Real Estate Risk and Hedge Fund Returns[1]

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Abstract

Extant literature has focused on the performance of hedge funds that invest in a wide range of investment strategies; however, an explicit analysis of funds that follow a real estate investment strategy is lacking. In this paper, we fill this void and explore a new dimension of hedge funds' investment strategy relating to their exposure to the real estate market. We augment existing literature by introducing a real estate source of variation to proxy for investments in the securitized and direct real estate markets. Using fund level data from 1994 to 2011 from a major hedge fund data vendor, we identify 1,230 hedge funds as having significant exposure to the direct and securitized real estate market. We document that funds with significant real estate exposure have lower incentive fees, longer redemption periods, and higher high water mark levels. Additionally, hedge funds that have significant exposure to real estate are predominantly classified as fund of hedge funds implying a diversification strategy through real estate investments. Finally, we test for the economic impact across funds with varying levels of real estate exposure, and show that funds with significant real estate exposure significantly underperform funds that do not have real estate exposure.

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Executive Summary

Hedge funds invest across asset classes through a range of diverse investment strategies. Given the performance of real estate over the past decade we investigate the performance of funds that follow a real estate specific investment strategy. Conventional investment strategies are broadly classified as Convertible Arbitrage, Dedicated Short Bias, Emerging Markets, Equity Market Neutral, Event Driven Hedge, Event Driven Distressed, Event Driven Multi-Strategy, Event Driven Risk Arbitrage, Fixed Income Arbitrage, Global Macro, Long Short Equity, Managed Futures, and Multi-Strategy. However, a real estate specific strategy is not directly apparent. Through a comprehensive sample from a major hedge fund vendor (Lipper TASS), we specify an empirical method to identify funds that have exposure to direct as well as securitized real estate. Following past literature encompassing the Fung-Hsieh risk factor methodology, we create factors that proxy for investment return in the NAREIT index (securitized market) and NCREIF NPI/TBI index (investment in direct real estate). Importantly, we account for multi-collinearity issues that arise due to simultaneous inclusion of risk factors that correlate with returns in the real estate market. Our identification strategy reveals that between the period 1994 to 2011, 1,230 hedge funds had significant exposure to either direct or indirect investments in the real estate market. Through an innovative bootstrap method, we confirm that the estimated fund level exposure to real estate cannot

be attributed to sampling variation and provide robust evidence of the true real estate exposure of hedge funds.

Next, we investigate the characteristics of hedge funds that differ by the level of real estate exposure. We find that funds with significant real estate exposure have lower incentive fees, longer redemption periods, and higher high water mark levels. Interestingly, hedge funds that have significant exposure to real estate are predominantly classified as fund of hedge funds implying that real estate is used as a device for diversifying portfolios. Finally, we contrast the performance of hedge funds with varying levels of real estate exposure and find that funds with significant real estate exposure significantly underperform funds that do not have real estate exposure. Our study is the first to formally identify and investigate the performance of hedge funds that follow a real estate strategy, thereby motivating further questions on the risk-return profile of hedge funds that invest in real estate as an asset class.

1. Introduction

One of the interesting aspects of the hedge fund industry is the fundamental problem of asymmetric information between the funds and their investors about the actual investments contained in the funds' portfolios. Fund managers have incentives to hide or mask their investment positions in order to prevent competitors from gaining an advantage in trading. However, hedge fund investors are often reluctant to invest without information about how the manager plans to deploy the investor's funds. As a result, hedge fund managers often provide minimal information about their investment allocations and positions by utilizing generic "strategy" descriptions. Furthermore, the hedge fund industry has created a number of strategy classifications with corresponding indexes in an effort to help investors evaluate and benchmark manager performance. For example, hedge funds are often described by the following investment strategy classifications: Convertible Arbitrage, Dedicated Short Bias, Emerging Markets, Equity Market Neutral, Event Driven Hedge, Event Driven Distressed, Event Driven Multi-Strategy, Event Driven Risk Arbitrage, Fixed Income Arbitrage, Global Macro, Long Short Equity, Managed Futures, and Multi-Strategy.[2] The Appendix provides a description of these strategies.

A large literature has developed surrounding the analysis of hedge funds with respect to these various strategy descriptions as well as investment styles. Traditionally, researchers focus on developing asset-pricing factor models as a means of exploring the return variability of hedge funds in order to understand their risk-reward relation. For example, early work by Fung and Hsieh (1997, 2001) and Agarwal and Naik (2004) incorporate option market factors into the traditional linear multi-factor asset pricing model to explore the sensitivity of hedge fund returns to dynamic risk. More recently, Sadka (2009) uses the similar multi-factor pricing model to assess the extent that market-wide liquidity is an undiversifiable risk factor.

Interestingly, real estate is not listed as one of the common hedge fund investment strategies and to date, no one has examined whether a market-wide real estate risk factor exists. Yet, U.S. commercial

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[2] Index level returns data for Hedge fund indexes obtained from *Dow Jones Indexes*.

real estate is a significant asset class valued at approximately $11.5 trillion as of the end of 2009.[3] In comparison, the value of all publicly traded shares at the end of 2009 was approximately $15.1 trillion.[4] As a result, real estate is often touted as having significant benefits for portfolio diversification and inflation hedging purposes. For example, beginning with Ibbotson and Siegel (1984) a lengthy literature has developed that examines the correlation between real estate investments and other asset classes.[5] These studies often show that real estate can provide significant diversification benefits in the context of modern portfolio theory. In addition, real estate investments during the previous decade significantly outperformed broader stock indexes. For example, over the period from 2000 to 2010, real estate investment trusts (REITs) had a compound annual total return of 10.6% compared to a -0.95% compound annual total return for the S&P500.[6] Figure 1 shows the performance of hedge funds, real estate investment trusts, and the broader stock market over the period from 2000 to 2012. The figure shows that even with the significant REIT correction in 2009, the cumulative performance of securitized real estate outperforms the general hedge fund index and the broader stock market. Furthermore, comparing the returns on the generic hedge fund index with the returns on the NCREIF property index (NPI) indicates a low level of correlation.

Given the size of the real estate market and the low historical correlations of real estate assets with other investments, a natural question is whether hedge funds invest in real estate assets and if so, do these investments give fund managers a performance edge. To address this issue, we develop an empirical method that identifies funds with significant exposure to the real estate market, either direct investment as captured by the NCREIF NPI or TBI index or indirect real estate investment as captured by sensitivity to real estate investment trusts as measured by the NAREIT index. Our empirical strategy finds that between 1994 and 2011, 1,230 out of 3,278 funds had significant exposure to real estate assets. Using the

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[3] See Florance et al. (2010) for a detailed estimation of the value of total U.S. commercial real estate property.

[4] CIA *The World Factbook*, https://www.cia.gov/library/publications/the-world-factbook/geos/us.html.

[5] See Sirmans and Sirmans (1987), Liu, et al. (1990), Chan et al. (1990), Webb, Miles and Guilkey (1992), Grauer and Hakansson (1995), and Peterson and Hsieh (1997) among many others for evidence on the role of real estate in asset allocation and modern portfolio theory.

[6] See *The Role of Real Estate in Weathering the Storm*, National Association of Real Estate Investment Trusts: http://www.reit.com/DataAndResearch/ResearchResources/~/media/PDFs/Weathering-The-Storm-Special-Report-2012.ashx.

bootstrap methodology of Kosowki et al. (2006, 2007), we confirm that our assignment of firms into real estate and non-real estate portfolios is not spurious. We then investigate the characteristics of these funds. First, we show that non-real estate funds are systematically clustered into Emerging Markets, Event Driven, Global macro, Long/Short Equity Hedge, Multi-Strategy, and Managed Futures investment strategies while real estate funds are primary concentrated in the Fund-of-Funds classification. Next, our results indicate that funds with significant real estate exposure have lower incentive fees, longer redemption periods, and higher high water mark levels. These results are consistent with the theory that fund governance structures actively impact individual fund investment allocations. Finally, we compare fund returns and find that funds with significant real estate exposure underperform funds that do not have real estate exposure. Given the correlation between fund governance structure and performance, our study has identified one potential channel as a source for this underperformance.

Our paper proceeds as follows: the next section discusses the hedge fund data followed by our empirical strategy for identifying funds with real estate exposure. We then proceed to examine the characteristics of funds that have real estate exposure and finally provide evidence concerning the performance of real estate and non-real estate funds.

2. Data

We identify hedge funds that follow a real estate investment strategy using hedge fund information contained in the Lipper TASS database over the period from 1994 to 2011. The TASS database tracks hedge funds that are operating (or "Live") as well as funds that no longer report (or "Graveyard"). By reporting on both operating and dead funds, TASS reduces the survivorship bias inherent in other hedge fund data providers. The TASS database allows us to track the monthly returns on funds net of all fees (management, incentive and other expenses).

TASS classifies individual hedge funds into ten strategy categories: convertible arbitrage, dedicated short bias, emerging markets, equity market neutral, event driven, fixed income arbitrage, fund of funds, global macro, long-short equity, managed futures, and multi-strategy. Following Sadka (2009), we retain the category "fund-of-funds" in the analysis since they are possible targets of investment by fund-of-funds-of-funds. Figure 2 plots the frequency distribution of hedge funds within each of these strategies. Interestingly, the most common investment strategy by far is the fund-of-funds followed by the long/short equity hedge strategy. Sadka (2009) notes that cross-sectional variation in returns exists across these investment styles and thus we use this variation in identifying a real estate market risk factor. We focus on the period from January 1994 onwards to mitigate the effect of survivorship bias. Furthermore, to account for backfill and selection bias we exclude fund data within the first 24 months of its introduction to the database. Our hedge fund sample includes 3,278 funds.

In addition to individual fund level investment strategy data, TASS reports individual fund characteristics that indicate whether the fund uses leverage or invests in other funds. For funds that use leverage, TASS further reports whether the leverage arises from the use of futures, derivatives, margin borrowing, or foreign exchange credit. TASS also reports each fund's minimum investment requirement, management and performance fees, high water mark, average and maximum leverage utilized, and whether the fund's principal has personal capital invested. Furthermore, TASS reports on any lockup and redemption period mandates allowing one to infer the fund's liquidity position. Finally, the TASS database contains a detailed description of each individual fund's investment strategy. Overall, the dataset provides a unique snapshot of the net-of-fee performance and characteristics of hedge funds that invest in a range of diverse strategies.

While the strategy categorizations employed by TASS are relatively broad and cover a variety of investment alternatives, TASS does not include an explicit real estate investment strategy. Yet, growth in the real estate market and in particular, growth in securitized claims on real estate (through real estate investment trusts (REITs) and mortgage-backed securities (MBS/CMBS)) suggest that hedge fund managers have ample opportunities to invest in real estate assets within the TASS style categories.

3. Identification of real estate hedge funds

We develop a real estate market factor methodology that builds on the hedge fund factor analysis of Fung and Hsieh (2004). Our goal is to first identify individual funds that utilize real estate investments (as revealed by their sensitivity to various real estate market factors) as part of their investment strategy and then second to examine the variation in real estate and non-real estate hedge fund returns. Fung and Hsieh (2002, 2004) show that the variation in hedge fund returns can be explained by a buy-and-hold strategy based on four factors capturing movements in the equity and bond markets as well as three "trend-following" factors based on the option pricing models of Black and Scholes (1973) and Merton (1973).[7] Thus, we augment their factor model to include a real estate factor as follows:

$$r_{i,t} = \alpha_i + \beta_{i,1}MKT_t + \beta_{i,2}SMB_t + \beta_{i,3}YLDCHG_t + \beta_{i,4}BAAMSTY_t + \beta(1)_{i,5}PTFSBD_t +$$

$$\beta_{i,6}PTFSFX_t + \beta_{i,7}PTFSCOM_t + \beta_{i,8}RE\_MKT_t + \varepsilon_{i,t} \tag{1}$$

where $r_{i,t}$ is the net-of-fee excess return of fund i in quarter t; MKT is the CRSP value-weighted return index (VWRETD) return less risk free-rate; SMB is a size factor represented as the spread between the returns on the Russell 2000 index and the S&P500 index; $YLDCHG$ is the change in the 10-year treasury constant maturity yield; $BAAMTSY$ is the change in the Moody's Baa yield less 10-year treasury constant maturity yield; $PTFSBD$ is the return of a bond primitive trend-following strategy; $PTFSFX$ is the return of a currency primitive trend-following strategy; $PTFSCOM$ is the return of a commodity primitive trend-following strategy; RE_MKT represents a real estate market factor (defined below); α_i is the risk adjusted performance of fund i; and $\beta_{i,1},......, \beta_{i,8}$ are the factor loadings of fund i.[8]

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[7] A trend following strategy captures the payoff generated when the asset price exceeds certain thresholds. Fung and Hsieh (2001) model the payoff of a trend following strategy through a look-back straddle that gives the owner a right to purchase an asset at the lowest price over the life of the option, along with a put option with a right to sell at the highest price during the life of the option. Hence, the monthly return of a trend following strategy is the payoff due to the difference between the highest and lowest price of the asset less the price of the look-back straddle. The three trend following risk factors capture movements in the bond, currency and commodity markets.

[8] Fung and Hsieh factor data available at: http://faculty.fuqua.duke.edu/~dah7/DataLibrary/TF-FAC.xls

We use three proxies for the real estate market factor based on direct real estate investment (NCREIF) and indirect real estate exposure through REIT securities. Specifically, we capture real estate risk through (1) the NAREIT index that acts as a proxy for the indirect or securitized equity real estate market, and (2) the NCREIF NPI and TBI indexes as a proxy for the returns on direct investment in institutional grade real property. However, to the extent that real estate investments are affected by the other equity and bond market factors, equation (1) will be over identified. Thus, we use the residual from the estimated regression equation of the real estate market excess return (NAREIT, NCREIF NPI and TBI) on Fung-Hsieh factors as our real estate market factor. Specifically, we estimate the following regression for the each real estate index:

$$RE\_INDEX_t = \delta_0 + \delta_1 MKT_t + \delta_2 SMB_t + \delta_3 YLDCHG_t + \delta_4 BAAMSTY_t + \delta_5 PTFSBD_t +$$
$$\delta_6 PTFSFX_t + \delta_7 PTFSCOM_t + \varepsilon_t \tag{2}$$

where *RE_INDEX* is the excess return of the *NAREIT, NCREIF NPI* or *TBI* index. The residual represents a real estate specific component that is not explained by the general equity market and is uncorrelated with the stock market factor (*MKT*) and other Fung-Hsieh factors.

We classify hedge funds that have a statistically significant coefficient on the real estate market factor (RE_MKT) as real estate hedge funds. The orthogonality of the real estate market factor ensures that our classification is not incorrectly picking up variation in other correlated factors.

Panels *A* and *B* of Table 1 report the summary statistics of our real estate factors and the Fung-Hsieh factors. We see that the average return of the stock market (CRSP VWRETD) is lower than that of the NAREIT index, implying a potential differential economic impact between portfolios comprising of the stock market and real estate market.[9] We also note that the Fung-Hsieh factors exhibit considerable variation in values over the sample time period, and could potentially explain the variation in returns of hedge funds that follow a real estate investment strategy.

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[9] NAREIT index return data obtained from REIT.com

Figure 3 presents the classification of hedge funds that have significant real estate factor loadings from the estimation of equation (1). Out of the 3,278 hedge funds in our sample, we find 1,230 funds have a significant loading on one of our real estate factors, and thus are classified as "real estate funds", while 2,048 have an insignificant loading on the real estate factors (and thus are classified as "non-real estate funds".) Out of the 1,230 "real estate funds" we see that 369 funds have exposure to the NCREIF NPI index only, 89 to the NCREIF TBI index only, and 518 to the NAREIT index only. Furthermore, we note that 192 hedge funds have exposure to the NCREIF NPI or TBI, indicating a high correlation between the two identification strategies. In contrast, only 95 hedge funds have exposure to the NCREIF NPI or TBI index and the NAREIT index suggesting that investment in direct real estate (NCREIF) versus securitized real estate (NAREIT) is somewhat mutually exclusive. Furthermore, only 33 funds have exposure to all three real estate indexes. Overall, our identification strategy reveals that a large number (38%) of hedge funds have exposure to the direct or indirect real estate market.

Next we turn to an analysis of the differences in returns for real estate versus non-real estate funds. Table 2 reports summary statistics of average quarterly returns of real estate hedge funds across the real estate strategy classifications. We see that our empirically identified "real estate funds" have a mean quarterly return of 1.54% (6.16% per year) while the non-real estate funds had a quarterly return of 2.06% (8.24% per year). Although real estate funds had a lower average return, we also note that they had a lower standard deviation (6.36% versus 6.96%). Examining the real estate funds based on the individual factor loading, we see that NAREIT loading hedge funds had a mean return of 1.52% per quarter (6.08% per year). In comparison, NCREIF NPI loading funds had a mean return of 1.50% per quarter (6.0% per year), and NCREIF TBI loading funds produced a quarterly return of 1.37% (5.48% per year). Figures 4 and 5 show the distribution of real estate hedge funds over time. It is interesting to note the increasing percentage of funds that loan on the NCREIF index over time suggesting that over time, funds have increased their sensitivity to direct real estate investment. Initially, the number of real estate hedge funds is low but increases up to 2006, the year prior to the financial crisis in 2007 – 2008. The post

crisis era experienced a significant drop in the number of hedge funds that explicitly follow a real estate investment strategy. Overall, our empirical strategy finds that a large number of hedge funds have exposure to the direct and securitized market real estate market.

4. Robustness Test

Fund level regressions implicitly assume normality of return data and this may result in inaccurate estimation and potential significance of the real estate market factor in the estimated model. To test for this possibility, we follow the Kosowki et al. (2006, 2007) bootstrap methodology to account for non-normality, heteroskedasticity, and serial correlation in hedge fund returns and obtain a robust distribution of the real estate market factors. Following the Kosowki et al. method, we construct a time series of pseudo–quarterly excess returns for each fund by imposing the null hypothesis of zero real estate exposure.[10] From these pseudo returns, we then build a distribution of the real estate factor coefficients that that result purely from sampling variation while imposing the null of no real estate exposure. Finding that the bootstrap distributions generate fewer extreme values for the real estate market factor coefficient than those observed in the actual data, would suggest that sampling variation is not the sole source of the empirical observation of fund level real estate exposure, but rather that the portfolios of hedge funds are genuinely comprised of real estate.

Table 3 presents the results of the bootstrap analysis. Comparing the *p*-values for the test of the difference between the actual and pseudo funds reveals that the statistical significance of real estate exposure of actual funds cannot be attributed to sampling variation, hence providing a robust inference on the true real estate exposure of individual funds. Panels *A, B* and *C* display the results for the hedge funds that have exposure to the NAREIT, NCREIF NPI and NCREIF TBI indexes, respectively. We rank funds according to the estimate of the real estate market factor's (*RE_MKT*) coefficient's *t*-statistic and report

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[10] The Appendix provides a detailed description of the bootstrap methodology.

bootstrap results for the 1st, 5th, and 10th percentile on both sides of the t-statistic spectra. The results indicate that the estimated exposure of "top" real estate funds cannot be attributed to sampling variation. The bootstrapped p-values of the top (1st, 5th, and 10th) percentile funds is 0.00, implying that we can reject the null hypothesis that statistical significance of the real estate market factor's (*RE_MKT*) coefficient is driven by sampling variability at the 1% level of significance. Additionally, we see that bootstrapped *p*-values of the bottom (1st, 5th, and 10th) percentile funds are also equal to 0.00, again implying that we can reject the null hypothesis that statistical significance of the real estate market factor's (*RE_MKT*) coefficient is driven by sampling variability at the 1% level of significance. Thus, the bootstrap results are consistent with the individual fund level results.

5. Real Estate Investment and Strategy Classification

Although hedge funds self-report investment strategy classifications to data vendors and most do not report a real estate investment strategy, our empirical analysis explicitly identifies funds that have exposure to direct or indirect real estate market. Thus, using that empirical identification, we now focus on answering the question: Do certain hedge fund strategies systematically use real estate investments?

To address this question, we first examine in Table 4 the proportion of funds within each general strategy classification that have significant real estate factor loadings. We find that 53.1% of funds with significant real estate exposure have a strategy classification of "Fund of Funds" compared to only 34.2% of funds without significant real estate exposure. Intuitively, this result suggests that fund of hedge funds utilize real estate exposure to achieve the diversification objective required by their investors. In contrast, a statistically higher (at the 5% level) proportion of non-real estate funds follow the "Emerging Markets", "Event Driven", "Global Macro", "Long/Short Equity Hedge", "Multi-Strategy", and "Managed Futures" strategies. As a result, it appears that the real estate loading funds are primarily "fund of funds" that are using real estate investments as a further diversification strategy.

In Table 5, we compare the strategy classifications based on the individual real estate index loadings to determine if there are systematic differences in fund categories with respect to direct versus indirect real estate exposure for those funds that are classified as real estate funds. Panel A reports the strategy classification of hedge funds that load on the NCREIF NPI based factor versus the NAREIT based factor. We find that 45.3% of hedge funds that are classified as having exposure to direct real estate (NCREIF) have an investment strategy classification of "Fund of funds". This increases to 61.9% for funds that load on the NAREIT based factor, implying that the majority of hedge funds that have significant exposure to real estate (the "fund of funds" in Table 4) obtain this exposure through investment in REITs. Furthermore, we see that 16.9% of the "Long/Short Equity Hedge" funds with significant real estate exposure load on the direct real estate factor while 22.4% load on the NAREIT factor. In contrast, we see that funds with significant real estate exposure that are classified as "Convertible Arbitrage", "Emerging Markets", "Event Driven", "Fixed Income Arbitrage", "Global Macro" and "Multi-Strategy" have significantly higher exposure to direct real estate (NCREIF) versus direct real estate investment.

Table 5, Panel B reports a similar, albeit less significant, comparison for the NCREIF TBI loading and NAREIT loading hedge funds. For example, we see that 55.2% of hedge funds that are classified as having exposure to the NCREIF TBI based factor have an investment strategy classification of "Fund of Hedge funds", which is not statistically different from the 60.5% of funds that load on the NAREIT based factor. Also, we find that the 15.7% of direct real estate based funds in the investment strategy of "Long/Short Equity Hedge" is marginally lower (significant at the 10% level) than the 21.3% of "Long/Short Equity Hedge" funds loading on the NAREIT factor. However, we do see a significant (at the 1% level) difference in the proportion of funds in the "Event Driven" category that load on NCREIF (9.68%) versus NAREIT (2.55%). Overall, the results in Table 5 confirm that changing the measure of direct real estate from the NCREIF NPI to the TBI based factor does not change the conclusion that the majority of hedge funds that have significant exposure to real estate are fund of funds.

6. Real Estate Investment and Fund characteristics

We next examine the differences in fund characteristics based on whether the fund has exposure to direct or indirect real estate as well as the differences in characteristics for real estate and non-real estate hedge funds. Table 6 compares real estate and non-real estate hedge funds based on self-reported use of leverage, investment in other funds, utilization of leverage through futures, derivatives, margin borrowing, or foreign exchange credit, and whether managers have with "Personal Capital" at stake in the fund. We find that non-real estate funds are more leveraged (55% versus 48%) and invest less in other funds (34% versus 52%) than real estate funds. In terms of the type of leverage used, we see that non-real estate funds are more likely to use futures contracts (23% versus 14%) and derivatives (19% versus 14%) than real estate funds. Additionally, we find a higher occurrence of principals investing personal capital in non-real estate funds (29%) versus real estate funds (19%).

Table 7 reports similar comparisons between the real estate funds based on whether they have exposure to direct (NCREIF) or indirect (NAREIT) real estate. Panel A contrasts hedge funds that load on the NCREIF NPI and NAREIT factors. We see that 50.6% of funds that are classified as having exposure to the direct real estate market (NCREIF NPI) report usage of leverage, whereas 42.8% of hedge funds that load on the NAREIT based factor report usage of leverage. Consistent with the strategy classification of "Fund of Funds" discussed in the previous section, we find that a high percentage of funds report investment in other funds (44.7% and 61.0% for NCREIF NPI and NAREIT loading funds respectively). Panel B contrasts across the alternative measure for direct real estate, the NCREIF TBI with the NAREIT based factor. Although the test-statistics for the differences in proportions are not significant, the general trend remains unchanged.

In addition to examining differences in fund characteristics, we also contrast investment criteria across varying real estate exposure. In other words, we test whether real estate investment is systematically related to individual fund investment criteria such as minimum investment amounts, lock-up and redemption notice periods, as well as fund governance structures involving management fees and

leverage. Table 8 presents the results for the logistic regression where the dependent variable equals one for real estate funds and zero for non-real estate funds. Column (3) reports the estimated coefficients for the model comparing real estate to non-real estate funds. We see that non-real estate funds have significantly lower (at the 1% level) incentive fees than real estate funds. Furthermore, real estate funds have significantly (at the 1% level) higher high water marks and longer redemption notice periods than non-real estate funds. However, we find no significant difference in minimum investments, use of leverage, or lock-up periods. In columns (1) and (2), we examine differences in direct (NCREIF) and indirect (NAREIT) loading factors. The statistically significant coefficients for redemption notice period indicate that, compared to hedge funds that have exposure to the direct real estate market, funds that have exposure to indirect real estate have less account liquidity (longer redemption periods).

7. Economic Value of real estate funds

In the previous sections, we identified hedge funds that have exposure to direct or indirect real estate indexes. Thus, in this section we turn to the question of what is the economic impact of investing across these two groups of hedge funds. To understand the economic impact, we contrast the performance of "tracking" portfolios of real estate hedge funds against portfolios of funds that do not load on the real estate market factors (NAREIT, NCREIF NPI or TBI loading).

In each quarter from December 1999, we estimate the real estate market factor's coefficient for each fund using the past 24-quarter estimation period, and form two portfolios based on the statistical significance of the real estate market factor's coefficient (5% level of significance). Hence, we have rolling portfolios across two groups: one portfolio index representing hedge funds' returns that are explained by the real estate market factor; and the second portfolio index comprising of funds that do not load on the real estate market factor.[11] Portfolios are re-balanced every quarter based on the level of real

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[11] Since portfolios are adjusted to reflect funds that load and do not load on the real estate market factor, the two portfolios thus created represent hedge funds with varying levels of exposure to the real estate market.

estate exposure measured through the estimated coefficient of the real estate market factor $(NAREIT\_MKT_t, NPI\_MKT_t, TBI\_MKT_t)$.

Figure 6 presents a striking contrast of the economic impact of funds that "track" the direct real estate market (NCREIF NPI) versus those that track the securitized market (NAREIT). Hedge funds that have exposure to direct real estate provide a return of 5.24%, whereas funds that have exposure to the securitized market provide a return of 5.06%. Up to September 2008, funds with exposure to direct real estate or securitized real estate had equal returns of 5.52%. Using NCREIF TBI as an alternative measure, we see that hedge funds that have exposure to direct real estate generated returns of 7.75%.

Figure 7 contrasts the economic impact of funds that "track" the real estate market (NAREIT, NCREIF NPI or TBI) against those that do not. Hedge funds that have exposure to the real estate market provide a return of 5.09%, whereas funds that do not have exposure to the real estate market provide a return of 6.60%.

8. Out of sample tests

In this section, we examine the question of whether real estate exposure increases the returns to fund investors. To gauge the significance of our direct and indirect real estate measures, we investigate the investment value of selecting portfolios based on varying levels of real estate exposure. In each quarter starting from December 1999, we estimate the real estate factor's coefficient (NAREIT, NCREIF NPI or TBI based residual factors) for each fund using the past 24-quarter estimation window, and then form portfolios based on the statistical significance of the real estate factor coefficients. This yields distinct time series of returns based on varying levels of real estate exposure from 1999 to 2011. If a fund disappears over the holding period, its returns are included in calculating the portfolio returns until its

disappearance, and the portfolio is rebalanced going forward. Next we estimate the seven-factor model and report each portfolio's "out-of-sample" alpha.

Table 9 presents evidence of the economic value of real estate exposure. Specifically, the spread from NAREIT and NCREIF loading based portfolios indicates that the alphas generated by funds that load on direct real estate are not statistically different from the alphas generated by funds loading on indirect real estate. However, the results do show that funds with real estate exposure do generate significant alphas. Thus, we conclude that hedge fund exposure to direct or indirect real estate does not provide a differential economic outcome.

Finally, we contrast the investment performance of real estate versus non-real estate hedge funds across in table 10. First we note that both real estate and non-real estate funds generated positive alphas over the sample period. However, comparing the performance differential between them, we see that non-real estate hedge funds generated statistically greater alpha (at the 5% level) than real estate loading funds.

Although we find that non-real estate funds appear to outperform real estate funds, it is possible that this performance differential could be the result of the difference in fund strategies pursued by the individual funds in the portfolios. For example, we noted above that the real estate exposure portfolio had a higher proportion of funds in the "funds of funds" strategy category than the non-real estate portfolio. Since fund-of-funds are investment vehicles that allocate client assets across a variety of individual hedge funds, the performance of fund of funds is subject to potentially greater fees. That is, the fund-of-fund manager takes a fee for making the asset allocation decisions and then the individual funds that the manager selects also impose fees. As a result, investments in a fund-of-funds tend to underperform other investments, on average. Thus, since our real estate funds portfolio has a higher percentage of funds of funds, it is possible that the observed underperformance is simply resulting from the underperformance associated with fund of funds.

In order to isolate whether the underperformance of real estate funds is the result of fund of funds, in Table 10, Panels C and D we report the out of sample alphas for the real estate and non-real estate

loading fund after removing the fund of funds. The results clearly indicate that the fund of funds were underperforming other funds. For example, the quarterly alpha for real estate loading funds was 0.78% without the fund of funds versus 0.52% when the funds of funds were included. We see a similar increase in quarterly alpha for non-real estate loading funds as well (1.16% versus 0.9%). However, the spread between real estate funds and non-real estate funds remains -0.38%, indicating that the underperformance of the real estate funds was not related to the higher percentage of fund-of-funds in the portfolio. Finally, Figure 8 shows the cumulative returns for the real estate tracking funds and the non-real estate tracking funds after netting out the fund-of-funds. Again, we see that non-real estate funds generate higher returns than real estate funds.

In summary, we find strong evidence that real estate exposure does not add value to fund investors. As a result, real estate investment does not appear to be a source of hedge fund alpha and the level of real estate exposure does not reflect hedge fund managerial skill.

9. Conclusion

In this paper, we explore a new dimension of hedge funds' investment strategy relating to their exposure to the real estate market. Our analysis reveals that 1,230 out of 3,278 hedge funds had significant exposure to the real estate market even though they were not classified as "real estate funds". To evaluate the performance of these funds, we construct real estate market factors that proxy for the return in the direct and indirect/securitized real estate market. Additionally, our bootstrap analysis provides robust evidence of real estate exposure at the individual fund level that cannot be attributed to sampling variation.

Our findings are robust with regard to the construction of the real estate market factors through the NAREIT, NCREIF NPI and NCREIF TBI indexes. We document that real estate hedge funds are

predominantly listed as fund of hedge funds, suggesting that fund of fund managers may utilize real estate investments for diversification. Also, the economic impact of funds differs significantly with varying levels of real estate exposure. Real estate hedge funds have lower incentive fees, higher high water marks, and less investor account liquidity than funds that do not have exposure to the real estate market. Finally, compared to hedge funds that have exposure to the direct real estate market, funds that have exposure to the securitized real estate market have less account liquidity due to longer redemption notice periods.

While the analysis of hedge fund performance and asset class styles is not new, this is the first study to document the extent to which hedge funds have exposure to real estate based investments. Since real estate is a major asset class, our results suggest that proper implementation of asset allocation models should account for whether hedge funds actually provide investors with exposure to real estate. Furthermore, we find an interesting puzzle in that hedge funds that have significant exposure to the real estate market factors tend to underperform funds that do not load on the real estate factors. Given that real estate significantly outperformed the stock market during the previous decade, the finding that funds with real estate exposure underperformed is a puzzle.

Appendix

Hedge Fund Investment Strategy Descriptions:

- Convertible Arbitrage: funds that aim to profit from the purchase of convertible securities and subsequent shorting of the corresponding stock.

- Dedicated Short Bias: funds that take more short positions than long positions and earn returns by maintaining net short exposure in long and short equities.

- Emerging Markets: measures funds that invest in currencies, debt instruments, equities and other instruments of countries with "emerging" or developing markets.

- Equity Market Neutral: funds take long and short positions in stocks while reducing exposure to the systematic risk of the market.

- Event Driven funds (Distressed, Multi-Strategy and Risk Arbitrage subsectors): invest in various asset classes and seek to profit from potential mispricing of securities related to a specific corporate or market event.

- Fixed Income Arbitrage: funds that exploit inefficiencies and price anomalies between related fixed income securities.

- Global Macro: funds that focus on identifying extreme price valuations and often use leverage in anticipating price movements in equity, currency, interest-rate and commodity markets.

- Long/Short Equity: funds that invest in both long and short sides of equity markets.

- Managed Futures: funds focus on investing in listed bond, equity, commodity futures and currency markets, globally.

- Multi-Strategy: funds that are characterized by their ability to allocate capital based on perceived opportunities among several hedge fund strategies.

- Hedge Fund Index: an all-encompassing investment strategy across all the asset classes and styles.

Bootstrap Analysis for the *RE_MKT* factor

In order to assess the statistical significance of the real estate market factor (*RE_MKT*) and its corresponding *t*-statistic for individual hedge funds we implement the following procedure[12]:

Step 1: Estimate the 8-factor model for each fund *i*:

$$r_{i,t} = \alpha_i + \beta_{i,1}MKT_t + \beta_{i,2}SMB_t + \beta_{i,3}YLDCHG_t + \beta_{i,4}BAAMSTY_t + \beta_{i,5}PTFSBD_t + \beta_{i,6}PTFSFX_t$$
$$+ \beta_{i,7}PTFSCOM_t + \beta_{i,8}RE\_MKT_t + \varepsilon_{i,t}$$

$$(7)$$

and store the *t*-statistic of the coefficient of the real estate market factor (*RE_MKT*) $\{t_{RE\_MKT}\}$ and the time series of estimated residual $\{\hat{\varepsilon}_{i,t}, t = 1, \ldots \ldots, T_i\}$[13].

Step 2: From the fund *i* residuals saved from the first step, draw a random sample with replacement to get a time series of resampled residuals $\{\hat{\varepsilon}_{i,t}^b, t = s_1^b, s_2^b, \ldots, s_{T_i}^b\}$, where $b = 1, \ldots \ldots B$ (in all our bootstrap tests, we set $B = 100$). Each sample is drawn such that it has the same number of residuals i.e. the same number of time periods T_i as the original sample for each fund *i*. Then for each bootstrap iteration we construct a time series of quarterly excess returns for each fund by imposing the null hypothesis of zero exposure to the real estate market factor or hedge funds which do not load on the real estate market factor $(\beta_{i,8} = 0,$ or equivalently $t_{RE\_MKT} = 0)$[14],

$$r_{i,t}^b = \alpha_i + \hat{\beta}_{i,1}MKT_t + \hat{\beta}_{i,2}SMB_t + \hat{\beta}_{i,3}YLDCHG_t + \hat{\beta}_{i,4}BAAMSTY_t + \hat{\beta}_{i,5}PTFSBD_t + \hat{\beta}_{i,6}PTFSFX_t$$
$$+ \hat{\beta}_{i,7}PTFSCOM_t + \hat{\varepsilon}_{i,t}^b$$

$$(8)$$

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[12] We evaluate and sort based on t-statistics instead of the actual coefficient, as it normalizes the estimated coefficient and hence corrects for spurious outliers.

[13] *t*-statistics are based on heteroscedasticity and autocorrelation consistent standard error estimates.

[14] Cao et al. (2010) use a similar method and "construct" mutual funds which don't have any liquidity timing skill by imposing the null hypothesis of zero timing skill on the liquidity factor's coefficient.

Step 3: For each fund i, regress the returns of a given bootstrap sample, b on the 8-factor model. A positive or negative real estate market factor coefficient and t-statistic may result, since the bootstrap sample may have drawn an abnormally high number of positive/negative residuals.

Step 4: Repeat steps one to three for each of the individual funds and bootstrap iterations, and store the cross-sectional real estate market factor coefficients and corresponding t-statistics. We thus obtain a cross-sectional distribution of the real estate market factor's coefficients' t-statistic estimates which result purely from sampling variation as the null hypothesis of no fund level real estate exposure is imposed.

Step 5: Calculate the empirical p-values by comparing the distribution of t-statistics of the real estate market factor's coefficient from individual funds with that of coefficients from pseudo funds which have no real estate exposure (as measured through the real estate market factor).

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Table 1: Summary statistics of factor data.

This table reports summary statistics of the quarterly *CRSP* value weighted market return, the NAREIT index return, the NCREIF (NPI) index return, the NCREIF (TBI) index return, as well as the Fung-Hsieh seven factors including the market excess return (*MKT*), a size factor (*SMB*), change in the 10-year treasury constant maturity yield (*YLDCHG*), change in the Moody's Baa yield less 10-year treasury constant maturity yield (*BAAMTSY*), and three trend-following factors: *PTFSBD* (bond), *PTFSFX* (currency), *PTFSCOM* (commodity). The sample period is from January 1994 to December 2011.

	Mean	Median	STD	25%	75%
Panel A: Market indexes					
CRSP	0.0233	0.0326	0.0927	-0.0201	0.0798
NAREIT	0.0289	0.0275	0.1032	-0.0142	0.0883
NCREIF (NPI)	0.0225	0.0263	0.0243	0.0173	0.0351
NCREIF (TBI)	0.0274	0.0198	0.0575	-0.0014	0.0572
Panel B: Fung-Hsieh factors					
MKT	0.0155	0.0256	0.0925	-0.0287	0.0717
SMB	0.0016	-0.0013	0.0475	-0.0339	0.0361
YLDCHG	-0.0005	-0.0005	0.0050	-0.0043	0.0036
BAAMSTY	0.0002	-0.0002	0.0046	-0.0021	0.0018
PTFSBD	-0.0235	-0.1206	0.3306	-0.2488	0.0948
PTFSFX	-0.0012	-0.1122	0.3524	-0.2413	0.2150
PTFSCOM	-0.0148	-0.0780	0.2173	-0.1610	0.1061

Table 2: Summary statistics of average returns on real estate oriented hedge funds.

This table presents summary statistics of average quarterly returns of real estate and non-real estate hedge funds. N is the number of funds that exist any time during the sample period. The sample period is from January 1994 to December 2011.

	N	Mean	Median	STD	25%	75%
Panel A: All hedge funds						
All funds	3278	0.0188	0.0191	0.0676	-0.0066	0.0438
Non real estate funds	2048	0.0206	0.0204	0.0696	-0.0063	0.0462
Real estate funds	1230	0.0154	0.0166	0.0636	-0.0071	0.0395
Panel B: Real estate hedge funds						
NAREIT loading funds	613	0.0152	0.0161	0.0641	-0.0098	0.0408
NCREIF (NPI) loading funds	592	0.0150	0.0166	0.0619	-0.0043	0.0376
NCREIF (TBI) loading funds	312	0.0137	0.0165	0.0616	-0.0062	0.0376

Table 3: Statistical significance of individual fund level real estate exposure.

Panel *A* presents the statistical significance of real estate exposure for *NAREIT* loading funds. Panels *B* and *C* present results for *NCREIF NPI* and *TBI* loading funds. The real estate market factor's coefficient is estimated relative to the Fung-Hsieh factors. The first and second rows report the *t*-statistic of the real estate market factor's coefficient based on heteroscedasticity and autocorrelation consistent standard errors and the bootstrapped *p*-value of the *t*-statistic. Values are reported for the top and bottom 1%, 5%, and 10% funds. The sample period is from January 1994 to December 2011.

	Bottom			Top		
	1%	5%	10%	10%	5%	1%
Panel A: NAREIT loading funds						
t-alpha	-8.17	-6.15	-5.43	-2.82	3.28	4.28
p-value (bootstrapped)	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: NCREIF loading funds (NPI)						
t-alpha	-7.94	-5.11	-4.49	5.20	6.31	8.27
p-value (bootstrapped)	0.00	0.00	0.00	0.00	0.00	0.00
Panel C: NCREIF loading funds (TBI)						
t-alpha	-5.31	-4.41	-3.82	4.84	5.59	6.29
p-value (bootstrapped)	0.00	0.00	0.00	0.00	0.00	0.00

Table 4: Strategy classification of real estate vs. non-real estate hedge funds

This table presents the strategy classification of hedge funds as reported to the data vendor. Funds that load on the NAREIT, NCREIF NPI or TBI residual factors are classified as real estate funds. Non real estate funds do not load on any of the three real estate measures. The values in the second, third, and fourth columns are percentage of funds that correspond to the investment strategy in the first column. N is the number of funds. The last column indicates the p-value of the Z-test for equality of proportions in columns 3 and 4.

	All funds	Real estate funds	Non-real estate funds	*p*-value
Convertible Arbitrage	2.10	2.52	1.86	0.199
Dedicated Short Bias	0.46	0.24	0.59	0.190
Emerging Markets	3.39	2.20	4.10	0.003
Equity Market Neutral	2.93	2.44	3.22	0.198
Event Driven	6.71	5.04	7.71	0.003
Fixed Income Arbitrage	2.59	2.11	2.88	0.181
Fund of Funds	41.31	53.09	34.23	0.000
Global Macro	2.87	2.03	3.37	0.026
Long/Short Equity Hedge	22.45	19.51	24.22	0.002
Managed Futures	6.53	3.66	8.25	0.000
Multi-Strategy	7.17	6.10	7.81	0.065
Options Strategy	0.27	0.24	0.29	1.000
Other	1.22	0.81	1.46	0.100
N	3278	1230	2048	

Table 5: Strategy classification of real estate hedge funds

This table presents the strategy classification of hedge funds as reported to the data vendor. Panel A contrasts funds that load on the *NCREIF (NPI)* residual or *NAREIT* residual factors. Panel B contrasts funds that load on the *NCREIF (TBI)* residual or *NAREIT* residual factors. The values in the second and third columns are percentage of funds that correspond to the investment strategy in the first column. N is the number of funds. The last column indicates the p-value of the Z-test for equality of proportions in columns 2 and 3.

Panel A: NCREIF NPI and NAREIT loading funds			
	NCREIF loading (*NPI*)	*NAREIT* loading	*p*-value
Convertible Arbitrage	4.92	0.00	0.000
Dedicated Short Bias	0.19	0.36	1.000
Emerging Markets	3.60	1.09	0.006
Equity Market Neutral	3.03	1.82	0.196
Event Driven	7.77	2.19	0.000
Fixed Income Arbitrage	3.03	0.36	0.001
Fund of Funds	45.27	61.93	0.000
Global Macro	2.84	1.09	0.038
Long/Short Equity Hedge	16.86	22.40	0.022
Managed Futures	3.60	4.01	0.726
Multi-Strategy	7.58	4.55	0.037
Options Strategy	0.19	0.00	0.490
Other	1.14	0.18	0.065
N	528	549	
Panel B: NCREIF TBI and NAREIT loading funds			
	NCREIF loading (*TBI*)	*NAREIT* loading	*p*-value
Convertible Arbitrage	2.02	0.55	0.116
Dedicated Short Bias	0.00	0.36	1.000
Emerging Markets	2.82	1.09	0.074
Equity Market Neutral	2.02	2.19	0.870
Event Driven	9.68	2.55	0.000
Fixed Income Arbitrage	0.81	0.55	0.649
Fund of Funds	55.24	60.47	0.165
Global Macro	2.02	1.46	0.564
Long/Short Equity Hedge	15.73	21.31	0.068
Managed Futures	1.61	4.19	0.088
Multi-Strategy	6.05	4.55	0.371
Options Strategy	0.40	0.18	0.526
Other	1.61	0.55	0.213
N	248	549	

Table 6: Characteristics of real estate vs. non real estate funds

This table presents the characteristics of hedge funds as reported to the data vendor. Funds that load on the NAREIT, NCREIF NPI or TBI residual factors are classified as real estate funds. Non real estate funds do not load on any of the three real estate measures. The values in the second and third columns are percentage of funds that correspond to the characteristic in the first column. The value in parenthesis is the number of funds. The fourth column indicates the p-value of the Z-test for equality of proportions in columns 1 and 2.

Panel A: NAREIT, NCREIF NPI and TBI loading funds

	Real estate funds	Non-real estate funds	p-value
Leveraged	47.48 (1,230)	54.88 (2,048)	0.0000
Invests in Other funds	52.44 (1,230)	33.98 (2,048)	0.0000
Futures	13.48 (816)	23.20 (1,470)	0.0000
Derivatives	14.22 (816)	18.71 (1,470)	0.0063
Margin	32.60 (816)	34.97 (1,470)	0.2526
FX Credit	8.21 (816)	9.05 (1,470)	0.4975
Personal Capital	19.35 (1,230)	29.15 (2,048)	0.0000
Real Estate/Property	3.27 (1223)	2.52 (2,027)	0.2065
MBS	5.64 (1,223)	4.88 (2,027)	0.3455

Table 7: Characteristics of real estate hedge funds

This table presents the characteristics of hedge funds as reported to the data vendor. Panel *A* contrasts funds that load on the *NCREIF (NPI)* residual or *NAREIT* residual factors. Panel *B* contrasts funds that load on the *NCREIF (TBI)* residual or *NAREIT* residual factors. The values in the second and third columns are percentage of funds that correspond to the characteristic in the first column. The value in parenthesis is the number of funds. The fourth column indicates the p-value of the Z-test for equality of proportions in columns 1 and 2.

Panel A: NCREIF NPI and NAREIT loading funds

	NCREIF loading (*NPI*)	*NAREIT* loading	*p*-value
Leveraged	50.57	42.81	0.0107
	(528)	(549)	
Invests in Other funds	44.7	61.02	0.0000
	(528)	(549)	
Futures	12.37	13.98	0.5310
	(372)	(322)	
Derivatives	12.90	14.91	0.4458
	(372)	(322)	
Margin	36.02	30.43	0.1197
	(372)	(322)	
FX Credit	8.33	7.45	0.6687
	(372)	(322)	
Personal Capital	20.83	16.94	0.1024
	(528)	(549)	
Real Estate/Property	3.63	2.55	0.3101
	(524)	(548)	
MBS	7.82	2.55	0.0000
	(524)	(548)	

Panel B: NCREIF TBI and NAREIT loading funds

	NCREIF loading (*TBI*)	*NAREIT* loading	*p*-value
Leveraged	47.58	44.26	0.3836
	(248)	(549)	
Invests in Other funds	55.24	59.56	0.2522
	(248)	(549)	
Futures	10.34	15.45	0.1126
	(174)	(330)	
Derivatives	9.77	16.06	0.0522
	(174)	(330)	
Margin	34.48	30.30	0.3379
	(174)	(330)	
FX Credit	7.47	8.79	0.6111
	(174)	(330)	
Personal Capital	20.56	17.49	0.2996
	(248)	(549)	
Real Estate/Property	2.86	2.37	0.6874
	(245)	(548)	
MBS	4.90	3.28	0.2712
	(245)	(548)	

Table 8. Logistic regressions on fund characteristics

Binary Logistic regressions are estimated on the cross-section of measures of estimated real estate exposure. The first column models the probability of being a NCREIF (NPI) loading fund. The second column models the probability of being a NCREIF (TBI) loading fund and the third column models the probability of being a real estate (NAREIT, NCREIF NPI or TBI) loading fund. The explanatory variables are hedge fund characteristics, such as the logarithm of minimum investment, incentive fee, high water mark, average leverage, maximum leverage, lockup period, and redemption notice period. The time period is from January 1994 to December 2011. Standard-errors of the estimated coefficients are reported in parenthesis. *, **, *** indicate significance at the 10%, 5%, and 1% level.

	Independent Variable		
Dependent variables	NAREIT vs. *NCREIF (NPI)* loading indicator	*NAREIT* vs. *NCREIF (TBI)* loading indicator	Real estate vs. non-real estate loading indicator
Intercept	-0.2150	-0.4525	-0.0683
	(0.4646)	(0.5961)	(0.2676)
Log (Min Investment)	-0.0155	-0.0387	-0.0322
	(0.0397)	(0.0514)	(0.0230)
Incentive Fee	0.0150	0.0085	-0.0463***
	(0.0111)	(0.0136)	(0.0066)
High Water Mark	-0.2769	-0.2022	0.6289***
	(0.1816)	(0.2186)	(0.1038)
Average Leverage	0.0013	0.0026	-0.0006
	(0.0014)	(0.0021)	(0.0006)
Maximum Leverage	0.0010	-0.0012	-0.0001
	(0.0008)	(0.0013)	(0.0004)
Lockup Period	0.0112	0.0227	0.0003
	(0.0139)	(0.0166)	(0.0070)
Redemption notice period	0.0098***	0.0064*	0.0052***
	(0.0031)	(0.0037)	(0.0017)
Adjusted R-square	0.0411	0.0225	0.0587
N	679	492	2243

Table 9: Economic value of tracking the real estate market: Evidence from out-of-sample alphas

This table presents the out-of-sample alphas for the portfolios consisting of funds exposed to different measures of real estate. In each quarter, we form 2 portfolios based on the funds' estimated exposure from the past 24 quarters (i.e., ranking period) and then hold these portfolios. The table reports the out-of-sample seven-factor alphas (in percent per quarter) estimated from the post-ranking returns. Heteroscedasticity and autocorrelation consistent *t*-statistics are reported in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level.

	NAREIT exposure funds	*NCREIF* exposure funds	Spread (*NAREIT - NCREIF*)
Panel A: Full Time period,			
NAREIT vs. *NCREIF*	0.0053*	0.0052**	0.0001
(NPI)	(1.96)	(2.13)	(0.03)
NAREIT vs. *NCREIF*	0.0053*	0.0091**	-0.0039
(TBI)	(1.96)	(2.57)	(-1.63)
Panel B: Sub-period up to September 2008			
NAREIT vs. *NCREIF*	0.0043	0.0058	-0.0015
(NPI)	(1.53)	(1.50)	(-0.58)
NAREIT vs. *NCREIF*	0.0043	0.0078*	-0.0035
(TBI)	(1.53)	(1.83)	(-1.10)

Table 10: Economic value of tracking the real estate market: Evidence from out-of-sample alphas

This table presents the out-of-sample alphas for the portfolios consisting of funds at different levels of real estate exposure. In each quarter, we form 2 portfolios based on the funds' estimated exposure from the past 24 quarters (i.e., ranking period) and then hold these portfolios. The table reports the out-of-sample seven-factor alphas (in percent per quarter) estimated from the post-ranking returns. Heteroscedasticity and autocorrelation consistent *t*-statistics are reported in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level.

|	Real estate index loading funds	Non real estate index loading funds	Spread (loading-non-loading)
Panel A: Full Time period			
Real estate loading vs.	0.0052**	0.0090***	-0.0038**
non-real estate loading	(2.40)	(4.69)	(-2.50)
Panel B: Sub-period up to September 2008			
Real estate loading vs.	0.0055*	0.0108***	-0.0054***
non-real estate loading	(1.82)	(3.95)	(-3.89)
Panel C: Full Time period, excluding Fund of Funds			
Real estate loading vs.	0.0078***	0.0116***	-0.0038**
non-real estate loading	(2.92)	(5.74)	(-2.11)
Panel D: Sub-period up to September 200, excluding Fund of Funds			
Real estate loading vs.	0.0065**	0.0132***	-0.0067***
non-real estate loading	(2.10)	(4.85)	(-4.62)
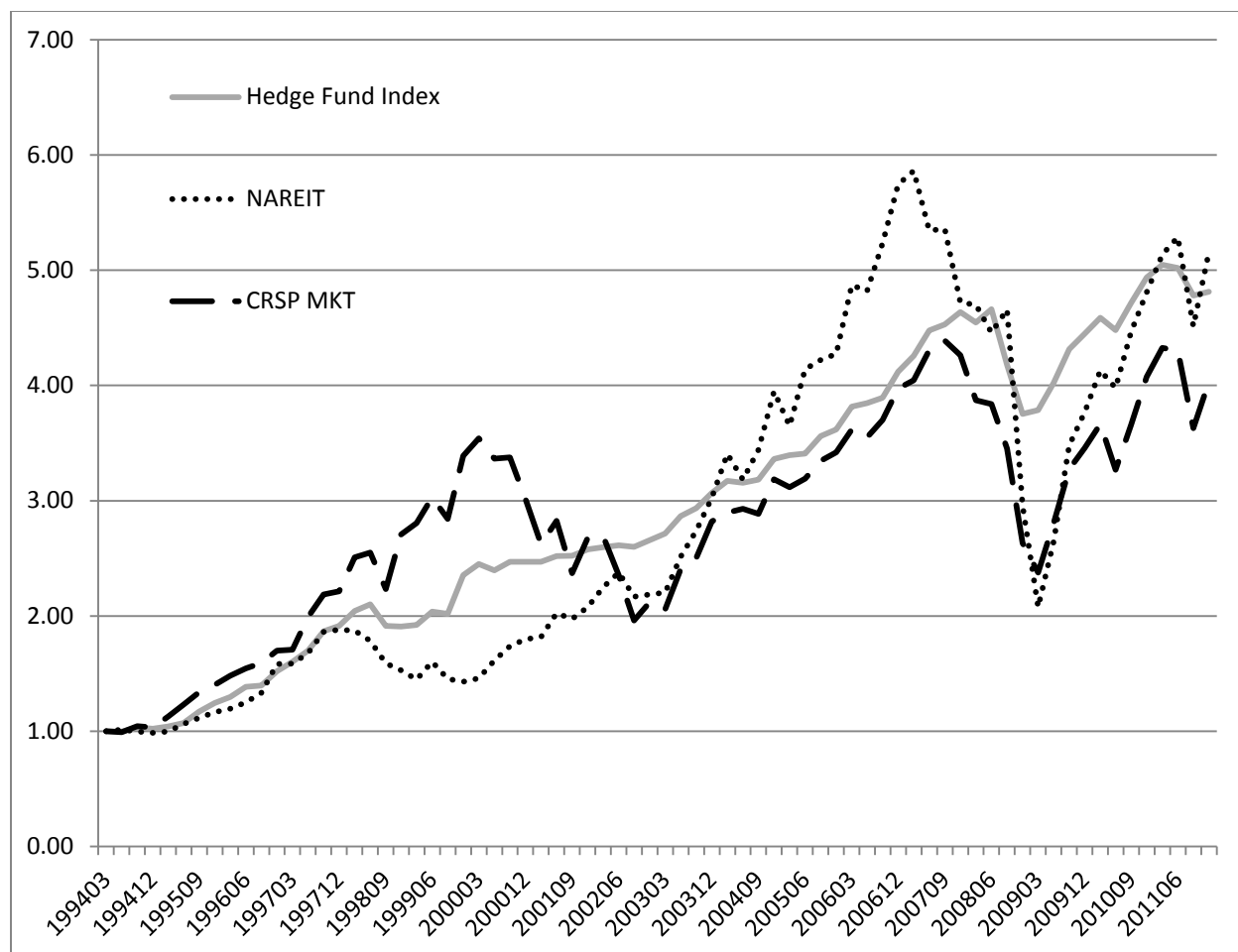
Figure 1: Performance of the *NAREIT*, *CRSP* market and Hedge fund index.

This figure contrasts the cumulative investment return of the NAREIT index with the performance of the CRSP value weighted market index and a hedge fund index across diversified strategies.
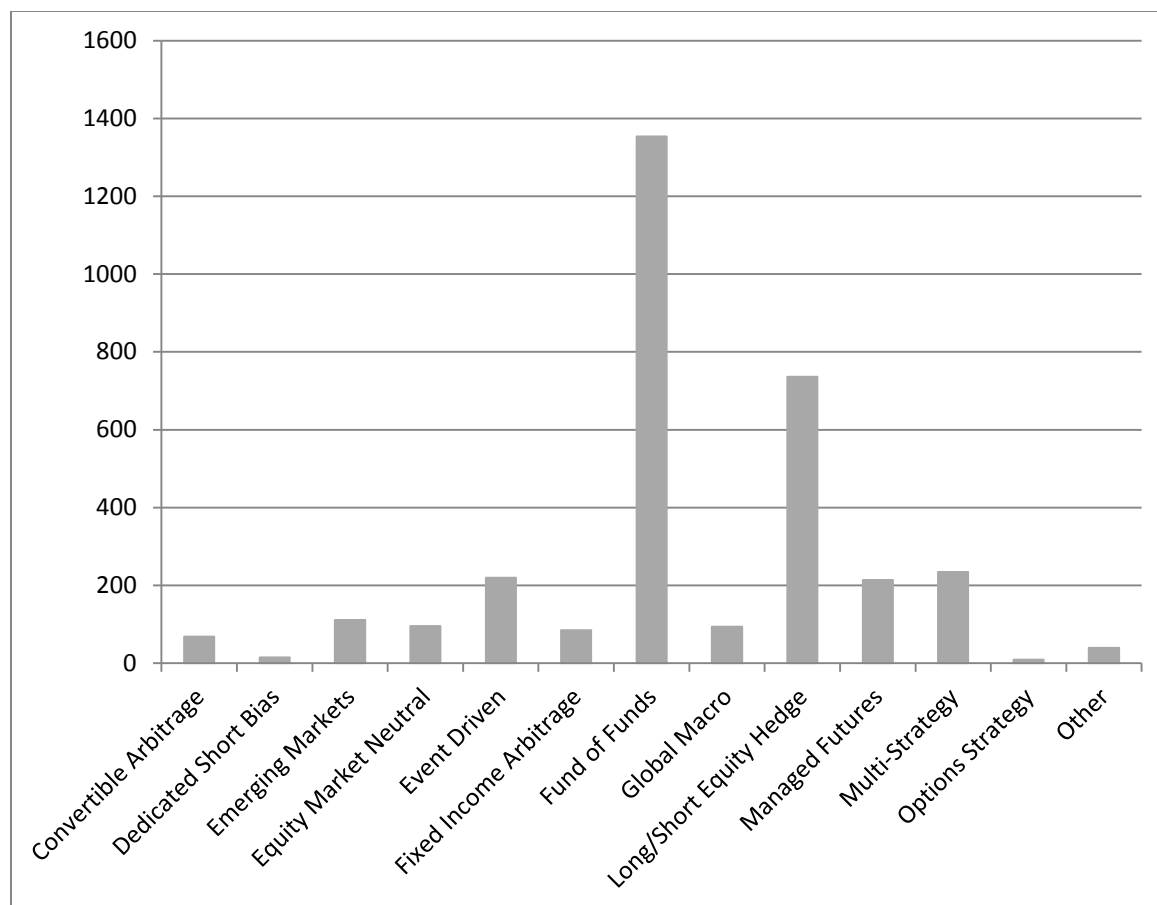
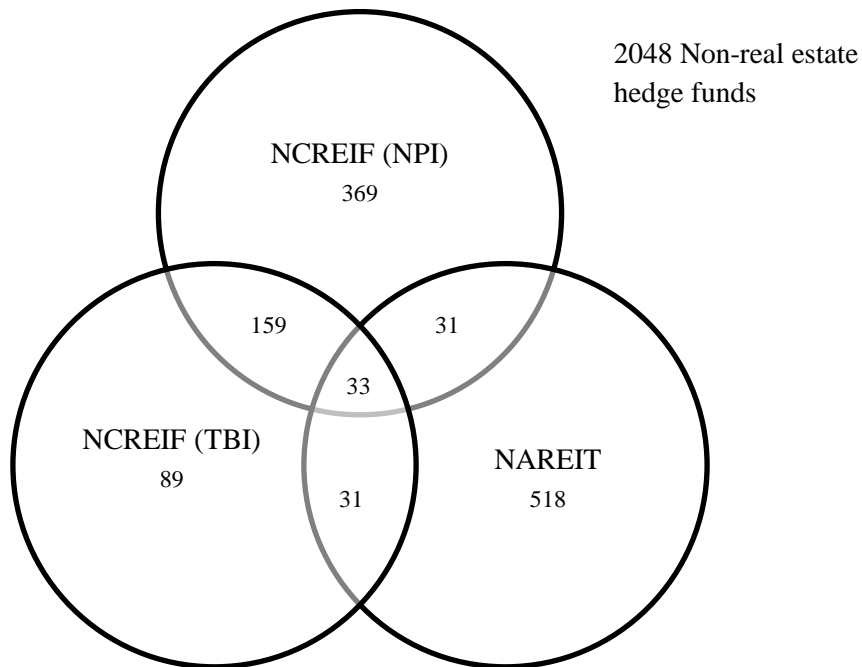**Figure 2: Frequency Distribution of Hedge Funds by Investment Strategy**

Figure 3: Classification of real estate hedge funds based on estimated exposure.

This figure depicts the number of hedge funds that are either unique or overlap across strategies based on the *NAREIT*, *NCREIF (NPI)* and *NCREIF (TBI)* indexes.
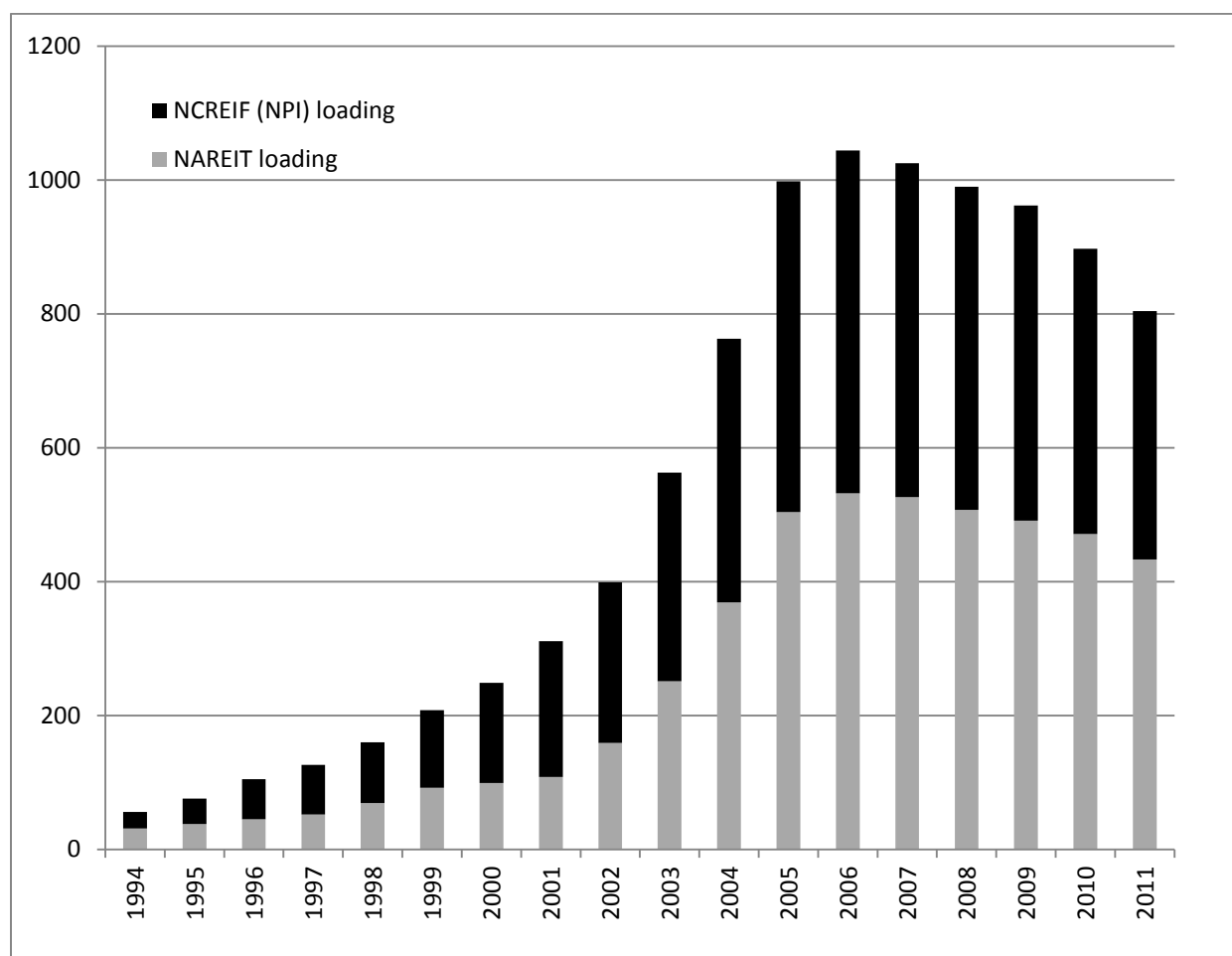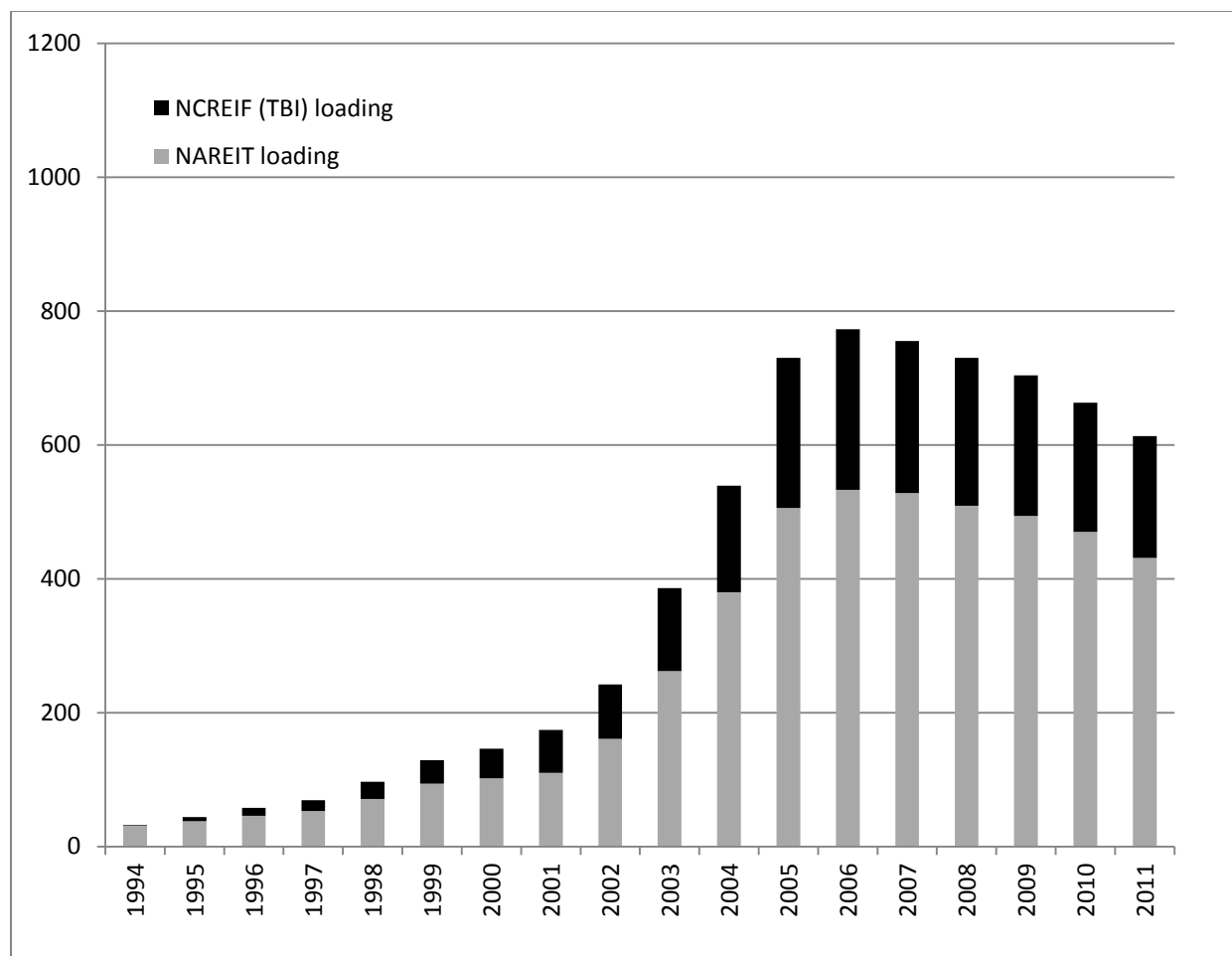
Figure 4: Evolution of real estate hedge funds over time, *NAREIT* vs. *NCREIF (NPI)* exposure funds

This figure plots the number of hedge funds that have exposure to the *NAREIT* or *NCREIF (NPI)* index. The yearly statistic is the number of hedge funds that exist any time during that year.

Figure 5: Evolution of real estate hedge funds over time, *NAREIT* vs. *NCREIF (TBI)* exposure funds

This figure plots the number of hedge funds that have exposure to the *NAREIT* or *NCREIF (TBI)* index. The yearly statistic is the number of hedge funds that exist any time during that year.
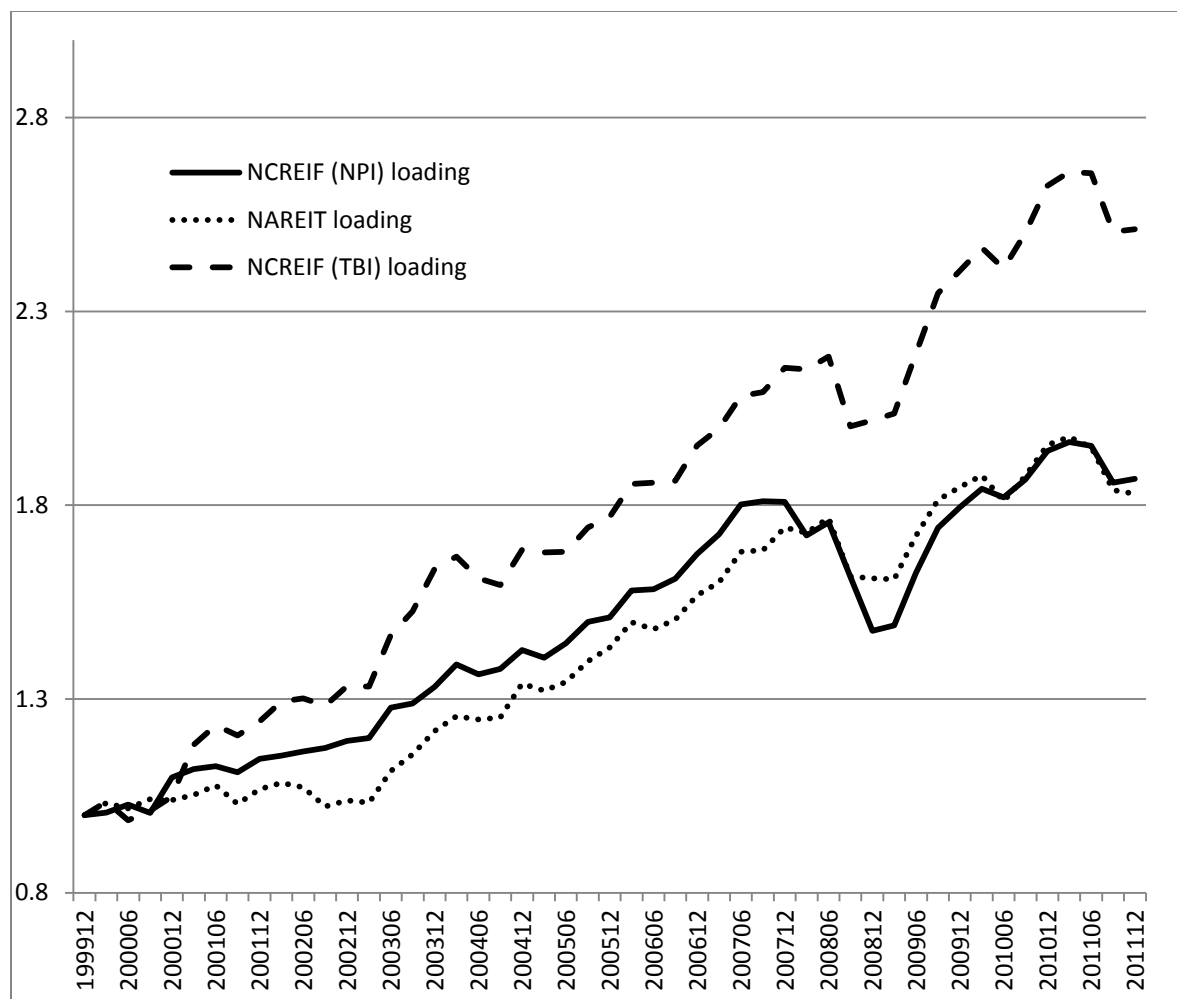
Figure 6: Economic Impact of real estate hedge funds

This figure plots the cumulative returns of portfolios consisting of *NCREIF* loading (*NPI*), NCREIF (*TBI*) loading and *NAREIT* loading real estate hedge funds as well as non-loading funds. In each quarter starting from December 1999, we form portfolios based on individual hedge funds' real estate exposure, estimated from the previous 24 quarters.
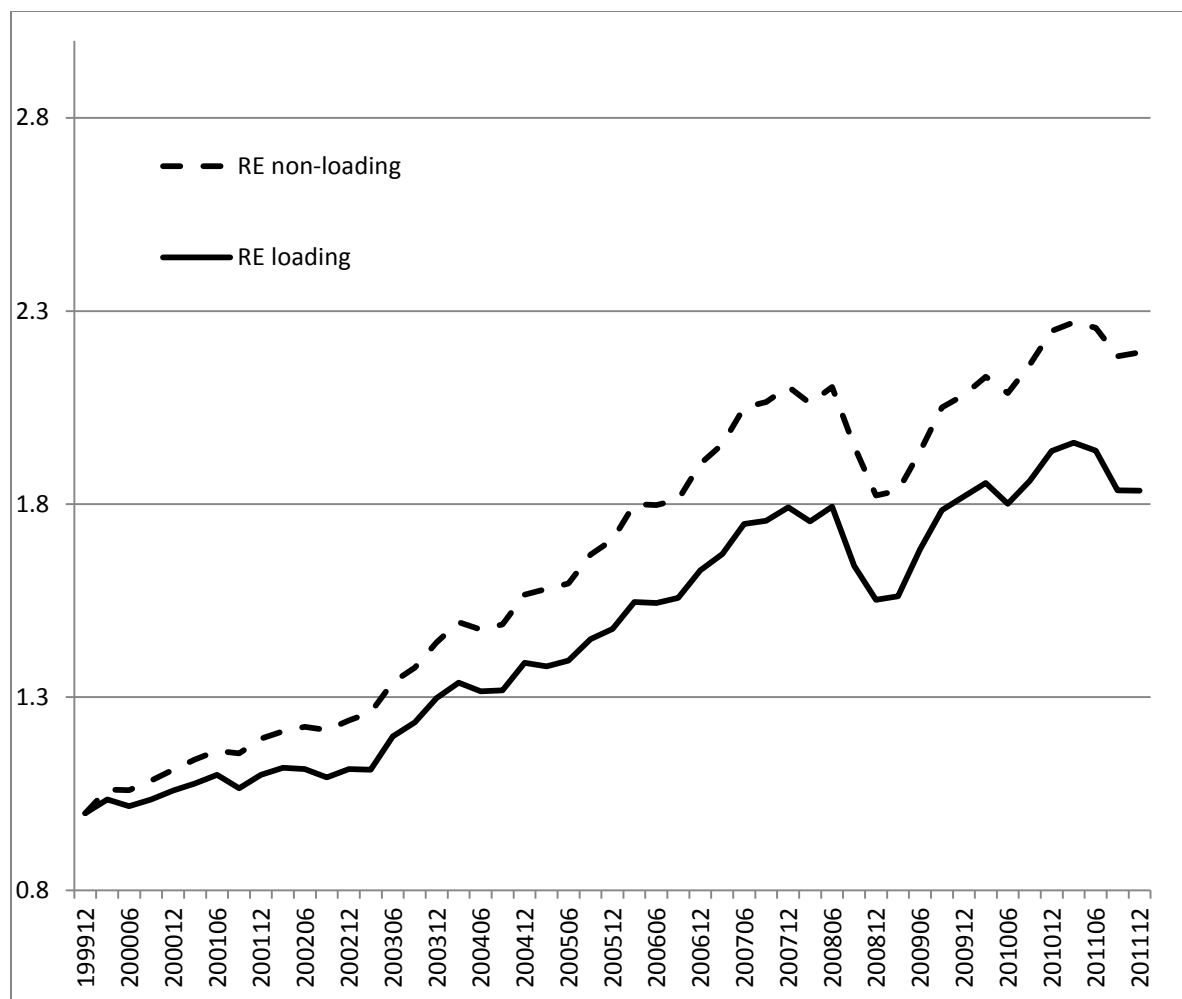
Figure 7: Economic Impact of real estate hedge funds

This figure plots the cumulative returns of portfolios consisting of real estate loading funds (*NCREIF NPI, TBI* or *NAREIT*) versus non-loading hedge funds. In each quarter starting from December 1999, we form portfolios based on individual hedge funds' real estate exposure, estimated from the previous 24 quarters.
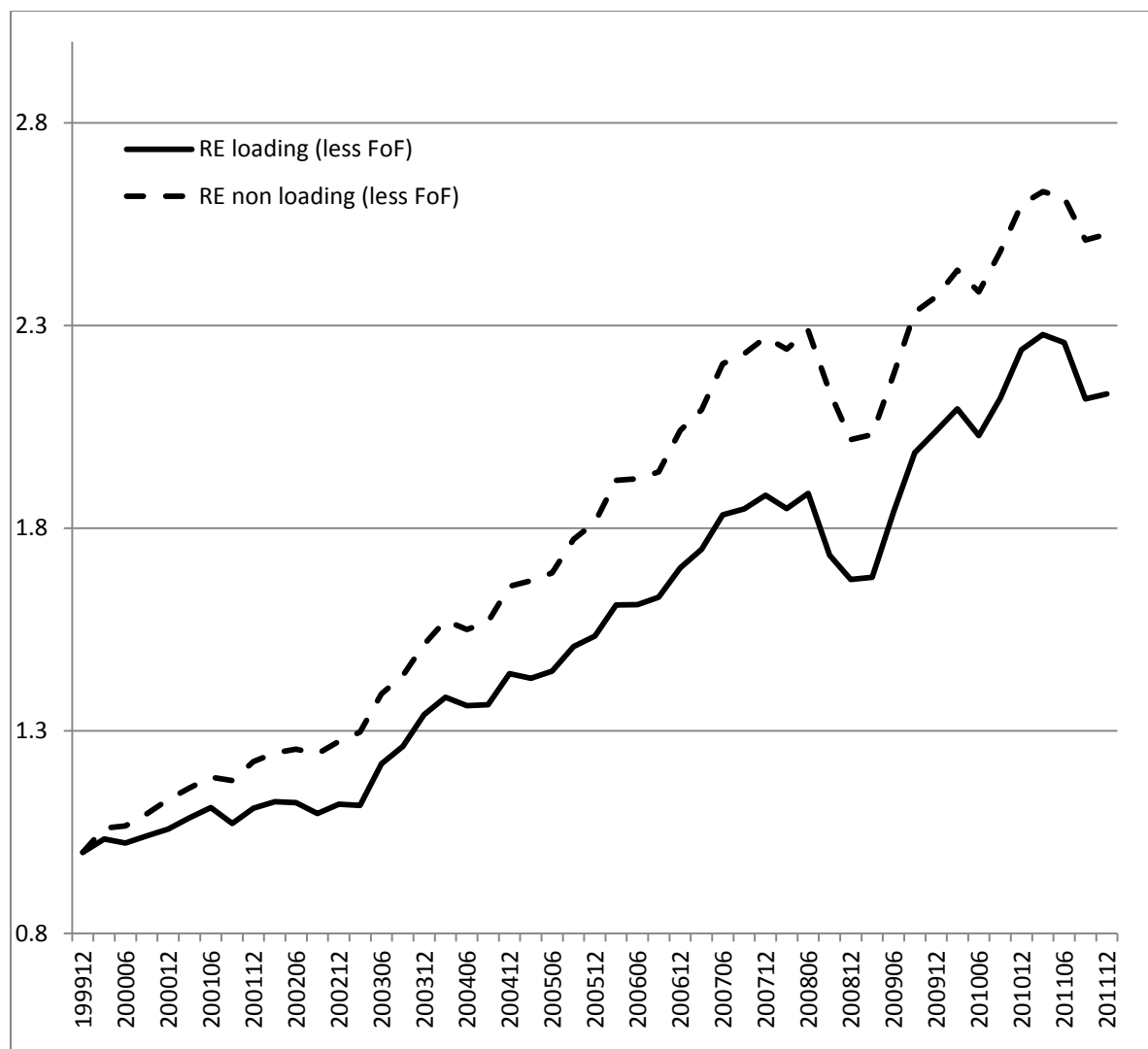
Figure 8: Economic Impact of real estate hedge funds

This figure plots the cumulative returns of portfolios consisting of real estate loading funds (*NCREIF NPI, TBI* or *NAREIT*) versus non-loading hedge funds net of fund of funds. In each quarter starting from December 1999, we form portfolios based on individual non fund of fund hedge funds' real estate exposure, estimated from the previous 24 quarters.