Trading Constraints and the Investment Value of Real Estate Investment Trusts: An Empirical Examination

Tobias Mühlhofer
London School of Economics and Political Science

PhD Thesis

Submitted 2005[1]

[1]My most heartfelt thanks go out to my parents and my entire family for their continued support, to Dr. Henry Overman for his supervision and suggestions, to Dr. John Board for all his guidance, to Prof. Chris Mayer for helping me with data and teaching me so many invaluable skills, to Steven Kleiman for his assistance when I needed it, and to Dr. Christian Hilber and Prof. Paul Cheshire.

Abstract

This study focuses on the property-derived cashflows that a REIT investor earns. We observe that, in the short run, REIT investors are only exposed to the income cashflows of a REIT's underlying portfolio and not to its property price fluctuations. Specifically, investors miss out on the component of appreciation returns not contained in income.

Chapter 3 observes this phenomenon and argues, without proof, that this is due to the trading restrictions that REITs face in order to operate tax free, which impose minimum holding periods on properties in REITs' portfolios. Chapters 4 and 5 show that the trading-restrictions explanation is indeed the reason for this phenomenon.

Specifically, chapter 4 tests how REITs with different firm characteristics are differently affected by the trading constraints. Firstly, we test for size effects and find that medium-sized and large firms offer investors better exposure to short-term fluctuations in property appreciation than small firms. This supports the trading restrictions hypothesis, as large firms are less affected by these. Secondly, we test for the effects of the degree of diversification in a REIT's portfolio and find that, while investing in a REIT which is diversified by property type gives an investor better exposure to appreciation cashflows, investing in one whose portfolio is merely geographically diversified does not. Finally, we test whether UPREITs give an investor better exposure to property appreciation cashflows and find strongly that this is so. Since the partnership that holds the property in an UPREIT is not subject to selling constraints, we find our hypothesis strongly supported.

Chapter 5 analyzes holding periods and selling decisions. We firstly simulate a possible filter-based market timing strategy which significantly outperforms a simple buy-and-hold strategy, and demonstrate to what extent holding periods shorter than what is allowed are required. We then analyze actual holding periods of properties in REITs' portfolios and model the decision to hold a property beyond four years, finding strong evidence that there is an incentive to do so in a rising market. This gives strong support to the trading-restrictions explanation.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

Real Estate Investment Trusts (REITs) are often considered by portfolio managers as a cheap and liquid way of adding real estate cashflows to a multiple-asset portfolio. Indeed, basic intuition supports this attitude: equity REITs, in fact, are firms which invest into properties, operate them, and collect rental cashflows from them. Thus, these firms consist of real estate assets and their cashflows are derived from these assets, and so basic intuition would say that an investor who buys a share in such a company would thereby participate in these real estate cashflows, simplistically speaking as if he had bought *a share in a building*.

Empirical tests throughout the REIT literature, however, show a slightly different picture. While it is true that, in the very long run, cashflows from a REIT portfolio resemble the cashflows obtained from a property portfolio, in the short run this only applies to a very limited extent, as REITs behave more stock-like and in addition have their own idiosyncratic return components. Thus, actual REIT returns do not reflect the attitude outlined here, and so the question that presents itself is *what sorts of cashflows does an investor buy, when buying a REIT?*

While this question has been addressed in previous literature, this study offers a somewhat new answer. We argue, in fact, that – in contrast with conventional intuition – in the short run, REIT investors are only exposed to the *income* (or rental) cashflows generated by a REIT's underlying portfolio and not to property price fluctuations associated with it. Specifically, we argue that investors miss out on the component of property *appreciation* returns not contained in income, that is, price fluctuations that come purely from changes in the capitalization rate. Thus, in the short run, REITs are not complete *property* investment vehicles, but only *property income* investment vehicles.

We then proceed to argue that this phenomenon is due to the legislative trading constraints REITs face in the property market, in order to obtain and retain tax-free REIT status. Specifically, a REIT must hold a passive portfolio of properties, meaning that it must hold each property in its portfolio for at least four years, and, once it sells, cannot sell more than ten percent of its net asset base at a time, if the REIT engages in more than seven sales transactions in a fiscal year. Should a REIT sell a property before four years, or sell more than ten percent at a time, a *prohibited transaction* is deemed to have occurred, and the REIT must pay a one-hundred-percent tax on the profits made from such a transaction. This trading constraint hinders a REIT's ability to time the market, which is required in order to realize short-term property appreciation profits: we argue that this inability to *sell high* after having *bought low* is the reason for the phenomenon in question.

This study proceeds as follows. Chapter 2 presents a technical overview of the REIT industry and a review of literature on Real Estate Investment Trusts. Chapter 3 empirically tests for the existence of the phenomenon in question. Chapters 4 and 5 then argue that the trading-restrictions are indeed the cause for this phenomenon.

Chapter 4 analyzes REIT firm characteristics, which, we argue, change the way in which a REIT is affected by the trading constraints it faces. Specifically, we test whether a firm's size, its degree of property portfolio diversification (both geographic and by property type), and its Umbrella-Partnership REIT (UPREIT[1]) status significantly affect whether an investor of this firm obtains short-term appreciation returns or not, and thereby start making the case for

[1]In an UPREIT, the REIT holds units in a limited partnership, which in turn holds the property.

the trading-restrictions explanation.

Chapter 5 analyzes simulated and actual holding periods of properties in REITs' portfolios and thereby assesses the bindingness of the four-year constraint, and to what extent this constraint hinders REITs from realizing short-term property-appreciation profits. First, we devise a set of filter-based trading strategies and show how these can be used to time the market to make abnormal profits, and the distribution of holding periods these strategies require. To illustrate the mechanics of how the four-year constraint reduces these abnormal profits we then test these strategies in a trading environment constrained in this way. We then proceed to analyze the distributions of actual holding periods and model the decision to hold a property beyond four years on the current return of the local real estate market and, once again, on UPREIT status, since, we argue, these factors affect the bindingness of the trading constraint.

Chapter 6 concludes.

Chapter 2

Current Research Into Real Estate Investment Trusts

2.1 Introduction

The REIT industry has boomed tremendously throughout the last decade. As institutional investors became interested in the diversification benefits that could be gained from real estate returns, and as tax legislation was passed which made it easier for institutional investors to invest in REITs, there has been a continuous inflow of capital to the industry. Correspondingly the industry grew from a market capitalization of under $8 billion in 1985 to over $333 billion in 2005[1], and matured as an investment in the process.

As the importance of REITs grew, there was demand for research in the field in order to better understand these investment vehicles. Thus research into REITs grew out of virtual nonexistence before 1980, and matured together with the industry itself, suggesting answers to many questions and discovering new questions and issues that need to be solved. The aim of this chapter is to survey the most important papers of the recent academic REIT literature relevant to this study and to organize them in a meaningful way. In order to

[1]Source: National Association of Real Estate Investment Trusts (NAREIT).

do this, we have divided the existing REIT literature into two major groups: the larger one contains research that deals with risk, return, and investment issues, while the smaller one contains selected topics out of the REIT-specific corporate finance literature[2]. In selecting these topics, an effort has been made to concentrate on those issues that have generated recent published research, and which are therefore ongoing issues of exploration and debate, rather than closed chapters. Furthermore, we have made an effort to concentrate on studies which are dedicated REIT studies, rather than general corporate finance research using REITs as a case. Each of the two major groups is organized into subgroups in order to be able to better group papers by topic and by research strand.

The rest of the paper is organized as follows: section 2.2 gives a brief overview of the REIT industry and its features, in order to familiarize the reader with the fundamentals; section 2.3 treats the first major group of literature, surveying research on risk, return, and investment issues; section 2.4 treats the second major group of literature, surveying research on corporate finance issues; section 2.5 concludes.

2.2 A Technical Overview of the REIT Industry

The Real Estate Investment Trust was conceived in the United States in the 1960s as a passive investment vehicle for real estate. A REIT was devised as a corporation which holds a more or less passive portfolio of properties in order to derive rental income from them. Very importantly, a REIT is normally a publicly traded company, raising equity capital by trading shares, mainly on a stock exchange. Conceptually, through the REIT investment vehicle, it is possible to overcome the problems of large lot size and indivisibility which act as substantial barriers to entry into the property investment market. Furthermore, good pricing information and liquidity, combined with low transactions costs are available in REIT investment, which is not the case in direct property. Thus, by investing in REITs as financial intermediaries facilitating the flow of capital

[2]Since REITs have less freedom in their management behavior compared to other firms, they offer a homogeneity which is well suited to study general corporate finance issues.

into the real estate market, an investor can expose his portfolio to the risk and return of the real estate asset, at a level of convenience which is normal in public equity markets.

The Internal Revenue Service sees REITs as fund-like pass-through investment vehicles rather than ordinary corporations and exempts them from paying corporate income tax subject to the following restrictions:

1. 75% or more of a REIT's total assets must be real estate, mortgages, cash, or federal government securities, and 75% of a REIT's annual gross income must be derived directly or indirectly from real property ownership (including mortgages, partnerships, and ownership in other REITs).

2. 90% or more of a REIT's annual taxable income must be distributed to shareholders in the form of dividends each year.

3. A REIT cannot be closely held, meaning that five or fewer entities may not own more than 50% of a REIT's stock. Furthermore, there must be at least 100 shareholders.

4. A REIT must derive its income from primarily passive sources such as rents and mortgage interest, as opposed to the direct trade or sale of property assets. A REIT is subject to a tax of 100% on net income from "prohibited transactions" such as the disposition of a property held primarily for sale. However, if a REIT sells a property it has held for at least four years, and – if the firm sells more than 7 properties in a given fiscal year – the aggregate adjusted basis of each property does not exceed 10% of the REIT's entire aggregate basis as of the beginning of the year, no prohibited transaction is deemed to have occurred.

It is clear from these restrictions that REITs are intended to be operated in their original passive fund-for-real-estate form.

To complete this structural overview, it is important to note that there are three major types of REITs. Firstly, we have equity REITs, which invest directly into property, hold equity therein, and collect rental income. Secondly, we have

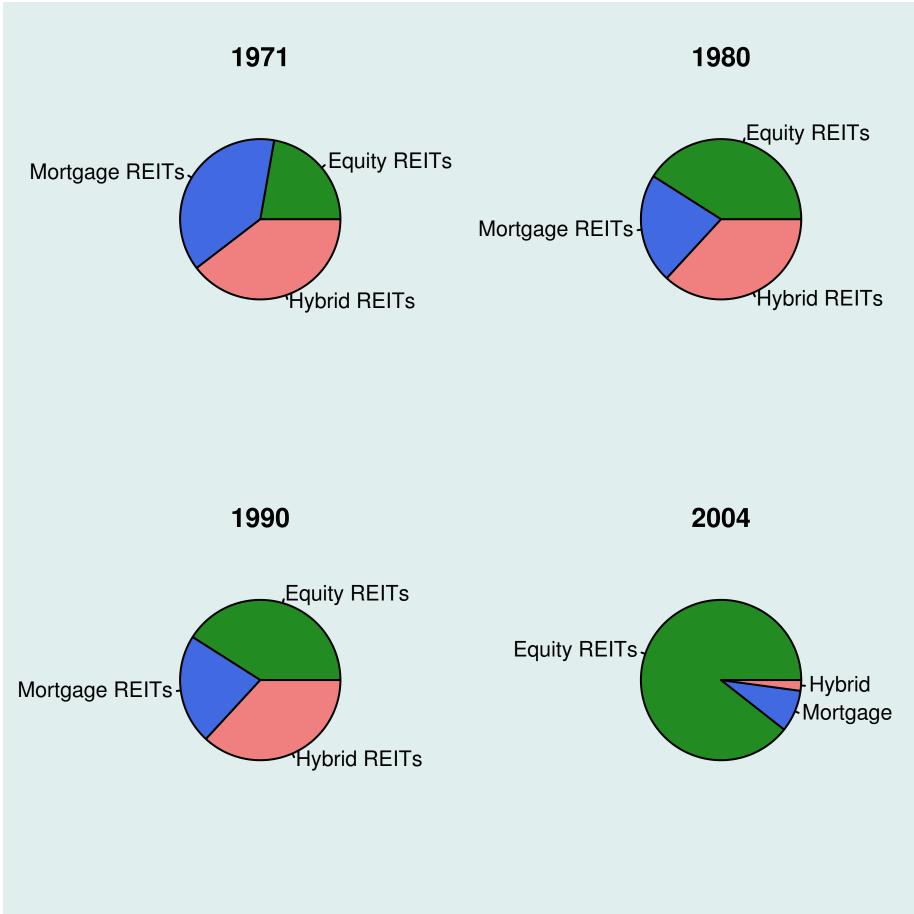

Figure 2.1: Illustration of the relative market shares of equity, mortgage and hybrid REITs, at four different times.

mortgage REITs which invest into debt secured on real estate, either by issuing it directly, or through a secondary market. Lastly, we have hybrid REITs which combine the two approaches. Figure 2.1 shows market capitalizations of each industry subsector at several points between 1971 and 2004.

While equity REITs were in a slight minority in 1971, they constitute a vast majority of the REIT industry in 2004, in the number of firms as well as in market capitalization.

Figure 2.2 shows the performance of the REIT industry (the National Association of Real Estate Investment Trusts (NAREIT) index) versus that of the

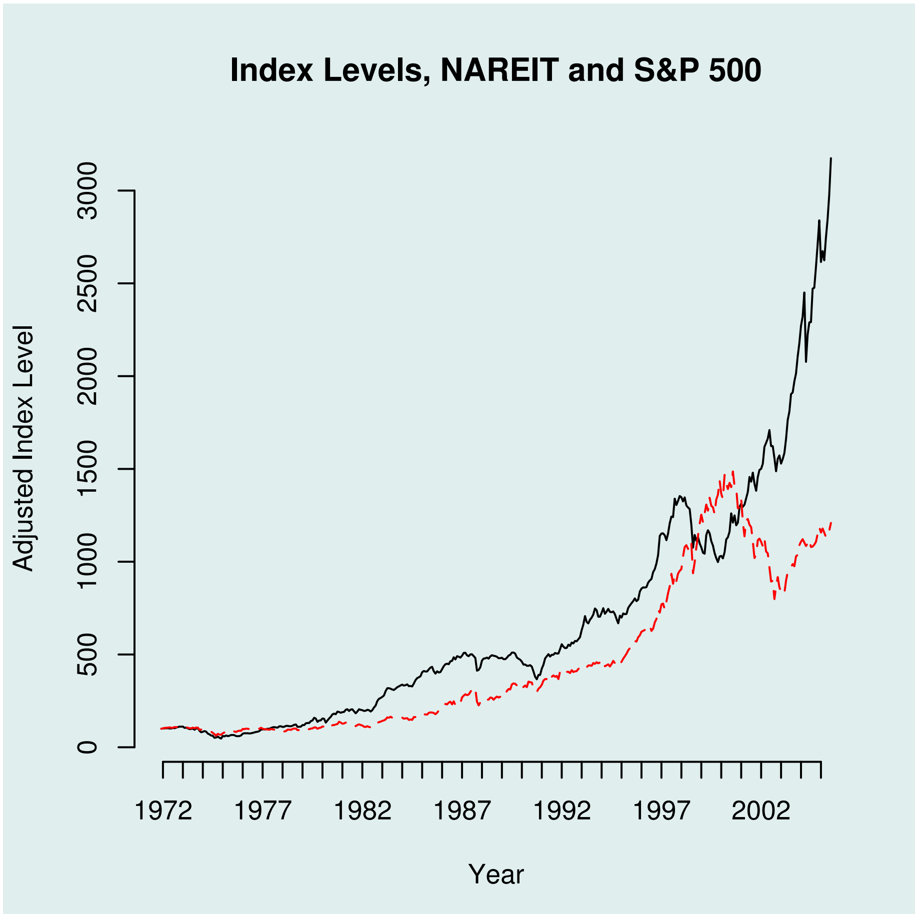

Figure 2.2: Illustration of the performance of the REIT industry (NAREIT index) versus the S&P 500. The NAREIT series is the black solid line, while the S&P 500 is the red dashed line. Both series normalized to the value of 100 in 1972.

general stock market (the Standard and Poors S&P 500 index). Notice that REITs slightly outperformed the general market throughout the expansion of the 1990s, and, after a brief dip, continued to vastly outperform the stock market. Several changes in the tax code have also facilitated this expansion, most notably the permission for REITs to self-manage their portfolios which became effective in 1986, the 1993 Revenue Reconciliation Act which enabled pension funds to invest in REITs more easily, as well as the 1999 REIT Modernization Act. Through the vast inflow of capital to the industry during this time, the structure of REITs has also changed, from the traditional passive investment vehicle to large vertically integrated real estate firms.

2.3 Risk, Return, and Investment Issues

2.3.1 The Stock/Property Dichotomy

We begin our survey of the REIT literature by examining research investigating the asset class that REITs belong to. This matter seems an easy task, given the fundamentals outlined in the previous section, as REITs consist of securitized real estate: however, performance studies have revealed that it is not straightforward to classify REITs as either real estate or pure stock.

A useful starting point for tracking this research lies in a Solomon Brothers study by Mengden and Hartzell (1986), in which a *hybrid securities* hypothesis about REITs is developed. The authors present the idea that REITs exhibit return characteristics that are partly associated with direct property and partly with stock, observing specifically that dividends are more like the income one would gain from a direct property investment, and price changes are more like what one would find in the stock market. A statistical analysis confirms this hypothesis, and the authors furthermore find the correlation between REITs and the general stock market to be .75 while the correlation between REITs and unsecuritized property is .29, in their sample of 19 REITs between 1977 and 1986.

We find support for this idea in a Goldman Sachs study of 1987 (Ross and

Zisler 1987), which attempts to quantify a *true* return for real estate. Ross and Zisler conclude that the NAREIT index representing securitized real estate overstates the return and volatility of the direct property market; they place the true risk/return of direct property between that implied by a direct property index (which has smoothing and stale appraisal problems and therefore understates volatility) and that of securitized real estate. While, for their study, this observation presents the question where true property returns lie exactly, for our thread of analysis we find that the question of classification of REITs as securities is a legitimate one.

The study by Mengden and Hartzell (1986) generated a large stream of research elaborating on the idea of REITs as hybrid securities. Most notably, we have two papers by Giliberto (1990, 1993). In his 1990 study, Giliberto uses data for direct real estate (the Russell-NCREIF[3]), REITs (the NAREIT equity index), stocks (the S&P 500), and bonds, in a sample from 1978 through 1989, to form a regression framework that also incorporates lagged relationships. By examining residuals from the REIT and the NCREIF series (the latter of which he uses without applying a correction for smoothing), Giliberto finds common factors driving both markets. He labels these *pure real estate factors*, as they represent market fundamentals. In this framework he finds that stock and bond market returns explain nearly 60% of REIT returns on his sample. Furthermore, Giliberto observes a lagged relationship between REITs and direct property, in that prices in the former market precede the latter; thus he finds evidence of some price discovery between REITs and direct real estate. In his 1993 paper, Giliberto extends this research by constructing a *hedged* REIT index that directly relates the returns of securitized real estate and direct property. He also analyzes optimal portfolio weights in multi asset investment strategies and finds the optimal weight for REITs to lie at 19%.

Several studies have either confirmed or rejected the results of Giliberto's work. While Goetzmann and Ibbotson (1990) find *little evidence* that securitized

[3]The appraisal-based index by the National Council of Rea Estate Fiduciaries (NCREIF), also employed in this study.

real estate contains useful information for predicting unsecuritized real estate in their sample of REITs that were actively traded between 1972 and 1987, Gyourko and Keim (1992) find REIT trading to be an important source of information about direct real estate, using a de-smoothed version of the NCREIF index as their indicator of the direct market in their 1978-1990 sample. They obtain similar results to Giliberto (1990, 1993) in that they find the correlation between REITs and the general stock market to lie at .65 while the contemporaneous correlation between REITs and direct real estate in their sample lies at .1. Similarly to Gyourko and Keim, Myer and Webb (1993) find, using Granger causality tests, that REIT returns lead those of unadjusted direct real estate in an autocorrelative way.

The hybrid securities idea of Mengden and Hartzell (1986) is tested in a slightly different way in Liu and Mei (1992). In this study, REIT excess returns are decomposed to determine whether a part of REIT returns can be predicted using existing capitalization rates from the current direct property market. The authors find that REIT returns are generally more predictable than the returns on ordinary stock and that direct property capitalization rates do indeed contain useful information about returns on securitized real estate. Furthermore, the hybrid hypothesis is supported by this study as well, as Liu and Mei also find a strong relationship with small cap stocks. Myer and Webb (1994), on the other hand, find a strong relationship between retail stocks and retail REITs but no relationship between unsecuritized retail real estate and retail stocks or REITs, in their sample of 8 to 10 retail REITs between 1983 and 1991.

Another thread of research can be traced from Geltner (1990), who compares a de-smoothed NCREIF direct property return series to the NAREIT index in order to measure noise in both markets. He defines noise as the excess volatility component not based on fundamentals, and finds that the direct and the indirect market are approximately equally noisy, although the two do not seem to underlie the same contemporaneous noise process. The fundamentals underlying the two markets seem more correlated than the noise processes. In a 1992 paper, Geltner follows up this analysis by taking a more general stand and performing a broader comparative analysis between the two series. Here Geltner discovers fundamental linkages between unsecuritized and securitized real estate in the long run, even though in the short run contemporaneous correlations are often low.

Barkham and Geltner (1993) observe that price changes in securitized real estate lead price changes in unsecuritized real estate by a year or more, thus supporting Giliberto's lead-lag relationship as well as Geltner's (1992) conclusions about fundamentals. It is important to notice here, however, that this finding is almost opposite to that of Liu and Mei (1992), who find that information travels from the direct to the securitized market and not vice versa as observed here.

An interesting continuation of the ideas presented here can be found in Pagliari and Webb (1995). The study separates the three fundamental components of the return process, dividends (or generally income), price processes, and dividend yields in a NAREIT and an NCREIF series. They find the strongest interlinkages between the two series in the long run price process. Furthermore, they find that the "dividends" in the direct market series have a volatility of 1.5 times that of the securitized market dividends, even though the price volatility of the NCREIF is only 25% of that of the NAREIT. The authors ascribe this clash with theory to the incompatibility of the two data series.

Ghosh, Guttery and Sirmans (1998) examine the reaction of REIT prices to announcements about investment-grade direct real estate. The authors argue that because the direct property market is thinly traded, REIT prices will react strongly to any announcement by financial institutions which give pricing or performance information. They test this hypothesis in a sample from the real estate crisis of 1989-1991, by examining the effect of such announcements on a portfolio of 69 REITs. As expected, they find significant negative reactions to negative announcements during this period.

Looking through the literature, one finds that more recent papers on this class of topics cannot clearly and unambiguously be classified under the purpose of analyzing the stock/property dichotomy in the nature of REITs, and so we prefer to list these in the subsequent sections: the reader should therefore consult these for a complete picture of the development of this chain of research in recent years. There is, however, one last study by Clayton and Mackinnon (2003) that caps off this account quite well. In this study, the authors develop and implement a variance decomposition for REITs that separates return variability into components directly related to major stock, bond, and real estate return indices. In this way, they trace the changing nature of the REIT asset class from the 1970s all through the REIT boom of the 1990s leading to the industry's maturation. They find that while large-cap stocks were of great importance in explaining REIT price movements early on, their importance decreases dramatically in the late 1980s, from which time a significant small-cap factor is observed. During the 1990s, a significant real estate factor emerges, especially in small-cap REITs, while, at the same time, the industry's idiosyncratic volatility also increases.

2.3.2 Risk and Correlation

The studies described in this section treat the topic of risk, including diversification benefits, associated with REITs, as well as general correlation issues, mostly excluding correlation with direct real estate, as this would have been covered in the previous section.

Once again, the industry studies by Mengden and Hartzell (1986), Ross and Zisler (1987), as well as Geltner (1990), form the start of more recent work in this topic, with their results for correlation coefficients as described above. Ennis and Burik (1991) find the correlation between REITs and stocks to lie at .8 and that between REITs and foreign stocks to lie at .72 in their 1980-1989 sample of nominal returns. They calculate the beta of the REIT industry to lie at 1.23, with individual betas often higher than the index beta, and they compute an optimal allocation of REITs in a multiple asset portfolio of 10 to 15 percent.

In terms of portfolio management issues, we point out the study by Miles and McCue (1982) as a starting point. This study examines portfolios of specialized REITs in order to test whether diversification benefits can be gained from property type or geographic diversification in a REIT portfolio: they find that only the former type of diversification yields benefits. Burns and Epley (1982) start off a tread of research specifically on the place of REITs in mixed asset portfolios, finding that mixed portfolios of stocks and REITs are mean-variance efficient in comparison with single asset type portfolios of either asset class, using a 1970s data set. Kuhle's (1987) findings fail to support this conclusion through a 1980-1985 data set.

Bharati and Gupta (1992) build a 14-factor model which includes T-bills, bond yields, stocks, dividend-earnings ratios, growth of industrial production, and real estate capitalization rates to find an optimal allocation of stocks, risk-free assets, and REITs. The results from fundamental-factors based portfolios are better than those from passive investment strategies, suggesting that superior performance may not be due to asset-class diversification benefits alone. Liu and Mei (1993) use REIT data, US stock data, and stock and securitized real estate data from six other countries to find high international integration across securitized real estate markets and moderate to high intra-country correlations between securitized real estate and stocks. Nevertheless, their findings suggest that diversification benefits can be gained from including both securitized real estate and stocks in multiple markets in a portfolio.

Khoo, Hartzell and Hoesli (1993) find that REIT returns declined considerably throughout the 1980s on an absolute basis as well as with respect to the S&P 500. They find the correlation between REITs and the stock market to be .6-.7 early in the decade, but that it declined to .4-.5 later on. Similar observations can be found in Liang, McIntosh and Webb (1995) as well as, much later, in Clayton and Mackinnon (2003) as described above.

A study by Mueller and Pauley (1995) examines the effect of interest rates on REITs through the interest rate cycles from 1972 to 1993. The study finds a poor correlation of REIT price movements with interest rate changes, especially as compared to the correlation of REIT price movements with those of the general stock market. Correspondingly, the authors call for further research, to ascertain the determinants of REIT price movements. A more specific approach is taken by Liang and Webb (1995). This study, in fact, examines the pricing of interest rate risk in mortgage REITs in equilibrium, over three periods (1976-79, 1980-82, 1983-90). By estimating a system of nonlinear equations the authors find a monthly interest rate risk premium over each of the three periods, and they further come to the conclusion that interest rate risk is not diversifiable in mortgage REITs and should thus command such a risk premium. This line of research can be traced back to Chen and Tzang (1988) who find that both equity and mortgage REITs are sensitive to changes in long-term interest rate over a 1973-1979 period while they are sensitive to changes in both long and short term interest rate over a 1980-1985 period. Closely related, we find the study by Mengden (1988), who argues that mortgage REITs should be more directly influenced by interest rates as leases can be renegotiated better than mortgage contracts in a changing interest rate environment, confirming this through correlational evidence.

Risk premia for both types of REITs are also analyzed in Peterson and Hsieh (1997). The authors examine monthly returns on equity and mortgage REITs between 1976 and 1992, and find that the risk premia on equity REITs are significantly related to risk premia on a market portfolio of stocks as well as to the returns of mimicking portfolios for size and book-to-market equity factors in common stock returns. Mortgage REIT risk premiums are significantly related to the three stock market factors as well as to two bond market return factors.

In this line of research we also find He (1998). From a 1972-1995 data set, the author finds evidence of a stable long-run linear relationship between equity and mortgage REITs, based on their common reaction to changes in factors such as market returns and interest rates. Furthermore, through Geweke causality tests, He finds a causal relationship running from equity to mortgage REIT returns, which may reflect the quicker response of equity REITs to changes in some fundamentals. In addition, the results suggest total linear feedback between changes in the stock prices of the two asset classes.

Like Peterson and Hsieh, Karolyi and Sanders (1998) also examine the risk premia of REIT returns. In this study, the authors examine the predictable components of stocks, bonds, and REITs through a multiple-beta asset pricing model, and find that while for both stock and bond markets the predictable components of the return variation of each market are explained to an important part by the respective risk premia, predictable components of REIT series are captured to an important part by a combination of bond and stock risk premia. Since REITs have a return predictability comparable to that of stocks, the authors conclude that there is an important economic risk premium for REITs that is not captured by a multiple-beta asset pricing model.

Oppenheimer and Grissom (1998) use cross-spectral analysis to examine the coherency between REIT and stock market index series as well as between REIT and US Treasury debt series between 1989 and 1995. They find significant co-movement between REITs and stock market indices with evidence of contemporaneous movement between the two asset classes, but not between REITs and debt market indices.

A study by Lizieri and Satchell (1997) examines the UK equity market and the UK market for listed property companies, but still deserves mentioning in this survey. The paper uses UK equity market and property company share data to explore the relationship between real estate and the rest of the economy, through a two-sector analytic model. The study finds causality running in both directions: the wider economy leads the real estate market in the short term, but with a longer lag structure positive real state returns may point to negative future returns in the rest of the economy.

Okunev, Wilson and Zubruegg (2000), on the other hand, examine the dynamic relationship between REIT and stock markets between 1972 and 1998, and observe that a uni-directional relationship exists from the securitized real estate- to the stock market. Non-linear causality tests, however, show an opposite relationship, which the authors find more plausible as it is also consistent with structural breaks in the data series. These results are also consistent with those obtained in Okunev and Wilson (1997).

Glascock, Lu and So (2000) examine the integration of REIT, bond, and stock markets using cointegration and vector autoregressive models. They find that REITs behave more like stocks and less like bonds after the structural changes in the early 1990s, and conclude that the diversification benefits of including REITs in multi asset portfolios diminish after 1992. Allen, Madura and Springer (2000) test whether differences in asset structure, financial leverage, and degree of specialization affect sensitivity to market risk of a REIT portfolio, finding that, while REITs can reduce their exposure to stock market risk by reducing leverage and by being self-managed, they seem to not be able to control their exposure to either short- or long-term interest fluctuations. Very interestingly, the authors cannot conclude from their data (1993-1997) that REIT type (equity or mortgage) makes a difference in terms of interest rate exposure. This last observation connects closely with the findings of Lee and Chiang (2003) who find that equity and mortgage REITs are *substitutable* between each other, a conclusion which they draw from their results of variance ratio tests and variance decompositions of forecast errors indicating the existence of informational commonalities between the two asset classes.

In line with the findings above, Swanson, Theis and Casey (2002) find that interest rates impact REIT returns, and specifically that REIT returns are more sensitive to maturity rate spreads between short and long term treasuries than the credit rate spread between commercial bonds and treasuries. Furthermore, the authors find a structural shift throughout the 1990s that made REITs more sensitive to credit risk.

Finally, Glascock, Michayluk and Neuhauser (2004) test the riskiness of REIT returns around the October 1997 stock market decline, and find that REIT stocks only declined by about half the amount by which other stock prices fell. Furthermore, they find that, while, in this environment of uncertainty, other stocks' bid-ask spreads continued to increase, REIT stocks' bid-ask spreads declined. This suggests that REITs can be classified as *defensive stocks*, as, like other defensive stocks, they are less affected by market disturbances.

2.3.3 Hedging

This section examines the hedging properties of REITs. Here, a useful starting point can be found in Gyourko and Linneman (1988) who examine the REIT return series for the various sub-markets between 1973 and 1986 and find that REITs are strongly negatively correlated with inflation, while appraisal-based indices are positively correlated with inflation. Murphy and Klieman (1989), Goebel and Kim (1989), and Myer and Webb (1990) confirm this result extending it to imply that REITs have good inflation hedging capabilities for both expected and unexpected inflation, while Park, Mullineaux and Chew (1990) refute this for both types of inflation.

Chatrath and Liang (1998) also treat this question. They find no evidence of a positive correlation of REIT returns with expected or unexpected inflation and refute the hypothesis that this is due to REITs' close dependence on the stock market. However, the authors do find evidence that REITs provide a more long-term inflation hedge. Glascock, Lu and So (2002) examine the nature of the negative relationship between REITs and inflation by testing for causal relationships among REIT returns, real activity, monetary policy, and inflation through a vector error correction model. They find that REIT returns Granger-cause expected and unexpected inflation: information is first discovered in the REIT market and then in the inflation rate.

2.3.4 Trading Anomalies, Market Microstructure Effects, and Issues of Investor Clientele

This section surveys the literature on market microstructure effects. These issues become especially important as the industry matures throughout the 1990s and institutional investment in REITs increases.

Colwell and Park (1990) test for seasonality effects in REIT returns. Using a sample of 28 equity REITs and 33 mortgage REITs between 1964 and 1986, they find that average REIT returns are higher in January than in any other month. The January effect disappears for large equity REITs and large mortgage REITs. Liu and Mei (1992) also follow up on this research with similar findings. Redman, Manakyan and Liano (1997) confirm this effect and also observe a Friday, turn of the month, and pre holiday effect. McInstosh, Liang and Tompkins (1991) test for a small-firm effect, assigning REITs to portfolios based on size, finding that smaller REITs provide greater returns without greater risk.

Wang, Erickson and Chan (1995) find that shares of REITs tend to have smaller turnover ratios, lower institutional investor participation, and a smaller following among security analysts than other stocks. Furthermore, contrary to predictions from an equilibrium model, REITs that are followed more closely by security analysts perform better than other REITs. The findings of Below, Kiely and McIntosh (1995) resemble those just mentioned but are expanded to a certain degree. In fact, the authors of this study find, in addition to this, that mortgage REITs trade at bid/ask spreads that are smaller than those of similar non-REITs while equity REITs trade at bid/ask spreads that are larger than those of similar non-REITs. Surprisingly, their analysis of institutional ownership suggests that those REITs that are most widely held by institutional investors exhibit the largest divergence from similar non-REITs in terms of intra-day trading activity and volume, but the smallest divergence in bid/ask spread. In general, the authors conclude that REITs are treated differently from non-REITs by investors. A 1996 study by the same authors examines the effects of the starting REIT boom on the phenomena outlined above. In fact, Below, Kiely, and McIntosh find that the bid/ask spread differential between REITs and non-REITs has approximately halved between 1991 and 1994.

Crain, Cudd and Brown (2000) analyze the impact that the 1993 Revenue Reconciliation Act had on the pricing structure of REITs, as it made the vehicle more attractive to institutional investors. They find a significant change in the role of unsystematic risk in pricing REITs before and after the passage of the act.

A final study that deserves our attention in this classification is that by Ciocchetti, Craft and Shilling (2002) who devise a model in which institutional investors have a need for a high degree of liquidity, which has as an implication a tendency to invest in REITs rather than direct real estate, and furthermore a tendency to invest in larger more liquid REITs even within the asset class. The evidence strongly supports the first implication, and also supports the second implication, but in a somewhat more limited fashion. The model should thus illustrate the importance of investor clienteles in REIT asset pricing.

2.3.5 Other Issues

Differing answers abound on the question of whether REITs outperform closed-end funds. In a 1976 study, Smith and Shulman find that equity REITs perform about the same as closed-end funds. Mengden and Hartzell (1986) find REITs outperform closed-end funds by 4%. This result is reproduced by Blake (1989) among others. Han (1990) and Glascock (1991) among others find no excess return by REITs. Martin and Cook (1991) find that closed-end funds outperformed individual REITs during the 1980s, and outperformed REIT portfolios from 1986 to 1990 but underperformed REIT portfolios from 1980 to 1985.

Han and Liang (1995) find that REIT portfolio performance throughout the 1970-1993 period was consistent with a CAPM-type securities market line even though the performance of individual REITs was not necessarily consistent with such a model. They also find that survivor REITs generally performed better than the overall REIT population. Li and Wang (1995) find that the REIT market is integrated with the general stock market and find no evidence of a higher degree of predictability in REIT returns than in general stock returns.

Capozza and Lee (1995) document the wide deviation of the value of equity REITs from the underlying value of property owned by the firm. By devising a method of estimating the net asset value of the property owned by an equity REIT they observe that retail REITs trade at premiums to their NAV while industrial and warehouse REITs trade at discounts. Similarly, small REITs trade at discounts while large REITs trade at premiums.

Graff and Young (1997) observe that annual and monthly REIT returns display serial persistence behaviors which, however, are qualitatively different from each other. By contrast, they find that quarterly REIT returns do not display serial persistence which suggests that REIT returns cannot be accurately described by linear factor models. Chen, Hsieh, Vines and Chiou (1998) investigate the cross-sectional variation in equity REIT returns through a pooled cross sectional time series model. They find that beta does not explain return variation. When size and book-to-market factors are included in a model, no other traditional variables are significant. They find that only unanticipated changes in term structure are significant in models that exclude firm-specific variables.

Gyourko and Nelling (1998) test the predictability of equity REIT returns and compare it with that for small- and mid-cap firms. They find evidence that equity REIT returns are predictable based on past returns, however not to such a degree as to cover transactions costs, thus making arbitrage possibilities unfeasible. Upon an examination of predictability by time period, they find that the most recent data (since 1992) shows the most predictability.

Similarly, Larson (2005) tests for predictability, specifically of stock price reversals. By calculating abnormal returns over the two days to firms whose price declines at least 5% in one day, Larson finds some market overreaction to negative news, leading to systematic reversals on the days following such announcements.

Young (2000) finds property-type specific REITs have become more integrated over the period of his 1989-1998 sample. This is true for both individual REITs and REIT portfolios. Finally, Bond and Patel (2003) test the time variability of higher order moments of REIT returns, finding only scattered evidence for the time variation of skewness.

2.4 Some Corporate-Finance and Related Issues

2.4.1 Asset Acquisition and Disposition, and Economics of Scale

Since REITs are required, for tax reasons, to hold a passive portfolio of assets, the acquisition and disposition of investment assets is an important occurrence for a REIT and there are many aspects that can be studied for such an event. A useful starting point for our survey can be found in the study by Shilling, Sirmans and Wansley (1986) in which the authors test the hypothesis that announcements of property acquisitions have a negative effect on share prices. They find no such significant effects using price data around 33 acquisition announcements between 1970 and 1983. Motivated by many results in the corporate finance literature that asset purchases should generate a positive share price reaction, Liang, McIntosh and Ott (1993) argue that these are due to a tax effect and should not happen to REITs as they are tax exempt. Indeed, like Shilling et al. (1986), Liang et al. (1993) find no excess returns upon asset purchases. They do find positive returns for asset sales, however.

Hardin and Wolverton (1999) argue on a basis of negotiation theory and implied agency costs that apartment REITs pay a premium upon asset purchase. In fact, they show that, in several urban markets, premia of 26-27% were evident. Pierzak (2001) examines payment choice in REIT property transactions. He examines several hypotheses why a REIT would choose tax advantaged units of exchange like operating partnership units.

Anderson, Fok, Springer and Webb (2002) analyze technical efficiency and economics of scale for REITs. They find that most REITs are operating at increasing returns to scale, suggesting that most REITs could improve performance through expansion. Furthermore, they find that internal REIT management is positively related to all measures of efficiency, while increasing leverage is negatively related to input utilization. Increasing REIT diversification across property types enhances scale efficiency but reduces input usage efficiency. Ambrose, Ehrlich, Hughes and Wachter (2000) construct shadow portfolios mimicking the exposure to changes in the local market conditions of 41 apartment REITs. Their results show no size economies, that branding in real estate is illusive, and that geographic specialization has no significant benefit.

2.4.2 Initial Public Offerings and Seasoned Equity Offerings

While an underpricing anomaly is well known for IPOs of ordinary corporations, this has not been found in IPOs of closed-end funds or other assets where the asset base is well known. Two studies of REIT IPOs, Wang, Chan and Gau (1992) and Balogh and Corgel (1992) find slight but significant overpricing of REIT IPOs. They argue that this may be due to the large number of small investors that participated in the IPOs in their samples and to informational asymmetries thus arising. In the latter study, the authors also observe that equity REITs are more likely to be mispriced than mortgage REITs. Below, McIntosh and Zaman (1992) report neither over- nor underpricing, but significant negative returns on the initial day of trading for mortgage REITs. Despite this, however, shortselling activity is negligible and the authors find that an investor is better off, after transactions costs, participating in an IPO rather than buying the assets in the open market thereafter.

Ling and Ryngaert (1997), on the other hand, find that equity REIT IPOs in the 1990s have been underpriced, on average by 3.6% and have moderately outperformed seasoned equity REITs in the 100 trading days after issue. They attribute the initial day underpricing of recent IPOs to greater valuation uncertainty that is inherent in the modern REIT and greater institutional involvement in the IPO market. Glascock, Hughes and Varshney (1998) take a market microstructure approach, analyzing bid/ask spreads immediately following the IPO. Their results are similar to those described in section 2.3.4 and thus do not lead to much new insight about the functioning of REIT IPOs.

Ghosh, Nag and Sirmans (1999) study the issue of seasoned equity offerings. They find a significantly negative reaction to both announcement and offer. The effect persists even after adjustment of returns by the bid-ask bounce induced by excessive selling of shares in the secondary market by institutional investors to take advantage of offer price discounts: a possible explanation for the result may be in part order flow imbalance around the offer day. The authors point out that this finding is inconsistent with extant literature and therefore they call for further investigation on this issue.

2.4.3 Management and Agency Costs

Up until 1986, REITs had to be externally managed. From then on, REITs were free to become self-managed. Since, even today, some (though very few) REITs remain which are externally managed, interesting issues about the effect of internal or external management on shareholder wealth can be investigated.

Cannon and Vogt (1995) examine possible agency problems in REITs, by contrasting the performance, structure, and compensation of the two REIT forms between 1987 and 1992. They find that self administered REITs clearly outperformed advisor REITs, even on a risk adjusted basis, as the former have more market risk. Performance of Advisor REITs is also significantly influenced by ownership structure: low insider-owned advisor REITs both underperform and take on less market risk than other REITs. Self administered REITs are not affected by ownership structure.

Capozza and Seguin (2000) continue this research and investigate why externally managed REITs underperform. They find that even though property-level cashflow yields are similar between the two managerial forms, corporate level expenses, especially interest expenses, are higher in externally managed REITs. Capozza and Seguin observe that the higher interest expenses are due to both higher levels of debt and to higher debt yields for externally managed REITs. The authors posit that compensating managers based on assets under their management or on property derived cashflows creates an incentive for them to increase the asset base by issuing debt, even at unfavorable interest costs.

2.5 Conclusion

In this chapter we have conducted a survey of the current state of knowledge and of research in the field of Real Estate Investment Trusts. From the fundamental question about the basic nature of REITs, which seems to be pointing toward a hybrid model as its answer, we have moved on to general investment considerations for the REIT vehicle, and then to issues of corporate finance including considerations for any portfolio restructuring a REIT must do, through the basic process of raising equity capital, to issues of management.

We have made an effort to include a large selection of previously published work which may be relevant to this thesis. For other literature, the reader should consult the literature reviews by Corgel, McIntosh and Ott (1995), Zietz, Sirmans and Friday (2003) and Chan, Erickson and Wang (2003).

Chapter 3

Income versus Appreciation: The Investment Value of Real Estate Investment Trusts

3.1 Introduction

Equity Real Estate Investment Trusts (REITs) are widely considered by analysts and institutional investors as additions to a diversified multi-asset portfolio, as a more liquid and more easily accessible alternative to holdings of direct real estate. However, as is widely documented, equity REIT returns do not strictly follow the movements and returns of the underlying direct property market: while in the long run a fundamental relationship between securitized and unsecuritized real estate seems to exist, in the short run REIT returns do not follow those of the underlying property market.

This chapter attempts to further explore the relationship (or apparent lack thereof) between the two markets. We do this by examining the relationship between equity REIT returns and property-level income returns, and property-level appreciation returns. We argue that REITs are income vehicles, rather than appreciation vehicles. In other words, by investing in a REIT, an investor only receives exposure to its rental cashflows and very little exposure, at best, to its short-term property value growth. In particular, property prices contain forecastable short-term growth opportunities not yet capitalized in rents, to which REIT investors do not have access. This hypothesis may offer a possible explanation for the short-term dichotomy between REIT price movements and property price movements.

This chapter will proceed as follows. Section 3.2 will present a brief review of past literature specific to this topic. Section 3.3 will then outline the theoretical elements that underlie this chapter. Section 3.4 presents the data sources and implements some adjustments to certain series. Section 3.5 presents preliminary results and outlines the need for further data adjustments which are implemented in section 3.6. Section 3.7 presents the final results for the chapter and section 3.8 concludes.

3.2 Previous Literature

There exist a large number of studies that investigate the correlation of REITs with other asset classes. The studies that incorporate a decomposition of direct property returns into income and appreciation are, however, very few. The most pertinent works to this chapter are Capozza and Lee (1995) and Pagliari and Webb (1995).

Capozza and Lee construct REIT Net Asset Values (NAVs) by using property-level income, in order to then determine what REITs trade at discounts and what REITs trade at premia to NAV. Pagliari and Webb, on the other hand, perform an investigation that is somewhat similar to this one. They try to equate property and REIT market return components, comparing direct-property income to REIT dividends and direct-property appreciation to REIT share prices. While this comparison seems very elegant and appealing, their results are generally inconclusive, at least on the income question. The problem here seems to be that dividends are managed, and that, therefore, despite the high dividend payout requirements that REITs face, property-level net operating income that enters the REIT is not necessarily carried through to the end investor purely as a dividend.

For this reason, in this study, we take a more relaxed view than Pagliari and Webb and analyze REIT total returns, consisting of both share price changes and dividend payouts combined. The reason for this is that, similar to the mechanisms governing coupon bonds, if investors perceive a different return to a REIT stock than is paid out in dividends, prices will simply adjust to reflect what is not paid out directly.

3.3 Theory

3.3.1 Property Markets

Traditionally, there are two separate return components to owning property for rent. Primarily, by owning a property, one has a right to the rental cashflows generated by that property. Traditionally (and most simplistically) this is the only investment value of a property, and property prices are determined as follows:

$$P_t = \frac{NOI_{t+1}}{(1+r)} + \frac{NOI_{t+2}}{(1+r)^2} + \frac{NOI_{t+3}}{(1+r)^3} + \cdots \tag{3.1}$$

Here P_t is the price of the property at time t, NOI_t is the property's net operating income, and r is a discount rate representing the required rate of return. Assuming values of NOI that are constant through time, and using the properties of infinite geometric series, equation 3.1 can be reduced to the well-known formula for a perpetuity.

$$P_t = \frac{NOI_{t+1}}{r} \tag{3.2}$$

If the NOI increases at a constant rate of g, we have the Gordon Growth model:

$$P_t = \frac{NOI_{t+1}}{r-g} \tag{3.3}$$

While property prices are often determined in this way in their most basic form, there is a vital component missing here. In order to investigate this component, we need to use the concept of market efficiency, or informational efficiency, which will be central to the methodology of this chapter. Specifically, we assume that today's prices already contain all of today's information, which implies that, given today's information, it is impossible to form a profitable trading strategy based upon this information.

By simply perpetualizing tomorrow's rent to determine a property price, we have not taken into account forecastable growth opportunities which we buy into by buying the property, but which are not yet shown in rents. In an informationally efficient market, prices must include all signals known today, including those concerning forecastable future events. However, in an ideally liquid rental market, these signals will only be present in rents once the forecast event actually occurs. We have thus identified a second component to property prices beyond pure NOI: that of forecastable growth opportunities. This component is often expressed as fluctuations in the capitalization rate. It is important to note that this component will only be present in the short run, as in the long run prices and rents should contain the same information.

It is often said that direct property markets are not efficient and there may be some truth to that. In spite of this low level of informational efficiency, however, it is realistic to assume the existence of enough information that is at least quasi-public (it is sufficient that the buyer and the seller in each transaction have it) to guarantee the existence of an expectations-based component in property values, such that property values contain information that is not contained in NOIs.

3.3.2 Stock Markets

The stock market (where REITs are traded) is generally perceived as having a much greater level of informational efficiency than the property market, and we will be making use of this efficiency.

In fact, in order to assess whether REITs are income vehicles or appreciation vehicles we will simply examine the REIT market's response to changes in the respective direct market series. If REITs depend on direct property market information, any relevant information from the direct property market should be shown in REIT prices, as soon as it is available. Conversely, we can assume that, due to the efficiency of the market, information that is public, but not shown in REIT prices, is not relevant to the pricing of REITs.

Thus, in order to address whether REITs can realize the forecast short-term appreciation opportunities of the property market, it suffices to examine whether changes in this component of property prices are reflected in REIT prices. If they are not, we can infer that investors perceive this component to be irrelevant, which can only be the case if REITs cannot realize such appreciation opportunities.

3.3.3 The Model

In our examination of REIT prices we will mirror the information gathering process of a REIT investor. An investor will start by using costless public information, then move on to cheap information sources, and then to more expensive ones. Furthermore, in an environment of costly information, an investor will only gather information on a factor which provides useful *incremental information content* over the factors that are already in the pricing model.

In a similar fashion, we will be building a factor model to assess the risk factors that determine fluctuations in REIT prices. After adding each explanatory variable, we will examine whether this last variable added provides useful *incremental information content* to the model. If not, the last added variable is not priced into REITs, and is thus not relevant as a REIT risk factor.

Specifically, we examine, initially, the explanatory power of a two-factor model of (freely available) trend – and market – control variables:

$$REIT_t = \alpha_1 + \beta_{11} stock_t + \beta_{21} int_t + \epsilon_{1_t} \tag{3.4}$$

Here, $REIT_t$ is a REIT index total returns series, $stock_t$ is a general stock market index return series, and int_t is changes in the interest rate, with ϵ an error term. The fact that REIT performance is strongly correlated with that of the general stock market is an idea that is quite common in the REIT literature and has often been observed (Mengden and Hartzell (1986), Peterson and Hsieh (1997), Oppenheimer and Grissom (1998), Clayton and Mackinnon (2003), to name a few). Explanations given for this often cite either liquidity trading, which would explain REITs' participation in market-microstructure related phenomena, such as the January effect, or the stock investor's ability to overreact or participate in fads, due to the easy reversibility of trades in a low-transaction-cost environment such as the stock market. The fact that REITs suffered in the stock market crash of *Black Monday* in October 1987, presents a prime example of how REITs are affected by general stock market performance. The main reason interest rate is a control variable in this model is that changes in the risk-free rate contribute strongly to changes in the discount factor used to price real estate[1]. We should thus expect a negative coefficient for *int*. By including these control variables in the model, as we start adding property-specific factors, we put the effect that this latter information has into perspective, compared to what can be explained without any such information, but just with general indicators.

Thus, we then add the first direct-market variable, changes in property-level income, *inc*:

$$REIT_t = \alpha_2 + \beta_{12} stock_t + \beta_{22} int_t + \beta_{32} inc_t + \epsilon_{2_t} \tag{3.5}$$

Finally, we add changes in property-level appreciation, *app*, to the model:

$$REIT_t = \alpha_3 + \beta_{13} stock_t + \beta_{23} int_t + \beta_{33} inc_t + \beta_{43} app_t + \epsilon_{3_t} \tag{3.6}$$

Rents generated by a property portfolio, *inc*, are not necessarily public information and data on these may be somewhat costly to obtain. Due to the nature of property[2], it is necessary to pay an appraiser to determine appreciation returns: this makes *app* the most expensive information to obtain, and we thus add it last. It is thus apparent how the construction of our model mirrors the investor's information gathering process.

[1] The reader should consult chapter 2 for details.

[2] see section 3.4.2 for more information on this

3.4 Data and Methodology

3.4.1 REITs

As data for our REIT price series, we take total returns for the National Association of Real Estate Investment Trust's (NAREIT's) Equity-REIT index. Thus, this includes both share price changes and dividend returns of the index constituents. As mentioned previously, this approach differs from that of Pagilari and Webb (1995), but, as dividends are managed, it is not advisable to separate the share-level income and appreciation components. In using a REIT index as our dependent variable we are proxying for a well-diversified REIT portfolio held by an investor.

The REIT boom of the 1990s substantially altered the REIT industry, increasing the level of institutional investor participation in the market (and therefore increasing investors' general understanding thereof), as well as generally causing enormous growth in the size of the industry and that of certain individual firms. These changes suggest that we may see a difference in our results between *old* and *new* REITs and we will therefore test time-period subsamples of the data as well as the entire 1978-2003 sample.

3.4.2 The Direct Real Estate Market

For direct market data we use the National Property Index (NPI) from the National Council of Real Estate Fiduciaries (NCREIF). This quarterly index is based on a database of institutionally-held non-agricultural investment-grade real estate currently valued at $138 billion. The index returns data is split into two components, income, and appreciation, both of which we use as data for the respective direct market variables. The income return component is computed purely on the basis of net operating income each property generates.

The appreciation component is computed as the scaled difference between each property's market value at the beginning of a quarter and at the end. However, due to infrequent trading in this market, market prices can only be observed seldomly and collecting such data becomes problematic. Furthermore, the property market is heterogeneous so that even when transactions are observed on a building other than the one being examined, the translation of the implications of such a transaction to the value of the building in question is often nontrivial. The common solution to this problem is to retain the services of a professional appraiser who will regularly estimate a valuation for a building. The appraisal process and the compiling of appraised data, however, implies many problems which must be accounted for. The issues associated with data such as this can be classified into two categories: *stale appraisals*, and appraisal *smoothing* or *anchoring*. We will address both of these issues in turn suggesting a remedy which we apply to our data.

Stale Appraisals

The problem of *stale appraisals* comes from the fact that the NCREIF's NPI is a quarterly index, yet many properties in its database are only appraised annually, respectively at different times throughout the year. Thus, while the database records quarterly observations, many of the appraisals it contains are up to a year old. This way, in each new observation we are observing a mixture of new and older information. This gives the series a temporal lag bias, causing it, for example, to miss market turnarounds.

Appraisal Anchoring

Appraisal *anchoring* or *smoothing* comes from the event of a renewed appraisal. If the same appraiser values a property which he has valued before, he will take his old valuation of the property as a starting point and then make adjustments according to market events that have occurred in the meantime. Through this procedure, appraisers will tend to give too much weight to their old valuation, which will cause the appraised values to understate volatility and, once again, miss market turnarounds. This phenomenon of appraisal smoothing has been widely documented in the literature, most notably so in Clayton, Geltner and Hamilton (2001). While previous studies only assumed appraisal anchoring to be the cause for the temporal lag bias present in appraised real estate values, Clayton et al have demonstrated this empirically. By analyzing both the appraisals and the raw data available to the appraisers of the properties of a Canadian real estate fund, this study finds that a repeat appraisal contains only 69% new information, while a fresh appraisal contains about 87% new information.

Corrective Measures for *Smoothing* and *Stale Appraisals.*

Because these issues exist systematically, we must take corrective measures to account for them. This is known as reverse-engineering of the appraisal-based data, and different methodologies for this can be found in the literature. A common such methodology is the following, first presented in Blundell and Ward (1987), refined in Geltner (1989), Ross and Zisler (1991), Geltner (1991), and finalized in Fisher, Geltner and Webb (1994). Fisher et al. (1994) describe the appraisal process in the following model:

$$P_t^* = w_0 P_t + b(B) P_{t-1}^* \tag{3.7}$$

where P_t^* is the series of logarithms of smoothed prices and P_t the logarithms of unobservable true prices. w_0 is a numeric weight and $b(B)$ is a polynomial function of the lag operator, B:

$$b(B) = b_1 + b_2 B + b_3 B^2 + \cdots \tag{3.8}$$

where B refers to one lag ($BP_{t-1} = P_{t-2}$), B^2 refers to two lags ($B^2 P_{t-1} = P_{t-3}$), etc. The appraiser thus combines new and old information to form his appraisal to proxy for today's unobservable price. Taking first differences, we obtain returns:

$$r_t^* = w_0 r_t + b(B) r_{t-1}^* \tag{3.9}$$

where r_t^* is the series of smoothed index returns, and r_t is the underlying unobservable true return. Conceptually, this model can be estimated as

$$r_t^* = b(B) r_{t-1}^* + e_t \tag{3.10}$$

with $e_t = w_0 r_t$, consisting of white noise, so that the autoregressive parameters (b_i) can be estimated. This fits nicely into the framework of unobservable true returns. The implied true returns are then simply the scaled residuals from this autoregression, namely:

$$r_t = \frac{\left(r_t^* - \widehat{b}(B)r_{t-1}^*\right)}{w_o} \tag{3.11}$$

One further condition must then be applied in order to evaluate w_0 and obtain the true return series, a condition limiting the volatility. In this case, Fisher, Geltner, and Webb stipulate simply that the standard deviation of the true returns be half that of the S&P 500, or

$$\sigma(r_t) \equiv \frac{\sigma(S\&P)}{2} \tag{3.12}$$

which, although rather arbitrary, seems to be the case in practice. Thus we have:

$$w_0 = \frac{2\sigma\left(r_t^* - \widehat{b}(B)r_{t-1}^*\right)}{\sigma(S\&P)} \tag{3.13}$$

A simplification can be applied to this model. As Quan and Quigley (1989, 1991) have demonstrated, a simple AR(1) process will capture appraiser behavior at the disaggregate level. Ross and Zisler (1991) and Geltner (1989, 1991) have shown that at the index level, for a quarterly index we can do this through an AR(1,4) process: as most properties are reappraised only annually, the 4th-order autoregression term corrects for anchoring of single appraisals. The 1st-order term now corrects for stale appraisals, with the implication that after one quarter not enough new information has entered the index.

The central assumption in Fisher, Geltner, and Webb's procedure is that property prices follow a random walk and that therefore returns should not be serially correlated. The model can thus be summarized by the following set of equations:

$$r_t^* = b_1 r_{t-1}^* + b_2 r_{t-4}^* + w_0 r_t \tag{3.14}$$

$$r_t \sim N(0, \sigma^2) \tag{3.15}$$

Together with equation 3.13, these can be combined to produce the following implications:

$$r_t^* = b_0 + b_1 r_{t-1}^* + b_2 r_{t-4}^* + \epsilon_t \text{ with } b_0 \approx 0,\ E(\epsilon_t) = 0,$$

$$\text{and } \sigma^2(\epsilon) = w_0^2\sigma^2 \tag{3.16}$$

$$w_0 \quad = \quad 2\sigma\left[r_t^* - \left(b_1 r_{t-1}^* + b_2 r_{t-4}^*\right)\right]/\sigma(S\&P) \tag{3.17}$$

A further improvement on this reverse engineering procedure is formulated by Cho, Kawaguchi and Shilling (2003). The basic model is specified in a very similar way, with the same construction as in 3.14 above. However, the condition imposed by expression 3.15 and 3.16 is reformulated, to allow for a random walk with drift, and some serial correlation in returns, whereby Cho et al. (2003) allow for long-run mean reversion, which seems to be the case in practice. Instead of condition 3.15 above, Cho et al. impose the following:

$$r_t = \alpha + \rho r_{t-1} + \epsilon_t, \text{ with } E(\epsilon_t) = 0,\ \sigma^2(\epsilon) = \sigma^2,\ |\rho| < 1, \text{ and } \alpha \neq 0 \tag{3.18}$$

The condition that $|\rho| < 1$ guarantees stationarity, and $\alpha \neq 0$ gives a compensation for risk, with mean return of $\alpha/(1-\rho)$. By substituting from the new solution for ϵ, equation 3.16 now becomes a model of generalized differences:

$$r_t^* - \rho r_{t-1}^* = \alpha w_0 + b_1\left(r_{t-1} - \rho r_{t-2}\right) + b_2\left(r_{t-4} - \rho r_{t-5}\right) + \epsilon_t' \text{ where } \epsilon_t' = w_0\epsilon_t \tag{3.19}$$

Instead of equation 3.17, which, despite seeming to be the case in reality, seems somewhat arbitrary, Cho et al. simply impose the condition that the weights given to each piece of information should add to 1, giving:

$$w_0 = 1 - b_1 - b_2 \tag{3.20}$$

They test this model's performance compared with that of Fisher et al. (1994), on the appreciation component of the NCREIF NPI. They find that, in the previous model, the desmoothed index seems plausible from 1978 until 1992, after which it completely divorces itself from the smoothed index. They ascribe this to the fact that in the model of Fisher et al., the weight w_0 is not constrained to be less than or equal to 1. Their own model does not show such a bias, throughout the entire time window.

Thus in this chapter we will be using the model of Cho et al. to correct for temporal lag bias in our direct market appreciation data. Equation 3.19 cannot be estimated directly through OLS, so, in line with the authors' empirical

Table 3.1: Regression results: Iterative estimation of $r_t^* - \rho r_{t-1}^* = \alpha w_0 + b_1 (r_{t-1} - \rho r_{t-2}) + b_2 (r_{t-4} - \rho r_{t-5}) + \epsilon_t'$

Variable	Coefficient	Std. Error	t-statistic	p-value
αw_0	0.0194794	0.0944057	0.2063	0.8370
b_1	−0.238997	0.0792469	−3.0159	0.0033
b_2	0.543328	0.0770052	7.0557	0.0000
ρ	0.737598	0.0675085	10.926	0.0000

Unadjusted R^2	0.433058
Adjusted $\bar{R}^2$	0.420995
$F(2,94)$	35.9008

application of their model, we use an iterative process to obtain estimates for the parameters b_1 and b_2. The procedures goes as follows. We stipulate an initial value for ρ which we use to form the generalized differences of the lagged returns, in order to estimate equation 3.19. In doing so we obtain estimates for the parameters b_1 and b_2 which we then insert into equation 3.19, rearranged to get a parameter estimate for ρ:

$$\left(r_t^* - b_1 r_{t-1}^* - b_2 r_{t-4}^*\right) = \alpha w_0 + \rho \left(r_{t-1}^* - b_1 r_{t-2}^* - b_2 r_{t-5}^*\right) + \epsilon_t' \tag{3.21}$$

The estimated new value for rho is then entered into equation 3.19 and so forth. With each iteration we obtain a better parameter estimate for ρ. We start with a guess of 0.5 for ρ and do 100 iterations, after which two consecutive estimates differ by less than 10^{-10} [3]. After only 33 iterations the estimates differ by less than 10^{-6}. Table 3.1, page 42 presents the results and significance levels of the final iteration.

We thus have now adjusted our appraisal-based appreciation series for temporal lag bias.

[3] A coarse grid search testing starting values of ρ between 0.05 and 0.95 by increments of 0.05 always yields conversion to the same final parameter estimates, with differences of less than 10^{-8} after 100 iterations.

More Corrective Measures: *Price Discovery.*

Conceptually, we have now brought this series from an appraisal-based level to a transactions level. There is, however, one further aspect that we must account for in our analysis, that of *price discovery*. This phenomenon, which, once again, is well-documented within the literature (Giliberto (1990), Myer and Webb (1993), Barkham and Geltner (1995), among others), consists of a time lag between securitized and unsecuritized real estate, with prices of the former being found to lead those of the latter by six months to two years, depending on the study. Once again this seems to contradict market efficiency as, surely, profitable trading strategies can be formed in the direct real estate market if it is known that the securitized market leads it. The fact that this is not so must be ascribed to frictions existing in the unsecuritized market. While the sale of a REIT share is nearly instantaneous, a transaction in the direct market is quite slow. The lags between the securitized market and the direct market are due to the transaction time of the direct market and therefore no profitable trading strategies can be formed upon them.

While the market remains informationally efficient despite this price discovery effect, for the purposes of our study this is not sufficient: in fact, once a transaction is complete (and has appeared in the public record), the pricing information contained therein is already three to twelve months old, as price tends to be more or less locked in toward the beginning of a transaction[4]. Thus our reverse engineered data shows us old pricing information. As a remedy to this, since money generally only changes hands once the transaction is official, we can liken a transaction in the real estate market to a forward contract. Assuming rational parties in the transaction, it is clear from general finance theory how a forward contract is priced. For our purposes, with this re-engineered (transaction-like) index we are observing the *forward price*, and we can thus deduce the *spot price*, or the pricing information at the time the price was set, using normal forward-pricing relationships. Only this way will we have pricing

[4]See, for example Geltner and Miller (2001), or Crosby and McAllister (2005) for detailed outlines of the sales process of a property.

information that is comparable to that we receive from the REIT market.

The well-known forward pricing relationship for a security without dividends is as follows:

$$F_t = S_0(1+i)^t \tag{3.22}$$

where F_t is the forward price for a contract expiring at time t, S_0 is the spot price today of the underlying asset, and i is the risk-free interest rate per period. Solving for S_0 we get:

$$S_0 = \frac{F_t}{(1+i)^t} \tag{3.23}$$

In our case we want to obtain quarterly returns data, rather than price data, so we let $R_0 = \ln(S_0) - \ln(S_{-1})$. Using quarterly annualized 6-month treasury-note rate data, and a transaction time of three quarters we obtain:

$$\begin{aligned} R_0 \quad = \quad & \ln\left[\frac{F_3}{(1+i_1)^{1/4}(1+i_2)^{1/4}(1+i_3)^{1/4}}\right] \\ & - \ \ln\left[\frac{F_2}{(1+i_0)^{1/4}(1+i_1)^{1/4}(1+i_2)^{1/4}}\right] \end{aligned} \tag{3.24}$$

Reducing, we obtain

$$R_0 = \ln F_3 - \ln F_2 + \frac{\ln(1+i_0) - \ln(1+i_3)}{4} \tag{3.25}$$

or

$$R_0 = r_3 + \frac{\ln(1+i_0) - \ln(1+i_3)}{4} \tag{3.26}$$

where r_t is the return on the reverse-engineered appraisal-based index, t quarters from the quarter being observed. The amount of lead time to be used (three quarters) was found by maximizing the time-displaced cross correlation of this series with market income. Since the income series does not suffer from appraisal-related error, as there is no appraisal used in constructing it, we can use it to determine the optimal lead: by maximizing the time-displaced cross correlation with income, we search empirically at which lead value the income-related component of appreciation best reflects current market income and find the above lead time. Furthermore, three quarters is also well within the range of realistic transaction lengths of three to twelve months quoted in the literature and by property professionals[5]. We can then examine the incremental information content the expectations component of appreciation provides in explaining REIT returns, once income is in the model.

3.4.3 Other data

For the stock market series, we take a Standard and Poors (S&P) 500 quarterly total returns series. For the interest rate factor, we use changes in 3-year US treasury note rates.

3.5 Preliminary Results

Throughout table 3.2 we assess the incremental information content that the two direct market variables (*income* and *app*) provide in explaining REIT returns.

From these results, we can draw some preliminary conclusions. Both the addition of *income* as well as that of *app* to the model raises the respective $\overline{R^2}$, from 21% to 26% and from 26% to 33% respectively, suggesting that over the entire sample (in the long run) the incremental information content added to the model by both of these variables is relevant. The signs of the coefficients of all variables look plausible. That of $d3yrtr$ is negative due to the intrinsic discount factor in the valuation of both securitized and unsecuritized real estate being linked closely to the underlying risk-free rate.

As for statistical significance level, we must approach these results with a large degree of caution. As is apparent from table 3.2, both the addition of *income*, and much more so that of *app* to the model, considerably alters coefficients and significance levels of other variables that were previously already present in the model. With the addition of *income*, the coefficient and standard error of *S&P500* are slightly affected and the coefficient of $d3yrtr$ is also slightly affected while its standard error remains largely unaffected.The addition of *app* to the model has an even more dramatic effect, making *S&P500*, and *income* insignificant, while drastically changing their coefficients.

[5] for example, Geltner and Miller (2001).

Table 3.2: Regression results.

Dependent variable: NAREIT equity index total returns. Standard errors in parentheses.

Time Period: 1978:1-2003:2

	Model 1	Model 2	Model 3
const	2.8321	−8.5499	−0.7775
	(0.7225)***	(5.3593)	(5.1849)
S&P500	0.2924	0.3132	0.1387
	(0.1064)**	(0.1059)**	0.0950
d3yrtr	−0.2826	−0.3288	−0.3206
	(0.0640)***	(0.0664)***	0.0533***
income		5.7331	1.6173
		(2.8232)*	(2.7127)
app			1.0643
			(0.3852)**
N	102		
$\overline{R}^2$	0.2150	0.2640	0.3313
F	14.8374	13.0762	13.0170

S&P500: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

app: Property-level appreciation returns.

*: significant at the 5% level.

**: significant at the 1% level.

***: significant at the 0.1% level.

White tests for heteroskedasticity were performed on the residuals, leading to a rejection of homoskedasticity at a 5% level or better in all cases. Therefore all the estimations presented in this chapter have been performed with Huber-White heteroskedasticity-adjusted standard errors.

We know, from economic intuition, that *income* and *app* are highly collinear, since one of the two components of property-price appreciation is completely income driven, and our price-discovery-adjusted appreciation variable is constructed in order to maximize this component. The large alterations in the coefficients and standard errors that occur when adding *app* to this model support this idea, but the changes in *S&P500* and the constant suggest that these variables might also be involved in the collinearity relationship[6].

3.6 Further Adjustment of the Data

In order to rigorously investigate these collinearity relationships empirically, we use the procedure of singular value decomposition. The procedure and its results are outlined in appendix A.

As table A.1, page 132 shows, the largest condition index for our data is 25.0817, indicating a near dependence. It is a four-way collinearity relationship between the intercept, *S&P500*, *income*, and *app*. Applying this technique to the subsamples we will be investigating, yields quite similar results, so these tables are not reported here to save space. Note, however, that over the 1999-2003 subsample, *d3ytr* is also part of the collinearity relationship. Conceptually, the fact that the intercept is involved in this relationship may seem surprising initially, although it can be explained quite plausibly by the smoothness of *income*: perhaps not surprisingly, there are quite small fluctuations in quarterly income returns over the entire time period. The fact that we have detected the involvement of the intercept in this relationship shows the effectiveness of this test for collinearity, as in many other types of test this important source of collinearity is often missed.

Clearly, since, by design, the collinearity relationships observed here are unavoidable, it is not possible to drop an explanatory variable, or undertake any other *simple remedies* to this problem, without ruining the probative value of this test. Instead, we adjust our data through the method of orthogonalization

[6] Once again, this would make economic sense, as all these variables have a constant trend, and there might be common economic factors driving stock- and real-estate markets.

or orthogonal projection. This is a technique often used in the financial asset pricing literature (most notably, perhaps, Fama and French (1993)) and some times in the REIT literature (Chatrath, Liang and McIntosh 1996). The former study uses this technique to find a pure cross effect of stock-market factors on the bond market, as bond-market and stock-market factors tend to be correlated, a problem not dissimilar in nature to the one we are facing. The latter study uses this technique to create a *pure industry factor* of REITs, orthogonal to the general stock market.

This technique consists of regressing one collinear variable on the other, and then using the residuals from this regression in the model. Due to the nature of ordinary least squares, the residuals will be orthogonal to the explanatory variables, removing the collinearity issues we are facing. This method is similar to a Gram-Schmidt orthogonalization (often also referred to as QR decomposition) used to form an orthogonal basis for a vector space[7]. In our case we estimate the following models:

$$\begin{aligned} income_t &= \gamma + \psi_1 S\&P500_t + \iota_t && (3.27) \\ app_t &= \delta + \zeta_1 S\&P500_t + \zeta_2 income_t + \xi_t && (3.28) \end{aligned}$$

Model 3.6 (page 36) then becomes

$$REIT_t = \nu + \varphi_1 S\&P500_t + \varphi_2 d3yrtr_t + \varphi_3 \widehat{\iota_t} + \varphi_4 \widehat{\xi_t} + \tau_t \qquad (3.29)$$

It is easy to show that this is nothing but a reparameterization of model 3.6 and that therefore $\tau = \epsilon_3$. To do this, we substitute into 3.29 from 3.27 and 3.28:

$$\begin{aligned} REIT_t &= \nu + \varphi_1 S\&P500_t + \varphi_2 d3yrtr_t + \\ &\quad + \varphi_3 \left(income_t - \gamma - \psi_1 S\&P500_t\right) + \\ &\quad + \varphi_4 \left(app_t - \delta - \zeta_1 S\&P500_t - \zeta_2 income_t\right) + \tau_t \qquad (3.30) \end{aligned}$$

Combining, we obtain

$$\begin{aligned} REIT_t &= (\nu - \varphi_3\gamma - \varphi_4\delta) + (\varphi_1 - \varphi_3\psi_1 - \varphi_4\zeta_1) S\&P500_t + \\ &\quad + \varphi_2 d3yrtr + (\varphi_3 - \varphi_4\zeta_2) income_t + \varphi_4 app_t + \tau_t \qquad (3.31) \end{aligned}$$

[7] See Seber and Lee (2003) for further information on this technique

Since we have merely reparameterized the model there should be no statistical concerns associated with performing this technique in terms of explanatory power, as the residuals remain the same, subject to the computer's rounding error. We altered the t-tests we perform, however, specifying how significance should be allocated. It must be noted here that it does matter in which order these orthogonal projections are performed. For us, however, only the order described above makes sense in the framework of our assessment of incremental information content, due to the functioning of the information gathering process described earlier[8]. Recall that the simplest information to obtain for an investor is trend- and general stock-market information, so we assign this information content, where contained in multiple variables, to these two, as these are the only data the investor needs to collect in order to have this information. Thus, by removing the component in *income* which is explained by simple trend and by *S&P500* we are testing for the significance of the information content of *income* that is unique to this variable. Similarly, data on property *income* is easier and cheaper for the investor to obtain than data on property appreciation, since the former can be taken off a property's balance sheet, while the latter requires an appraiser, so we assign income information contained in both *income* and *app* to *income*, as only income data needs to be collected to have this information, while appreciation data does not. Thus, having removed the trend as well as the effects of the stock market and of *income* from *app* we test for the significance of the information content that is unique to *app*, and for which, therefore, it would be necessary to collect appraisal information. Note further, that this isolates exactly the component of appreciation that we are after, that is, fluctuations in prices caused solely by a change in capitalization rate. The improvement we have here over our results in table 3.2 is that we can draw meaningful conclusions about variable significance, and therefore assess the relevance of information content in an incremental sense, in a multiple regression containing all factors. This will be somewhat more illustrative than simply examining contributions to $\overline{R^2}$.

[8]See section 3.3.3, page 35.

3.7 Results

Table 3.3, page 51 shows the results of this investigation using the orthogonal projections *income_o* and *app_o* derived above, to proxy for the variables *income* and *app* respectively. In this table, all data series have been scaled by their respective standard deviations, to enable us to compare coefficient sizes in a meaningful way, without problems of scaling.

In this orthogonalized framework, in Model 4, all variables are significant over the entire sample. The sizes of the coefficients for *income* and *app* are similar, which, with the strong contribution to $\overline{R^2}$ of appreciation information that we saw in table 3.2 (page 46), suggests the conclusion that appreciation content is relevant in explaining REIT prices in the long run. In fact, in the long run, the expectations-based component of property value that differs from income information disappears, as all (correctly) expected shocks are capitalized into rental cashflows sooner or later. We must look at the time-period subsamples to determine whether this is the case in the short run, also because our full sample contains both *old* REITs as well as *new* REITs which may behave quite differently from each other, with respect to the phenomenon in question.

Table 3.3 examines the following subperiods: 1978-1992, the pre-boom period; 1993-2003, the boom and post-boom period; 1999-2003, a strictly post-boom period. The orthogonalized versions of the direct market variables have been recomputed over each subperiod as, while the general nature of the collinearity relationships remains unchanged, there may have been small changes in the sizes of the coefficients involved.

As is clearly visible from the results in table 3.3, *old* REITs (Model 5) seem to have undoubtedly been income vehicles. The coefficient for *income_o* grows by 75%, with only a slight increase in standard error, while the coefficient for *app_o* is reduced by a factor of 100 and becomes insignificant, compared to the entire sample. This makes a rather strong statement about the accuracy of our hypothesis in the case of old REITs. The data shows that the non-income information content of property appreciation is not contained in REIT prices and that therefore *old* REITs were perceived by investors as pure income

Table 3.3: Regression results with orthogonalized explanatory variables.

Dependent variable: NAREIT equity index total returns.

Heteroskedasticity-corrected standard errors in parentheses.

	Model 4	Model 5	Model 6	Model 7
Time Window	1978:1-2003:2	1978:1-1992:4	1993:1-2003:2	1999:1-2003:2
Number of Obs.	102	55	43	19
Intercept	0.3319	0.3227	0.4320	0.2879
	(0.0977)***	(0.1182)***	(0.1571)***	(0.1990)
S&P	0.2746	0.0343	0.0278	0.0005
	(0.0984)***	(0.0137)**	(0.0189)*	(0.0277)
d3yrtr	−0.4993	−0.0491	−0.0133	0.0207
	(0.0861)***	(0.092)***	(0.0104)	(0.0195)*
income_o	0.2094	0.3578	−0.2282	0.8667
	(0.0600)***	(0.0858)***	(0.1342)*	(0.2660)*
app_o	0.2263	0.0038	0.0306	0.1035
	(0.0884)**	(0.1125)	(0.1547)	(0.2365)
$\overline{R^2}$	0.3684	0.4941	0.0365	0.5785
F	15.1426	13.1840	1.360	5.8035

S&P: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

app: Property-level appreciation returns.

*: significant at the 5% level.

**: significant at the 1% level.

***: significant at the 0.1% level.

All variables scaled by their standard deviation.

vehicles.

The results over the 1992-2003 time period (Model 6) listed in table 3.3 do not look very promising in terms of helping us in our investigation. While the coefficient for *income_o* is still much larger that for *app_o*, which is insignificant, it has a negative sign, a result which is difficult to rationalize economically, as property-market income should positively affect REIT returns, by most theories. We must keep in mind that throughout the REIT boom, especially between 1992 and 1998, the industry saw an enormous amount of capital inflow that was due to the changing institutional landscape aided by the amendments in tax legislation, and thus a change in REIT investor clientele. Many changes in the market during this time period were caused by factors other than property fundamentals, and thus the most likely explanation for these results seems to be that a fundamentals-based models would be generally misspecified over this time period.

In the 1999-2003 or strictly post-boom subsample (Model 7), the coefficient for *income_o* is now positive again, as we would expect it to be. Furthermore, even in this sample, *income_o* is large and significant once again, while *app_o* is small and not significant. Based on this, we can cautiously accept the hypothesis that appreciation does not provide relevant incremental information content to REIT investors even in post-boom times, suggesting that even *new* REITs are income vehicles, at least in the short run. We must be cautious about this, mainly because these results are based on only 19 observations[9]. However, only with time will more data become available, so we can only improve on this problem by waiting. This point also may apply to the $\overline{R^2}$. While these values would indicate an extremely good model specification in terms of explanatory power, this may be partly due to the low sample size and thus low statistical power in this case. The fact that the coefficient for *S&P500* becomes small and insignificant in model 7 is in line with previous REIT literature, which finds a decreasing dependence of the REIT industry on the general stock market,

[9]A sensitivity analysis in which we drop or add observations at the early end and drop observations at the late end yields similar results.

linked with the rise of the *new* REIT and investors' better understanding of the industry.

From these results we can thus infer, albeit cautiously for *new* REITs, that both *old* and *new* REITs are income vehicles rather than appreciation vehicles. There generally seems to be a reversion of REIT prices to property values in the long run, where the expectations component of appreciation is less pronounced.

3.8 Conclusion

Throughout this chapter we have investigated the question of whether short-term property-level appreciation is realizable to a REIT end-investor. In order to do this we have applied many corrections to our data, especially those sources reflecting the direct property market: this was necessary due to the nature of the direct property market and its poor liquidity and transparency. Throughout the study we have examined incremental information content of different explanatory variables, arguing that if a variable provides no useful additional information in explaining REIT returns, investors perceive that this variable is irrelevant to REIT returns and that therefore it is not a fundamental which is realized therein.

We found that over our entire 1978-2003 sample, which includes both *new* and *old* REITs, both property-level income and property-level appreciation are positive and significant. Once we divide the sample and examine period sub-samples these conclusions change: over the *old* REIT sample of 1978-1992, income remains large and statistically significant, while appreciation becomes insignificant, strongly supporting our hypothesis for *old* REITs, that investors are not able to realize appreciation returns through these vehicles. Over the 1993-2003 subperiod, our results are inconclusive. We ascribe this fact to the *REIT boom* of the mid 1990s during which the REIT industry grew enormously, to some extent based on factors other than property market fundamentals. Over the post-boom sample of *new* REITs (1999-2003) we find income returns to be significant while appreciation remains insignificant. We further find that the general stock market index becomes insignificant, which is consistent with the rise of the *new* REIT industry, and investors' better understanding thereof. We must be cautious about accepting the findings over this time period, however, due to the few observations they are based on.

We have thus found that, in the short run, REIT returns primarily consist of property-level income and not property-level appreciation. Over the long run, on the other hand, there seems to be a reversion of REIT values toward property values. This seems consistent with previous literature, in that REIT returns have often been found to diverge from direct property total returns in the short run, but to conform to these in the long run. Thus, we may have found a possible explanation for the short-term dichotomy between the performance of REITs and direct real estate. In line with these findings, it seems to be a fallacy to declare REITs as *property* vehicles, as, in the short run all they are is property *income* vehicles.

The next two chapters of this study are devoted to explaining the reason for this phenomenon, and to offering proof for this. In anticipation, we offer this explanation here, without proof. The idea takes as its basis the trading constraints imposed on REITs in order to obtain and retain tax-exempt status. In order to qualify as a REIT, a firm must, among other things, hold each of its properties in its portfolio for at least four years. Furthermore, REITs may only sell 10% or less of their asset base at a time if they sell more than 7 properties per fiscal year. REITs are thus limited in their ability to enter and exit the market, making it difficult for them to *time* the market. Thus, it may be impossible for a REIT to realize a predictable short-term appreciation opportunity. The coming chapters offer evidence that this is the correct explanation for this phenomenon.

Chapter 4

REIT Firm Characteristics and the Income-Appreciation Dichotomy

4.1 Introduction

In chapter 3, we argued that Real Estate Investment Trusts are *property income* vehicles rather than full *property* vehicles, in the short run. That is, a REIT investor is only exposed to cashflows related to the rent generated by that REIT's portfolio, and not to short-term price fluctuations that are not also present in rents[1]. In the conclusion to chapter 3 we posit, without proof, that this phenomenon may be due to the trading restrictions a REIT faces in the direct property market. In fact, in order to retain its tax-free status, a REIT must hold each property in its portfolio for at least four years, and once it sells it can only sell at most ten percent of its net asset base at a time, assuming the

[1] These are often referred to as *changes in capitalization rate*.

REIT makes more than seven transactions in a given year. This renders a REIT unable to time the market, and specifically to sell properties at the correct time, which is necessary in order to realize short-term appreciation gains that are not manifest in income.

In this and the next chapter we present evidence that this trading-restrictions hypothesis is indeed the reason for why REIT investors do not participate in short-term appreciation cashflows. This chapter analyzes REIT firm characteristics, which, we argue, change the way in which a REIT is affected by the trading constraints it faces. The characteristics by which we classify firms are firm size, the degree of geographic and property-type diversification of a REIT's portfolio, and whether a REIT is an Umbrella Partnership REIT (UPREIT) or not. For each set of firm characteristics, we form portfolios of REITs that exhibit similar traits in a particular respect, and compare the extent to which the different portfolio returns reflect shocks in direct-property income and appreciation (the component that is not reflected in income). Then, we combine all firm-characteristic factors in the same model, and assess whether any characteristic dominates over others.

This chapter proceeds as follows: section 4.2 presents background information and previous literature on the issues of size, diversification, and UPREITs. Section 4.3 presents the size test, section 4.4 presents the diversification test, section 4.5 presents the UPREIT test, section 4.6 presents the combined test of all firm characteristics, while section 4.7 concludes. Each of sections 4.3 – 4.6 first presents the theoretical background, arguing why each firm characteristic should affect REIT performance, then presents the relevant model, and then the data used for each test. Subsequently each section outlines the portfolio sort methods used, and finally presents test results and discusses implications.

Since each of the tests of firm characteristics has some precedents in the general finance literature, it will also be interesting to observe to what extent these results translate to REITs.

4.2 Background and Previous Literature

4.2.1 Size Tests

Size tests have, in the last decade or so, featured extremely prominently in shaping the general landscape of the factor modeling literature, as prompted by the resurgence of the Arbitrage Pricing Theory, mainly through the work of Fama and French (1992, 1993). Studies abound in which firm size characteristics are observed and the associated risk factors documented. Even in the REIT literature, firm size characteristics have often been studied, for example in Colwell and Park (1990), McInstosh et al. (1991), and Clayton and Mackinnon (2003). The reader should consult the literature review chapter (chapter 2) earlier in this work, for details on these studies.

4.2.2 Diversification Tests

In the finance literature, one of the main answers to the question of whether there is value in investing in a diversified firm stems back to the Capital Asset Pricing Model (CAPM). The condition of infinite asset divisibility, as part of the assumption of perfect capital markets inherent in this model, implies that, while every rational investor will hold a perfectly diversified portfolio, investors are not willing to pay a premium for diversified firms over specialized firms, as every investor is able to create his own diversified portfolio of specialized firms: therefore, since every investor can diversify individually, there is no need to have firms diversify their activities.

This basic approach, however, can be extended to include costly financial distress. Under such an assumption, it is possible to construct a model in which the individual probability of bankruptcy for each firm diminishes with the degree of diversification of its activities, and thus a diversified portfolio of diversified firms should be worth more than a diversified portfolio of specialized firms, since idiosyncratic risk is reduced at firm level and thus the remainder of idiosyncratic risk left in a reasonably diversified portfolio is also reduced. Furthermore, conglomerates may exploit mental or material synergies, thus again causing a *diversification premium*.

Further considerations raised in this respect concern agency costs associated with firm diversification, especially when this diversification is associated with a merger or an acquisition, as the takeover could be made by the manager as an *empire-building* strategy and not for genuine value maximizing reasons.[2] Under this view, these aspects cause a *diversification discount*.

There is a host of recent literature which finds other explanations for a *diversification discount* ascribing this to an association of diversification with lower values of Tobin's q as in Lang and Stulz (1994), generally linking lower productivity in each sector with diversification (Schoar 2002, Matsusaka 2001, Bernardo and Chowdhry 2002), or simply ascribing this discount to a negative selection bias in firm characteristics of acquiring or acquired firms, rather than to destruction of value in diversification per se.[3] Finally, Gomes and Livdan (2004) construct a model with possibilities for advantages or disadvantages to diversification dependent on firm characteristics.

An important distinction must be made between the concept of diversification in the general finance literature and in the REIT literature. The finance literature examines companies such as Virgin which provides many services ranging from records over mobile phones to airline travel when considering diversification of activities. By these standards, no REIT will *ever* be diversified, as, inherently, all the services a REIT can produce consist exclusively of real estate. What is meant by diversification in this case is diversification of a REIT's property portfolio among different geographic areas of the country and among different property sectors. However, the point cannot be stressed enough that no matter how diversified a REIT's portfolio is, all the REIT provides is property.

In the larger framework of real estate finance, even the original CAPM result on the value of diversification needs to be revised: since property investment requires large amounts of capital, the assumption of perfect divisibility of assets for any investor in the market is naïve. Thus a vehicle such as a REIT is required

[2]See Jensen (1986), Amihud and Lev (1981), Jensen and Murphy (1990), Schleifer and Vishny (1989) among others.

[3]Campa and Kedia (2002), Graham, Lemmon and Wolf (2002).

in order for investors to be exposed to a diversified property portfolio. However, once this vehicle exists, it is, in principle, not necessary for each REIT to be diversified, as then the investor finds himself in a stock-market environment, and asset divisibility is then given to a certain extent, so that the investor can diversify among specialized REITs.

The issue of bankruptcy protection gained from diversification is also a valid one here, as property cycles among different property sectors and different geographical areas of the United States are to some degree asynchronous, in that they reflect a combination of area-specific volatility as well as systematic, nationwide volatility. Therefore, REITs with diversified portfolios may be less likely to incur financial distress caused by subsector specific downturns, thus reducing the overall likelihood of financial distress of any firm in a diversified portfolio of diversified REITs, compared to a diversified portfolio of specialized REITs.

The question of whether shareholder value is increased by a diversified REIT is addressed specifically in Miles and McCue (1982) who find that only geographic diversification, and not property-type diversification, creates shareholder value. Gyourko and Nelling (1996) find that neither diversification by property type, nor geographic diversification affects shareholder value. Chen and Peiser (1999) find that REITs that diversify by property type have a lower level of return, after adjusting for total risk. In a related group of studies, Young (2000) finds that the performance of equity REITs grouped by real estate sector has become more integrated between 1989 and 1998. The reader should, once again, consult the literature review chapter on details about these and other studies.

4.2.3 UPREITs

While the advent of the UPREIT structure has been hailed and acknowledged by many in the REIT literature as contributing to the cause for a structural break in REIT performance, most of these statements have been qualitative or theoretical, probably also due to the young age of the UPREIT vehicle, and therefore to the low availability of data. It seems, however, that many REITs have adopted this structure since it was conceived, and that therefore some research on its value is more than warranted.

4.3 Size Test

4.3.1 Theory

While the finance literature's interest in size characteristics are as described in section 4.2.1, our interest in size characteristics for the purpose of this investigation is of a different nature. In fact, we hypothesize that firm size plays an essential role in determining the way in which REITs are affected by the trading constraints they face.

The holding constraint is, of course, twofold. Our main interest in this test lies in the second part, which says that if a REIT has more than seven sales transactions in a year, each sale must constitute 10% or less of its net asset base. It is this second constraint that will affect firms of different size in different ways, due to the large asset size and poor divisibility of property. To illustrate this, let us consider the following two scenarios.

Suppose a REIT owns nine approximately equally valued properties and has owned these for more than four years. The REIT now receives a reliable (and, ex-post, correct) sell signal on eight of them. Of course, the firm cannot sell all of these properties within a year and still retain both its REIT status, and the profits from these transactions. Thus, the firm is unable to satisfactorily time the market which is necessary for realizing the short-term property appreciation profits that would stem from this signal.

Now suppose, on the other hand, that the REIT that owns these nine properties owns them as part of a portfolio of 100 properties and it receives that same sell signal on the same eight properties. This REIT will be able to sell all eight of these properties, thus exploiting the full value of the sell signal, and capitalizing on the positive short-term price shock. Thus, this REIT has managed to time the market satisfactorily and realizes short-term appreciation gains.

We now take firm size as a proxy for the number of properties contained in a REIT's portfolio, which, as we have just illustrated, should affect a REIT's ability to time the market.

4.3.2 The Model

To test this hypothesis, we augment the basic model from the previous chapter by a size factor, as follows:

$$\begin{aligned} REIT_t &= \alpha + \beta_1 stock_t + \beta_2 int_t + \beta_3 inc_t + \beta_4 app_t \\ &\quad + \beta_5 size_t + \beta_6 size_t \cdot inc_t + \beta_7 size_t \cdot app_t + \epsilon_t \end{aligned} \tag{4.1}$$

As in the previous chapter, we use REIT total returns ($REIT$) as a dependent variable and we use our two control variables *stock* (total stock market returns) and *int* (changes in interest rate). *size* is a dummy variable accounting for firm size[4] while *inc* and *app* are property-level income and appreciation, as in the previous chapter.

4.3.3 Data and Methodology

Data

For direct market data, as in the previous chapter, we use the income and appreciation sub indices from the NCREIF's National Property Index. The same de-smoothing and forward-pricing methodology as in the previous chapter is used on the appreciation series and the reader should consult section 3.4.2 (page 37) for more information on this procedure. The data series is quarterly and covers the time period from the first quarter of 1978 until the second quarter of 2003.

As we have done previously, we use total returns of the S&P 500 index as stock market returns and we use changes in the 3-year treasury note rate as our changes in interest rate.

[4]see section 4.3.3 on details about how this is constructed.

For the dependent variable, we use value-weighted portfolios of all REITs (firms with SIC code 6798) that exist in the returns data obtained from the Center for Research into Securities Prices (CRSP).

Portfolio Sort

For this study we use a similar portfolio sort to that of Fama and French (1992, 1993). At the beginning of quarter t, we compute values for firm market capitalization (cap) and total industry market capitalization ($icap$) for the quarter, based on the closing prices and shares outstanding for each firm at the close of the last trading day of quarter $t-1$ as follows:

$$cap_{i,t} = prc_{i,t-1} \cdot shrout_{i,t-1} \tag{4.2}$$

$$icap_t = \sum_{i=1}^{N} cap_{i,t} \tag{4.3}$$

where $prc_{i,t-1}$ is the share price of firm i at the end of quarter $t-1$ and $shrout_{i,t-1}$ is the amount of shares outstanding for this firm at this time; $i \in [1, N]$ represents each firm that exists in the CRSP database on the last trading day of quarter $t-1$. Firms that are founded during quarter t are only included in the portfolio for quarter $t+1$, while firms that cease to exist during quarter t are included in the quarter's portfolio, provided a figure for return is recorded during one of the three months contained in quarter t.

Based on these market capitalization figures, we form tercile size portfolios, such that the total capitalization of each portfolio ($pcap_t$) is one third of $icap_t$. More precisely, at the end of each quarter, we select the firm in the market that has the smallest market capitalization and assign it to the *small* portfolio. Then we select the next larger firm and also assign it to this portfolio, and so forth, until the total market capitalization of the *small* portfolio just exceeds $\frac{icap_t}{3}$. This last marginal firm is then removed from the *small* portfolio and assigned to the *medium* portfolio. Subsequently the next larger firm is assigned to this portfolio, and so forth until the *medium* portfolio's market capitalization just exceeds $\frac{icap_t}{3}$. This marginal firm as well as the remaining unassigned firms are then assigned to the *large* portfolio.

Table 4.1: Number of Firms per Size Portfolio

Portfolio	Maximum	Mean	Minimum
small	257	168	88
medium	42	18	4
large	15	6	1

The reason why this sorting algorithm is used, rather than a conventional quantile sort putting an equal number of firms in each portfolio lies in the uneven distribution of market capitalization that prevails in the REIT industry. Table 4.1 illustrates this, by showing the maximum, mean, and minimum number of firms in each portfolio.

Notice that 168 firms on average make up the lowest third of industry capitalization while only 6 firms make up the top third. If a quantile sort were used and 64 firms (on average) put in each portfolio, we would have two portfolios completely made up of *small* firms and a third one made up of mostly *small* firms with a few *medium* and *large* added, thus making it impossible to observe size characteristics. Figure 4.1, page 64, illustrates this concept more dramatically: notice how much distributional mass is at the low end of market capitalizations and how little at the high end[5].

Further, note that the placement of the marginal firm that overlaps each portfolio break is such as to favor the larger portfolios. Especially in the first few years of the sample this decision is crucial, as more than the upper third of industry capitalization is made up of only one single firm, and it would clearly be a mistake to place this firm in the *medium* portfolio and leave the *large* portfolio empty, which would be the case if the algorithm were to put the marginal firm in the lower portfolio. In the latter part of the sample, the distinction is not as dramatic, but in order to adopt a consistent policy towards the placement of the marginal firm, this one is used throughout.

[5]While this cross-sectional distribution is at a single date, the illustration is certainly representative of the entire sample.

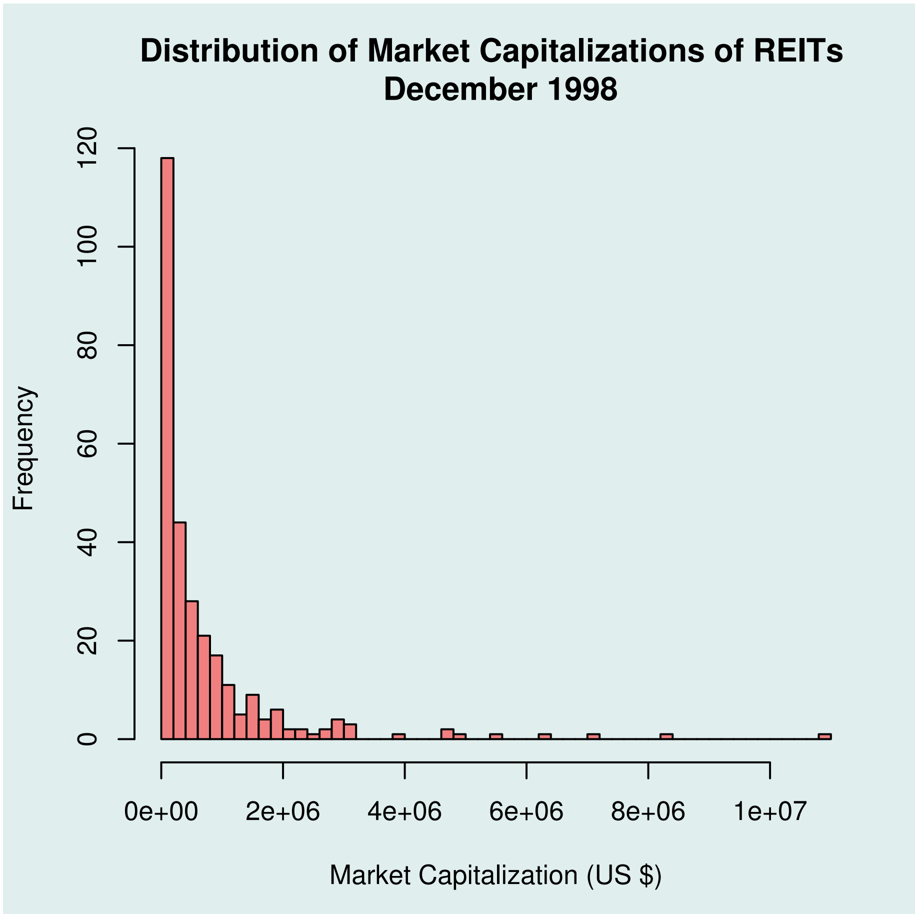

Figure 4.1: Illustration of the distribution of individual firm market capitalizations. While this cross-sectional distribution is at a single date, the illustration is certainly representative of the entire sample.

For the purposes of our estimation, it seems necessary to make an adjustment to this portfolio sort. While, in principle, we use tercile portfolios, we have found, in results not reported here to save space, that, due to the small number of firms in the *large* portfolio, the returns to this portfolio seem to be dominated by idiosyncratic factors and noise, and that, in order to draw inferences about systematic risk factors associated with size, it makes sense to create a *Large* portfolio that consists of firms in either the *medium* or the *large* portfolio[6]. In other words,

$$i \in Large \quad \Longleftrightarrow \quad i \in (medium \cup large) \tag{4.4}$$

Once each firm is assigned to a portfolio, we compute the value-weighted portfolio return for portfolio k in quarter t, ($vwret_{k,t}$) as follows:

$$vwret_{k,t} \quad = \quad \sum_{i \in k} vw_{k,i,t} \cdot ret_{i,t} \tag{4.5}$$

where $vw_{k,i,t}$ is defined as

$$vw_{k,i,t} \quad = \quad \frac{cap_{i,t}}{\sum_{i \in k} cap_{i,t}} \tag{4.6}$$

Here, k is the portfolio identifier and takes a value of *small*, or *Large* while i is the firm identifier, as before. Note that $cap_{i,t}$ is computed at the beginning of each quarter, based on the closing prices and shares outstanding of the previous quarter $t-1$ (see equation 4.2), whereas $ret_{i,t}$, the total return for this firm, is computed at the end of the last trading day of quarter t. This way of constructing and weighting portfolios makes this type of portfolio sort tradeable, mimicking the following strategy: before markets open on the first day of quarter t, a trader sorts firms into portfolios and weights them, according to the previous day's closing data. When markets open that day, the trader then purchases this portfolio and holds it until the end of quarter t, recording the returns to the portfolio.

[6]We considered as an alternative to simply split the firms into portfolios which each occupies half the industry's capitalization, but found that even with such a division, the number of firms in the large portfolio is too small over most of the data set.

We then stack the return series $vwret_{k,t}$ with $k \in small \cup Large$ and define a $Large$ dummy such that

$$Large = \begin{cases} 1 & \text{if } k = Large \\ 0 & \text{if } k = small \end{cases} \tag{4.7}$$

We thus specify the model with one dummy and a constant, as a base-effect plus incremental-effect model, using both pure and interaction effects. Furthermore, as discussed in the previous chapter, we account for the *REIT boom* of the 1990s and use two time period dummies to account for structural breaks in our sample. These are defined as follows:

$$boom = \begin{cases} 1 & \text{if } t \text{ lies between January 1, 1993, and December 31, 1998} \\ 0 & \text{otherwise.} \end{cases} \tag{4.8}$$

$$new = \begin{cases} 1 & \text{if } t \text{ occurs after January 1, 1999} \\ 0 & \text{otherwise.} \end{cases} \tag{4.9}$$

The full model we estimate is best expressed in vector notation

$$\begin{aligned} vwret_{k,t} = {} & [(1 \quad Large \quad boom \quad new \quad Large \cdot boom \quad Large \cdot new) \\ & \otimes (1 \quad S\&P_t \quad d3yrtr_t \quad inc_t \quad app_t)] \cdot \beta \\ & + \epsilon_{k,t} \end{aligned} \tag{4.10}$$

where β is a column vector values β_j, $j = 1, 2, 3, \ldots, 30$. The time series of explanatory variables are recycled to make a small panel dataset with two panel group values (*small* and *Large*). In total, we estimate a model of pure effects of each variable and interaction effects of the explanatory variables with each dummy by itself, as well as the size dummy combined with each time-period dummy. It should be noted as well that *inc* is orthogonalized with respect to *S&P*, and *app* is orthogonalized with respect to *S&P* and *inc*. This way *inc* contains no stock market effects, and *app* contains no stock market or property-level income effects, since we are testing for whether the component of property prices that is not reflected in income is available to the REIT investor, as in the previous chapter.

Table 4.2: Regression Results for Size Test. Dependent Variable: Value-Weighted Portfolio Return. Standard errors in parentheses.

	Model 1	Std. Err.	Model 2	Std. Err.
Intercept	0.0169	(0.00455)***	0.0284	(0.00779)***
S&P500	0.748	(0.0576)***	0.839	(0.108)***
d3yrtr	-0.110	(0.0329)***	-0.0854	(0.0504)$^{\circ}$
income	5.462	(2.363)*	17.0503	(3.223)***
app	0.0890	(0.283)	-0.0972	(0.341)
Large			-0.0225	(0.0121)$^{\circ}$
boom			-0.0180	(0.0308)
new			-0.0345	(0.0690)
$income \cdot Large$			-14.314	(5.0102)**
$app \cdot Large$			0.845	(0.517)$^{\circ}$
$income \cdot boom$			-9.940	(14.304)
$income \cdot new$			13.254	(65.0827)
$app \cdot boom$			1.615	(0.804)*
$app \cdot new$			-1.309	(2.061)
$Large \cdot boom$			0.0337	(0.0586)
$Large \cdot new$			-0.00965	(0.0854)
$income \cdot Large \cdot boom$			2.289	(26.434)
$income \cdot Large \cdot new$			29.968	(78.671)
$app \cdot Large \cdot boom$			-1.946	(1.504)
$app \cdot Large \cdot new$			-0.865	(2.664)
Number of observations:	196			
$\overline{R^2}$	0.4868		0.6712	
F	14.73		47.24	

$^{\circ}$: significance level $\leq$ 10%. *: significance level $\leq$ 5%.
**: significance level $\leq$ 1%. *** : significance level $\leq$ 0.1%.
S&P500: The S&P 500 stock index.
d3yrtr: Changes in the 3-year treasury rate.
income: Property-level income returns.
app: Property-level appreciation returns.

4.3.4 Results and Implications

Table 4.2, page 67 shows results for the regressions estimated in this section. Model 1 is the same regression as in the previous chapter, but with the portfolio returns to the size portfolios as a dependent variable instead of the NAREIT index, while Model 2 is the model described in equation 4.10. In order to prevent errors stemming from misspecification, the control variables were also combined with each combination of dummy variables, but these parameter estimates are not reported here to save space.

We estimate the model in equation 4.10 by ordinary least squares at first. Since a White test on the residuals from this model rejects homoskedasticity at better than 5% significance, the results reported here are heteroskedasticity-adjusted estimates. It would be reasonable to assume that the sources for the heteroskedasticity across time of our residuals come primarily from the stock market, the interest rate, and the property market, and so we model the logs of squared residuals on the explanatory variables and their squares, using the fitted values to construct weights with which we rerun the original OLS regression. This is the familiar two-step feasible generalized least squares procedure.[7] Modeling the heteroskedasticity, instead of, for example, just computing a White correction for random heteroskedasticity, seems especially appropriate here, since, due to the panel-nature of our model, there should be a parallel volatility structure between simultaneous observations on the two portfolios.

The results for Model 1 are included as a calibration to compare the results for Model 2 with. The results for Model 1 differ slightly from those in the previous chapter, in that the coefficient for *app* is not statistically significant, even over the whole sample. We suspect that this is due to the fact that small firms are weighted more heavily in the full two-portfolio panel than they are in the NAREIT index. The effect that this has will become apparent as we further analyze Model 2.

Note that the results for Model 2 in the first panel only apply to *small* REITs before 1993. In this panel, the results fairly closely resemble those from

[7]See, for example, Greene (2003) for details of this estimation procedure.

Model 1, except for the negative sign on the coefficient for *app* – which, however, is not particularly meaningful, given its standard error – and the slightly worse significance of the coefficient for *d3yrtr*. In this subpart of the model, we can conclude with some confidence that REITs do not react to direct-property appreciation shocks that are not contained in income, implying that an investor misses out on short-term property appreciation returns. The next two panels will tell us about the changes that happen outside this base sample.

We now examine the parameters associated with *Large* in the second panel of table 4.2. First of all *Large* itself has a negative value, implying a lower intercept for Large than for small REITs in the pre 1993 sample, thus implying that all else held constant, large firms trade at a discount over small ones, a result that is contrary to the general finance literature. However, it might be the case, that large firms actually do have a higher risk-adjusted return, but a lower total level of return, because their risk is lower.

Of more importance for our study is that large REITs before 1993 are significantly less affected by income than small REITs and significantly more affected by appreciation information not contained in income, as the incremental effect of $app \cdot Large$ is significantly positive. Thus the appreciation effect for large REITs is significantly greater than the one for small REITs (which was indistinguishable from zero). The relatively weak significance value may be due to the fact that size only helps a REIT to overcome (in part) the problems posed by the second half of the trading constraints, and does not in any way alleviate the problems posed by the four-year minimum holding period. In spite of this, however, we can say with some degree of confidence that large REITs are better at realizing appreciation returns that are not contained in rents and do not have as much of an income dependency as small REITs. Thus, large REITs can be considered to reflect much better the underlying property portfolio.

The only other parameter value in the second panel of table 4.2 that is significantly different from zero is $app \cdot boom$, which, in fact, is significantly positive. This implies that during the REIT boom of the 1990s (specifically between the beginning of 1993 and the end of 1998) small REITs also became appreciation driven, in addition to their income dependency. This may suggest that during this period the size distinction among REITs became less pronounced, and that all REITs managed to transmit, to a better extent than before, the total cash-flows of the underlying property portfolio to their investors. This way, as small firms grew, their property portfolios grew in numbers, and thus the trading constraints became less limiting. There may, however, be another explanation for this: it may simply be the case that since the REIT boom of the 1990s was accompanied by a strong real estate market and generally a strong economy, there would have been less of a need for selling properties quickly during that time. In other words, in a market which rises steadily for a long time, the ideal timing strategy is clearly a simple buy-and-hold which no trading restriction prevented REITs from pursuing. In fact, the coefficient value for $app \cdot new$, which is not distinguishable from zero, supports this latter explanation, as this implies that there is no incremental effect over the base value for *app* which was insignificant. Thus, in order for the former explanation to apply, REITs would have had to shrink in size after 1999, which was not the case.

Panel 3 of table 4.2 shows combined time-period size effects, or whether the performance characteristics of large firms change over time. The fact that all the parameter values listed in this table are insignificant implies that the coefficients for $income \cdot Large$ and $app \cdot Large$ in the previous panel apply over our whole sample.

Some concerns may be raised about endogeneity in this model, suggesting that causality might run from returns to size. The method of portfolio sort that we use, however, should help alleviate these concerns, as we are effectively lagging size one period ahead of returns.

These results show that over the entire 1978 to 2003 sample, the relatively few medium and large REITs in existence managed much better to reflect price shocks in the direct property market that were not purely income related, than the many small REITs. Coupled with their weaker income dependency, these large firms seem to be better pass-through securities than small firms, in that they better reflect value fluctuations in their underlying portfolios. The many small firms in the industry did, between 1993 and the end of 1998, also reflect direct property appreciation not contained in income, but this effect was only short-lived and possibly had to do with the monotonicity of the rising market in this period. We thus see that, almost independently of the time period, large firms better reflect short-term appreciation returns than small firms. The fact that large firms trade at a discount to small firms (the negative value of $Large$), while at odds with the general finance literature is in line with the REIT literature and could simply be due to large firms' lower level of risk.[8]

4.4 Diversification Test

4.4.1 Theory

Once again, our primary interest in the question of REIT portfolio diversification is of a different nature than that of the general finance literature. We hypothesize that, just like with size, the degree of a REIT's portfolio diversification will influence how it is affected by the holding period constraint. We focus, once again, on the second half of the selling constraint, which says that once a REIT sells, it can only sell 10% of its asset base at once, if it undertakes more than seven sales transactions in a year.

Let us consider once again the second scenario presented in section 4.3.1, page 60. The large REIT with the 100 properties in its portfolio receives a sell signal on eight of them, which, in this stylized example, it can react to without a problem, satisfactorily timing the market. We must consider, however, the nature of this signal. If the REIT has all of its 100 properties in a single city and all properties are of the same type, it is somewhat more likely that this sell signal would concern all of its properties, especially if it contains information that is systematic to that city's market or that particular property type. Thus, with such a systematic sell signal, the REIT will be unable to act accordingly to time the market, despite its size. We thus argue that for many systematic market signals, size only helps overcome the second half of the trading constraints when

[8]See, for example, Colwell and Park (1990) who obtain similar results.

it is coupled with a certain degree of portfolio diversification. Whether this needs to be only geographic diversification, or property-type diversification, or both, would depend on the specific signal and in general on the synchronicity of property markets across different areas and different property types.

In addition to our main investigation, this section will also yield some insight on the value of diversification in REITs, weighing the value of diversification and bankruptcy protection against the ideas of comparative advantage through specialized local or property-type know how.

4.4.2 The Model

In order to test the general effects of portfolio diversification, as well as its effect on a REIT's income and appreciation dependency, we adapt the model from the previous section, equation 4.1, page 61, to include a diversification dummy instead of the size dummy.

$$\begin{aligned} REIT_t &= \alpha + \beta_1 stock_t + \beta_2 int_t + \beta_3 inc_t + \beta_4 app_t \\ &\quad + \beta_5 div_t + \beta_6 div_t \cdot inc_t + \beta_7 div_t \cdot app_t + \epsilon_t \end{aligned} \tag{4.11}$$

In this model, all variables are as defined in equation 4.1, and *div* is a dummy for the degree of diversification.[9] While we say that diversification is an important *additional factor to size* in helping overcome the problems posed by the second half of the trading constraints, we do not include size in this model, since size is to a large extent correlated with diversification, in that a REIT's portfolio obviously needs to be comprised of many different properties in order to be diversified.

4.4.3 Data and Methodology

Data

The data sources for the main explanatory variables and for the dependent variable are analogous to the previous section.[10]

[9]Details on how this is constructed can be found in section 4.4.3.
[10]See section 4.3.3, page 61.

The diversification data comes from SNL datasource. SNL compiles a database of information contained in 10k and 10q end-of-year and end-of-quarter statements that REITs file with the securities and exchange commission. In this case, we use SNL's property database, which summarizes information REITs give on these statements on a property-by-property basis. Specifically, the database lists, among other things, for each property an identifier of the firm that owns it, the date the firm bought the property, the date it sold it (if it is not still in its portfolio), the property location CBSA code[11], the property location's economic region identifier, and the property's primary property sector classification. From this, we construct a database organized by firm and quarter, listing for each firm-quarter combination how many properties the firm owns in each CBSA, economic region, and for each property type. While SNL started limited coverage of REITs in 1990, it expanded its coverage considerably from 1994 on to include a vast majority of firms in the industry, and so this later date constitutes the starting point of our analysis in this section, to avoid any firm-selection bias that might be associated with SNL's coverage before this date.

The end date and frequency for our analysis is once again dictated by the NCREIF direct-property indices, which terminate at the second quarter of 2003, and are of quarterly frequency.

Portfolio Sort

Just like in the previous section, we use as our dependent variable returns from value-weighted portfolios formed according to firm characteristics, in this case portfolio diversification.

In order to quantify the degree of diversification of a REIT's portfolio, we use a modified Herfindahl index methodology. This methodology originates from the economic analysis of competition in a particular industry, but will serve our purpose very well. We define the value of the Herfindahl index for firm i in

[11]These Core-Based Statistical Areas replace the old MSA (Metropolitan Statistical Area) codes in identifying urban regions.

quarter t as follows:

$$H_{i,t} = \sum_{n=1}^{Q} \left(\frac{prop_{i,t,n}}{\sum_{n=1}^{N} prop_{i,t,n}} \right)^2 \tag{4.12}$$

$n \in [1, Q]$ represents a set of markers for the different CBSAs, economic regions, or property types, making $prop_{i,t,n}$ the amount of properties firm i owns in subgroup n at the end of quarter t. The practicality of $H_{i,t}$, the sum of squared fractional exposures to each subgroup, in assessing the level of a REIT's portfolio diversification can be seen at once: a firm that has all its properties in one subgroup will have an index value of 1, while, for example, a firm with $\frac{1}{4}$ of its portfolio each in a different one of four subgroups will have an index value of 0.25. But this methodology allows us to be more sophisticated than that: a firm which divides its portfolio equally among two subgroups will have an index value of 0.5 while a firm which has $\frac{3}{4}$ of its portfolio in one subgroup and $\frac{1}{4}$ in another will have an index value of 0.625 indicating a higher level of concentration for the latter than for the former, even though both firms divide their portfolios among two subgroups. The lowest values of H can be attained by having the lowest amount of concentration, that is by dividing a portfolio equally among all groups. In this case, the value of H will be the reciprocal of the number of subgroups a portfolio is divided amongst.

For each firm, in each quarter, we construct one Herfindahl index for CBSA-level diversification, one for economic-region diversification, and one for property-type diversification. For each type of Herfindahl in each quarter, we then form a portfolio of *diversified* firms with $H_{i,t} \leq 0.5$ and one for *non-diversified* firms with $H_{i,t} > 0.5$. As before, we assign firms to portfolios at the beginning of quarter t, based on the state of their portfolio at the end of quarter $t-1$. Again, we weight each firm by its market capitalization as a fraction of the portfolio's total market capitalization, based on closing prices and shares outstanding on the final trading day of quarter $t-1$. We then compute portfolio returns for quarter t which we use as our dependent variable[12]

Table 4.3 presents summary statistics for the number of firms and the values

[12] See section 4.3.3 for details on this procedure.

Table 4.3: Number of Firms and Weighted Average Herfindahl per Portfolio, for the Three Diversification Factors

Portfolio	**Maximum**	**Mean**	**Minimum**
CBSA			
Diversified			
Number of Firms	123	96	54
Weighted Average Herfindahl	0.2771	0.1127	0.0960
Non − Diversified			
Number of Firms	15	12	9
Weighted Average Herfindahl	0.9791	0.8891	0.7151
Economic Region			
Diversified			
Number of Firms	94	67	32
Weighted Average Herfindahl	0.3229	0.2722	0.2327
Non − Diversified			
Number of Firms	46	41	31
Weighted Average Herfindahl	0.8622	0.7475	0.6794
Property Sector			
Diversified			
Number of Firms	27	22	17
Weighted Average Herfindahl	0.3972	0.3713	0.3303
Non − Diversified			
Number of Firms	117	86	46
Weighted Average Herfindahl	0.9260	0.8553	0.7950

Note: a company is classified as *Diversified* in a particular factor for quarter t if its value of $H_{i,t} \leq 0.5$.

for H in each portfolio. The weighted average Herfindahl is computed using the same value weights that are used to compute value-weighted returns.

Note once again that we simulate a tradeable investment strategy. At the beginning of each quarter, the investor assigns firms to portfolios and weights each firm by its closing market capitalization from the previous day. At the opening of trade the first day of the quarter, the investor buys these portfolios, holds them until the end of the quarter and records returns. The strategy can be summarized as a comparison between the returns to a diversified portfolio of specialized REITs and a diversified portfolio of diversified REITs.

Once again, to estimate this model we stack the two sets of portfolio returns and create a dummy variable, *div* defined as follows:

$$div = \begin{cases} 1 & \text{if } k = Diversified \\ 0 & \text{if } k = Non-diversified \end{cases} \tag{4.13}$$

where k is the portfolio marker. Since our sample starts in 1994, we only use one time-period dummy, *new*, which is defined as in equation 4.9, page 66.

The entire model we estimate thus becomes:

$$\begin{aligned} vwret_{k,t} \quad = \quad & [(1 \quad div \quad new \quad div \cdot new) \\ & \otimes (1 \quad S\&P_t \quad d3yrtr_t \quad inc_t \quad app_t)] \cdot \beta \\ & + \epsilon_{k,t} \end{aligned} \tag{4.14}$$

Here, β is a column vector with values β_j, $j = 1, 2, 3, \ldots, 20$. We estimate one model for CBSA diversification, one for economic-region diversification, and one for property-type diversification.

4.4.4 Results and Implications

We use the same weighted estimation procedure as in section 4.3.4, page 68 and the results from the three models are presented in table 4.4, page 77.

Looking at the results in table 4.4, we find positive and significant coefficients for *income* in both models 3 and 4, as we did in models 1 and 2 in table 4.2, page 67. In addition, in this case, we also find positive and significant base effects for

Table 4.4: Regression Results for Diversification Test. Dependent Variable: Value-Weighted Portfolio Return. Standard errors in parentheses.

	Model 3 CBSA	Std. Err.	Model 4 Economic Region	Std. Err.	Model 5 Property Type	Std. Err.
Intercept	-0.00671	(-0.724)	0.0467	(0.00865)***	0.0460	(0.0129)***
S&P500	0.712	(0.0725)***	0.420	(0.0638)***	0.375	(0.0972)***
d3yrtr	-0.201	(0.0139)***	-0.228	(0.0395)***	-0.209	(0.0510)***
income	66.133	(20.088)**	30.764	(13.237)*	44.541	(11.607)***
app	2.515	(0.768)**	1.743	(0.528)**	0.699	(0.516)
div	0.0649	(0.0122)***	0.00587	(0.0102)	0.0196	(0.00782)*
new	0.101	(0.0274)***	0.0447	(0.0227)°	0.0290	(0.0224)
$income \cdot div$	-35.753	(22.638)	-2.769	(21.793)	-31.150	(10.719)**
$app \cdot div$	-2.0420	(0.819)*	-1.159	(0.692)°	1.934	(0.379)***
$income \cdot new$	-16.845	(43.223)	8.376	(31.419)	13.0725	(26.974)
$app \cdot new$	-5.798	(1.717)**	-4.0592	(1.345)**	-3.934	(1.674)*
$div \cdot new$	-0.0956	(0.0318)**	-0.00251	(0.0271)	-0.0459	(0.0183)
$income \cdot div \cdot new$	30.913	(48.727)	27.957	(37.729)	48.403	(22.979)
$app \cdot div \cdot new$	1.368	(2.253)	0.595	(1.858)	1.501	(1.088)
Number of observations	68		68		68	
$\overline{R}^2$	0.8349		0.7719		0.9178	
F	18.83		12.93		40.37	

° : significance level ≤ 10%. *: significance level ≤ 5%.

: significance level ≤ 1%. * : significance level ≤ 0.1%.

S&P500: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

app: Property-level appreciation returns.

Note: The control variables *S&P500* and *d3yrtr* combined with the same dummies as the variables displayed here were included in the model but omitted from this table to improve readability.

app: that is, geographically undiversified REITs realize appreciation returns. We must remember, however, that the base time period for this estimation is the one labeled as *boom* in model 2 and that therefore this could be a similar effect to the one discussed in section 4.3.4, page 69. In fact, the coefficient for $app \cdot new$ in the second panel of table 4.4 is significantly negative, suggesting an undoing of this effect after 1999, exactly in parallel with the results for the size test.

What is perhaps more surprising is the significantly negative coefficient for $app \cdot div$ in the second panel of table 4.4 for both of the geographic diversification models, implying that geographically diversified REITs actually do not participate in this *boom* effect, or at least to a much lesser extent. The coefficients for $app \cdot div \cdot new$ in the third panel, which are insignificant, show that, while geographically non diversified REITs are both income and appreciation-driven during the *boom* period and only income driven thereafter, geographically diversified REITs are never appreciation driven.

The slightly weaker negative coefficient for $app \cdot div$ in model 4 and the fact that model 4 is generally slightly weaker than model 3 (in terms of $\overline{R^2}$ and F statistic) suggests that the distinction between geographically diversified and non diversified in these effects is very rigid, with diversification effects taking force as soon as a REIT's portfolio significantly exceeds CBSA limits and that there is little or no additional effects if a REIT's portfolio reaches into a different area of the country. Surprisingly, though, while, all things being equal, a geographically diversified REIT trades at par or in some instances at a slight premium to one that is not geographically diversified, the former do not manage to realize short term appreciation returns while the latter do. Perhaps it is the case that the value of the little market timing that is possible to a very localized REIT, combined with that REIT's intimate knowledge of the local market, exceeds the value of the increased market timing possibilities but perhaps more superficial local market knowledge of geographically diversified REITs. This would be congruous with a set of very idiosyncratic timing signals dominating the market, masking the effect of trying to time the market according to larger systematic signals.

Model 5, on the other hand, paints a completely different picture for the effects of property-type diversification. While the base effect for *income* in the first panel of table 4.4 is strongly positive and significant, that for *app* is not. Examining the coefficients for $income \cdot div$ and $app \cdot div$ in the second panel in conjunction with this, we can tell a similar story for property-type diversification as for size. A REIT that is diversified by property type seems to trade at a premium to one that is not, and seems to better reflect the value of the underlying property portfolio than one that is not diversified in this way, as the former is less income driven and significantly more driven by appreciation effects that are not contained in income, than the latter. As the third panel illustrates, these implications seem fairly consistent over the two different time-period market environments that we analyze. This outcome strongly supports our hypothesis, as, it seems, the asynchronicity that exists among property cycles for different property types better allows a REIT to time the market despite the selling constraints imposed upon it. The one issue that seems puzzling about this model is the significantly negative coefficient to $app \cdot new$ which, in conjunction with the base effect for *app* which is statistically zero, implies that, after 1999, REITs that were not diversified by property type actually reacted negatively to appreciation shocks that were not contained in income.

To summarize these findings, we can thus say that REITs that are diversified by property type consistently trade at a premium over REITs that are not, and their performance is driven by both the rents and the prices of their underlying portfolios, while the performance of property-type specialized REITs is purely income driven. For geographic diversification, the opposite is the case, implying that very locally focused REITs actually profit more from the ability to time idiosyncratic shocks in their portfolios than geographically diversified REITs profit from the ability to time larger systematic shocks. [13] It thus seems to be the case that know-how is better transferable across property types than across

[13]These findings are in direct opposition to those of Miles and McCue (1982) who find that only geographic and not property-type diversification creates value.

local markets.

4.5 UPREIT Test

4.5.1 Theory

While an UPREIT test has no general equivalent in the finance literature, it should be of extremely high interest in this study. An UPREIT does not own property directly, but rather owns partnership units in a limited partnership that owns the property: thus the property is not owned by the REIT, implying that it can be sold without any holding restrictions what so ever, since the entity that holds the property is not a REIT, and a partnership is not governed by these holding period restrictions. For our study, this presents an ideal experimental setup, as we can compare the performance of regular REITs and UPREITs, two entities which are extremely similar in most of their characteristics, except for the way in which they are affected by the holding period constraints. In fact, while the other two tests in this study distinguish only between how firms are affected by the 10% rule, UPREITs are also unaffected by the 4-year holding restriction and can therefore sell properties to time the market as they see fit.

It needs to be noted here that UPREITs were originally set up in order for non-REIT entities to defer capital gains taxes by selling a property for partnership units, and that, in the spirit of this idea, UPREITs would actually be less likely to sell properties and thus to be able to time the market than regular REITs. This test will implicitly weigh these two hypotheses against each other.

4.5.2 The Model

We estimate the usual model for this test, adapting the functional form used in the previous section to include an UPREIT indicator instead of a diversification one:

$$\begin{aligned} REIT_t &= \alpha + \beta_1 stock_t + \beta_2 int_t + \beta_3 inc_t + \beta_4 app_t \\ &\quad + \beta_5 UPREIT_t + \beta_6 UPREIT_t \cdot inc_t + \beta_7 UPREIT_t \cdot app_t + \epsilon_t \end{aligned} \tag{4.15}$$

In this model, all variables are as defined in equation 4.1 and 4.11, and $UPREIT$ is a dummy showing whether a firm is an UPREIT at time t.

4.5.3 Data and Methodology

Data

All REIT return data, stock-market data, interest-rate data, and direct-real-estate-market data sources are as before.

To identify whether firms are UPREITs or not, we use, once again, SNL datasource. In this case, SNL publishes a firm-by-firm database listing specifically, at the end of each year, whether a firm classifies itself as an UPREIT for that year or not, in its 10k and 10q form submissions. This database starts with the end of the year 1993, so due to the nature of our portfolio sort, we start this analysis at the beginning of the year 1994.

The limit on frequency and end date comes once again from the NCREIF dataset which is quarterly and ends after the second quarter of 2003.

Portfolio Sort

Despite the fact that SNL's data is only annual, we use a quarterly frequency here, reconstituting portfolios annually and value-weighting them quarterly as follows.

At the beginning of quarter 1 of year t, we assign firms to an UPREIT or a regular-REIT portfolio, according to their declarations made at the end of year $t-1$. At the same time, we compute value weights, as described in section 4.3.3 (page 62), based on the closing prices and shares outstanding of the previous trading day. At the end of quarter 1, we record the value-weighted portfolio returns, and reweight the portfolios according to the closing prices the last trading day of quarter 1, and hold firms in this weighting until the end of quarter 2, and so forth. Portfolios are reconstituted annually and reweighted quarterly. It is apparent how, here too, we simulate a strategy that is tradeable. Table 4.5 presents summary statistics for the numbers of firms per portfolio.

Table 4.5: Number of Firms per Portfolio

Portfolio	Maximum	Mean	Minimum
Regular REITs	76	60	45
UPREITs	125	109	73

Once again, we stack the return series for the two portfolios and define the usual dummy, in this case

$$UPREIT = \begin{cases} 1 & \text{if } k \text{ is the portfolio of UPREITs} \\ 0 & \text{if } k \text{ is the portfolio of regular REITs} \end{cases} \tag{4.16}$$

Here, too, we use the *new* dummy, as defined in equation 4.9, page 66. The full model we estimate thus becomes

$$\begin{aligned} vwret_{k,t} &= [(1 \quad UPREIT \quad new \quad UPREIT \cdot new) \\ &\quad \otimes (1 \quad S\&P_t \quad d3yrtr_t \quad inc_t \quad app_t)] \cdot \beta \\ &\quad + \epsilon_{k,t} \end{aligned} \tag{4.17}$$

where β is as defined in section 4.4.3, page 76.

4.5.4 Results and Implications

The results from this model are presented in table 4.6, page 83. We use the same weighted estimation procedure as in the previous sections, which is described in detail in section 4.3.4, page 68.

The base effects in the first panel of table 4.6 show a significant positive coefficient for *income* and one that is indistinguishable from zero for *app*, showing that (at least) regular REITs before 1999 are purely income vehicles, with no short-term appreciation gains available to the investor. If we proceed to the second panel of table 4.6, we find most prominently a strong positive coefficient for $app \cdot UPREIT$. Thus UPREITs retain their income dependency from base effects (since the $income \cdot UPREIT$ coefficient is not significantly negative) and add to this a strong positive dependency on appreciation shocks that are not contained in income. Examining the rest of table 4.6, we find that there are

Table 4.6: Regression Results for UPREIT Test. Dependent Variable: Value-Weighted Portfolio Return. Standard errors in parentheses.

	Model 6	Std. Err.
Intercept	-0.0203	(0.0158)
S&P500	0.148	(0.0467)**
d3yrtr	-0.142	(0.0256)***
income	18.058	(8.248)*
app	-0.251	(0.341)
UPREIT	0.0215	(0.0154)
new	0.00685	(0.0232)
$income \cdot UPREIT$	-3.552	(8.098)
$app \cdot UPREIT$	1.234	(0.337)***
$income \cdot new$	14.203	(46.127)
$app \cdot new$	-1.235	(1.540)
$UPREIT \cdot new$	0.00832	(0.0200)
$income \cdot UPREIT \cdot new$	-24.713	(32.852)
$app \cdot UPREIT \cdot new$	-0.898	(0.964)
Number of observations	68	
$\overline{R^2}$	0.5900	
F	6.075	

°: significance level ≤ 10%. *: significance level ≤ 5%.

: significance level ≤ 1%. * : significance level ≤ 0.1%.

S&P500: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

app: Property-level appreciation returns.

Note: The control variables *S&P500* and *d3yrtr* combined with the same dummies as the variables displayed here were included in the model but omitted from this table to improve readability.

no significant changes to the situation outlined here, as we proceed from the booming market of the 1990s into the steadier market thereafter.

The picture presented throughout is thus that regular REITs are only income driven, while UPREITs also reflect property price returns not present in rental cashflows. Thus, UPREITs much better reflect the values of their underlying property portfolios than regular REITs and we can consider UPREITs true property investment vehicles and not just property income vehicles, as we have classified the REIT asset class in the previous chapter. UPREITs thus seem to have a much better ability to time the market than regular REITs and correspondingly their returns reflect appreciation cashflows not contained in income, while regular REITs do not fully have this ability and their returns do not reflect these cashflows. The trading restrictions hypothesis seems to be strongly supported by these results, outweighing the delay-of-taxes effects that would cause longer holding periods in an UPREIT.[14] We can also add here that these results seem to suggest that UPREITs are investment vehicles that are far superior to regular REITs in providing a liquid total-property investment vehicle, as opposed to just an income vehicle: correspondingly we should see UPREITs continue to dominate the industry, and perhaps push regular REITs out of the market within the near future.

4.6 Combined Firm Characteristics

4.6.1 Methodology

In this section, we estimate firm-by-firm panel models which combine all firm characteristics previously measured (size, diversification, and UPREIT status). This will enable us to see whether any particular characteristic dominates all the others in affecting whether a firm's performance is appreciation driven.

In order to do this, we use the same portfolio sorting criteria for each set of characteristics that we used before, but, instead of constructing value-weighted portfolio returns, we simply determine, for each firm-quarter, the values of five

[14] For more on holding periods and UPREITs, see chapter 5.

dummy variables, indicating which portfolio a firm belonged to during a specific quarter, for a particular characteristic. Specifically, we use the dummy variables $Large$, $UPREIT$, $CBSAdiv$, $ERdiv$, and $PTdiv$, to indicate size, UPREIT status, diversification at the CBSA level, diversification at the economic-region level, and diversification by property type, respectively. $Large$ is defined by the same criteria that are used for the portfolio sort in section 4.3.3, page 62; $UPREIT$ is defined by the same criteria that are used for the portfolio sort in section 4.5.3, page 81; the diversification dummies are defined by the same criteria that are used for the respective portfolio sorts in section 4.4.3, page 73. So, for example, if a firm, at a particular date, was previously put into the $Large$ portfolio, we set the value for $Large$ for that firm-quarter to 1, and proceed similarly for the other dummy variables. We also use the *new* dummy, for structural breaks in time, which we have used throughout. We then stack all the firm returns to make a large panel data set with observations through time, grouped by firm.

If we were to interact *income* and *app* with all of these firm characteristics, this would generate a very large amount of factors, resulting in a model in which effects are subdivided to such a large extent, that the coefficients and the t statistics shrink, to produce an outcome which is largely dominated by noise. In order to draw any inferences from the data at hand, it is necessary to be somewhat economical with the inclusion of explanatory variables. As a sensible solution to this problem, we have chosen to only include interaction effects for *app*, as our primary interest lies in testing how firm characteristics affect a firm's appreciation dependence. The results for appreciation effects seem to be very robust to model specification, and the models presented here were simply chosen to maximize the probative value of the other factors included, especially *income*. It should further be noted that we can only use observations for this test which exist in all datasets, so this test is based on fewer observations than were used to construct each subportfolio in the previous sections. Specifically, the time window starts in 1994.

It would be rather cumbersome to write out the the models estimated here in full equation form, so the reader should simply consult table 4.7, page 87 for the individual specification of each model. The estimation techniques we apply are fixed effects, random effects, and mixed effects, all with respect to a grouping factor by firm. In a mixed effects model (also known as a random-coefficient model) we allow random firm effects on not just the constant, but also the coefficients for the control variables, and *income* and *app*.

4.6.2 Results and Implications

Table 4.7 shows the results from three different model specifications for measuring the various firm-characteristic effects against each other. Notice that model 7 does not include a constant, as a complete set of firm dummies is implied in a fixed effects model, and thus including a constant would yield a singular matrix of explanatory variables. Notice also the exclusion of the control variables from model 8: while the appreciation effects are robust to these small alterations, these were made to make the effect of *income* meaningful.

The top panel of table 4.7 shows the same picture as the preceding sections: the base effect for *income* is positive and significant, for all model specifications, while that for *app* is not significant. *Large* is negative and strongly significant for all model specifications, same as in previous sections. In model 7, $UPREIT$ is also positive and significant, implying that UPREITs trade at a premium to regular REITs. This effect is visible in table 4.6, page 83, but, despite the fact that the standard error is fairly small, the t value for that coefficient misses the 10% significance level. Interestingly, none of the diversification dummies even come close to being significant, with the magnitude of standard errors exceeding that of coefficients. This differs from the results obtained in table 4.4, page 77, where the dummy for CBSA diversification and that for property-type diversification was positive and significant.

The most interesting result for this study can be seen in the second panel of table 4.7. The only appreciation effect that is significant, when accounting for all characteristics, is that given by $UPREIT$, which is of positive sign and significant in all models. This supports our economic intuition on this issue

Table 4.7: Regression Results for Combined Characteristics Test. Dependent Variable: Quarterly firm stock return. Standard errors in parentheses.

	Model 7	Std. Err.	Model 8	Std. Err.	Model 9	Std. Err.
Estimation Method	Fixed Effects		Random Effects		Mixed Effects	
$income$	5.284	(2.054)*	3.268	(1.910)$^{\circ}$	4.903	(2.570)$^{\circ}$
app	0.0655	(0.604)	0.107	(0.599)	0.135	(0.658)
$Large$	-0.0485	(0.00942)***	-0.0162	(0.00591)**	-0.0161	(0.00590)**
$UPREIT$	0.109	(0.0448)*	0.00170	(0.00486)	0.00134	(0.00489)
$CBSAdiv$	0.0121	(0.0149)	0.00106	(0.00821)	0.00297	(0.00833)
$ERdiv$	0.0106	(0.0146)	0.00368	(0.00773)	0.00630	(0.00785)
$PTdiv$	-0.0114	(0.0112)	-0.00425	(0.00535)	-0.00523	(0.00540)
$app \cdot Large$	-0.0214	(0.480)	-0.00586	(0.475)	0.00156	(0.497)
$app \cdot UPREIT$	0.988	(0.414)*	0.901	(0.486)$^{\circ}$	1.123	(0.539)*
$app \cdot CBSAdiv$	0.906	(0.615)	0.796	(0.610)	0.689	(0.656)
$app \cdot ERdiv$	0.418	(0.579)	0.320	(0.574)	0.184	(0.620)
$app \cdot PTdiv$	0.655	(0.414)	0.629	(0.410)	0.622	(0.450)
$app \cdot new$	-2.624	(0.627)***	-2.547	(0.621)***	-2.613	(0.626)***
$app \cdot UPREIT \cdot new$	-0.317	(0.737)	-0.201	(0.734)	-0.459	(0.743)
Controls included	Yes		No		Yes	
Number of Observations	3417		3417		3417	
$\overline{R^2}$	0.09486					
F	3.693					

$^{\circ}$: significance level $\leq 10\%$. *: significance level $\leq 5\%$. **: significance level $\leq 1\%$. *** : significance level $\leq 0.1\%$.

$income$: Property-level income returns.

app: Property-level appreciation returns.

$CBSAdiv$, $ERdiv$, $PTdiv$: Dummies for diversification by CBSA, Economic Region, and Property Type.

$Large$: Size dummy.

$UPREIT$: Dummy for UPREIT status.

Note: Models 8 and 9 include an intercept, while model 7 does not.

The control variables are *S&P 500* and *d3yrtr*, as before.

very well: as we argue throughout this paper, UPREIT status is the only firm characteristic which helps a REIT overcome both the four-year and the 10% sellling constraint, while all other characteristics only help with the 10% constraint. Hence, when accounting for UPREIT status, all other appreciation effects become insignificant.

It has to be noted, of course, that the coefficients for $app \cdot CBSAdiv$ and $app \cdot PTdiv$ are somewhat larger than their standard errors and that thus, while no other appreciation effect in itself is significant, there seems to be a (weak) additional cumulative positive appreciation effect in panel two, indicated by these two parameter values. This idea, however, changes once we examine the third panel of table 4.7: the strongly negative and significant coefficient for $app \cdot new$ combined with the insignificant coefficient for $app \cdot UPREIT \cdot new$ suggests that any appreciation effects outside of those for UPREITs that existed during the boom period, stopped after 1998. Only the UPREIT-related effects continued after this time. The other positive appreciation effects, thus, could once again simply have been due to the monotonically increasing markets of the late 1990s, as previously discussed.

These results, once again, lend strong support to the economic intuition presented throughout this study. We have, in fact, argued that UPREIT status is the most effective firm characteristic in allowing a REIT to time the market and realize short-term appreciation profits, because it is the only characteristic which helps REITs overcome the four-year constraint. These results, which show dramatically that, when accounting for all firm characteristics, UPREIT status trumps all others, thus lend strong support to our trading restrictions hypothesis.

4.7 Conclusion

Throughout this chapter we have presented some evidence that the reason why REIT investors overall cannot realize short-term appreciation gains that do not come from income, lies in the selling restrictions imposed upon REITs' portfolio management strategies. To do this, we have investigated how different firm characteristics – which, we have argued, will distinguish the way REITs are affected by trading restrictions – have affected the income- and appreciation dependency of their returns. The characteristics we tested were size, the degree of portfolio diversification, and whether a firm is an UPREIT or not. In each case, we also analyzed whether effects associated with firm characteristics differ among the major time periods through which the REIT industry has lived.

For size, we find that, while small REITs are generally only income vehicles, large REITs consistently manage to reflect both income- and appreciation-related fluctuations of their portfolio values. We argue that this is because large REITs are better equipped to overcome the 10% constraint than small REITs. While small REITs managed to reflect appreciation-related fluctuations in their portfolios between 1993 and 1999, we argue that this does not necessarily imply that small REITs briefly acquired the ability to time the market and then lost it again, but that this effect might simply be due to the monotonicity of the rising market during this time period which required little selling. We also find that large REITs actually trade at a slight discount to small REITs which is incongruous with the general finance literature, but corresponds to past results in the REIT literature.

For diversification, we find, surprisingly, that, contrary to our initial intuition, geographic diversification actually does not help a REIT's returns better reflect the appreciation content of its price information. We speculate that it may be the case that more profits can be made from small idiosyncratic very localized price shocks, that either type of REIT, given it is large enough, is *legally* equally well equipped to exploit, and which locally specialized REITs with good local knowledge may be in a better position to recognize. For diversification by property type, our initial intuition seems to hold very strongly, however, as returns to property-type diversified REITs reflect both income and appreciation information, while returns to REITs that are not diversified by property type are purely income driven. Thus, the asynchronicity-of-shocks explanation may be correct for property-type diversification, but may be outweighed by the one given above for geographic diversification. In any case, our results are opposite to those of past literature, specifically Miles and McCue (1982), although it may be the case that this is due to the nature of the real-estate and REIT market that has changed somewhat from then until now.

We then test whether the returns for UPREITs better reflect appreciation content than the returns for regular REITs, and strongly find that this is so, across all time periods. This lends strong support to our trading-restrictions explanation, as the limited partnership that holds the properties in an UPREIT is not subject to any holding constraints, and, besides that difference, UPREITs and non UPREITs are very similar vehicles.

Finally, we combine all firm-characteristic factors in a firm-by-firm panel model, and find that, when accounting for all characteristics, UPREIT status is the only one which shows a positive appreciation effect throughout the entire sample period. This, once again, lends strong support to our economic intuition, as UPREIT status is the only characteristic which helps a REIT overcome both parts of the selling constraint, and therefore has the strongest effect, dominating others.

Despite these last findings, there should still be some value to the results from the size- and diversification tests. In fact, one would need to think carefully whether a possible conclusion that these two effects only proxy as an UPREIT test is warranted. For size, especially, we were able to test a time period during which UPREITs did not exist, which speaks in favor of an actual size effect existing and being successfully captured by our test. It might simply be the case that these firm criteria are to a large extent collinear and that, thus, the strongest effect (which both empirically and by economic intuition should be UPREIT) receives all the significance allocated to it. Furthermore, from an investment perspective, it might be easier and cheaper to collect size information than UPREIT-status information and so, despite the size effect being weaker than the UPREIT effect, a size sort may still be preferred over an UPREIT sort.

These tests overall, thus, strongly support the hypothesis that the fact that

REITs, as a whole, are *property income* vehicles, as opposed to full *property* vehicles is due to the trading constraints which they face. It is true that, for each firm characteristic, it might be possible to find a different explanation of why REITs that belong to one group better reflect appreciation returns than REITs that belong to another (although this may be most difficult for the UPREIT test). Whether it is possible to find an explanation that is consistent over all these tests is a different question, but even that may be possible. The purpose of this chapter is to give some evidence that the trading-restrictions explanation is the correct one, and that purpose we have fulfilled without doubt. For further and more conclusive proof on this, the next chapter picks up right where this one leaves off.

Chapter 5

The Proof of the Pudding: An Analysis of Simulated and Actual Holding Periods

5.1 Introduction

In the previous chapter, we analyze firm characteristics, and thus give evidence that the reason why REIT investors do not have access to short-term appreciation gains in the underlying property portfolio can be found in the trading constraints REITs face. In this chapter, we take a more direct approach to the task of showing that this is the case, by analyzing simulated and actual holding periods of properties in REIT portfolios: in this way, we show the bindingness of the holding period constraint and the extent to which this constraint hinders REITs' abilities to time the market.

First, we illustrate the mechanics of how the holding period constraint affects a REIT's market timing ability, in a controlled environment, by devising and simulating a filter-based trading strategy with which we time the real estate market. We show that this strategy significantly outperforms a simple buy-and-hold strategy under various levels of transaction costs, and thus that this is a profitable market timing strategy. We then analyze the holding periods that this strategy requires, testing whether significant amounts of sales need to be made before the four-year minimum. Further, we simulate this strategy in an environment constrained by a four-year holding period, and assess to what extent this strategy underperforms that in an unconstrained environment. This set of simulated trading results allows us to monitor closely how a manager could possibly time the market if he were allowed to trade freely, and the loss of profits that appears once the trading constraint is imposed.

We then proceed to analyze actual distributions of property holding periods in a REIT's portfolio, assessing the bindingness of the holding constraint. Further, we model how the decision to hold a property for a certain amount of time is affected by the general state of the market, testing whether in a rising market a manager is likely to hold a property longer than in a falling market. We then specify this model to assess the specific effect the market situation has on the decision to hold a property beyond four years, as, in a rising market, a REIT needs to hold a property beyond this minimum time in order to retain the capital gains made on it. Throughout this part of the analysis we also examine the important distinction in this respect between regular REITs and Umbrella Partnership REITs (UPREITs), since the latter are not bound by the four-year constraint.

The paper proceeds as follows. Section 5.2 presents a review of pertinent academic literature from finance and real estate; section 5.3 presents the analysis of the filter-based timing strategy; section 5.4 presents the analysis of actual holding periods; section 5.5 concludes. Sections 5.3 and 5.4 each explain the theory behind the test being conducted, specify the model, explain the data sets and methodologies used, and present results and implications.

5.2 Previous Literature

The existence of technical trading strategies which systematically outperform buy-and-hold strategies shows that a market is not informationally efficient, as, in a market which follows a random walk, it should not be possible to systematically time the market to make abnormal profits. Thus, literature focusing on such strategies is invariably part of the general market efficiency literature, testing whether informational efficiency holds under different versions of the random walk hypothesis, of which studies abound. Some examples of studies on the effectiveness of various technical-analysis based trading strategies in the stock market include Edwards and Magree (1966), Murphy (1986), and more recently Blume, Easley and O'Hara (1994), Brock, Lakonishok and LeBaron (1992), LeBaron (1996).

Literature that treats the subject of market timing through filter rules to a larger extent stems from Alexander (1961, 1964), who applied the most basic form of filter in which an asset is purchased when its price increases by a certain percentage and is sold or short-sold when its price drops by a certain percentage. Such a trading rule (like all filter rules) is designed to *filter* out small movements around a general trend in asset price, thereby trading on just this trend. Fama (1965) and Fama and Blume (1966) analyze these filter rules for their effectiveness and find that small filters (that is, small percentage-change thresholds used to trigger a buy or a sell signal) are indeed effective at timing the market, but that the systematic excess returns disappear when combined with transaction costs, due to the high amount of transactions required by this strategy[1].

While filter rules are sometimes used in academic studies, research into filter rules themselves seems to be more of an area for industry studies, as many traders and academics who are fundamentalists believe that this field is, for the stock market at least, something between a short-lived game of chance and black magic. This may also be related to the fact that academic financial research is deeply founded in general economics and there is fairly little economic content in the outcome of an effective filter rule.

In the real estate literature, just like in the finance literature, several studies

[1]For a further review of literature on filter rules, the reader should consult Campbell, Lo and MacKinlay (1997).

investigate the informational efficiency of the real estate market, generally finding that real estate markets are less informationally efficient than stock markets. Some studies that quantify the predictability of different sectors of the direct real estate market include Liu and Mei (1994), Barkham and Geltner (1995), Case and Shiller (1990), Case and Quigley (1991), and Gyourko and Keim (1992). Out of these, perhaps the most relevant seems the study of Case and Shiller which documents the predictability of the housing market.

It seems, the only time filter rules have been examined in the real estate literature was in the context of REITs, where Cooper, Downs and Patterson (1999) apply a filter-based contrarian trading strategy to the REIT market and find that this strategy systematically outperforms the market, even after execution costs. This, however, is once more related to the stock market, as that is where REITs are traded. Not much literature seems to exist applying technical-analysis based trading strategies to direct property, perhaps due to the high transaction costs and low execution speeds possible in this market.

While some literature which analyzes the performance of mutual fund managers in terms of market timing ability indirectly analyzes holding periods of securities in a fund's portfolio, no academic literature seems to exist analyzing portfolio holding periods for REITs.

5.3 A Filter-Based Trading Strategy

5.3.1 Theory

Market Timing and Filter Rules

The idea of *market timing* consists of trying to *buy low* and *sell high*, that is, in a cyclical market, to buy at a trough and sell at a crest. One of the main endeavors in devising such a strategy is therefore to find a way of observing larger-scale market turnarounds, in the midst of small-scale volatility. While many different strategies have been devised to try to do this (and some have done this with more success than others), in this study we choose to employ a timing strategy based on moving average prices, as these present a higher level of sophistication than simple return-filter based strategies.[2]

Suppose we have an asset whose price we have observed today (at time t) and at several different equally spaced intervals in the past, over a sufficiently long time window. The K-period moving average price at time t is simply defined as

$$map_{K,t} = \frac{\sum_{\tau=0}^{K-1} p_{t-\tau}}{K-1} \tag{5.1}$$

Here, p_τ is the asset's price at time τ. Looking at this expression, it should be clear that in a rising market (where $p_{t-1} < p_t \ \forall\ t$), $map_{K,t} < p_t \ \forall\ K > 0$. Conversely, in a falling market (where $p_{t-1} > p_t \ \forall\ t$), $map_{K,t} > p_t \ \forall\ K > 0$. Thus when the market changes from rising to falling, or vice versa, p_t will *cut through* $map_{K,t}$. Hence, we have illustrated a possible way to observe market turnarounds, simply by computing the moving average price with every new observation and observing when $p_t = map_{K,t}$. This often occurs between two points, so that if $p_{t-1} < map_{K,t-1}$ and $p_t > map_{K,t}$, we have observed a trough which constitutes a *buy* signal, while $p_{t-1} > map_{K,t-1}$ and $p_t < map_{K,t}$ represents a peak and thus a *sell* signal.

Note further that, in a monotonic market, the size of K will determine the distance between the price and its moving average, or

$$K \quad \propto \quad |map_{K,t} - p_t| \tag{5.2}$$

That means the size of K can be adjusted in order to *filter* noise and trigger signals only at larger turnarounds, since, for example, a market that was monotonically increasing and changes to decreasing needs to show longer consistent decreasing tendencies, before covering the distance between itself and the moving average, if that distance is larger. Hence, the size of K becomes a filter level and fulfills a similar role to the size of the filter used in Alexander (1961).

However, in what we have just observed, we have implicitly created a problem: while waiting until the asset price cuts the moving average will filter out noise reversals and only signal large reversals (depending on the size of K), it

[2] Information on MA-based trading strategies and trading bands can be found in most technical analysis textbooks, for example Murphy (1999).

should also be clear that the actual market turnaround occurs some time before the point at which $p_t = map_{K.t}$ and that, while the price cutting the moving average is useful in filtering small shocks from large cycles, we have actually missed a peak or trough if we wait until the crossover point, and thus we have sold somewhere below the peak and bought somewhere above the trough.

Figure 5.1, page 98 illustrates this phenomenon. While we would be correct in identifying upturns and downturns by waiting for the price to intersect the moving average, the trough and peak, respectively, have already occurred at this point, making us miss out on some returns.

One way to improve upon this is through the use of so-called trading bands. These consist of threshold values that track alongside the moving average at a certain distance, one above and one below, as follows:

$$b_{+,t} = map_{K,t} + s \tag{5.3}$$

$$b_{-,t} = map_{K,t} - s \tag{5.4}$$

Traditionally, the distance variable s is a predetermined fixed value, and trading bands are laid out in such a way as to contain most small price movements. A larger price movement, however, will touch one of the bands, and this triggers a signal. Specifically, $p_t \leq b_{-,t}$ constitutes a *buy* signal, while $p_t \geq b_{+,t}$ constitutes a *sell* signal. It is readily apparent that if such a trading band somewhere above (below) the moving average is used to trigger a *sell* (*buy*) signal, the problem of missing the turnaround described above is somewhat alleviated. Since the two bands track a certain distance from the moving average, the filtering properties of the moving average are still retained, since a strong enough shift in the market needs to occur for the price to not just cross the moving average, but travel a certain distance from it and then return.

Bollinger[3] made another innovation on this trading rule, in that he devised a way of going about determining the value of the bandwidth parameter s. Instead of predetermining a value for this, Bollinger uses a multiple of the K-

[3]The main published work on this seems to be Bollinger (2001).

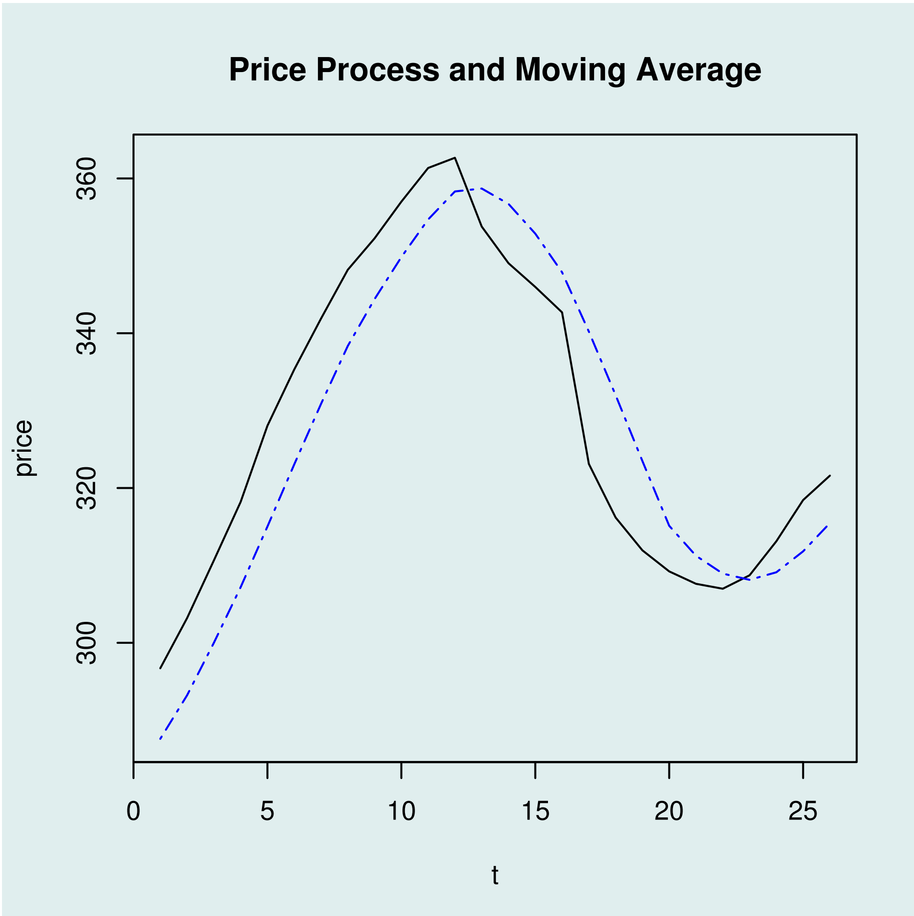

Figure 5.1: Illustration of the relationship between a price process and its moving average: the price series is the black solid line, while the moving average is the blue alternation of dots and dashes. Data from the NCREIF national property index.

period moving standard deviation, defined as follows

$$s_{K,t} = \left[\frac{\sum_{\tau=0}^{K} (map_{K,t} - p_{t-\tau})^2}{K-1} \right]^{\frac{1}{2}} \tag{5.5}$$

making the trading bands

$$B_{+,t} = map_{K,t} + \alpha s_{K,t} \tag{5.6}$$

$$B_{-,t} = map_{K,t} - \alpha s_{K,t} \tag{5.7}$$

The value of α should be determined by the trader according to the market environment.

While generally this rule uses fairly large values of α, like 1.5 or 2, to produce wide bands, we find it more appropriate for this study to use fairly narrow bands (we use a value for α of $\frac{1}{3}$), and we therefore slightly alter the trading rule. Traditionally, the price process would *touch* a band from the inside in order to trigger a timing signal, and right away retreat back inside in most cases, due to the large bandwidth used. We alter this picture in such a way that in this case the bands are constructed narrower, so that in a strong market upturn (downturn), $p_t > B_{+,t}$ ($p_t < B_{-,t}$). That is, in major cyclical market movement, the price is *outside* the respective trading band and breaks back inside very shortly after a turnaround: this happens, of course, some time before breaking through the moving average. Figure 5.2, page 100 illustrates this concept.

A buy signal is thus generated by $p_{t-1} < B_{-,t-1}$ and $p_t > B_{-,t}$ and a sell signal is generated by $p_{t-1} > B_{+,t-1}$ and $p_t < B_{+,t}$. As is apparent from figure 5.2, this strategy better times turnarounds than a pure moving-average strategy. Notice also how the bandwidth changes with volatility, as is the nature of Bollinger bands.

The decision to undertake alterations to the traditional way in which this trading rule is applied stems from the low frequency of our data: while this rule is usually applied to daily stock market data and a 20-day moving average, our property market data is of quarterly frequency[4], and we use one-year (four-data-point) moving averages. Given such an environment, this modified rule seems to perform better than the traditional version.

[4]see section 5.3.2, page 102, for more information on our data set.

Figure 5.2: Illustration of the relationship between a price process, its moving average, and a set of Bollinger bands constructed around it: the price series is the black solid line, the moving average is the blue alternation of dots and dashes, and the Bollinger bands are the red dashed lines. Data from the NCREIF national property index.

We apply this filter rule to a variety of different property portfolios, testing its performance in various transaction cost environments.

Practical Considerations

The direct property market is characterized by poor pricing information, long transaction times, and high transaction costs, all of which may pose problems to implementing a technical trading strategy.

The evidence on poor pricing information stems mainly from literature about the validity of appraisal-based data in assessing market performance. In this literature, the assumption being made (at least implicitly) is generally that agents who transact in the market have some pricing information based on which they transact, and that there is an incomplete flow of information from agents in the market to appraisers, leading to appraisal-anchoring and stale-appraisal biases in an appraisal-based index. Appraisal-based indices have thus been modified through *de-smoothing* procedures such as the one used in this study in order to recreate, conceptually, a data series that is equivalent to a transactions-based index.[5] Thus, these procedures are used in order to give the academic researcher outside the market a way to infer the level of pricing information that agents within the market had at a particular time. This suffices for the implementability of the strategies described here, since it is agents within the market who execute these strategies, and not appraisers. They will thus not implement these trades based on a publicly available index series, but upon their own index series generated with their assumed superior knowledge.

For the issue of long transaction times, we simply make the assumption that was made in the chapter 3 and upon which the forward-pricing solution to the price discovery problem is built. This assumption is that the sale price of a property is generally locked in fairly early in the transaction process, which suffices for the feasibility of our market timing strategy. A manager reacts to a signal right away, and the price is locked in very soon: the fact that money only

[5] A transactions-based index is, of course, not feasible in the commercial property market due to this market's poor liquidity.

changes hands several months later becomes irrelevant at this point, because the property will be sold at the price for which the signal was obtained.

Transaction costs in the property market are usually considered high: a figure of five to ten percent round-trip transaction costs is considered common. Transaction costs will, of course, be related to the size of the entity undertaking the transaction: it is conceivable, for example, that a large REIT will have an in-house legal team which draws up all sales contracts, and a team of surveyors which value properties, and so forth. For such an entity, these types of expense, which are generally considered part of the transaction costs involved in dealing with direct property, would probably fall more generally under management expenses, as these become fixed costs if the services are internalized. The bottom threshold that is not dependent on scale, is, of course, property transfer tax, which ranks from zero to about two percent, dependent on the state and city. For this reason, we run our tests with different levels of transaction cost, ranging from free transactions (which is probably never realistic, but interesting for calibration purposes) to 10% round-trip costs.

5.3.2 Data and Methodology

We test our filter-based investment strategy on data from the National Property Index (NPI) compiled by the National Council of Real Estate Fiduciaries (NCREIF). While we have been using the primary index of this data set all throughout this study, the entire panel data set contains many levels of disaggregation, by property sector, region, state, Metropolitan Statistical Area (MSA), and all interactions of these classifications. These 1041 subindices thus proxy for property portfolios of various degrees of diversification, any combination of which could conceivably be held by a REIT. The data is quarterly and goes at its longest from the first quarter of 1978 until the second quarter of 2003. Certain subindices start later.

To overcome the problems of stale appraisals and appraisal anchoring inherent in this data, we use the de-smoothing methodology of Cho, Kawaguchi, and Shilling, which is outlined in great detail in chapter 3. We first undertake the iterative estimation procedure to derive single values of ρ, and thus b_1, and b_2 for the entire panel dataset, and we call these $b_{1,whole}$ and $b_{2,whole}$. We then proceed through the disaggregated panel subsets: for any subset j which contains 20 or more observations, we redo the iterative estimation procedure for this subset individually, and define $b_{1,j}$ and $b_{2,j}$. We then desmoothe each subset using its own values of $b_{i,j}$ if these were defined, and if not using $b_{i,whole}$. This procedure should reduce the amount of outliers produced by estimating desmoothing parameters that have little statistical power.

Since in this chapter we do not need to compare the information sets between the direct property market and the REIT market, we only desmoothe the appraisal data and do not use the forward pricing approach to correct for the apparent price discovery.

As before, we apply the desmoothing procedure only to the appreciation subseries of each portfolio, as the income series is not the product of an appraisal process. The de-smoothing procedure is applied on the appreciation returns series which is then added to the income returns to generate a new series of desmoothed total index returns. Since, for the implementation of our filter rules, we require a price series, we set each portfolio subindex to 100 the quarter before the first return figure is available, and then compute series of total index levels as cumulative products of the previous returns plus one.

We then test the trading rules described in section 5.3.1 against a buy-and-hold strategy, which consists of simply buying each portfolio at the time its data becomes available and holding it until the end. For the filter-based strategy, we also buy the portfolio at the beginning of its data series and hold it until the first sell signal. At the next buy signal we buy the portfolio and hold it until the next sell and so forth. If the last signal for the portfolio was a buy, we sell at the end of the data series. Should the data generate two identical signals in a row, we react to the first and thereby ignore the second. For each strategy, we record total returns and then do statistic comparisons between the returns to the two strategies.

We also test the mean outperformance of the filter-based timing strategy over the buy-and-hold strategy under round-trip transaction costs of 1, 2, 3, ..., 10 percent for each transaction. Thus the buy-and-hold strategy would incur these transaction costs once, and the filter strategy N times. Since we are interested in relative outperformance, we waive the transaction costs for the buy-and-hold strategy and charge the transaction cost $N - 1$ times for the filter strategy.

Furthermore, under transaction costs, we also test the performance of an adaptive strategy. In this strategy we also buy at the beginning of the portfolio's life, but upon obtaining the first sell signal, we test whether we have made a profit for this transaction, net of transactions costs. If yes, we sell, if not, we ignore the signal. Once we sell, we buy at the next buy signal and upon encountering the next sell signal we carry out the same test before implementing it. This strategy yields fewer transactions, which may be advantageous under high transactions costs, but may make us stay in the market through troughs, during which we could otherwise have been out of the market and cut losses. For calibration, we also implement this strategy under zero transactions costs, just testing that we made a profit whenever selling.

Finally, we test the effect of the four-year holding period restriction on the outperformance of the filter-based strategy. In this case, we simply ignore sell signals that occur less than four years after the beginning of the portfolio's life, or less than four years after a buy transaction. As with the adaptive strategy, if we ignore a sell signal, we wait for the next one before we sell, ignoring any buy signals that occur along the way.

Through these methods, we aim to illustrate the mechanics of how the four-year trading constraint affects REITs' market timing abilities. Only in this controlled environment of simulated trading strategies on actual market data can we truly compare the performance of a market timing strategy with and without the four-year constraint.

5.3.3 Results and Implications

Table 5.1, page 105, shows the mean outperformance (excess returns), generated by the non-adaptive and the adaptive strategy under different levels of trans-

Table 5.1: Mean Outperformance of Filter-Based Strategy over Buy-And-Hold Strategy, over the entire 1978-2003 Sample

Transaction costs										
0	**1%**	**2 %**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
Non-Adaptive Strategy										
0.1805***	0.1652***	0.14994***	0.1346***	0.1194**	0.1041**	0.08876*	0.07347*	0.05817°	0.04287	0.02758
Adaptive Strategy										
0.1646***	0.1480***	0.1305***	0.1192***	0.1083***	0.09386**	0.08624**	0.07757**	0.07785**	07376*	0.07605**
Non-Adaptive Strategy, 4-Year Constraint										
0.1146***	0.1075***	0.1004**	0.09325**	0.08611**	0.07897**	0.07183*	0.06469*	0.05756*	0.05042°	0.04328°
Adaptive Strategy, 4-Year Constraint										
0.1253***	0.1190***	0.1128***	0.1056***	0.09892***	0.09265**	0.08674**	0.08149**	0.07501**	0.06921*	0.06221*

Total return for buy-and-hold strategy: 2.8646

° : significance level $\leq 10\%$. *: significance level $\leq 5\%$. **: significance level $\leq 1\%$. *** : significance level $\leq 0.1\%$.

Hypothesis tested: H_0: *mean outperformance* $= 0$ against the 1-sided alternative.

action costs, both in an unconstrained environment and under the four-year minimum holding period under which REITs operate. Notice the difference in outperformance of the non-adaptive and the adaptive strategy, first of all. Up to 7% transactions costs, the plain filter-based strategy outperforms the adaptive strategy; for transaction costs between 7% and 10%, the adaptive strategy performs better, first marginally, then significantly. This situation does not present a problem to the implementability of the trading strategy, since a REIT manager will generally be able to gage the level of transactions costs he faces with his portfolio, and can therefore adopt one of the two strategies accordingly, with which his portfolio will significantly outperform a buy-and-hold strategy, even under 10% transaction costs.

We now examine the returns for the two strategies subject to the four-year minimum holding period. At any level of transaction cost, the adaptive strategy outperforms the non-adaptive strategy under this trading constraint, and thus a manager will always choose the adaptive strategy in this case. Comparing the performance of the adaptive strategy under the four-year constraint, to the optimum performance without constraints, we find that, especially for low levels of transactions costs, the excess returns from the constrained strategy are substantially lower than those from the unconstrained strategy. The gap between the returns shrinks as transaction costs increase, and for 7% the constrained strategy actually yields slightly higher returns than the respective optimal unconstrained strategy (in this case, the adaptive strategy). While these values are probably too close to be statistically distinguishable from each other, there may be a zone of transaction costs around 7%, in which the holding period constraint *protects an investor from himself*, in that the transaction costs are at a level at which the savings in transactions costs forced upon the investor outweigh the missed market timing opportunities. However, as the transactions costs increase, and the adaptive trading strategy gives fewer trading signals, the missed timing opportunities seem to come into play again, as the unconstrained strategy outperforms the constrained strategy to a larger extent again. Notice, also, that both the mean and the significance level increase again in the unconstrained adaptive strategy from 9% to 10%. It seems to be the case that the longer holding periods and fewer transactions which incur costs, suggested by the adaptive strategy at this level of transaction costs, lower volatility and raise returns. Thus, here the savings on transaction costs strongly outweigh the market timing opportunities that have been missed by waiting for each transaction to generate a profit.

It should also be apparent that any outperformance by a timing strategy over a buy-and-hold strategy must necessarily be due to appreciation returns, and not income returns. Counting income returns only, the buy-and-hold strategy will necessarily outperform a market timing strategy, simply because it is not likely that there will be a period of negative rents generated from an entire property portfolio, during which a timing strategy could dictate staying out of the market. On an income basis, the strategy which stays in the market the longest will perform best. Thus, the appreciation-driven excess returns generated by the timing strategies are actually large enough to much more than outweigh the additional income generated by the buy-and-hold strategy. The implication for this study should thus be clear: the missed returns of the constrained strategies over the unconstrained strategies are purely appreciation returns.

We have demonstrated that at almost any level of transaction costs the holding constraints make a REIT worse off than an unconstrained investor. To illustrate this point, figure 5.3, page 108, shows the holding period distribution dictated by the non-adaptive strategy, and table 5.2, page 109 shows distributional statistics for both the non-adaptive strategy, and the adaptive strategy under the different transaction cost levels.

Note, in figure 5.3, the mass of the distribution that is to the left of 16 quarters. In fact, as we see in table 5.2 even the median of the distribution is below 16 (at 12) quarters. This strategy (and thus this distribution of holding periods) is optimal up to and including 6% transaction costs, so the 4-year holding period represents a huge hindrance to the implementation of timing strategies such as this one. REITs that would be especially affected by this

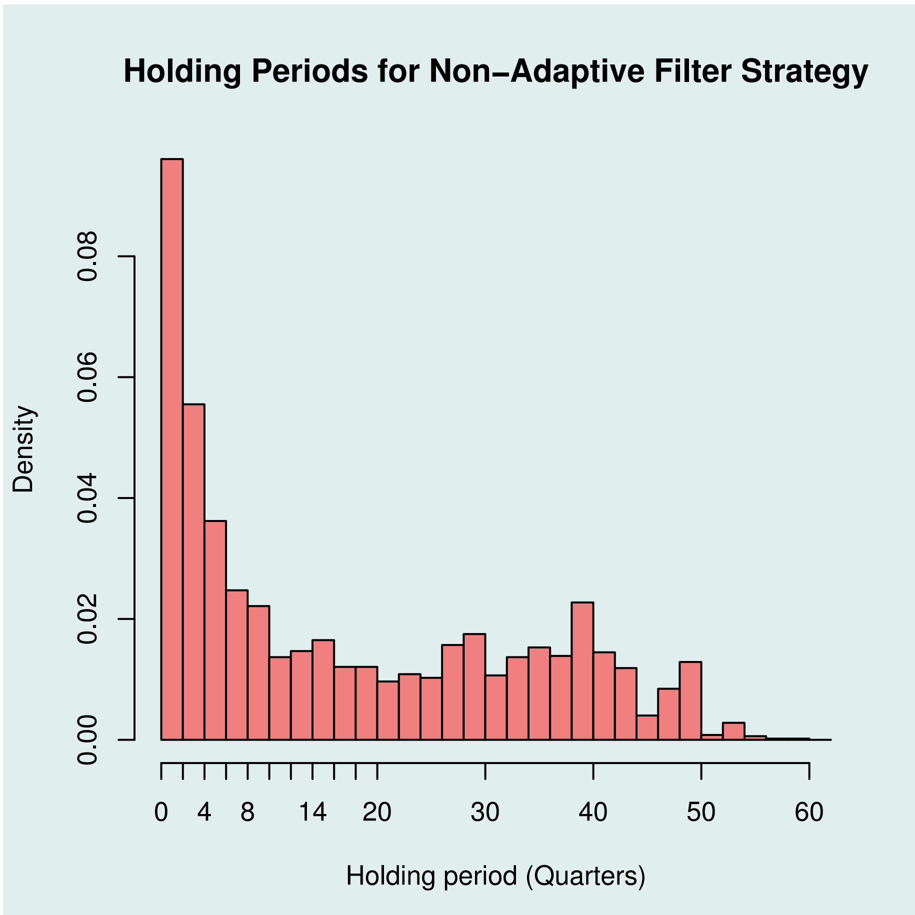

Figure 5.3: Histogram of the empirical distribution of holding periods for the non-adaptive strategy.

Table 5.2: Distributional Statistics for Holding Periods

	1st Quartile	Median	Mean	3rd Quartile
Non-Adaptive Strategy				
	3.00	12.00	17.00	31.00
Adaptive Strategy				
Transaction Costs				
0	7.00	20.00	22.98	39.00
1%	8.00	21.00	23.85	39.00
2 %	9.00	22.00	24.45	40.00
3%	9.00	22.00	24.92	40.00
4%	9.00	23.00	25.31	40.00
5%	10.00	24.00	25.66	40.00
6%	10.00	24.00	25.87	41.00
7%	10.25	25.00	26.19	41.00
8%	11.00	25.00	26.51	42.00
9%	11.00	26.00	26.74	42.00
10%	12.00	26.00	26.91	42.00

All figures in quarters.

constraint would tend to be large REITs, which, as we said before, may be able to trade at fairly low transaction costs, because they can internalize many of the services required in a property trade.

Notice also that, even in the adaptive strategy, the first quartile of the distribution is at 7 quarters for zero transaction costs and never goes above 12 quarters. Thus, even between 7% and 10%, where this strategy is optimal, the four-year holding constraint cuts out a large number of trades required by it: the loss of returns this implies has already been discussed.

We have thus successfully presented an example of a trading strategy that can be used to time the direct real estate market to significantly outperform a buy-and-hold strategy, and shown that the implementation of this strategy is hindered to a considerable extent by the minimum holding period constraint which REITs face, especially for large firms which may face the lowest transaction costs. Hence, we have shown that a REIT's opportunity set for making abnormal appreciation profits in the real estate market is diminished by the holding-period constraints it faces.

It should be noted here that no REIT will ever simultaneously invest in all the portfolios upon which this trading strategy is tested. In reality, a REIT will invest into a small combination of these portfolios, and the performance of each portfolio will be a random variable drawn from a distribution which, in its mean, significantly outperforms the buy-and-hold strategy, and does so to a much lesser extent under the holding period constraints. Furthermore, in this section we only presented one possible (and, we argue, feasible) trading strategy with which to time the market, and there may exist many other such strategies. In reality, while such a technical strategy may be used, it would invariably also be combined with fundamentals-based signals, and thus the required amount of transactions could even increase from what is shown here. In any case, we have shown in this section that a REIT can outperform the market by pursuing an actively traded market timing strategy, and that the holding-period constraints imposed upon REITs reduce their ability to do so.

5.4 Actual Holding Periods

5.4.1 Theory

While it is useful to analyze different aspects of the implications that the trading constraints have on REIT performance, the most conclusive type of evidence can be found by analyzing how long a REIT will actually hold a property in its portfolio on average. We have shown in section 5.3 that REITs can outperform the market by pursuing an active trading strategy, which would require selling after short holding periods. We now investigate whether REITs are indeed pursuing such strategies, and specifically how quickly properties are sold from REITs' portfolios.

We also investigate whether holding time changes according to the performance of the local real estate market, of which a particular property is a part. If a REIT sells a property before the four years are over, or sells too much of its portfolio at a time, a *prohibited transaction* is said to have occurred: on such *prohibited transactions*, a 100% gains tax is due. It follows that, in a falling market, when a REIT is likely to make a loss by selling a property, the manager would be indifferent to this constraint and its consequences, as no profit has been made and therefore nothing will be lost in taxes. Thus, in a falling market, a REIT could sell properties at will in order to cut losses, no matter how long these properties have been in the REIT's portfolio.

As has been discussed in the previous chapter, UPREITs may have an advantage over regular REITs with respect to the holding-period constraints. Since, in an UPREIT, a limited partnership (therefore an entity which is not a REIT) owns the properties, the property portfolio is not subject to the trading constraints. Recall that, out of the firm characteristics discussed in the previous chapter only UPREIT status helps the REIT overcome the four-year constraint, while the other characteristics only helped with the 10% constraint.

5.4.2 The Model

We examine distributions of holding periods for regular REITs and UPREITs. We also model holding period in terms of local market performance, estimating the following regression:

$$hp_i = \alpha + \beta_1 ret_l + \beta_2 UPREIT_i + \beta_3 ret_l \cdot UPREIT_i + \epsilon_i \tag{5.8}$$

Here hp_i is the amount of time (in years) property i, located in area l, was owned by a specific REIT, ret_l is the total return on the local real estate market during that time, and $UPREIT_i$ is a dummy variable indicating whether the REIT that owns property i is an UPREIT.

We also estimate a probit regression which models the REIT's decision to hold a property beyond four years, as follows:

$$fourplus_i = \alpha + \beta_1 ret_l + \beta_2 UPREIT_i + \beta_3 ret_l \cdot UPREIT_i + \epsilon_i \tag{5.9}$$

Here, $fourplus_i$ is a binary variable which indicates whether property i was held for more or less than four years, and everything else is as defined above.

5.4.3 Data and Methodology

For holding period data, in this section, we use the property database from SNL datasource, used in the previous chapter. For each property, we use the date it was bought by a REIT, the date it was sold, the identifier for the firm that had it in its portfolio, and the CBSA code for the property's location. Note that, since we are examining the decision to sell a property from a REIT's portfolio, we only use properties that were bought and sold within the period covered by the database (up to 2004) and not properties which were still in a REIT's portfolio at the time the database's coverage ends.

We then combine this data with SNL's firm-by-firm database, from which we extract information on whether a REIT was operating as a declared UPREIT the year it sold a property. Correspondingly, we define the dummy $UPREIT$ as

$$UPREIT_i = \begin{cases} 1 & \text{if a REIT was an UPREIT at time of sale} \\ 0 & \text{otherwise} \end{cases} \tag{5.10}$$

As a measure of the performance of the local real estate market, we use the total return series from the MSA-level subindices of the National Property Index from NCREIF. The appreciation components are desmoothed, as discussed in section 5.3.2, page 102. Since the regional identifiers in the property dataset are the newer CBSA codes, while those in the market index dataset are the older MSA codes, we translate from one to the other, in order to match each property with its correct MSA-area subindex values. For each property, we determine the quarter it was purchased and record the level of the local real estate market subindex at the end of that quarter. An analogous procedure is used for the sale date and the current level of the local subindex.

From this data, we then construct annualized returns, as total returns over the entire holding period, divided by the holding period in years. The reason for using annualized returns comes from the assumption that the property market price process contains a drift parameter, generating a positive annual return, equivalent to the average risk premium required by investors. Under this assumption, longer holding periods would necessarily cause higher returns, as the annual required return is earned more often. With annualized return, we account for this, and can thus infer with a higher degree of confidence that the causality relationship runs from the market performance to the holding period length and not vice versa. We thus define the variable $pareturn_l$ as the per annum CBSA-wide market return for area l, during the time a REIT owned property i located in CBSA l.

We further define a dummy variable $fourplus_i$ as follows:

$$fourplus_i = \begin{cases} 1 & \text{if } hp_i \geq 4 \\ 0 & \text{otherwise} \end{cases} \tag{5.11}$$

The actual models we estimate thus become

$$\begin{aligned} hp_i &= \alpha + \beta_1 pareturn_l + \beta_2 UPREIT_i \qquad (5.12) \\ &\quad + \beta_3 pareturn_l \cdot UPREIT_i + \epsilon_i \\ fourplus_i &= \alpha + \beta_1 pareturn_l + \beta_2 UPREIT_i \qquad (5.13) \\ &\quad + \beta_3 pareturn_l \cdot UPREIT_i + \epsilon_i \end{aligned}$$

As a robustness check, we further estimate a version of the probit model (equation 5.13) which also includes the other firm characteristics that we observed in the previous chapter. Because, according to our economic rationale, only the characteristic of being an UPREIT should help a REIT overcome the 4-year portion of the trading constraints, the results from a model which includes all firm characteristics could lend strong support to this explanation over possible other ones.

This model, thus, becomes:

$$\begin{aligned} fourplus_i &= \alpha + \beta_1 pareturn_l + \beta_2 UPREIT_i \\ &\quad + \beta_3 pareturn_l \cdot UPREIT_i \\ &\quad + \beta_4 CBSAdiv_i + \beta_5 ERdiv_i + \beta_6 PTdiv_i + \beta_7 Large \\ &\quad + \beta_8 pareturn_l \cdot CBSAdiv_i + \beta_9 pareturn_l \cdot ERdiv_i \\ &\quad + \beta_{10} pareturn_l \cdot PTdiv_i + \beta_{11} pareturn_l \cdot Large_i + \epsilon_i \end{aligned} \tag{5.14}$$

Here, $CBSAdiv$, $ERdiv$, and $PTdiv$ are dummies that indicate the degree of portfolio diversification of the REIT owning property i at the time of sale, with respect to CBSA, economic region, and property type, respectively. We use the Herfindahl indices we used in the previous chapter to assess a firm's level of diversification and define the dummy variables as we did there. $Large$ is the size dummy used in the previous chapter, and defined the same way, indicating whether a firm is part of the upper two thirds of total industry capital or not.

In order to observe whether localized real estate market performance affects the decision to hold a property beyond the four-year mark, we limit our data to properties held up to six years only, so we can observe how decisions close to the four-year cutoff are made.

5.4.4 Results and Implications

Table 5.3, page 118, and figures 5.4 – 5.6, pages 115 – 117, show distributional statistics for the holding periods of all properties in the SNL dataset. Notice the amount of distributional mass that lies in the low holding periods. The median holding period for all properties is exactly 4 years, and figure 5.4 confirms this

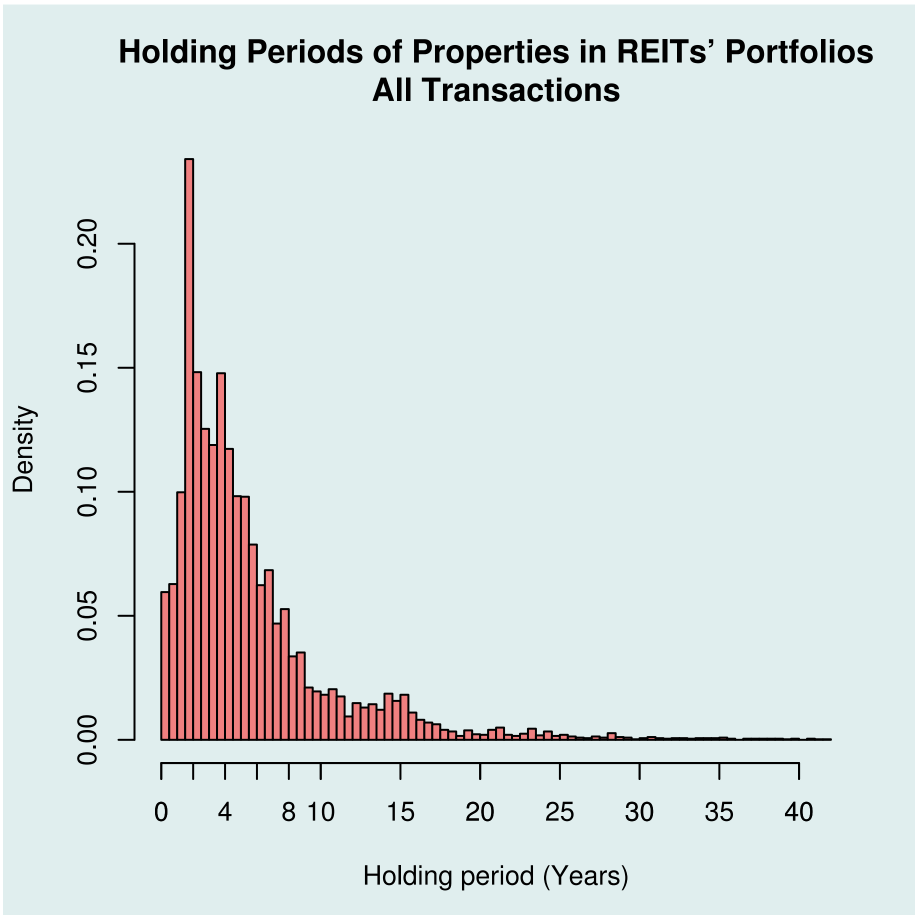

Figure 5.4: Histogram of the empirical distribution of holding periods, for all properties.

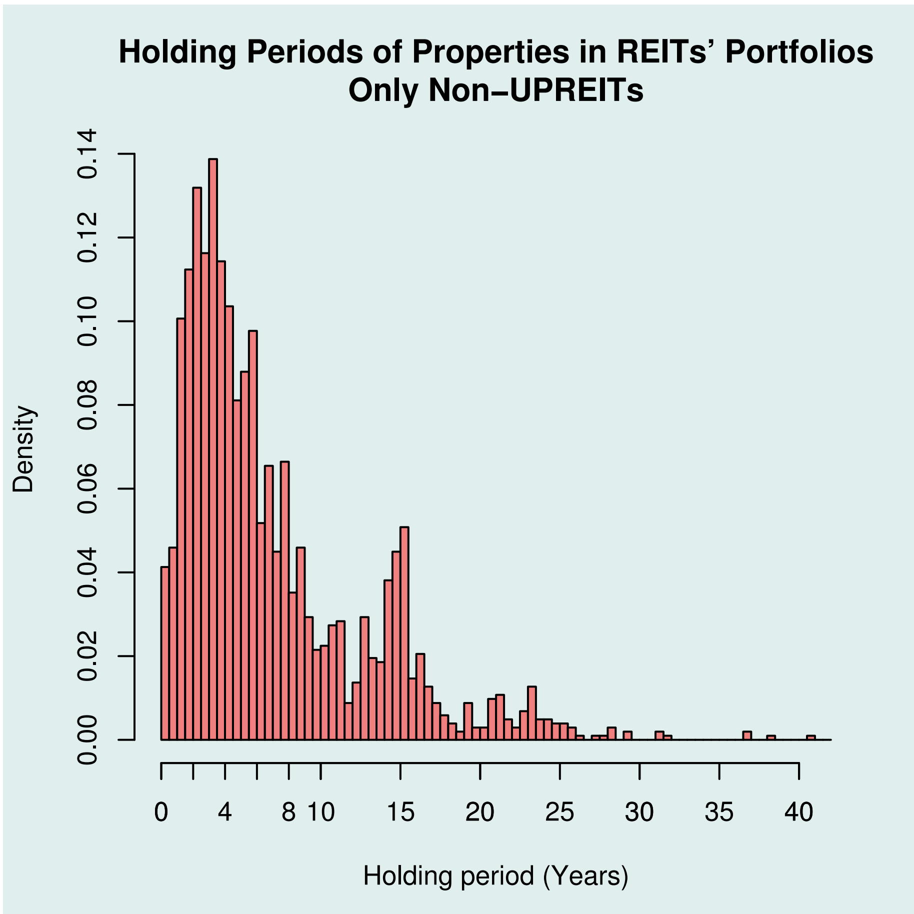

Figure 5.5: Histogram of the empirical distribution of holding periods, for properties owned by non-UPREITs.

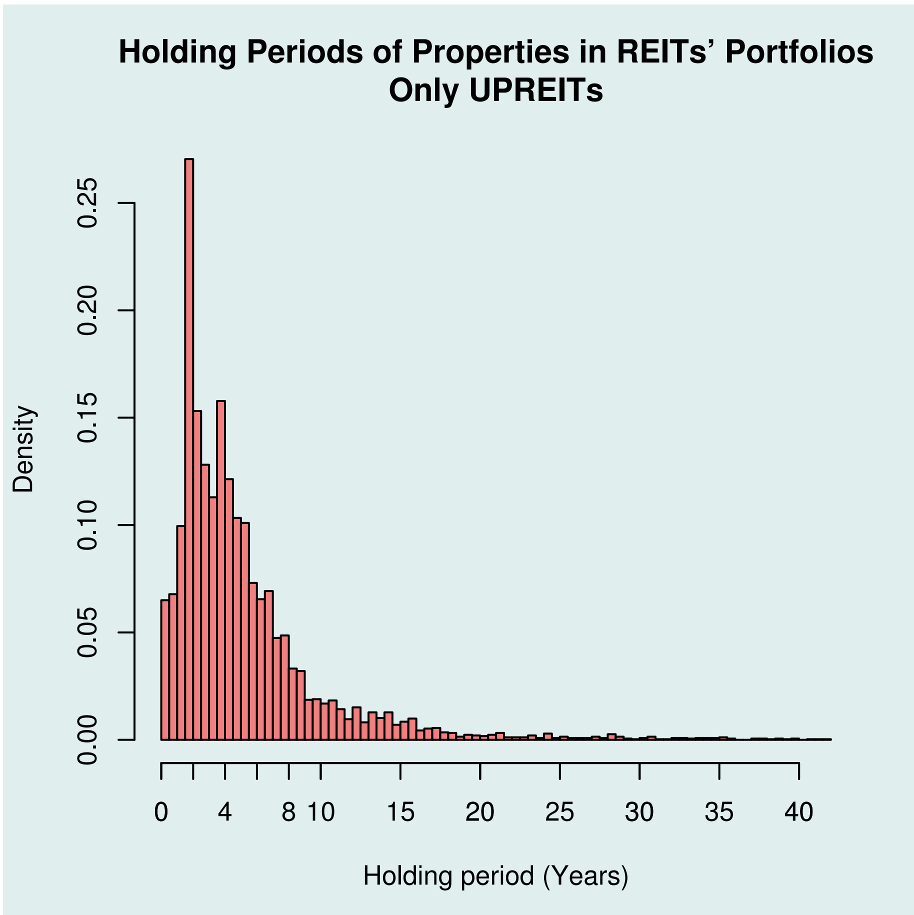

Figure 5.6: Histogram of the empirical distribution of holding periods, for properties owned by UPREITs.

Table 5.3: Distributional Statistics for Holding Periods of Properties owned by all REITs, Non-UPREITs, and UPREITs.

	1st Quart	**Median**	**Mean**	**3rd Quart**	**N**
All REITs	2.121	4.000	5.532	6.825	8918
Non-UPREITs	2.804	5.003	6.930	9.316	2047
UPREITs	1.992	3.836	5.115	6.323	6871

All figures in years.

graphically. Thus, we can definitely not say that the four-year holding constraint is irrelevant to the holding periods which REITs require: as this distributional analysis shows, the four-year holding constraint is extremely binding, and REITs seem very eager to dispose of some properties after a fairly short period of time. Furthermore, the similarities between the empirical holding period distributions shown here, and that produced by our simulated market timing strategy (figure 5.3, page 108) should be noted: while the strategy that we implemented may not be the only way to time the market, it seems to be the case in reality that REIT managers want to engage in actively traded market timing strategies, because of the profits that these yield.

Notice next the difference in distributional statistics between regular REITs and UPREITs. As shown in table 5.3, the median holding period for non-UPREITs is 5.003, while the median holding period for UPREITs is 3.836 years and the first quartiles differ by almost as much. The histograms in figures 5.5 and 5.6 tell the same story: notice how little mass is in the higher part of the distribution for UPREITs, compared to that for regular REITs. This data clearly shows that REITs have the need to follow an active trading strategy with short holding periods, and that UPREITs better manage to do this than non-UPREITs.

A question we need to ask ourselves is, however, why do regular REITs still

Table 5.4: Regression Results, Ordinary Least Squares. Dependent Variable: Holding Period. Standard errors in parenthses.

	Model 1	Std. Error
$Intercept$	2.1923	$(0.1371)^{***}$
$pareturn$	6.9989	$(1.0367)^{***}$
$UPREIT$	0.2480	(0.1515)
$pareturn \cdot UPREIT$	-2.5994	$(1.1577)^{*}$
N	6212	
$\overline{R^2}$	0.323	
F	40.11	

$^{\circ}$: significance level $\leq 10\%$. *: significance level $\leq 5\%$.

**: significance level $\leq 1\%$. *** : significance level $\leq 0.1\%$.

$pareturn$: Annualized return of the local property market index.

$UPREIT$: Dummy variable indicating whether the transacting firm is an UPREIT.

Note: only properties with holding periods of 6 years or less are included.

have such a large mass of holding periods below four years? Some of these transactions may have incurred losses and so there is no incentive to hold the property for the whole four years, if the firm can cut its losses by selling earlier. On some other transactions, especially where the profit is small, it may actually be advantageous to surrender profits to the state, in order to be able to leave a market before a downturn, rather than waiting until the property has actually incurred a loss. Then, when the market has passed its trough, the REIT can buy back into it, and thus realize higher profits at the next peak [6].

Table 5.4 shows the regression results of holding period on the annualized local market index return and the $UPREIT$ dummy. Notice, first of all, the positive and strongly significant coefficient on $pareturn$. This implies that an up-market is associated with longer holding periods: this, of course, deviates from a random walk assumption (and, since these are annualized returns, also

[6]assuming, of course, that this peak will occur after four years or more.

from a random walk with drift assumption), as in a weak-form efficient market, time-adjusted holding period return should be unrelated to holding period length. It is probably sensible to assume that causality, if any, runs in such a way that the market environment determines holding periods and not vice versa.

Now notice the incremental effect for $pareturn \cdot UPREIT$, which is negative and significant. The net effect on UPREITs is not zero, given the size of this coefficient, but, nonetheless, UPREITs show a significantly shorter holding period associated with a rising market than regular REITs. This combination of results fits well with our trading-restrictions hypothesis: regular REITs want to retain the profits of a rising market and thus hold properties beyond the four-year constraint. Furthermore, in most cases, just like in our simulated trading strategy, it will be optimal to wait beyond the fourth year, until a new sell signal occurs, before selling a property. Hence, especially in this subset of properties being sold within six years, we argue that rising markets *cause* longer holding periods in regular REITs. UPREITs, which, of course, are not subject to the holding period constraints, show this effect much less.

Table 5.5, page 121, shows the results from the probit regressions, which model the specific decision to hold a property beyond four years on the annualized local market return and firm characteristics. Once again, in model 2, the coefficient for *pareturn* is positive and strongly significant, indicating that the probability that a property which is held for six years or less is held beyond the all important four-year mark is significantly higher in a rising market. Similarly to the previous result, we obtain a negative coefficient for $pareturn \cdot UPREIT$, indicating that an UPREIT is significantly less likely to hold a property beyond four years in a rising market.

Accounting for other firm characteristics, as we do in model 3, strengthens this result. The coefficient for *pareturn* increases; the absolute value of the coefficient for $pareturn \cdot UPREIT$ also increases, while its standard error remains largely unchanged, thus showing an even stronger negative UPREIT effect, once size is accounted for. Out of the new variables included, only *Large*

Table 5.5: Regression Results, Probit. Dependent Variable: $fourplus$. Standard errors in parentheses.

	Model 2	Std. Error	Model 3	Std. Error
$Intercept$	-0.9935	$(0.1297)^{***}$	-1.4545	$(0.3515)^{***}$
$pareturn$	3.6518	$(0.9549)^{***}$	8.7703	$(3.0241)^{**}$
$UPREIT$	0.1768	(0.1447)	0.5747	$(0.2382)^{*}$
$pareturn \cdot UPREIT$	-1.9651	$(1.0845)^{\circ}$	-6.6142	$(1.8549)^{***}$
$CBSAdiv$			0.6392	(0.4369)
$ERdiv$			0.4740	(0.3872)
$PTdiv$			-0.3978	(0.2518)
$Large$			-0.6732	$(0.1507)^{***}$
$pareturn \cdot CBSAdiv$			-3.2074	(3.5423)
$pareturn \cdot ERdiv$			-2.4414	(3.2211)
$pareturn \cdot PTdiv$			1.4676	(1.8967)
$pareturn \cdot Large$			3.2875	$(1.2208)^{***}$
N	6212		4242	

$^{\circ}$: significance level $\leq$ 10%. *: significance level $\leq$ 5%.

**: significance level $\leq$ 1%. *** : significance level $\leq$ 0.1%.

$pareturn$: Annualized return of the local property market index.

$UPREIT$: Dummy variable indicating whether the transacting firm is an UPREIT.

$CBSAdiv$: Dummy variable indicating whether the transacting firm's portfolio is CBSA-level diversified.

$ERdiv$: Dummy variable indicating whether the transacting firm's portfolio is economic-region diversified.

$PTPdiv$: Dummy variable indicating whether the transacting firm's portfolio is property-type diversified.

$Large$: Dummy variable indicating whether the transacting firm is large.

Note: only properties with holding periods of 6 years or less are included.

and $pareturn \cdot Large$ are significant, the former negative and the latter positive. This suggests that in general large firms are more likely to sell early, but that in a rising market they are more likely to hold beyond the four-year mark than small firms. This result is likely driven by large non-UPREIT firms. As large firms tend to be more closely followed by investment analysts than smaller firms, management would perhaps get penalized more severely for the foregone profits of selling early in a rising market[7], and thus the probability of a large firm holding a property beyond four years in such a market is even greater than for a smaller firm. Neutral of market performance, however, if a large firm faces lower transactions costs, as argued earlier, its management would be more likely to actively trade its portfolio, and therefore less likely to hold beyond four years. What is more important for our investigation, however, is that the positive coefficient for $pareturn$ and the negative coefficient for $pareturn \cdot UPREIT$ are unaffected (or even stronger) when accounting for other firm characteristics: this finding yields strong support to the trading restrictions explanation, since only the UPREIT structure allows a firm to overcome its four-year selling constraint, while other firm characteristics would not have this effect.

These results give extremely strong support to our trading-restrictions hypothesis: in a rising market, a REIT wants to retain the profits it made and therefore has no choice but to hold each property beyond the four-year mark and then sell it at the next available opportunity. UPREITs, which can dispose of properties without holding constraints, are less likely to hold each property for four years: this demonstrates once again the bindingness of the four-year constraint.

5.5 Conclusion

In this chapter we analyze holding periods of properties in REITs' portfolios in order to asses the bindingness of the trading constraints faced by REITs,

[7]Assuming rational profit-maximizing managers such a sale might occur for liquidity reasons, for example. Otherwise there might be agency problems involved, and not profit maximization.

and to assess how these constraints hinder REITs in their ability to time the market. In order to do this, we first devise a filter-based trading strategy, and we show that this strategy considerably outperforms a simple buy-and-hold strategy over a wide range of transaction cost levels. We analyze the holding periods required by this strategy, and find that a significant portion of the empirical distribution of these holding periods is shorter than the four-year minimum imposed on REITs. Further, we analyze the performance of this trading strategy in a holding-period constrained environment, and find that this constrained strategy substantially underperforms the unconstrained strategy. The difference between the returns from the two strategies is especially dramatic for scenarios in which there are low transaction costs, thus suggesting that large REITs, which often manage to trade with very favorable costs, are especially strongly affected by the trading constraints. Since any outperformance over a buy-and-hold strategy must, we argue, be due to appreciation gains and not income gains, this strongly illustrates the mechanics of how the trading constraints hinder a REIT investor's ability to make appreciation profits.

While the filter-based strategy we use is only one possible trading strategy, we have shown successfully how appreciation profits from this trading strategy are reduced by the trading constraints REITs face, and thus how these trading constraints reduce REITs' opportunity sets for profit making. Furthermore, most managers will combine any technical trading strategy with fundamentals-based information, possibly leading to a necessity for even shorter holding periods. It would also seem that our illustration of how the trading constraints hinder this strategy in generating market-timing profits could be easily transferable to many other market timing strategies.

We then proceed to analyzing actual holding periods of properties in REITs' portfolios. We find that a significant amount of the distribution of holding periods lies below or just above the four-year mark, suggesting that REITs are eager to hold properties for a short time and that the four-year holding period is very binding. This matches with the holding periods required by our simulated trading strategy and suggests that REIT managers want to try to time the market, as, especially given the predictability of the direct property market, large profits can be made by doing this. We also find that UPREITs, which are not constrained by the holding period restrictions, tend to hold more of their properties for shorter periods than regular REITs which are affected by holding constraints.

We then analyze holding period length as determined by the current market situation and find that holding periods tend to be longer in rising markets for regular REITs and much less so for UPREITs. We also analyze the decision to hold a property for more than four years in a set of properties that were held for six years or less, and find very strongly that regular REITs are more likely to hold a property beyond four years in a rising market than in a falling one, while for UPREITs this relationship is significantly weaker. These results are strengthened when the other firm characteristics used in the previous chapter are included in the model. This, once again, lends strong support to our hypothesis, as UPREITs can simply sell a property whenever the manager feels the ideal time is, while regular REITs must wait beyond the four-year mark in order to be able to retain the profits made in the rising market.

Because of the predictability of the direct property market, considerable profits can be made from short-term market timing strategies, as we have shown, and the four-year constraint hinders REITs' abilities to make such profits, thus rendering them to the most extent unable to transmit short-term property appreciation gains to investors, and making them ineffective pass-through securities for property.

Chapter 6

Conclusion

Throughout this study, we address the fundamental question on the investment value of Real Estate Investment Trusts, namely, what property-related cashflows a REIT investor obtains and why.

After presenting a review of recent literature investigating REIT asset prices in chapter 2, we argue in chapter 3 that a REIT investor, in the short term, is only exposed to *property income* cashflows and not *property appreciation* cashflows not contained in *income*, or price fluctuations that come about purely from changes in the capitalization rate.

Specifically, we compare the income and appreciation returns from a diversified property portfolio to the total returns from a diversified REIT portfolio (accounting for pure stock-market effects and interest rate effects) and find that, in the short term, REIT returns are driven primarily by property income, and that fluctuations in property appreciation not contained in income do not affect REIT returns. We find that this is the case for both *old* REITs, before the boom of the 1990s, and (cautiously so) for *new* REITs, although it would be necessary to wait for more post-boom data to become available in order to be able to argue this with more certainty. Since we use appraisal-based data to proxy for appreciation returns to the direct property portfolio, we devote some space in chapter 3 to adjusting this series for systematic bias found in such data.

The rest of the study is devoted to showing why this phenomenon occurs.

We posit, without proof, at the end of chapter 3 that this is due to the trading restrictions which REITs face in the direct property market, in order for their portfolios to be considered *passively traded*. Chapters 4 and 5 present evidence that this explanation for this phenomenon is the correct one.

In chapter 4 we do this by testing whether firms that can be classified differently according to various sets of firm characteristics, are differently affected by income and appreciation. Specifically, we first test whether firm size affects the way a REIT reflects appreciation returns, arguing that size, as a proxy for the number of properties in a REIT's portfolio, should help a REIT overcome at least in part the ten-percent selling restriction. In order to do this, we sort firms into value-weighted size portfolios every period and compare the returns earned by each of the two size portfolios to property income and appreciation returns. The empirical results in this section indeed show that large firms seem to better reflect appreciation returns than small firms, throughout the entire time sample. This finding supports our trading restrictions hypothesis.

We then do a similar test for portfolio diversification, again arguing that holding a more diversified property portfolio should help a REIT partly overcome the ten-percent selling constraint, when dealing with price shocks that are asynchronous over the different sectors of its portfolio. We test this by sorting REITs into value-weighted portfolios by level of diversification, first geographically and then by property type. For geographic diversification, we obtain the opposite effect than is expected, in that less diversified REITs are more appreciation driven than more diversified ones: this suggests that it might be the case that the localized knowledge a geographically specialized REIT has, which enables it to time idiosyncratic shocks, seems to outweigh the benefits a diversified REIT has, of being able to time asynchronous systematic shocks across different geographic areas. For property-type diversification we find that more diversified REITs better reflect appreciation returns than less diversified REITs, which supports our trading restrictions hypothesis.

The third test we perform in chapter 4 tests whether UPREIT status affects how well firms reflect appreciation returns. In fact, since in an UPREIT the properties are held by a limited partnership, the entity trading the properties is not affected by the trading constraints. Once again, we form portfolios of UPREITs and regular REITs and find that the returns to the UPREIT portfolio significantly reflect appreciation returns, while those to the non-UPREIT portfolio do not. This, once again, lends strong support to our trading restrictions hypothesis, since there are few systematic distinguishing characteristics between regular REITs and UPREITs, and perhaps the most prominent one is the fact that UPREITs can sell properties without constraint.

Finally, we combine all the factors tested in this chapter in a large firm-by-firm panel model and find that when accounting for all characteristics, only UPREIT status gives a significant appreciation effect. Once again, we argue that this strongly supports our hypothesis, since UPREITs are able to completely ignore both parts of the selling constraint, while non UPREITs that are favorably affected by the other characteristics are only helped to some extent with the ten-percent constraint. Thus, in an environment of noise and to some extent collinear firm effects, UPREIT status, as the strongest, trumps the others. However, even though UPREIT status seems to be the most effective characteristic in allowing an investor to participate in property appreciation cashflows, other characteristics, especially size, might be easier and cheaper for an investor to observe and thus some investors might still prefer, for example, a size sort over an UPREIT sort, as this yields similar results in terms of appreciation returns and is easier to accomplish.

In chapter 5 we take a different approach towards this issue, by analyzing holding periods of properties in REITs' portfolios. We first devise a set of filter-based strategies which, we show, can be used to time the property market and make abnormal profits under a wide range of transaction costs. We then analyze the holding periods implied by these strategies and find that a significant number of holding periods shorter than four years is required by them. Further, we test the performance of this strategy under a four-year holding constraint and find that in this environment the outperformance over a simple buy-and-hold strategy is considerably less. We argue further that any outperformance of a market-timing strategy over a buy-and-hold strategy must be due to appreciation returns[1]. Thus, these results from the simulated trading strategies clearly illustrate the mechanics of how the trading constraint affects this component of REIT returns.

We then proceed to analyzing actual holding periods of properties in REIT portfolios under different market conditions, arguing that the selling constraint is actually only binding in a rising market, as in a falling market no money is lost to the state since the 100% tax is only on profits from prohibited transactions, and no profits would have been made in a falling market. We thus model holding period length on the performance of the local real estate market during this time, for properties that were held six years or less, in order to analyze the decision to hold a property beyond the four-year mark. We find a significant positive relationship between holding period and local market return, which is significantly weaker for UPREITs than for regular REITs. We then model the specific decision to hold a property beyond four years on local market performance in a probit regression, and find that, while regular REITs are significantly more likely to hold a property beyond four years in a rising market than in a falling one, this is not the case for UPREITs. When accounting for the other firm characteristics treated in chapter 4, we still find the strong UPREIT effect, and very little in terms of other effects. We argue that this is the case, because other firm characteristics besides UPREIT status do not help a firm overcome the four-year trading constraint. These results strongly illustrate the bindingness of the trading constraint on regular REITs and how this constraint prevents these firms from satisfactorily timing the property market and thus realizing appreciation returns.

While some promising results have been produced in this study, there is certainly room for further research in this topic. Specifically, it will be important to see whether the results for *new* REITs in chapters 3 and 4 hold as time passes and more data becomes available. Furthermore, these results could be

[1] Since rental cashflows are always positive, the strategy which stays in the market the longest (the buy-and-hold strategy) will always prevail in terms of income returns.

strengthened if it were possible to obtain time series data on private valuations by institutional investors, for individual REITs. For example the REIT Net Asset Values and REIT Warranted Values produced by Greenstreet Advisors may lead to some interesting insights.

All in all, however, in this study, we have produced a fairly important and useful set of results for the determination of the investment value of Real Estate Investment Trusts and the determination of their ability to expose an investor to all types of property cashflows. This should be of interest for the assessment of the place of this asset class, as well as that of specific firms with certain characteristics, in a diversified multiple-asset portfolio.

Appendix A

Investigating Collinearity Relationships through Singular Value Decomposition

In this section, we investigate the collinearity relationships in chapter 3 through the method of singular value decomposition. This procedure is thoroughly outlined in Belsley, Kuh and Welsch (1980), Belsley (1991), and Board, Rees and Sutcliffe (1992), and we therefore not spend too much time on its fundamentals but give a brief procedural outline of this technique.

Given any $n \times k$ matrix $\mathbf{X}$ of explanatory variables, this matrix can be decomposed into the product of three matrices as follows:

$$\mathbf{X} = \mathbf{UDV}' \tag{A.1}$$

where $\mathbf{U}$ is an $n \times k$ matrix and $\mathbf{V}$ is a $k \times k$ matrix with $\mathbf{U}'\mathbf{U} = \mathbf{V}'\mathbf{V} = \mathbf{I}$, the $k \times k$ identity matrix. It can be shown that the columns of $\mathbf{U}$ are the eigenvectors of $\mathbf{XX}'$ while the columns of $\mathbf{V}$ are the eigenvectors of $\mathbf{X}'\mathbf{X}$. In this case, $\mathbf{D}$ will be a $k \times k$ diagonal matrix with positive diagonal elements called the *singular* *values* of $\mathbf{X}$, which we will denote by $\mu_i, 1 \leq i \leq k$, and which can be shown to be the square roots of the eigenvalues of $\mathbf{X'X}$. In the presence of exact linear dependency among columns of $\mathbf{X}$, one or several of these singular values will be zero, making $\mathbf{X'X}$ singular and making it impossible to compute the OLS estimator. With near linear dependencies, it will be possible to compute the OLS estimator, but one or several singular values will be *small*. To define *small*, we construct a condition index ϕ defined as:

$$\phi_i = \frac{\mu_{max}}{\mu_i} \text{ with } 1 \leq i \leq k \tag{A.2}$$

Belsley et al. (1980) suggest that a condition index of 5 to 10 indicates weak linear dependency among columns while an index of 15 to 30 indicates near dependencies.

While by finding condition indices we detect the presence of collinearity in our matrix of explanatory variables, this does not tell us anything about the variables involved in this dependency. In order to find out this information, we can decompose the covariance matrix as follows. By equation A.1 and the properties of $\mathbf{V}$, the covariance matrix can be rewritten as

$$\sigma^2(\mathbf{X'X})^{-1} = \sigma^2\mathbf{V}\mathbf{D}^2\mathbf{V}' \tag{A.3}$$

In scalar notation, the ith diagonal element of the covariance matrix becomes

$$var(b_i) = \sigma^2 \sum_{j=1}^{k} \left(v_{ij}^2/\mu_{ij}^2\right) = \sigma^2 \sum_{j=1}^{k} n_{ij} \tag{A.4}$$

where $n_{ij} = v_{ij}^2/\mu_j^2$ and v is an element of $\mathbf{V}$. The proportion of the variance of the ith explanatory variable caused by the jth singular value is then simply

$$\pi_{ji} = \frac{n_{ij}}{\sum_{j=1}^{k} n_{ij}} \tag{A.5}$$

Note that these terms will all be positive and sum to 1. We can then construct a matrix $\mathbf{\Pi}$ of proportions of variances consisting of elements π_{ij}.

For our sample from chapter 3 the results of this procedure are shown in table A.1.

Table A.1: Singular Values, Condition Indices, and Variance Proportions, based on the 102 observations 1978:1–2003:2.

Singular Value	Condition Index	*const*	*S&P500*	*d3yrtr*	*income*	*app*
1.1392	1.3057	0.0002	0.0054	0.2461	0.0002	0.011
0.8853	1.6802	0.0001	0.0162	0.0318	0.0001	0.0452
0.8378	1.7755	0.0005	0.0032	0.4763	0.0004	0.0389
0.0593	25.0817	0.9972	0.9750	0.2456	0.9972	0.9047

Bibliography

Alexander, S.: 1961, Price movements in speculative markets: Trends or random walks, *Industrial Management Review* **2**, 7–26.

Alexander, S.: 1964, Price movements in speculative markets: Trends or random walks, *in* P. Cootner (ed.), *The Random Character of Stock Market Prices*, Cambridge, MA: Massachusetts Institute of Technology Press.

Allen, M. T., Madura, J. and Springer, T. M.: 2000, Reit characteristics and the sensitivity of reit returns, *Journal of Real Estate Finance and Economics* **21**(2), 141–152.

Ambrose, B. W., Ehrlich, S. R., Hughes, W. T. and Wachter, S. M.: 2000, Reit economies of scale: Fact or fiction?, *Journal of Real Estate Finance and Economics* **20**(2), 211–224.

Amihud, Y. and Lev, B.: 1981, Risk reduction as a managerial motive for conglomerate mergers, *Bell Journal of Economics* **12**, 605–617.

Anderson, R. I., Fok, R., Springer, T. M. and Webb, J. R.: 2002, Technical efficiency and economies of scale: A non-parametric analysis of reits, *European Journal of Operations Research* .

Balogh, C. and Corgel, J. B.: 1992, Initial return behavior of one class of composite security ipos: Reits, *Working Paper, Bentley College* .

Barkham, R. and Geltner, D.: 1993, Price discovery and efficiency in american and british property markets, *Working Paper: University of Cincinnati* .

Barkham, R. and Geltner, D.: 1995, Price discovery in american and british property markets, *Real Estate Economics* **23**(1), 21–44.

Below, S. D., Kiely, J. K. and McIntosh, W.: 1995, An examination of informed traders and the market microstructure of real estate investment trusts, *Journal of Real Estate Research* **10**(3), 335–346.

Below, S. D., Kiely, J. K. and McIntosh, W.: 1996, Reit pricing efficiency; should investors still be concerned?, *Journal of Real Estate Research* **12**(3), 398–408.

Below, S. D., McIntosh, W. and Zaman, M. A.: 1992, The pricing of real estate investment trust initial public offerings, *Working Paper, University of Kentucky* .

Belsley, D. A.: 1991, *Conditioning Diagnostics. Collinearity and Weak Data in Regression*, New York: Wiley.

Belsley, D., Kuh, E. and Welsch, R.: 1980, *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*, New York: Wiley.

Bernardo, A. and Chowdhry, B.: 2002, Resources, real options, and corporate strategy, *Journal of Financial Economics* **63**, 211–234.

Bharati, R. and Gupta, M.: 1992, Asset allocation and predictability of real estate returns, *Journal of Real Estate Research* **7**(4), 469–484.

Blake, C. S.: 1989, The real estate investment trust: Performance over the business cycle, *Working Paper, MIT* .

Blume, L., Easley, D. and O'Hara, M.: 1994, Market statistics and technical analysis: The role of volume, *Journal of Finance* **49**, 153–181.

Blundell, G. and Ward, C.: 1987, Property portfolio allocation: a multi-factor approach, *Land Development Studies* **4**, 145–156.

Board, J., Rees, B. and Sutcliffe, C.: 1992, Measuring the incremental information content of multiple accounting signals: A note on the use of the singular value decomposition, *Journal of Business Finance & Accounting* **19**(3), 447–454.

Bollinger, J. A.: 2001, *Bollinger on Bollinger Bands*, McGraw-Hill.

Bond, S. A. and Patel, K.: 2003, The conditional distribution of real estate returns: Are higher moments time varying?, *Journal of Real Estate Finance and Economics* **26**(2), 319–333.

Brock, W., Lakonishok, J. and LeBaron, B.: 1992, Simple technical trading rules and the stochastic properties of stock returns, *Journal of Finance* **47**, 1731–1764.

Burns, W. L. and Epley, D. R.: 1982, The performance of portfolios of reits and stocks, *Journal of Portfolio Management* **8**(3), 37–42.

Campa, J. and Kedia, S.: 2002, Explaining the diversification discount, *Journal of Finance* **57**, 135–160.

Campbell, J. Y., Lo, A. W. and MacKinlay, A. C.: 1997, *The Econometrics of Financial Markets*, Princeton: Priceton University Press.

Cannon, S. E. and Vogt, S. C.: 1995, Reits and their management: an analysis of organizational structure, performance and management compensation, *Journal of Real Estate Research* **10**(3), 297–317.

Capozza, D. R. and Lee, S.: 1995, Property type, size, and reit value, *Journal of Real Estate Research* **10**(4), 363–374.

Capozza, D. R. and Seguin, P. J.: 2000, Debt, agency, and management contracts in reits: The external advisor puzzle, *Journal of Real Estate Finance and Economics* **20**(2), 91–116.

Case, B. and Quigley, J.: 1991, Dynamics of real-estate prices, *Review of Economics and Statistics* **73**(1), 50–58.

Case, K. and Shiller, R.: 1990, Forecasting prices and excess returns in the housing market, *AREUEA Journal* **18**(3), 253–273.

Chan, S. H., Erickson, J. and Wang, K.: 2003, *Real Estate Investment Trusts: Structure, Performance, and Investment Opportunities*, New York: Oxford University Press.

Chatrath, A. and Liang, Y.: 1998, Reits and inflation: A long-run perspective, *Journal of Real Estate Research* **16**(3), 311–322.

Chatrath, A., Liang, Y. and McIntosh, W.: 1996, Apartment reits and apartment real estate, *Journal of Real Estate Research* **11**(3), 277–289.

Chen, J. and Peiser, R.: 1999, The risk and return characteristics of reits, 1993-1997, *Real Estate Finance* **16**(1), 61–68.

Chen, K. and Tzang, D. D.: 1988, Interest rate sensitivity of real estate investment trusts, *Journal of Real Estate Research* **3**(3), 13–21.

Chen, S.-J., Hsieh, C., Vines, T. W. and Chiou, S.-N.: 1998, Macroeconomic variable, firm-specific variables and returns to reits, *Journal of Real Estate Research* **16**(3), 269–277.

Cho, H., Kawaguchi, Y. and Shilling, J. D.: 2003, Unsmoothing commercial property returns: A revision to fisher-geltner-webb's unsmoothing procedure, *Journal of Real Estate Finance and Economics* **27**(3), 393–405.

Ciocchetti, B. A., Craft, T. M. and Shilling, J. D.: 2002, Institutional investors' preferences for reit stocks, *Real Estate Economics* **30**(4), 567–593.

Clayton, J., Geltner, D. and Hamilton, S.: 2001, Smoothing in commercial property valuations: Evidence from individual appraisals, *Real Estate Economics* **29**(3).

Clayton, J. and Mackinnon, G.: 2003, The relative importance of stock, bond and real estate factors in explaining reit returns, *Journal of Real Estate Finance and Economics* **27**(1), 39–60.

Colwell, P. F. and Park, H. Y.: 1990, Seasonality and size effects: The case of real estate related investment, *Journal of Real Estate Finance and Economics* **3**(3), 251–259.

Cooper, M., Downs, D. H. and Patterson, G. A.: 1999, Real estate securities and a filter-based, short-term trading strategy, *Journal of Real Estate Research* **18**(2), 313–334.

Corgel, J. B., McIntosh, W. and Ott, S. H.: 1995, Real estate investment trusts: A review of the financial economics literature, *Journal of Real Estate Literature* **3**, 13–43.

Crain, J. L., Cudd, M. and Brown, C. L.: 2000, The impact of the revenue reconciliation act of 1993 on the pricing structure of equity reits, *Journal of Real Estate Research* **19**(3), 275–285.

Crosby, N. and McAllister, P.: 2005, Liquidity in commercial property markets: Deconstructing the transactions process, *Working Paper, University of Reading* .

Edwards, R. and Magree, J.: 1966, *Technical Analysis of Stock Trends*, Boston: John Magree.

Ennis, R. M. and Burik, P.: 1991, Pension fund real estate investment under a simple equilibrium pricing model, *Financial Analysts Journal* **47**(3), 20–30.

Fama, E.: 1965, The behavior of stock markets, *Journal of Business* **38**, 34–105.

Fama, E. and Blume, M.: 1966, Filter rules and stock market trading profits, *Journal of Business* **39**, 226–241.

Fama, E. F. and French, K. R.: 1992, The cross-section of expected stock returns, *Journal of Finance* **47**, 427–465.

Fama, E. F. and French, K. R.: 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* **33**, 3–56.

Fisher, J. D., Geltner, D. and Webb, R. B.: 1994, Value indices of commercial real estate: A comparison of index construction methods, *Journal of Real Estate Finance and Economics* **9**, 137–164.

Geltner, D.: 1989, Estimating real estate's systematic risk from aggregate level appraisal-based returns, *AREUEA Journal* **17**(4), 463–481.

Geltner, D.: 1990, Real estate and the diversifiability of stock market noise, *Working Paper: University of Cincinnati* .

Geltner, D.: 1991, Smoothing in appraisal-based returns, journal of real estate finance and economics, *Journal of Real Estate Finance and Economics* **4**(3), 327–345.

Geltner, D.: 1992, Estimating market value from appraised values without assuming an efficient market, *Working Paper: University of Cincinnati* .

Geltner, D. and Miller, N.: 2001, *Commercial Real Estate Analysis and Investments*, Mason, OH: Southwestern, Thomson Learning.

Ghosh, C., Guttery, R. S. and Sirmans, C.: 1998, Contagion and reit stock prices, *Journal of Real Estate Research* **16**(3), 389–399.

Ghosh, C., Nag, R. and Sirmans, C. F.: 1999, An analysis of seasoned equity offerings by equity reits (1991-1995), *Journal of Real Estate Finance and Economics* **19**, 175–192.

Giliberto, S. M.: 1990, Equity real estate investment trusts and real estate returns, *Journal of Real Estate Research* **5**(2), 259–263.

Giliberto, S. M.: 1993, Measuring real estate return: the hedged reit index, *Journal of Portfolio Management* **19**(3), 94–99.

Glascock, J., Hughes, W. T. and Varshney, S. B.: 1998, Analysis of reit ipos using a market microstructure approach: Anomalous behavior or asset structure, *Journal of Real Estate Finance and Economics* **16**(3), 243–256.

Glascock, J. L.: 1991, Market conditions, risk, and real estate portfolio returns: Some empirical evidence, *Journal of Real Estate Finance and Economics* **4**(4), 367–373.

Glascock, J. L., Lu, C. and So, R. W.: 2000, Further evidence on the integration of reit, bond, and stock returns, *Journal of Real Estate Finance and Economics* **20**(2), 177–194.

Glascock, J. L., Lu, C. and So, R. W.: 2002, Reit returns and inflation: Perverse or reverse causality effects?, *Journal of Real Estate Finance and Economics* **24**(3), 301–317.

Glascock, J., Michayluk, D. and Neuhauser, K.: 2004, The riskiness of reits surrounding the october 1997 stock market decline, *Journal of Real Estate Finance and Economics* **28**(4), 339–354.

Goebel, P. R. and Kim, K. S.: 1989, Performance evaluation of finite-life real estate investment trusts, *Journal of Real Estate Research* **4**(2), 57–69.

Goetzmann, W. N. and Ibbotson, R. G.: 1990, The preformance of real estate as an asset class, *Journal of Applied Corporate Finance* **13**(1), 65–76.

Gomes, J. and Livdan, D.: 2004, Optimal diversification: Reconciling theory and evidence, *Journal of Finance* **59**(2), 507–535.

Graff, R. A. and Young, M. S.: 1997, Serial persistence in equity reit returns, *Journal of Real Estate Research* **14**(3), 183–194.

Graham, J., Lemmon, M. and Wolf, J.: 2002, Does corporate diversification destroy value?, *Journal of Finance* **57**, 695–720.

Gyourko, J. and Keim, D. B.: 1992, What does the stock market tell us about real estate returns?, *AREUEA Journal* **20**, 457–485.

Gyourko, J. and Linneman, P.: 1988, Owner-occupied homes, income-producing properties, and reits as inflation hedges: Empirical findings, *Journal of Real Estate Finance and Economics* **1**(4), 347–372.

Gyourko, J. and Nelling, E.: 1996, Systematic risk and diversification in the equity market, *Real Estate Economics* **24**, 493–515.

Gyourko, J. and Nelling, E.: 1998, The predictability of equity reit returns, *Journal of Real Estate Research* **16**(3), 251–262.

Han, J.: 1990, Did reits really outperform the stock market portfolio?, *Working Paper, MIT* .

Han, J. and Liang, Y.: 1995, The historical performance of real estate investment trusts, *Journal of Real Estate Research* **10**, 235–262.

Hardin, W. G. I. and Wolverton, M. L.: 1999, Equity reit property acquisitions: Do apartment reits pay a premium?, *Journal of Real Estate Research* **17**(1), 113–126.

He, L. T.: 1998, Cointegration and price discovery between equity and mortgage reits, *Journal of Real Estate Research* **16**(3).

Jensen, M.: 1986, Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review* **76**, 323–329.

Jensen, M. and Murphy, K.: 1990, Performance pay and top management incentives, *Journal of Political Economy* **98**, 225–264.

Karolyi, A. G. and Sanders, Anthony, B.: 1998, The variation of economic risk premiums in real estate returns, *Journal of Real Estate Finance and Economics* **17**(3), 245–262.

Khoo, T., Hartzell, D. and Hoesli, M.: 1993, An investigation of the change in real estate investment trust betas, *AREUEA Journal* **21**(2), 107–130.

Kuhle, J. L.: 1987, Portfolio diversification and return benefits – common stock vs. real estate investment trusts (reits), *Journal of Real Estate Research* **2**(2), 1–9.

Lang, L. and Stulz, R.: 1994, Tobins q, corporate diversification, and firm performance, *Journal of Political Economy* **102**, 1248–1280.

Larson, S.: 2005, Real estate investment trusts and stock price reversals, *Journal of Real Estate Research* **30**(1), 81–88.

LeBaron, B.: 1996, Technical trading rule profitability and foreign exchange intervention, *Working Paper 5505, NBER* .

Lee, M.-L. and Chiang, K. C.: 2003, Substitutability between equity reits and mortgage reits, *Journal of Real Estate Research* .

Li, Y. and Wang, K.: 1995, The predictability of reit returns and market segmentation, *Journal of Real Estate Research* **10**(4), 471–482.

Liang, Y., McIntosh, W. and Ott, S. H.: 1993, The wealth effects of real estate transactions: The case of reits, *Working paper, University of Kentucky* .

Liang, Y., McIntosh, W. and Webb, J. R.: 1995, Intertemporal changes in the riskiness of reits, *Journal of Real Estate Research* **10**(4), 427–433.

Liang, Y. and Webb, J. R.: 1995, Pricing interest-rate risk for mortgage reits, *Journal of Real Estate Research* **10**(4), 461–469.

Ling, D. C. and Ryngaert, M.: 1997, Valuation uncertainty, institutional involvement, and the underpricing of ipos: The case of reits, *Journal of Financial Economics* **43**, 433–456.

Liu, C. H. and Mei, J.: 1992, The predictability of returns on equity reits and their comovement with other assets, *Journal of Real Estate Finance and Economics* **5**(4), 401–418.

Liu, C. H. and Mei, J.: 1993, Evidence on the integration of international real estate markets and diversification consequences, *Working paper, New York University* .

Liu, C. H. and Mei, J.: 1994, An analysis of real estate risk using the present value model, *Journal of Real Estate Finance and Economics* **8**, 5–20.

Lizieri, C. and Satchell, S.: 1997, Interactions between property and equity markets: An investigation of linkages in the united kingdom 1972-1992, *Journal of Real Estate Finance and Economics* **15**(1), 11–26.

Martin, J. D. and Cook, D. O.: 1991, A comparison of the recent performance of publicly traded real property portfolios and common stock, *AREUEA Journal* **19**.

Matsusaka, J.: 2001, Corporate diversification, value maximization, and organizational capabilities, *Journal of Business* **74**, 409–431.

McInstosh, W., Liang, Y. and Tompkins, D. L.: 1991, An examination of the small firm effect within the reit industry, *Journal of Real Estate Research* **6**(1), 9–17.

Mengden, A. E.: 1988, *Real Estate Investment Trusts - Sensitivity of Dividend Yields to Changes in Interest Rates*, New York: Salomon Brothers, Inc.

Mengden, A. E. and Hartzell, D. J.: 1986, *Real Estate Investment Trusts - Are they Stocks or Real Estate?*, New York: Salomon Brothers Inc.

Miles, M. and McCue, T.: 1982, Historic returns and institutional real estate portfolios, *AREUEA Journal* **10**(2), 184–199.

Mueller, G. R. and Pauley, K. R.: 1995, The effect of interest-rate movements on real estate investment trusts, *Journal of Real Estate Research* **10**(3), 319–325.

Murphy, J.: 1986, *Technical Analysis of the Futures Markets*, New York: New York Institute of Finance.

Murphy, J. A. and Klieman, R. T.: 1989, The inflation-hedging characteristics of equity reits: An empirical study, *Quarterly Review of Economics and Business* **29**(3), 95–101.

Murphy, J. J.: 1999, *Technical Analysis of the Financial Markets: A Comprehensive Guide to Trading Methods and Applications*, Prentice Hall Press.

Myer, F. N. and Webb, J. R.: 1990, Reit returns and economic news, *Working paper, Cleveland State University* .

Myer, F. N. and Webb, J. R.: 1993, Return properties of equity reits, common stocks, and commercial real estate: A comparison, *Journal of Real Estate Research* **8**(1), 87–106.

Myer, F. N. and Webb, J. R.: 1994, Retail stocks, retail reits and retail real estate, *Journal of Real Estate Research* **9**(1), 65–84.

Okunev, J. and Wilson, P.: 1997, Using nonlinear tests to examine integration between real estate and stock markets, *Real Estate Economics* **25**, 487–503.

Okunev, J., Wilson, P. and Zubruegg, R.: 2000, The causal relationship between real estate and stock markets, *Journal of Real Estate Finance and Economics* **21**(3), 251–261.

Oppenheimer, P. and Grissom, T. V.: 1998, Frequency space correlation between reits and capital market indices, *Journal of Real Estate Research* **16**(3), 291–310.

Pagliari, J. L. and Webb, J. R.: 1995, A fundamental examination of securitized and unsecuritized real estate, *Journal of Real Estate Research* **10**(4), 381–425.

Park, J. Y., Mullineaux, D. J. and Chew, I.-K.: 1990, Are reits inflation hedges?, *Journal of Real Estate Finance and Economics* **3**(1), 91–103.

Peterson, J. D. and Hsieh, C.-H.: 1997, Do common risk factors in the returns on stocks and bonds explain returns on reits?, *Real Estate Economics* **25**(2), 321–345.

Pierzak, E. F.: 2001, Payment choice in reit property acquisitions, *Journal of Real Estate Research* **21**(1), 105–139.

Pinheiro, J., Bates, D., DebRoy, S. and Sarkar, D.: 2005, *nlme: Linear and nonlinear mixed effects models*. R package version 3.1-64.

Quan, D. and Quigley, J.: 1989, Inferring an investment return series for real estate from observations on sales, *AREUEA Journal* **17**(2), 218–230.

Quan, D. and Quigley, J.: 1991, Price formation and the appraisal function in real estate, *Journal of Real Estate Finance and Economics* **4**(2), 127–146.

R Development Core Team: 2005, *R: A language and environment for statistical computing*, R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0.
URL: *http://www.R-project.org*

Redman, A. L., Manakyan, H. and Liano, K.: 1997, Real estate investment trusts and calendar anomalies, *Journal of Real Estate Research* **14**(1), 19–28.

Ross, S. A. and Zisler, R. C.: 1987, *Managing Real Estate Portfolios Part 2: Risk and Return in Real Estate and Part 3: A Close Look at Equity Real Estate Risk*, New York: Goldman Sachs.

Ross, S. and Zisler, R.: 1991, Risk and return in real estate, *Journal of Real Estate Finance and Economics* **4**(2), 175–190.

Schleifer, A. and Vishny, R.: 1989, Managerial entrenchment, the case of manager-specific investment, *Journal of Financial Economics* **25**, 123–139.

Schoar, A.: 2002, Effects of corporate diversification on productivity, *Journal of Finance* **57**, 2379–2403.

Shilling, J. D., Sirmans, C. and Wansley, J. W.: 1986, Do reit shares trade at a discount? some indirect evidence, *Working Paper, Louisiana St University* .

Smith, K. V. and Shulman, D.: 1976, The performance record of the equity reits, *Finance Analyst Journal* **32**(5), 61–66.

Swanson, Z., Theis, J. and Casey, K. M.: 2002, Reit risk premium sensitivity and interest rates, *Journal of Real Estate Finance and Economics* **24**(3), 319–330.

Wang, K., Chan, S. H. and Gau, G.: 1992, Initial public offerings of equity securities: Anomalous evidence using reits, *Journal of Financial Economics* **31**(3), 381–410.

Wang, K., Erickson, J. and Chan, S. H.: 1995, Does the reit stock market resemble the general stock market?, *Journal of Real Estate Research* **10**(4), 445–456.

Young, M. S.: 2000, Reit property-type sector integration, *Journal of Real Estate Research* **19**(1), 3–14.

Zeileis, A.: 2004, Econometric computing with hc and hac covariance matrix estimators, *Journal of Statistical Software* **11**(10), 1–17.
URL: *http://jstatsoft.org/v11/i10/*

Zietz, E. N., Sirmans, S. G. and Friday, S. H.: 2003, The environment and performance of real estate investment trusts, *Journal of Real Estate Portfolio Management* **9**(2), 127–165.