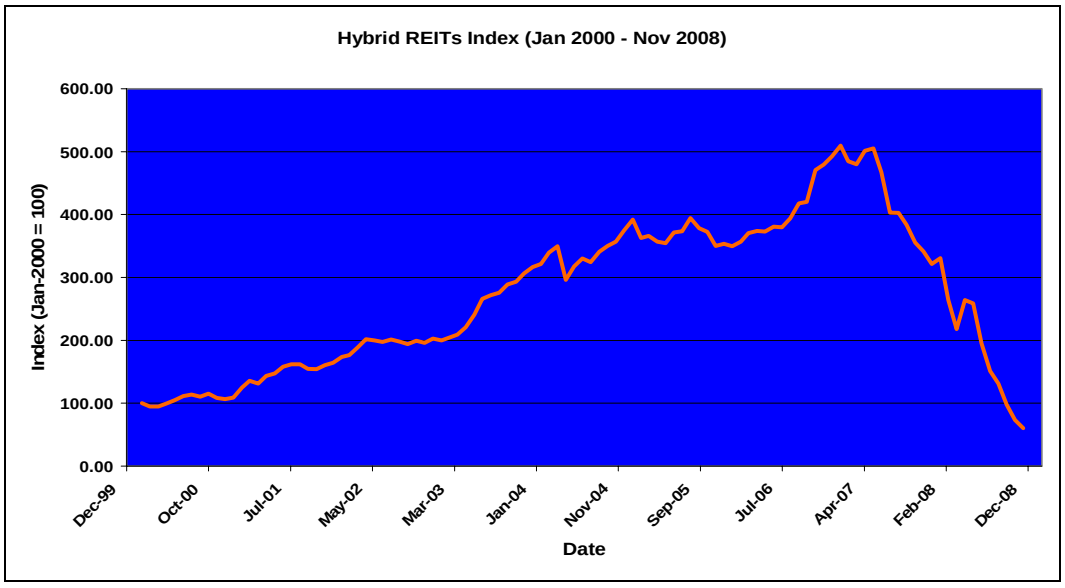


C.

Figure 3C shows that Mortgage REITs were confronted with a severe decline in the beginning of 2007, earlier than Equity REITs. This was due to the decline of US housing prices in 2006-2007 (RealtyTrac, n.d.), before the tumbling of the financial market late 2008. Before this, Mortgage REITs were riding high after 9/11 (Cook, 2007). This was caused by the high interest spread, short-term rates were low and

long-term rates were high (Cook, 2007). Lending is one of the primary activities of Mortgage REITs.

As a result of the bursting housing bubble, many were not able to make their mortgage payments. Even though the subprime mortgage crisis at first had its largest impact on the residential real estate market, it also affected commercial real estate markets. As described before a Mortgage REIT purchases residential and other mortgage debt obligations, therefore the performance of Mortgage REITs were directly impacted. For example, an increasing number of foreclosed homes became rental units, causing an oversupply of rental units which led to decreasing rental rates. This for example, impacts the performance of Mortgage REITs who specialize in retail, office and apartment properties.



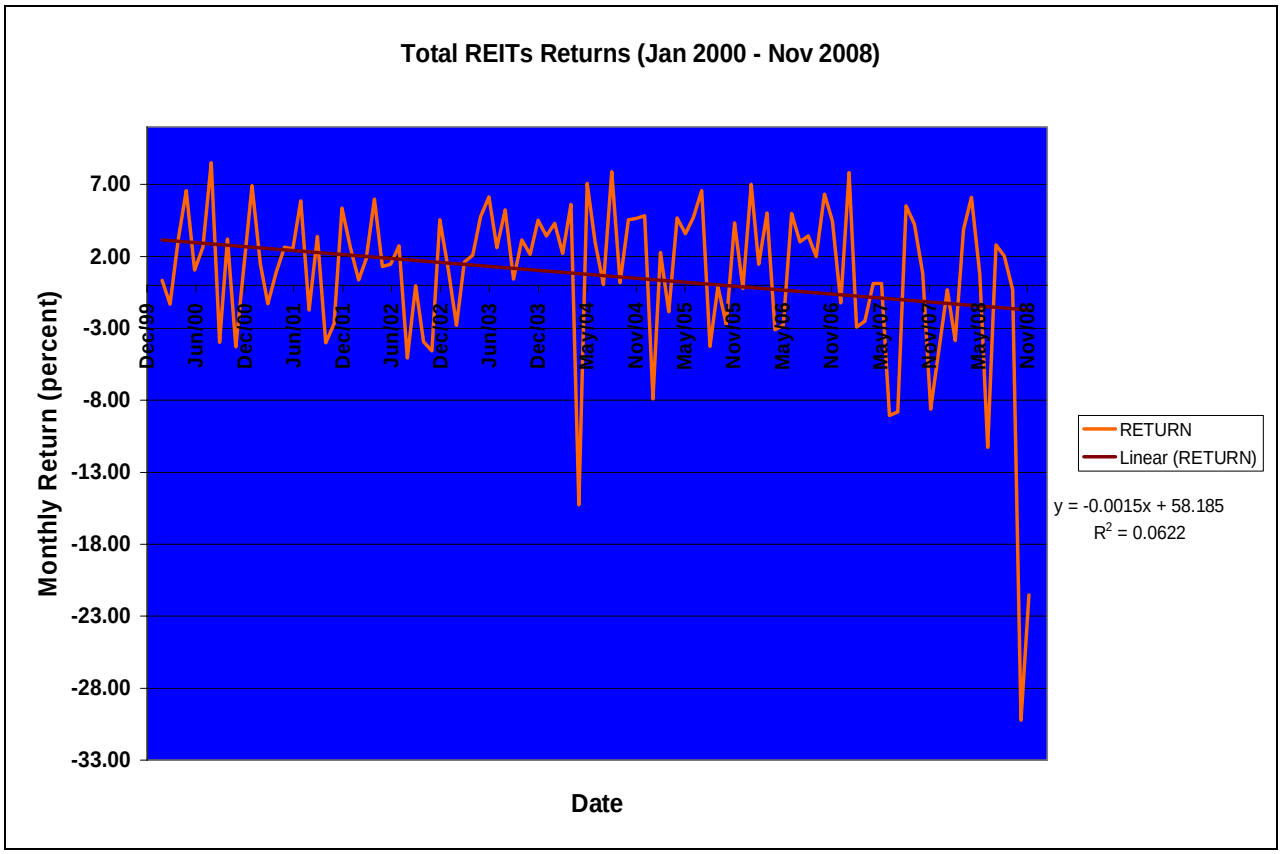
D.

Hybrid REITs combine the activities of Equity REITs and Mortgage REITs. Figure 3D illustrates the effect of the housing crisis on Hybrid REITs. From June 2007 there has been a constant drop. The main explanation for this is similar to that of Equity REITs and Mortgage REITs, heavy price losses on the stock markets, problems regarding mortgage-backed assets and massive growth of foreclosures. In September 2008 the index dropped below the starting point of the 21st century. The growth realized in the past 8 years has been vaporized. As mentioned before Hybrid REITs are diminishing

in terms of capitalization. In 1972 total capitalization of Hybrid REITs was 40% of the entire REIT industry, in 2006 it was less than 2% (Cook, 2007). This is partly caused by the inferior returns in comparison to Equity and Mortgage REITs (Cook, 2007).

Figure 4 shows the monthly returns of total REITs, it is a composite of the three REIT types combined. The trend line has a negative slope, hitting the negative numbers somewhere in mid 2005. At the end of 2008 a huge negative return was realized. October 2008 showed a negative return of 30.23%, such a negative return had not been realized since administration of listed REIT returns had begun in January 1972. A month later another huge negative return of 21.51% had been realized. This figure clearly illustrates that REITs are not immune to the effects of the current economic crisis.

Figure 4. Monthly Returns of Total REITs.



5. Data and Methodology

5.1. Data

For the application of empirical tests, data is required for the nominal return on REIT shares and for actual inflation and expected inflation. The National Association for Real Estate Investment Trusts (NAREIT) publishes a total return index for REITs. The data set consists of monthly REIT indices for All REITs, Equity REITs, Mortgage REITs and Hybrid REITs. This study analyzes the relationship between monthly REIT returns and changes in actual, expected and unexpected inflation over three time periods-January 1990 through November 2008, January 1990 through August 2001 and August 2001 through November 2008. The time period January 1990 through November 2008 is split in two periods, in order to investigate a post 9/11 period including the beginning and worsening situation of the current global financial crisis which started on the US housing market.

For the actual inflation measure, the US Consumer Price Index is used. It is regarded as the broadest and most frequently used proxy for actual inflation (Wurtzebach, Mueller & Machi, 1991). The inflation rate is just the sum of its expected and unexpected components (Fama & Schwert, 1977). Since expected inflation is not directly observable, the Treasury bill rate is used as a proxy (assuming that bills are perfectly liquid). This measure of expected inflation has often been used for empirical tests concerning REITs inflation-hedging characteristics [see Park, Mullineaux & Chew, 1990; Larsen & Mcqueen, 1995; Yobaccio, Rubens & Ketcham, 1995; Liu, Hartzell & Hoesli, 1997; Chatrath & Liang, 1998; and Glascock, Lu & So, 2002].

Fama (1975) concluded, if the expected real return on the bill is constant through time and the bill market is efficient, then the nominal return on the bill is equal to the constant expected real return and the expected inflation rate (Fama & Schwert, 1977),

$$B_t = E(i) + E(\tilde{\Delta}_t \mid \phi_{t-1}). \qquad (1)$$

Where:

B_t = nominal return or interest rate on a Treasury bill at time t;

$E(i)$ = constant expected real return;

$E(\tilde{\Delta}_t \mid \phi_{t-1})$ = expected inflation rate.

So, the expected inflation rate is,

$$E(\tilde{\Delta}_t \mid \phi_{t-1}) = -E(i) + B_t. \qquad (2)$$

Tests of (2) can be obtained from estimates of,

$$\tilde{\Delta}_t = \alpha + \beta \ B_t + \tilde{\varepsilon}_t. \qquad (3)$$

For equation (3) the proposition is that β=1 and $E(\tilde{\varepsilon}_t \mid \phi_{t-1})$=0, which means that all variation in the nominal return B_t set at $t-1$ reflects variation in $E(\tilde{\Delta}_t \mid \phi_{t-1})$, the best possible assessment at $t-1$ of the expected value of the inflation rate to be observed at t (Fama & Schwert, 1997, p. 124). Empirical studies in the past have assumed that the expected real return is constant or independent of the expected inflation rate (Park, Mullineaux & Chew, 1990). The regression results of Fama and Schwert (1977) showed that estimates of equation (3) are consistent with the notion that changes in the nominal return B_t, correspond to the changes in the expected inflation rate $E(\tilde{\Delta}_t \mid \phi_{t-1})$. Therefore I use the nominal return or interest rate on a Treasury bill as a proxy for the expected inflation rate for period t (Fama & Schwert, 1977).

There has been some criticism surrounding Fama's results, and his study is somewhat dated (Park et al., 1990). Some studies [see Hess & Bicksler, 1975; and Fama & Gibbons, 1982] have found variation in expected real returns on Treasury bills. This could lead to the conclusion that bill rates may not perform well as proxies for expected inflation. Therefore it seems useful to include an alternative measure for anticipated inflation. The so-called Livingston survey data offer such an alternative

and have been employed in many empirical studies (Park et al., 1990, p. 95). The survey is based on semi-annual forecasts of CPI levels by business and academic economists, which is published by the Federal Reserve Bank of Philadelphia. From these predicted CPI levels an expected inflation rate can be constructed. Since these predicted CPI levels are over a 6 month time span, I will match the horizon of REIT returns to the horizon of the Livingston forecasts. The actual inflation rate is measured as the rate of change in the CPI index over the relevant time horizon, this way I can calculate the unexpected inflation rate based on the Livingston survey. So now I have not only constructed an alternative expected inflation rate, but also an alternative unexpected inflation measure. The time span studied is from December 1992 through December 2008, due to data requirements. Although the period examined is not identical, only 1990 and 1991 are missing, a comparison of the outcome can be made with the Treasury-bill-based results. The period is split in two periods for the same reasons as mentioned before, a period before 9/11 and a period after 9/11 through 2008.

The unexpected inflation rate is computed as the difference between current actual inflation (rate of change in CPI) and last period's expected inflation (Wurtzebach et al., 1991),

$$UI_t = CPI_t - EI_{t-1}. \qquad (4)$$

In our case EI_{t-1} is comprised of the monthly Treasury bill rate at first, and the alternative 6 month expected inflation rate from the Livingston survey.

Table 6. Data description.

Contents	Sources	Sample Period
Consumer Price Index	Datastream-IMF	January 1990-November 2008
All REITs Total Return Index	NAREIT	January 1990-November 2008
Equity REITs Total Return Index	NAREIT	January 1990-November 2008
Mortgage REITs Total Return Index	NAREIT	January 1990-November 2008
Hybrid REITs Total Return Index	NAREIT	January 1990-November 2008
Three Month Treasury Bill Rate	Datastream-IMF	January 1990-November 2008
Livingston Survey	Philadelphia Fed.	December 1992-December2008

5.2. Methodology

In order to test the inflation-hedging characteristics of REITs on the long term, I will employ cointegration tests between the REIT indices and the inflation measures. To measure cointegration between two data series, a multi-stage process is needed. Before I can conduct a cointegration test, the variables have to be tested for unit roots. These tests will show if the time series are nonstationary. The series have to be nonstationary and integrated of the same order, to proceed with cointegration tests.

A stationary time series is a stochastic process with mean (μ) and variance (σ^2) constant over time, and the j-th autocovariance (σ_j) depends only on the time interval (Lu & So, 2001, p. 106). If two time series are nonstationary at the level series and stationary in the return series (first difference), then the stochastic process has a unit root and is integrated of order one, denoted as *I*(1). The opposite is *I*(0), in this case the two time series are stationary in the levels. If there is a long-run relationship among nonstationary variables, deviations from this long-run path will be stationary (Lu & So, 2001, p. 106). In financial-economic terms cointegration means that there is an existence of a long-run equilibrium relationship between two variables. In determining the order of integration of the chosen time series, a unit root test will be performed. I chose the Phillips-Perron (PP) test, which is robust to the existence of heteroskedasticity and serial correlation (Glascock, Lu & So, 2002). The subsequent equation shows the PP test, the following regression is run (Lu & So, 2001),

$$\Delta P_t = \alpha + \beta P_{t-1} + \sum_{i=2}^{m} \gamma i \Delta P_{t-i} + \phi t + e_t \qquad (5)$$

where P_t is the natural logarithm of the time series, $\alpha, \beta, \gamma i$ and ϕ are parameters to be estimated and m is the number of lags, which is determined in this study by the Akaike Information Criteria (AIC). In this equation the parameters are estimated by ordinary least squares and the t-statistic is corrected for autocorrelation in e_t, by the Newey-West (1987) method.

The PP test statistic is defined as,

$$PP = T(\hat{\beta}-1) - 1/2(T^2 \hat{\sigma}_{\hat{\beta}}/s^2) * (\hat{\psi} - \hat{\omega}_0) \qquad (6)$$

in which T is the number of observations, s^2 is the mean square error of the regressions in equation (5) and $\hat{\omega}_0$ is the estimated variance of the residuals (Lu & So, 2001). When the PP statistic is not statistically significant, there exists a unit root at the level series and the time series is not stationary. After this the first difference is taken and the Phillips-Perron test is used again to test for the stationarity of the first difference. If the PP statistic is significant, then the return series are stationary and there is an *I*(1) process.

When the time series are integrated of the same order, a cointegration test can and will be employed in this study to determine the long-run relationship between REITs and inflation. I will test cointegration between two time series by using the Engle-Granger Residual-Based method. The Engle-Granger method states, that a long-run relationship is established between the dependent variable Y_i and the independent variable X_i when the residuals are stationary. These residuals are obtained by the following regression,

$$Y_i = \alpha + \sum_{i=1}^{n} b_1 X_i + e_t \,. \qquad (7)$$

A unit root test is performed on the obtained residuals in order to establish cointegration between the variables Y_i and X_i, in this case an augmented Dickey-Fuller test (ADF) is used. An ADF test involves the following regression,

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \sum b_j \Delta y_{t-j} + e_t \qquad (8)$$

where Δ is the difference operator and e_t is a white-noise innovation. The test examines the negativity of the parameter γ based on its regression t ratio (Cheung & Lai, 1995, p. 277). The residuals are stationary when the t-statistic of the ADF test is significant at the level series, which means that there exists a long-term relationship between the two time series. Critical values for cointegration tests are provided by MacKinnon (1991), according to the following equation,

$$C(p) = \phi_\infty + \phi_1 T^{-1} + \phi_2 T^{-2}. \qquad (9)$$

Something worth noting about the Engle-Granger test is the fact that one variable is placed on the left side of the equation, automatically becoming the dependent variable Y. The other variable becomes the independent variable X. If we switch the variables the results are off course different, therefore it can be that cointegration exists between two time series, but when variable Y and variable X are switched there seems no relationship at all (Gilmore & McManus, 2002).

As mentioned before cointegration tests can only be employed when two time series are integrated of order one *I*(1). When this is not the case, I am forced to choose another test for measuring the inflation-hedging characteristics of REITs. In this study I will employ regressions when series are not *I*(1) or when the number of observations are to small. To test the effect of actual, expected and unexpected inflation on the REIT returns, regression equations were estimated. For the three inflation types and for each of the REIT types, the following equations were used [see Rubens, Bond & Webb, 1989; Wurtzebach et al., 1991],

For actual inflation:

$$R_{i,t} = \alpha_0 + b_1 CPI_t + e_t. \qquad (10)$$

For expected inflation:

$$R_{i,t} = \alpha_0 + b_1 EI_{t-1} + e_t. \qquad (11)$$

For unexpected inflation:

$$R_{i,t} = \alpha_0 + b_1[CPI_t - EI_{t-1}] + e_t . \qquad (12)$$

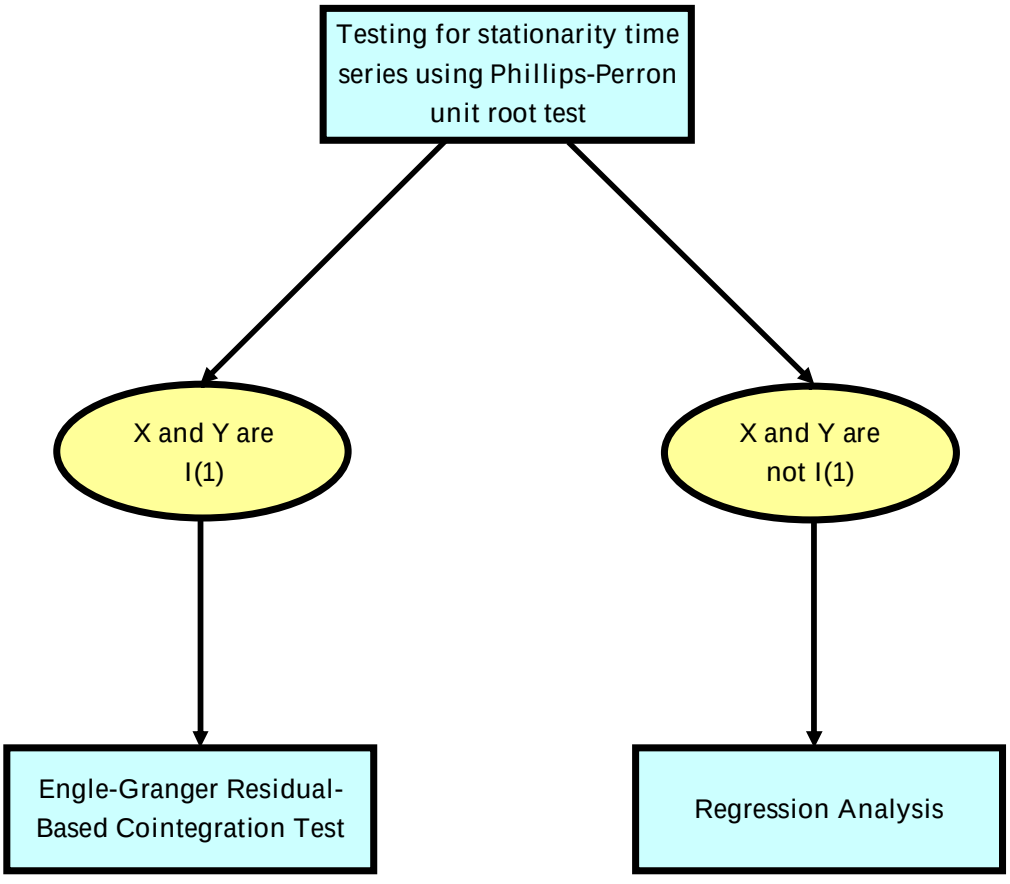
Where:

$R_{i,t}$ = the nominal return from time $t-1$ to t;

CPI_t = actual inflation rate as measured by the Consumer Price Index at time t;

EI_{t-1} = expected inflation rate as measured by the US Treasury bill, and as estimated by the Livingston Survey from $t-1$ to t.

Figure 5. Testing approach.



The tests employing the semi-annualized data (Livingston survey) will only include a regression analysis due to the low number of observations. The total sample of the Livingston survey consists of 33 observations.

6. Results

The results in this chapter are discussed by expected inflation measure and time period. First the results of the Treasury bill as an expected inflation measure will be discussed, and then the findings of the Livingston Survey as a proxy will be explained and compared.

6.1. Treasury-bill-based results

(January 1990 – November 2008)

As mentioned before I use the Treasury bill rate as an expected inflation proxy. Before discussing the results a summary of the data is given in the following table. Table 7 presents the descriptive statistics.

Table 7. Descriptive Statistics of Monthly Data (Jan 1990 - Nov 2008).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	0.716	1.313	9.964	-30.226	4.653	-2.023	12.996
Equity REITs	0.781	1.170	10.940	-31.668	4.818	-2.019	13.593
Mortgage REITs	0.487	1.138	14.166	-24.107	6.225	-1.140	5.588
Hybrid REITs	0.037	1.013	21.264	-25.569	6.308	-1.285	7.179
Actual Inflation	0.231	0.220	1.139	-1.908	0.339	-1.165	10.184
Expected Inflation	0.327	0.366	0.633	0.025	0.140	-0.214	2.380
Unexpected Inflation	-0.099	-0.132	0.892	-1.978	0.346	-0.463	6.769

All REITs, Equity REITs, Mortgage REITs, Hybrid REITs and Actual Inflation are respectively, the rates of change of the REITs total return index and Consumer Price Index. Number of observations is 227.

The data analysis reveals that Equity REITs realized the highest mean in comparison to the other type of REITs. Noteworthy is the much lower realized mean of the Hybrid REITs in comparison to Equity and Mortgage REITs. Be aware that All REITs is not a different type of REIT on its own, but an overall performance indication of the three types. That being said, Hybrid REITs did realize the highest monthly return and Equity REITs the lowest. The REITs discussed in this study are exchange listed companies, it seems clear that Hybrid REITs and Mortgage REITs were traded with the most volatility. Whether this is due to the housing bubble in the United States is hard to tell, the period shown here is not specific enough. All the REIT types reveal negative skewness, showing negative return outliers. The losses were higher for the

REITs than expected based on the normal distribution. The REIT types and inflation rates posses a high positive kurtosis (leptokurtic). This means the data series are not normally distributed, they have high peaks around the mean and fatter tails than a normally distributed variable. From this I can conclude that the used time series have higher variances due to the infrequent extreme deviations of the returns and inflation rates.

Table 8. Correlations: REIT Returns and Inflation (Jan 1990 - Nov 2008).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	0.131	0.023	0.123
Equity REITs	0.146	0.028	0.135
Mortgage REITs	-0.078	-0.044	-0.062
Hybrid REITs	0.087	0.035	0.075

Table 8 depicts the correlations among the variables. Note that Mortgage REITs are negatively related with all types of inflation, which means that Mortgage REITs are a perverse inflation hedge. The other two types of REITs reveal low positive coefficients, indicating weak inflation-hedging effectiveness. It should be noted that the correlation coefficients are low, for all the REITs. So there is no indication of a strong negative / positive relationship between REIT returns and inflation. The results seem to indicate that there is no linear relation between the variables.

Table 9. Phillips-Perron Unit Root Test Statistics.

Data Series	Level Series			Return Series		
	None	Constant	Constant+Trend	None	Constant	Constant+Trend
All REITs Return Index	1.42	-1.41	-0.83	-10.85**	-10.86**	-10.95**
Equity REITs Return Index	1.59	-1.48	-0.86	-10.74**	-10.91**	-10.99**
Mortgage REITs Return Index	0.38	-1.39	-0.82	-13.74**	-13.73**	-13.79**
Hybrid REITs Return Index	-0.32	-1.33	0.57	-10.44**	-10.44**	-10.69**
Consumer Price Index	8.50	-1.33	-3.78*	-6.30**	-6.78**	-6.85**
Expected Inflation Rate	-1.77	-1.73	-2.06	-8.74**	-8.88**	-8.86**
Unexpected Inflation Rate	-7.50**	-7.71**	-7.69**	-23.80**	-23.72**	-23.78**

The PP test is carried out at level and return series. Three PP models are tested: without constant, with constant and with constant and deterministic trend. ** indicates 1% significance level and * 5% significance level.

As mentioned before time series need to be integrated of the same order for the successful deployment of cointegration tests. Table 9 reports the PP t-statistics that test for the null of nonstationarity with the alternate that the series have no unit root, in other words $I(0)$. The PP test reveals that the null for any of the series cannot be

rejected at the 1% level, except for the unexpected inflation series. On the other hand, the statistics reveal stationarity in their first differences for all the series. The null that all differenced series are nonstationary is rejected at the 0.01 level. This concludes that all series, except unexpected inflation are described as *I*(1), and therefore are appropriate for the deployment in standard cointegration tests (Chatrath & Liang, 1998). Due to the fact that the unexpected inflation series is not integrated of order 1, I will test the inflation-hedging characteristics of REITs against unexpected inflation through the employment of regression analysis. More specifically, the monthly returns of REITs will be regressed against the monthly unexpected inflation rate. The hedging effectiveness of REITs against actual inflation and expected inflation on the long term will be measured by the Engle-Granger cointegration method.

Table 10. Engle-Granger Residual-Based Test (Jan 1990 - Nov 2008).

	Actual Inflation	Expected Inflation
All REITs	-1.6873	-2.7802
Equity REITs	-1.8015	-2.8350
Mortgage REITs	-2.6578	-2.2346
Hybrid REITs	-1.8899	-2.9337

A.

The test is performed by using the Augmented Dickey-Fuller test, without a constant. It is assumed that regression residuals do not posses a trend. The lag lengths were chosen by the Akaike Information Criteria. The critical values were calculated according to the formula of MacKinnon (1991). The "Critical Values for Cointegration Tests" are: 1% =-3.9471; 5% = -3.3642 and 10% = -3.0642. ** indicates that the null hypothesis of no cointegration is rejected at the 0.01 level, and * indicates the rejection of the null hypothesis at the 0.05 level. The time series displayed vertically are the dependent variables and the time series displayed horizontally are the independent variables.

Table 10A reports the t-statistics of the Engle-Granger test. It seems clear that the results conclude that no cointegration exists between inflation rates and REITs. The null hypothesis of no cointegration can not be rejected in all the cases for the time span of 1990 through 2008. These results seem not surprising based on the correlations displayed in table 8, which indicate very weak positive coefficients. As mentioned before the Engle-Granger method places one variable on the left-side of the equation automatically becoming the dependent variable (Gilmore & McManus, 2002). At first I examined the results where REIT indices are noted as the Y variable, and the inflation measures as X. In table 10B the variables are switched. As in table

10A the time series displayed vertically are the dependent variables and the variables displayed horizontally are the independent series.

	All REITs	Equity REITs	Mortgage REITs	Hybrid REITs
Actual Inflation	-1.1626	-1.3128	-0.2180	0.0889
Expected Inflation	-3.5064*	-3.5129*	-3.3157	-2.6685

B.

When the variables are switched cointegration is measured at the 5% significance level between All REITs and expected inflation, as well as expected inflation and Equity REITs. For the other REIT types and all the REIT types against actual inflation the null hypothesis could not be rejected at the 0.05 level. Although some evidence is found for Mortgage REITs as a hedge against expected inflation, the t-statistic of -3.3157 rejects the null at the 0.10 level. For the period 1990–2008 we can conclude that REIT returns do not protect the investor against actual inflation, only some hedging-effectiveness is found against expected inflation. This however does not imply that investments in REITs aren't useful to the portfolio manager for diversification purposes (Chatrath & Liang, 1998). Although research by Glascock, Lu and So (2000) suggest that the diversification benefits by including REITs in multi-asset portfolios has diminished since 1992.

The Phillips-Perron test reveals that the unexpected inflation series is not integrated of order 1, therefore I couldn't perform a cointegration test to examine the inflation-hedging capabilities of REITs against the unexpected component of inflation. As indicated before I will then employ a regression analysis. Table 11 presents the results of this test.

Table 11. Hedging Effectiveness against Unexpected Inflation (Jan 1990 – Nov 2008).

Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	1.6535	1.8579*	0.8900	0.02
Equity REITs	1.8858	2.0497*	0.9200	0.02
Mortgage REITs	-1.1093	-0.9264	1.1975	0.00
Hybrid REITs	1.3752	1.1345	1.2122	0.01

Regression of monthly REIT returns against the monthly unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

As the results indicate, the null hypothesis of no significant relationship between REIT returns and unexpected inflation is rejected at the 0.05 level for All REITs and Equity REITs. This regression indicates that Hybrid REITs and Mortgage REITs at least do not protect the investor against the unexpected movement of inflation. If the total results are examined, including the cointegration tests, we can conclude that between 1990 and 2008 the investor good not be protected against any type of inflation by investments in Hybrid and Mortgage REITs. Only investing in Equity REITs seemed useful, as indicated by the regression and cointegration test. Equity REITs were able to protect the investor at a certain level against expected and unexpected inflation. Although it is noteworthy to mention that these hedging results do not reveal a strong hedge at all.

(January 1990 – July 2001)

Table 12. Descriptive Statistics of Monthly Data (Jan 1990 - Jul 2001).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	0.862	0.861	9.964	-10.347	3.500	0.111	3.344
Equity REITs	0.930	0.984	10.940	-9.437	3.642	0.286	3.388
Mortgage REITs	0.699	1.082	14.166	-20.656	5.579	-0.828	5.218
Hybrid REITs	0.542	0.937	14.506	-15.851	4.745	-0.298	4.894
Actual Inflation	0.247	0.220	1.093	-0.290	0.217	0.963	4.899
Expected Inflation	0.401	0.409	0.633	0.234	0.095	0.312	3.109
Unexpected Inflation	-0.156	-0.191	0.477	-0.600	0.212	0.388	2.990

AREIT, EREIT, MREIT, HREIT and Actual Inflation are respectively, the rates of change of the REITs total return index and Consumer Price Index. Number of observations is 139.

From table 12 we can conclude that the period 1990-2001 is less volatile than the 1990-2008 period. The standard deviations are less huge. This can be affirmed by the smaller minimum losses compared to the previous examined period. The minimum realized for All REITs is -10.347%, that is a significant smaller loss than the -30.226% realized in the period 1990-2008. This could be due to the exclusion of the current financial crisis, which had an enormous negative impact on the stock market. The collapse of the stock market at the end of 2008 has not spared the REITs (Phoon, 2009). Another item that differs from the 1990-2008 period is the skewness presented in this table. The skewness of Mortgage and Hybrid REITs are less negative and All REITs and Equity REITs show positive skewness. This indicates higher positive

returns than expected for the latter two REITs, based upon the normal distribution. Also the kurtosis of All and Equity REITs show a less peaked distribution than before.

Table 13 shows the correlation coefficients for this intra time period. Noticeable are the negative correlations for All and Equity REITs against any type of inflation, which is opposite to the overall period. On the other hand Mortgage REITs reveal negative coefficients against all types of inflation in the 1990-2008 period. In this period Mortgage REITs do show positive coefficients with regards to actual and unexpected inflation.

Table 13. Correlations: REIT Returns and Inflation (Jan 1990 - Jul 2001).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	-0.103	-0.106	-0.076
Equity REITs	-0.113	-0.108	-0.084
Mortgage REITs	0.074	-0.007	0.061
Hybrid REITs	0.012	-0.173	0.066

In conjunction with the overall period, the coefficients do not seem significantly different form zero. Therefore it is hard to conclude whether a positive relationship exists on the long term.

Table 14. Phillips-Perron Unit Root Test Statistics.

Data Series	Level Series			Return Series		
	None	Constant	Constant+Trend	None	Constant	Constant+Trend
All REITs Return Index	2.39	-0.62	-1.98	-9.67**	-10.04**	-10.00**
Equity REITs Return Index	2.67	-0.73	-1.96	-10.01**	-10.44**	-10.41**
Mortgage REITs Return Index	0.77	-1.21	-1.71	-11.02**	-10.99**	-10.95**
Hybrid REITs Return Index	0.74	-1.28	-1.40	-9.47**	-9.49**	-9.46**
Consumer Price Index	12.49	-2.38	-3.72*	-5.14**	-9.13**	-9.33**
Expected Inflation Rate	-1.49	-2.23	-2.17	-7.83**	-7.92**	-7.92**
Unexpected Inflation Rate	-7.38**	-9.80**	-9.88**	-46.47**	-45.27**	-45.00**

The PP test is carried out at level and return series. Three PP models are tested: without constant, with constant and with constant and deterministic trend. ** indicates 1% significance level and * 5% significance level.

The PP test reveals the same conclusion for the period 1990-2001 as the overall period examined before, all series are *I*(1) with the exception of the unexpected inflation series. Therefore the same technique will be used, cointegration tests and a regression analysis.

Table 15. Engle-Granger Residual-Based Test (Jan 1990 - Jul 2001).

	Actual Inflation	Expected Inflation
All REITs	-2.1279	-0.6228
Equity REITs	-2.1764	-0.5558
Mortgage REITs	-1.8824	-1.2813
Hybrid REITs	-2.8248	-1.0306

A.

	All REITs	Equity REITs	Mortgage REITs	Hybrid REITs
Actual Inflation	-2.2442	-2.2341	-1.3584	-0.9547
Expected Inflation	-2.8796	-2.8889	-2.7218	-2.8638

B.

Table 15A and B are performed by using the Augmented Dickey-Fuller test, without a constant. It is assumed that regression residuals do not posses a trend. The lag lengths were chosen by the Akaike Information Criteria. The critical values were calculated according to the formula of MacKinnon (1991). The "Critical Values for Cointegration Tests" are: 1% = -3.9774; 5% = -3.3811 and 10% = -3.0758. ** indicates that the null hypothesis of no cointegration is rejected at the 0.01 level, and * indicates the rejection of the null hypothesis at the 0.05 level. The time series displayed vertically are the dependent variables and the time series displayed horizontally are the independent variables.

Table 15A and B indicate clearly the lack of hedging capabilities of REITs against actual and expected inflation for the 1990-2001 period. None of the t-statistics show significance at the 0.10 level.

Table 16. Hedging Effectiveness against Unexpected Inflation (Jan 1990 – Jul 2001).

Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	-1.2496	-0.8884	1.4067	0.01
Equity REITs	-1.4506	-0.9918	1.4626	0.01
Mortgage REITs	1.6010	0.7134	2.2442	0.00
Hybrid REITs	1.4736	0.7721	1.9084	0.00

Regression of monthly REIT returns against the monthly unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

The regression in table 16 reveals that REITs are neither a perverse or effective inflation hedge against unexpected inflation between 1990 and 2001. The hedges are indeterminant, not significant from zero. This of course does not indicate that REIT investments during this period were a wasteful investment. From the portfolio perspective, diversification through different sorts of asset classes (financial & real) is always a beneficiary thing to do (Chun, Ciochetti & Shilling, 2000). The results for this period are somehow in line with the overall period, in neither of the examined

time spans we were able to find strong evidence of inflation-hedging characteristics. Even though there was some significance found for All REITs and Equity REITs in the overall period (1990-2008). For this period the null hypothesis of no significant relationship between unexpected inflation and REIT returns could not be rejected. The results so far indicate that REITs have more in common with stocks than unsecuritized real estate, previous literature has shown that unsecuritized real estate is at least a partial hedge against inflation.

(August 2001 – November 2008)

This period includes the attack of 9/11 and the aftermath through the beginning of the current global financial crisis. The financial crisis started on the US housing market before 2008. By using this time span the results could suggest something about the effect of the crisis on the performance of REITs.

Table 17. Descriptive Statistics of Monthly Data (Aug 2001 - Nov 2008).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	0.485	1.993	7.882	-30.226	6.060	-2.345	10.852
Equity REITs	0.546	1.827	8.421	-31.668	6.259	-2.416	11.485
Mortgage REITs	0.151	1.563	11.192	-24.107	7.150	-1.281	5.135
Hybrid REITs	-0.759	1.284	21.264	-25.569	8.160	-1.259	5.272
Actual Inflation	0.206	0.220	1.139	-1.908	0.471	-1.151	6.473
Expected Inflation	0.210	0.158	0.409	0.025	0.119	0.456	1.722
Unexpected Inflation	-0.007	0.007	0.892	-1.978	0.475	-0.988	5.319

AREIT, EREIT, MREIT, HREIT and Actual Inflation are respectively, the rates of change of the REITs total return index and Consumer Price Index. Number of observations is 88.

As table 17 reveals, the crisis made its impact on the REIT returns. The mean returns of the REITs for this period are much lower than between 1990 and 2001. Interesting is the difference between the mean returns of the Mortgage REITs. In the pre-9/11 period it was 0.699%, for this period it was only 0.151%. This is not surprising, since the financial crisis started with the subprime lending fallout. Not only had the subprime crisis made an impact on the performance of Mortgage REITs, but also the interest rate volatility of the past 5 years (Cook, 2007). As mentioned before, Mortgage REITs make money by borrowing in the short-term and lending in the long-term. Unfortunately for REITs, the Federal Reserve began to increase the short-term rates in 2004 (Cook, 2007). In 2006 the yield curve inverted, the short-term rates

were higher than the long-term rates, hitting Mortgage REITs very hard (Cook, 2007). Not only Mortgage REITs have been hit by the crisis, this unprecedented turmoil has wiped US$ 160 billion off the total market capitalization of global REITs in the year to end-June 2008 (Phoon, 2009). Equity REITs who act as private equity investors were struck hard by the tumbling real estate prices, which began in 2006-2007 with the burst of the housing bubble (Lahart, 2007). Also the credit freeze by banks, which lead to higher interest rates, had negative consequences for Equity REITs. When interest rates are high, Equity REITs will suffer because their capital (cost of equity) will be more expensive (Cook, 2007). The American REITs saw its market cap shrink with 41 billion dollar during that period (Phoon, 2009). So the recent collapse of the stock markets around the world has not spared REITs.

Also worth noting are the significant higher standard deviations for all the REIT types during this period. For All REITs the standard deviation was almost twice as high as the pre-9/11 period. This affirms that there was a lot of volatility in the market, with huge maximum losses. All REITs most negative monthly return was -30%, in the 1990-2001 period All REITs realized a maximum negative return of -10%. Past research has confirmed that the attacks of 9/11 were followed by an increasing volatility of the US stock market, but as mentioned before the effects were merely transitory for US real estate securities. This was revealed by Gheno and Lee (2006), so the increasing volatility for this time period is likely caused by the subprime/financial crisis rather than the terrorist attacks on 9/11, see table 31 in the appendix.

The skewness of the REITs were all negative, this means that the mass distribution of monthly REIT returns is concentrated to the right and it has relatively few low values. This seems in conjunction with the facts, during the period right after the tech bubble burst (2001) and 9/11 REITs were realizing profits, one of the reasons was the high spread between short term and long term interest rates (Cook, 2007). The huge negative returns were realized during the financial crisis, for example the negative return of -30% for ALL REITs was realized in October 2008. For all the three REIT

types (equity, mortgage and hybrid) their minimum return outliers were realized in 2008.

The inflation measures don't reveal shocking differences with the pre-9/11 period, the means are comparable for the three inflation types. Only this period indicates more volatility as shown by the higher standard deviations. This is in accordance with the increasing interest rate volatility of the past 5 years, as mentioned by Cook (2007). Also the minimums for this period are more negative for actual inflation and expected inflation compared to the 1990-2001 horizon. The skewness of actual and expected inflation is negative, indicating relatively few low inflation rates.

Table 18. Correlations: REIT Returns and Inflation (Aug 2001 - Nov 2008).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	0.228	0.070	0.221
Equity REITs	0.254	0.086	0.244
Mortgage REITs	-0.174	-0.187	-0.120
Hybrid REITs	0.112	0.052	0.114

The correlation coefficients in table 18, do not give the impression that the increase of a volatile market made a huge impact on the inflation-hedging characteristics of REITs. Correlation coefficients are still low, whether they are negative or positive. This is similar to the correlations of the pre-9/11 period and the overall period examined. Some correlations are a bit higher, such as Equity REITs versus actual inflation. More interesting is the comparison of Mortgage REITs versus inflation with the previous period. The current period, even though small, the correlations are all negative. This seems in conjunction with the previous explanation for the downfall of Mortgage REITs due to the inverted yield curve and the subprime crisis. All the other REITs do not indicate a negative relationship with inflation.

Table 19. Phillips-Perron Unit Root Test Statistics.

Data Series	Level Series			Return Series		
	None	Constant	Constant+Trend	None	Constant	Constant+Trend
All REITs Return Index	0.25	-1.36	2.65	-6.10**	-6.06**	-6.51**
Equity REITs Return Index	0.29	-1.30	2.46	-5.92**	-5.88**	-6.26**
Mortgage REITs Return Index	-0.12	-1.01	-0.24	-8.12**	-8.07**	-9.36**
Hybrid REITs Return Index	-0.68	0.15	6.25	-5.15**	-5.20**	-6.46**
Consumer Price Index	3.38	-0.47	-3.05	-3.75**	-3.86**	-3.77*
Expected Inflation Rate	-1.15	-0.84	-0.51	-4.32**	-4.36**	-4.43**
Unexpected Inflation Rate	-3.80**	-3.77**	-3.77*	-10.76**	-10.72**	-10.96**

The PP test is carried out at level and return series. Three PP models are tested: without constant, with constant and with constant and deterministic trend. ** indicates 1% significance level and * 5% significance level.

The PP test draws the same conclusion as the PP tests employed for the previous periods. Results in this panel show that the level series of these variables are not stationary, but their first differences are. Only the unexpected inflation rate is not an *I*(1) series. Therefore I will use the same methodology as before.

Table 20. Engle-Granger Residual-Based Test (Aug 2001 - Nov 2008).

	Actual Inflation	Expected Inflation
All REITs	0.0353	-2.7992
Equity REITs	-0.0097	-1.9941
Mortgage REITs	-0.9712	-1.6708
Hybrid REITs	-0.1385	-0.6954

A.

	All REITs	Equity REITs	Mortgage REITs	Hybrid REITs
Actual Inflation	1.3727	0.8249	-1.1581	-0.2163
Expected Inflation	-2.4154	-2.4668	-1.1929	-1.6859

B.

Table 20A and B are performed by using the Augmented Dickey-Fuller test, without a constant. It is assumed that regression residuals do not posses a trend. The lag lengths were chosen by the Akaike Information Criteria. The critical values were calculated according to the formula of MacKinnon (1991). The "Critical Values for Cointegration Tests" are: 1% = -4.0237; 5% = -3.4067 and 10% = -3.0932. ** indicates that the null hypothesis of no cointegration is rejected at the 0.01 level, and * indicates the rejection of the null hypothesis at the 0.05 level. The time series displayed vertically are the dependent variables and the time series displayed horizontally are the independent variables.

Both panels reveal no rejection of the null, this is similar to the pre-9/11 period. During the "crisis" period REITs have not proven to be a safe haven for investors against actual and expected inflation. This is not completely surprising, with the increasing volatility of the stock market and tumbling real estate prices in the US. As mentioned Mortgage REITs were hit by the inverted yield curve and Equity REITs by the declining value of their existing real estate portfolios, Hybrid REITs employ both

activities so they have not been spared either. Therefore a lot of investors sought to look for safety by investing in gold or other precious commodities, instead of real estate (Peroulakis, 2009). In the past real estate was viewed as a safe haven, especially direct real estate. This was off course due to the continuous rise of real estate prices.

Table 21. Hedging Effectiveness against Unexpected Inflation (Aug 2001 – Nov 2008).

Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	2.8243	2.1062*	1.3409	0.05
Equity REITs	3.2102	2.3306*	1.3774	0.06
Mortgage REITs	-1.8085	-1.1229	1.6107	0.01
Hybrid REITs	1.9589	1.0648	1.8396	0.01

Regression of monthly REIT returns against the monthly unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

Table 21 reveals inflation-hedging effectiveness for Equity REITs and the All REITs measurement. Both are significant at the 0.05 level with p-values close to 0.01, which is somewhat surprising considering the results against actual inflation and expected inflation. Even though the mean and median of the unexpected inflation series are close to zero, the standard deviation for this time horizon is twice as high as the pre-9/11 standard deviation. Irrespective of the higher volatility compared to the previous period, All REITs and Equity REITs are still able to hedge unexpected inflation risk to a certain degree. In accordance with recent economic events and previous results Mortgage REITs and Hybrid REITs prove again not being able to hedge any of the inflation types.

6.2. Livingston Survey

(December 1992 – December 2008)

As an alternative I used a survey based expected inflation measure. These rates were estimated over a 6-month horizon.

Table 22. Descriptive Statistics of Semi-Annual Data (Dec 1992 - Dec 2008).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	4.985	5.967	26.713	-33.672	12.381	-0.858	4.237
Equity REITs	5.333	5.703	26.626	-35.406	12.408	-0.970	4.818
Mortgage REITs	3.986	6.211	49.036	-41.164	20.566	-0.108	2.606
Hybrid REITs	2.291	4.375	44.793	-59.747	21.324	-0.834	4.056
Actual Inflation	1.306	1.398	2.322	-0.062	0.561	-0.557	2.882
Expected Inflation	1.252	1.237	1.854	0.653	0.276	0.216	2.669
Unexpected Inflation	0.053	0.105	1.015	-1.394	0.603	-0.422	2.528

AREIT, EREIT, MREIT, HREIT and Actual Inflation are respectively, the (semi-annualized) rates of change of the REITs total return index and Consumer Price Index. Number of observations is 33.

The panel indicates that on average the actual inflation was higher than the expected rate, this was not the case with the T-bill for the 1990-2008 period (see table 7). The participating individuals had underestimated the inflation, therefore a positive unexpected inflation average was realized for this period. Also the standard deviation of the actual rate was twice as high compared to the expected rate. From this we can conclude that the participants of the survey expected lower inflation volatility. The shocks in the actual inflation rate were eventually steeper.

Table 23. Correlations: REIT Returns and Inflation (Dec 1992 - Dec 2008).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	0.194	-0.118	0.234
Equity REITs	0.228	-0.121	0.267
Mortgage REITs	-0.083	0.031	-0.092
Hybrid REITs	0.110	0.015	0.096

The correlation coefficients are low for all the REIT types. No clear indication of hedging characteristics is shown. Comparing the correlation coefficients against expected inflation with table 8, concludes that both expected inflation measures reveal low correlations. The only difference is that with the Livingston survey All REITs and Equity REITs posses a low negative correlation. When using the T-bill rate, only the Mortgage REITs reveal a low negative correlation. The hedging effectiveness

with regards to unexpected inflation is quite similar with table 8. Also in this case only Mortgage REIT has a low negative correlation.

Table 24. Hedging Effectiveness against Inflation (Jan 1992 – Dec 2008).

Actual Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	4.2735	1.0993	3.8873	0.04
Equity REITs	5.0351	1.3022	3.8667	0.05
Mortgage REITs	-3.0550	-0.4658	6.5591	0.01
Hybrid REITs	4.1906	0.6178	6.7830	0.01
Expected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	-5.3026	-0.6616	8.0144	0.01
Equity REITs	-5.4575	-0.6797	8.0289	0.01
Mortgage REITs	2.3048	0.1720	13.4003	0.00
Hybrid REITs	1.1668	0.0839	13.8993	0.00
Unexpected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	4.8015	1.3402	3.5827	0.05
Equity REITs	5.4925	1.5433	3.5589	0.07
Mortgage REITs	-3.1228	-0.5123	6.0955	0.01
Hybrid REITs	3.3811	0.5352	6.3178	0.01

Regression of semi-annual REIT returns against the semi-annual actual-, expected- and unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

The regression in table 24 shows no clear indication of a significant relation between the semi-annual REIT returns and any of the inflation types. The null hypothesis could not be rejected for all the REITs. These results are somehow in line with the T-bill measure, although the Engle-Granger found some long term movement in the 1990-2008 period with expected inflation (see table 10B). As mentioned before the Livingston participants underestimated the expected inflation rate, this could be the reason that none of the REITs have significant t-values according to this proxy. This also leads to a higher unexpected inflation rate, which obviously had its effect. Some hedging effectiveness was found for All REITs and Equity REITs against unexpected inflation (see table 11), this is not the case with the Livingston measure. At the end it is safe to mention that no huge differences are noted between the two proxies regarding the hedging results for the identical periods.

(December 1992 – June 2001)

Table 25. Descriptive Statistics of Semi-Annual Data (Dec 1992 - Jun 2001).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	6.042	7.456	26.713	-14.414	9.800	-0.304	3.223
Equity REITs	6.401	6.263	26.626	-13.132	9.636	-0.157	3.016
Mortgage REITs	5.546	7.031	49.036	-41.164	22.015	-0.168	2.969
Hybrid REITs	4.640	5.319	44.793	-31.645	17.282	-0.016	3.699
Actual Inflation	1.333	1.408	1.948	0.494	0.392	-0.412	2.510
Expected Inflation	1.403	1.394	1.854	1.047	0.240	0.218	2.086
Unexpected Inflation	-0.070	-0.098	0.741	-0.802	0.441	0.109	2.248

AREIT, EREIT, MREIT, HREIT and Actual Inflation are respectively, the (semi-annualized) rates of change of the REITs total return index and Consumer Price Index. Number of observations is 18.

The mean Livingston estimate was higher than the actual inflation mean, noteworthy is the similar median value. A difference with table 22 is the more comparable standard deviation between actual and expected inflation. The mean and median of the unexpected inflation rate is negative over this time horizon, the overall period showed a positive rate. Based on the standard deviations of this period, I can conclude that the volatility of the inflation rates were less compared to the overall period. This is highly probable caused by the exclusion of the before mentioned interest rate volatility of the past 5 years, off course the tumultuous period of 2008 surely made its impact.

Table 26. Correlations: REIT Returns and Inflation (Dec 1992 – Jun 2001).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	0.382	0.154	0.256
Equity REITs	0.372	0.144	0.252
Mortgage REITs	0.394	0.221	0.230
Hybrid REITs	0.516	0.369	0.258

According to table 26 all the REIT types were positively correlated with inflation. Hybrid REITs reveals at least a partial hedge with actual inflation, also against expected and unexpected inflation some promising results are found. The correlations of the REITs are the strongest with regards to actual inflation. Correlations with unexpected inflation are pretty similar between the REIT types. Hybrid REITs seem to have the best hedging capabilities against expected inflation. When the results are compared with table 13, huge differences are noted. All the REITs possessed negative correlation, although low, with expected inflation. This is

likely caused by the difference between the two inflation proxies, but keeps in mind that the two periods are not identical. Also differences can be subscribed to the computation of the REIT returns on a 6-month basis.

Table 27. Hedging Effectiveness against Inflation (Jan 1992 – Jun 2001).

Actual Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	9.5442	1.6514	5.7795	0.15
Equity REITs	9.1370	1.6008	5.7079	0.14
Mortgage REITs	22.1334	1.7144	12.9103	0.16
Hybrid REITs	22.7766	2.4123*	9.4420	0.27
Expected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	6.2797	0.6214	10.1049	0.02
Equity REITs	5.8025	0.5832	9.9497	0.02
Mortgage REITs	20.2805	0.9052	22.4056	0.05
Hybrid REITs	26.6077	1.5875	16.7611	0.14
Unexpected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	5.6811	1.0577	5.3709	0.07
Equity REITs	5.5004	1.0405	5.2865	0.06
Mortgage REITs	11.4871	0.9458	12.1450	0.05
Hybrid REITs	10.1275	1.0701	9.4638	0.07

Regression of semi-annual REIT returns against the semi-annual actual-, expected- and unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

Table 27 concludes that REITs were not effective as inflation hedges. These results are similar to the T-bill measure for the corresponding period (see table 15 and table 16). Only differences are the results against actual inflation. Hybrid REITs reject the null at the 0.05 level, and proves to be at least a partial hedge against actual inflation. The other REITs had p-values close to 0.05 regarding actual inflation. This period the use of an alternative expected inflation measure does not reveal a different outcome with the pre-9/11 period, using T-bills as a proxy. Also the findings with regards to unexpected inflation are similar. None of the REITs were able to perform at least a partial hedge, coefficients were not statistically significant from zero. Noteworthy are the huge standard errors, especially for Mortgage REITs. Therefore it is not surprising that their hedging effectiveness is indeterminant.

(June 2001- December 2008)

Table 28. Descriptive Statistics of Semi-Annual Data (Jun 2001 - Dec 2008).

Data Series	Mean (%)	Median (%)	Maximum (%)	Minimum (%)	Std. Dev. (%)	Skewness	Kurtosis
All REITs	3.717	4.904	24.002	-33.672	15.185	-0.834	3.439
Equity REITs	4.053	5.509	24.707	-35.406	15.360	-0.988	3.911
Mortgage REITs	2.114	1.196	29.526	-27.963	19.270	-0.095	1.751
Hybrid REITs	-0.527	4.113	31.197	-59.747	25.711	-0.918	3.108
Actual Inflation	1.273	1.364	2.322	-0.062	0.729	-0.417	2.066
Expected Inflation	1.072	1.085	1.411	0.653	0.199	-0.180	2.736
Unexpected Inflation	0.201	0.517	1.015	-1.394	0.744	-0.955	2.734

AREIT, EREIT, MREIT, HREIT and Actual Inflation are respectively, the (semi-annualized) rates of change of the REITs total return index and Consumer Price Index. Number of observations is 15.

The post 9/11 period has a positive unexpected inflation mean, the surveyors expected a lower inflation rate on average. Also the unexpected median is significantly higher than the previous period. If these inflation forecasts are compared with table 17, I can conclude that for the post-9/11 period T-bills were a more accurate measure for expected inflation than the Livingston survey. The median and mean of the unexpected inflation rate in table 17 are very close to zero, indicating low discrepancies between actual and expected inflation on average.

The highest expected inflation rate (1.411%) was forecasted for December 2006 through June 2007, this is when the housing prices already started to decline. At the time central banks were targeting inflation rates, the Fed raised the Fed funds significantly between July 2004 and July 2006. This lead to an increase of the adjustable-rate mortgage (ARM), making ARM interest rate resets more expensive for homeowners (Mastrobattista, 2009). The interest rate on an ARM loan is periodically adjusted, based on indices such as Treasury securities.

Table 29. Correlations: REIT Returns and Inflation (Jun 2001 – Dec 2008).

	Actual Inflation	Expected Inflation	Unexpected Inflation
All REITs	0.110	-0.597	0.268
Equity REITs	0.164	-0.589	0.319
Mortgage REITs	-0.459	-0.437	-0.333
Hybrid REITs	-0.075	-0.517	0.065

Table 29 presents the correlation coefficients, obviously REITs seem unable to protect the investor against expected inflation. The results vary by type, Mortgage REITs

seem to be a perverse hedge against all the inflation types, which is in line with table 18. Different is the fact that all correlations are negative with expected inflation, the T-bill-based results only reveals negative correlation with Mortgage REITs. Again the other REITs have a positive correlation with unexpected inflation, which is the same as in table 18. Still the coefficients aren't that high.

Table 30. Hedging Effectiveness against Inflation (Jun 2001 – Dec 2008).

Actual Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	2.2886	0.3985	5.7426	0.01
Equity REITs	3.4618	0.6005	5.7648	0.03
Mortgage REITs	-12.1299	-1.8619*	6.5147	0.21
Hybrid REITs	-2.6528	-0.2719	9.7553	0.01
Expected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	-45.4545	-2.6827**	16.9438	0.36
Equity REITs	-45.4058	-2.6313**	17.2561	0.35
Mortgage REITs	-42.1900	-1.7497	24.1120	0.19
Hybrid REITs	-66.6865	-2.1789*	30.6057	0.27
Unexpected Inflation				
Asset Type:	Beta Coefficient	T-value	Standard Error	R-squared
All REITs	5.4674	1.0020	5.4564	0.07
Equity REITs	6.5911	1.2140	5.4290	0.10
Mortgage REITs	-8.6205	-1.2719	6.7776	0.11
Hybrid REITs	2.2464	0.2348	9.5690	0.00

Regression of semi-annual REIT returns against the semi-annual actual-, expected- and unexpected inflation rate. ** indicates statistically significant at the 99% level or better, and * indicates statistically significant at the 95% level or better.

Table 30 shows that all the t-values are at least significant at the 0.05 level for expected inflation, except for Mortgage REITs which was close to the 95% significance level. This indicates that REITs were at least a partial negative hedge regarding the Livingston forecasts, but keep in minds that this period included a relatively small sample (15 observations) and a high volatility in the REIT returns. This is affirmed by the high standard errors. A huge difference with the T-bill measure for the corresponding period is the notion that all the REIT types posses an indeterminant relation with unexpected inflation based on the Livingston forecasts. In table 21 there is a positive relationship noted between All REITs and Equity REITs

with unexpected inflation. Even though table 30 reveals positive beta coefficients for the two mentioned REITs, the standard errors are too large in order to be significant. Further more a significant negative beta coefficient is found for the relationship Mortgage REITs-actual inflation. Again it is not surprising that Mortgage REITs performed worse against actual inflation in this period, an explanation for this is given.

6.3. Differences

When comparing the results between the two expected inflation measures, not many differences are found. Based on the Livingston forecasts REITs were not able to hedge the expected component of inflation. The results based on the T-bills revealed some inflation-hedging capability against expected inflation, but it was only for All REITs and Equity REITs in the 1990-2008 period. For the interval periods no indication of hedging characteristics was found either. On the other hand the outcome with regards to unexpected inflation had a noticeable difference for the post-9/11 period. According to the Livingston expectations REITs were a perverse hedge, contrary to the T-bill-based results which even indicated a positive hedge for All REITs and Equity REITs. Also for the overall period a positive hedge was noticed, for the Livingston results the outcome was not significant to determine.

7. Conclusion

My study was motivated by the different findings in the literature concerning inflation-hedging capabilities of financial and real assets. While stocks are generally found to be "perverse" hedges, physical real estate assets offer at least a partial hedge against inflation (Park, Mullineaux & Chew, 1990, p.100). These findings raise questions about the inflation behavior of assets whose financial claims are backed by real estate and real estate related products, such as REITs.

This research focuses on the inflation-hedging characteristics of American Real Estate Investment Trusts. The inflation measure is divided in various components, such as actual, expected and unexpected. Actual inflation is obtained by using the commonly well known Consumer Price Index. Expected inflation is not directly measurable therefore I was obliged to use a proxy. Treasury bill rates were used as a proxy for inflation expectations, based on primarily work by Fama and Schwert (1977). Also a survey-based (Livingston) measure of anticipated inflation was employed. Unexpected inflation was merely the difference between actual and expected. I chose a time period starting in the early 1990's through 2008. This way the effects of the tumbling housing market in the US, and the global downturn of the stock market was incorporated. Also a distinction could be made between a period before and after 9/11. In order to test the inflation-hedging effectiveness of the different types of REITs I employed a combination of cointegration tests and regressions.

The outcome suggests that REITs tend to behave more like equities than direct real estate with regards to their hedging characteristics. Some hedging effectiveness was found against anticipated and unanticipated inflation, which was contrary to the results based on the Livingston survey. The results based on the survey indicated that REITs were not an effective hedge at all, especially in the post-9/11 period. REITs tended to be negative hedges against expected inflation after 9/11, this was the only huge noticeable difference between the two proxies. Another differing outcome is the result regarding unexpected inflation. The T-bill-based results

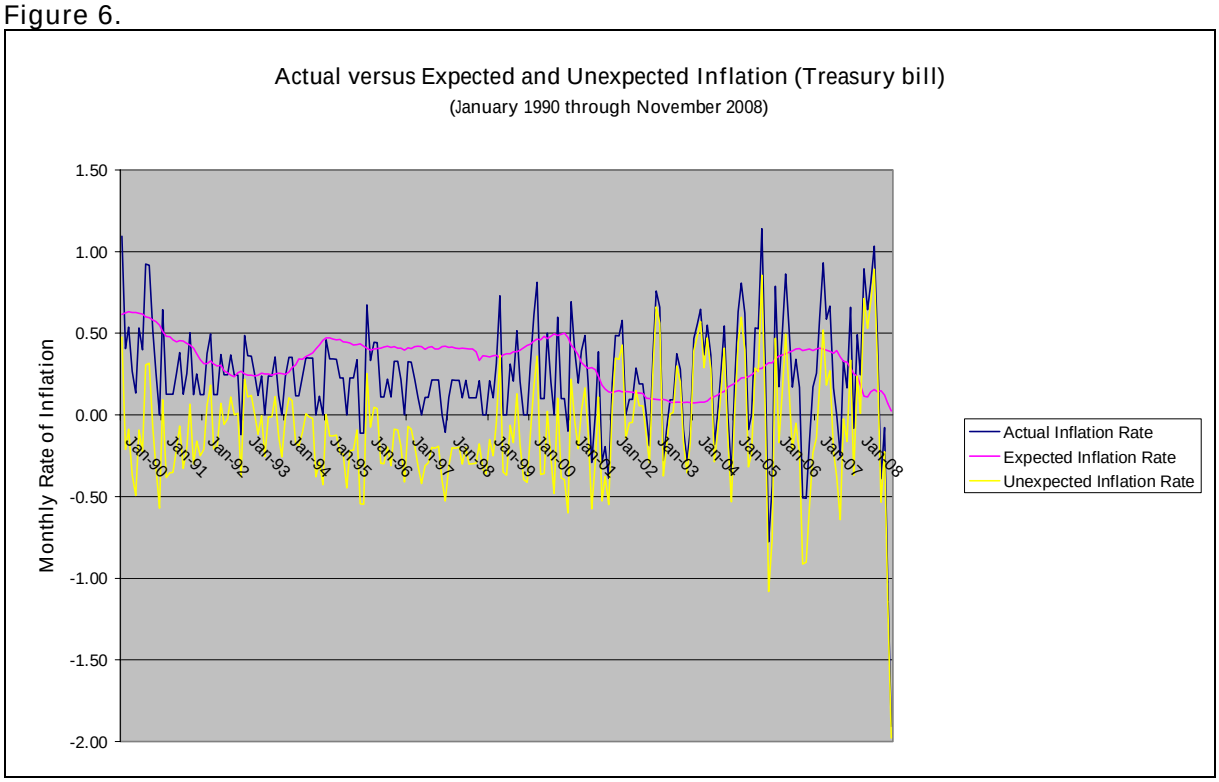
indicate some hedging effectiveness against unanticipated inflation for All REITs and Equity REITs, this was not affirmed by the survey based outcome. All the survey based results were indeterminant, no significant positive/negative relationship was found with unanticipated inflation. Surprising are the inflation-hedging results with actual inflation, regardless of the period almost none of the REITs seemed able to perform as an effective hedge. Cointegration tests and regressions revealed an indeterminant hedge, except for Hybrid REITs (see table 27). Mortgage REITs were a negative hedge against actual inflation after 9/11, this is mainly caused by the subprime crisis which struck the value of mortgage-backed assets, and the diminishing spread between short-term and long-term interest rates.

The results presented in this study are mostly in conjunction with the literature. Most of the studies come to the conclusion that REITs have more in common with stocks than unsecuritized real estate, in general terms of their hedging characteristics [see Park, Mullineaux & Chew, 1990; Larsen & Mcqueen, 1995; Liu, Hartzell & Hoesli, 1997; and Chatrath & Liang, 1998]. Some studies conclude that REITs are a partial hedge against actual and expected inflation [see Gyourko & Linneman, 1988; Park, Mullineaux & Chew, 1990; and Yobaccio, Rubens & Ketcham, 1995]. This wasn't necessary the case in this study, with some exceptions (see table 10 & 27). This could be caused by the time period chosen, most of the studies were conducted before the 21st century. None of the studies included the years of 2006, 2007 and 2008 where the foundation of currents financial crisis was laid, beginning with the burst of the housing bubble in the US. Another similar conclusion can be made about the hedging effectiveness of REITs against unexpected inflation, the literature presented reveals that no evidence is found of a positive hedge [see Gyourko & Linneman, 1988; Larsen & Mcqueen, 1995; and Yobaccio, Rubens & Ketcham, 1995]. The survey based results did not provide any evidence of a positive hedge with unexpected inflation either. On the other hand the T-bill-based results revealed some hedging effectiveness for All REITs and Equity REITs (see table 11 & 21), but not for Mortgage and Hybrid REITs. When the total outcome is analyzed, I come to the overall finding that REITs are indistinguishable from stocks in terms of inflation-hedging characteristics. REITs

were not an adequate (complete positive) inflation-hedging instrument for investors in the past two decades. Further research on this matter could be based on alternative inflation measures and the inclusion of other variables which has its effect on inflation, such as alterations in the interest rate made by the Federal Reserve and the European Central Bank.

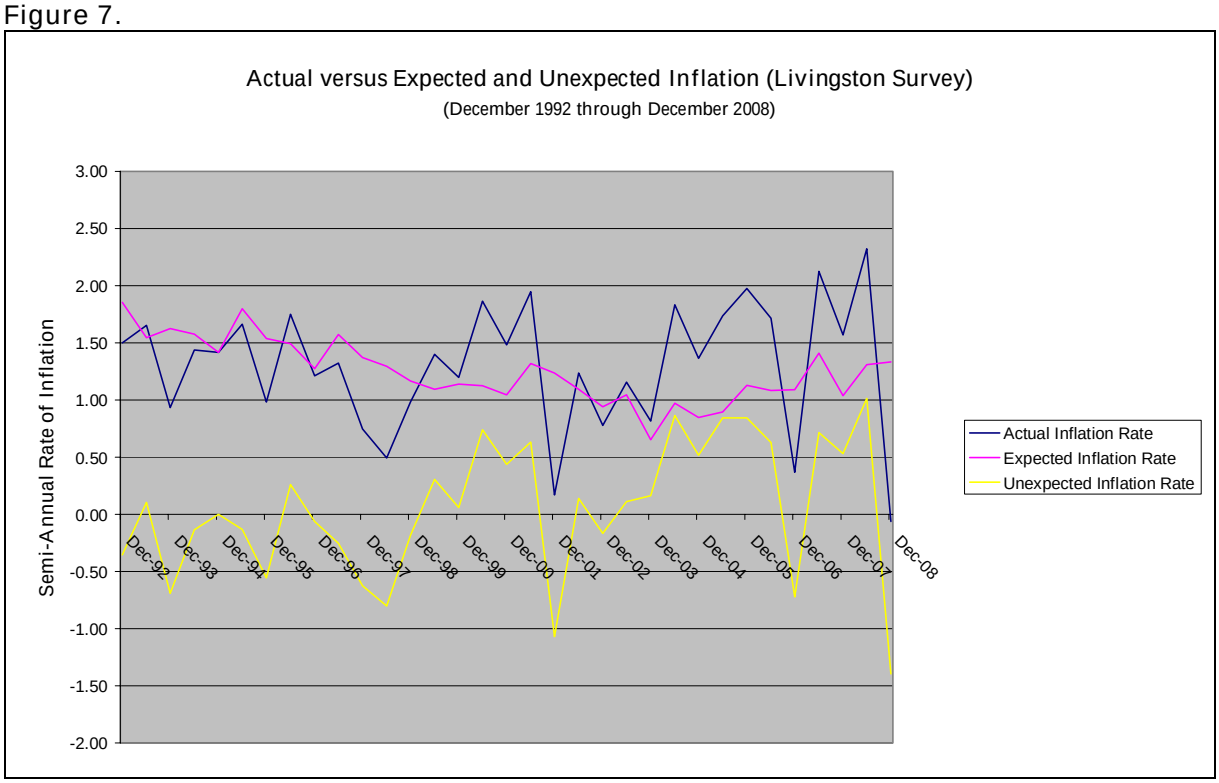
8. Appendix

Figure 6.



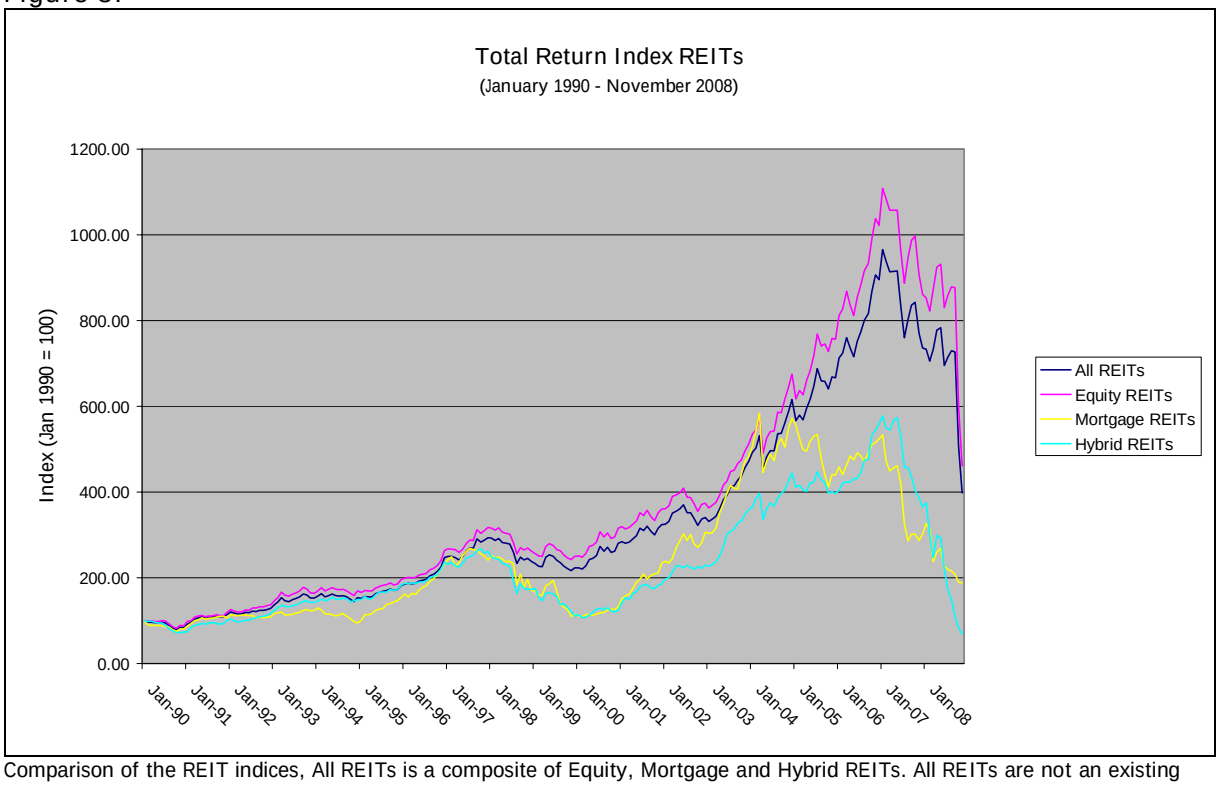
The actual inflation rate is measured as the rate of change in the Consumer Price Index, inflation expectations are derived from the US Treasury bill. The unexpected inflation rate is merely the difference between actual and expected inflation.

Figure 7.



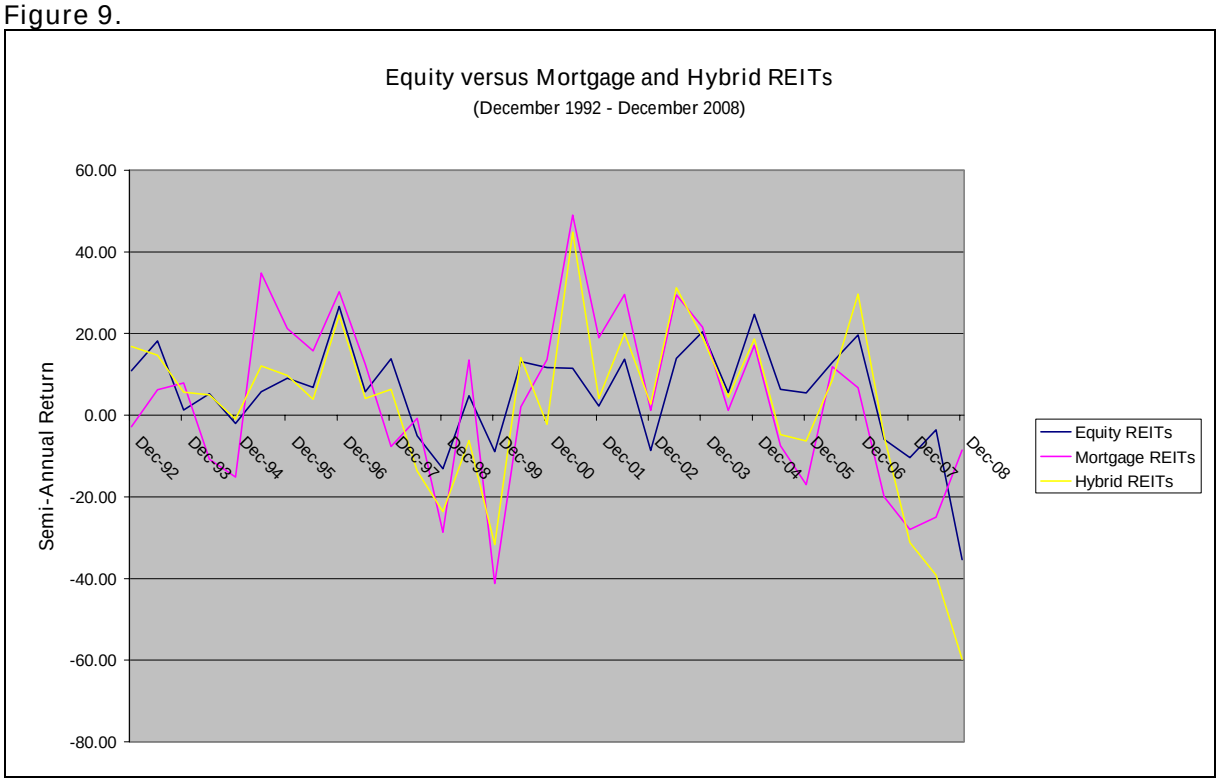
Actual inflation is measured as the rate of change in the Consumer Price Index on a 6 month basis. The expected inflation rate is based on the Livingston Survey, which is forecasted on a 6 month basis. Unexpected inflation is calculated as the difference between actual and expected inflation.

Figure 8.



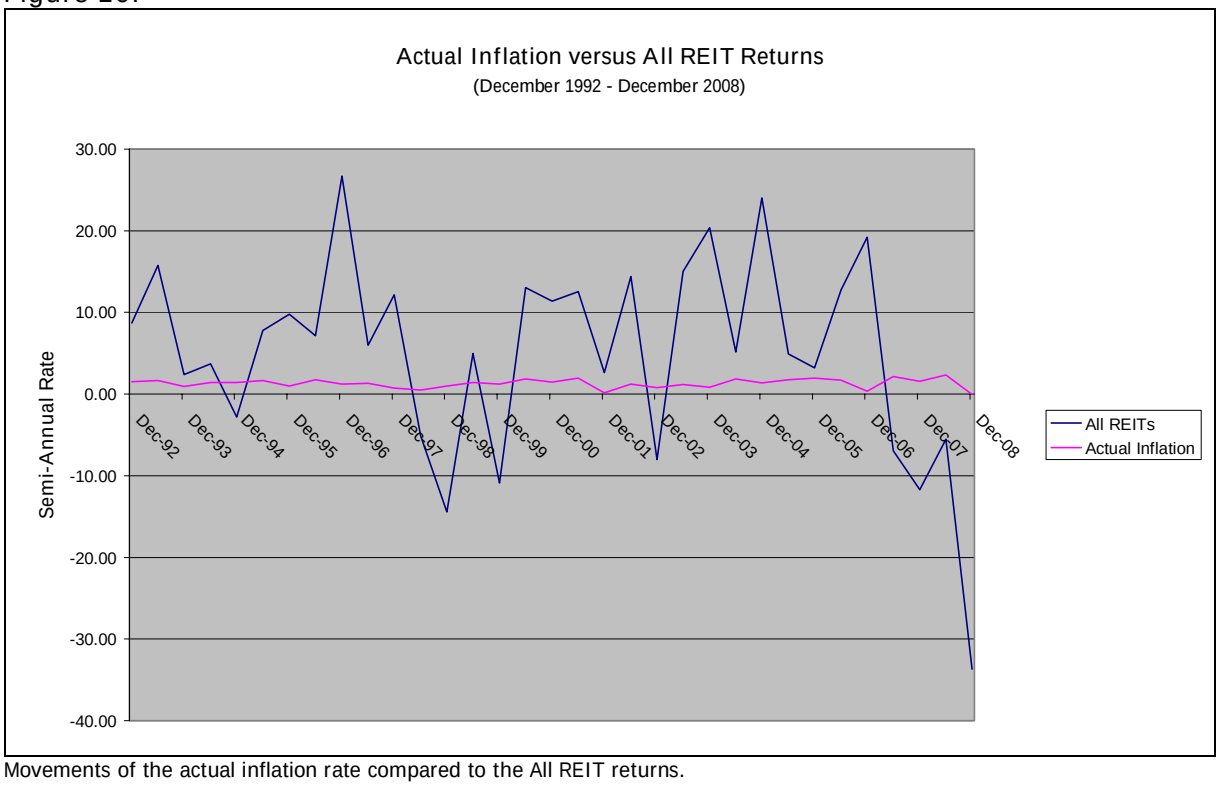
Comparison of the REIT indices, All REITs is a composite of Equity, Mortgage and Hybrid REITs. All REITs are not an existing type, in this figure it serves as an average. January 1990 is chosen as the base year=100. Noticeable are the inferior returns of Hybrid REITs to Mortgage and especially Equity REITs. The steep increase after 9/11 for Mortgage REITs was due to the high interest spread (Cook, 2007).

Figure 9.



Comparison of semi-annualized REIT returns, over the years Mortgage REITs realized the highest peaks but also the steepest declines. Equity REITs reveal less negative outliers than the other two types.

Figure 10.



Movements of the actual inflation rate compared to the All REIT returns.

Table 31. Volatility of Actual and Implied Daily Volatility in US REIT Markets: Pre- and Post- 9/11

	Daily Variances		Monthly Variances		Daily Ratio	Monthly Ratio (Implied Daily Variances)	Monthly (Post/Pre Ratio), Daily Implied Versus Actual Variance
	(1)	(2)	(3)	(4)	(5=2/1)	(6=4/3)	(7=(6-5)/5)
REIT	Pre	Post	Pre	Post	Post/Pre	Post/Pre	% Change
All REITs	0.23	0.41	0.23	0.25	1.76	1.07	-39.45
Equity REITs	0.25	0.43	0.23	0.26	1.73	1.11	-36.18
Mortgage REITs	0.72	1.04	0.56	0.55	1.45	0.97	-33.25
Hybrid REITs	0.72	0.67	0.76	0.42	0.93	0.55	-40.52
Average	0.48	0.64	0.45	0.37	1.47	0.92	-37.35

Source: Gheno, A. and S. L. Lee, 2006, "The impact of 9/11 on US REIT Returns: Fundamental or Financial?", *International Journal of Strategic Property Management* 10, 209-216.

Gheno and Lee (2006) investigated the 9/11 impact on US REIT returns in terms of volatility. The notion that REIT returns revealed higher daily volatility caused by the terrorist attacks was a proven fact. The question remaining, was whether this increased volatility was persistent (fundamental) or transitory (financial). Both authors compared the *actual* daily variance of REIT returns with the monthly variance, the *implied* daily variance. In order to answer the question the authors compared the post-crisis increases in daily variances (column 5) versus the post-crisis in monthly variances (column 6), the results are shown in column 7. An increase in the difference will be interpreted as a fundamental effect and a decrease as a financial (noise trading) effect. Column 7 indicates that the increase in monthly (implied daily) market volatility was less than the actual daily variance for all the REIT indexes. Therefore the authors concluded that the impact of 9/11 on US REITs was short-lived and not fundamental.

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