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Abstract: This study examines the net monthly returns of real estate exchange-traded funds (ETFs) through various performance evaluation models and market situations. The results reveal that these ETFs generated positive alphas and outperformed benchmark indices in absolute returns. However, their performance varied across market conditions, demonstrating both outperformance and underperformance compared to U.S. and global stocks. During the COVID-19 pandemic, real estate ETFs displayed a decline, trailing behind U.S. and global equities in both absolute returns and risk-adjusted performance. This emphasized their vulnerability during economic crises. Utilizing the Carhart four-factor model, significant exposure of real estate ETFs to the stock market was observed. Moreover, an assessment of ETF portfolio managers' skills indicated proficiency in security selection but limited capabilities in market timing.

Keywords: real estate exchange-traded funds; COVID-19; alpha; Fama–French model; Sharpe ratio; Sortino ratio; Omega ratio

1. Introduction

Real estate exchange-traded funds (ETFs) are a new type of investment vehicle that track the performance of publicly traded real estate entities such as real estate investment trusts (REITs) or real estate operating companies (REOCs). These ETFs give investors exposure to the real estate market without requiring direct property ownership or management of rental units. Because of the intrinsic value and tangible nature of real estate assets, which have historically demonstrated resilience or appreciation during inflationary periods, this unique investment vehicle holds promise as a potential hedge against inflation.

However, despite their potential, the evaluation of real estate ETFs remains understudied in the literature. While acknowledging the significance of these funds in the real estate sector, it is important to note the scarcity of comprehensive studies evaluating their performance characteristics, risk–return profiles, and comparative advantage over traditional market instruments.

The importance of these evaluations was highlighted by Goodwin et al. (2021), who shed light on the high returns offered by real estate ETFs despite a marginally higher risk compared to U.S. market ETFs. Understanding the nuanced risk–return dynamics of these ETFs becomes critical for investors and portfolio managers navigating these instruments' complexities.

This study fills that void by meticulously examining the risk-adjusted performance of real estate exchange-traded funds (ETFs) from February 2000 to July 2023. The chosen time frame allows for a comprehensive view that includes multiple market cycles and critical economic events such as the 2008 economic crisis, the disruptive impact of COVID-19, and the subsequent post-vaccine recovery phase. Currently, no research has conducted a comparative analysis of real estate exchange-traded funds' performance both prior to and during the pandemic along with the pre- and post-2008 economic crisis periods. Additionally, the emergence of COVID-19 as a black swan event holds extensive implications

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for financial markets. Considering its profound impact on a wide array of global financial assets, it becomes imperative to examine REETFs' performance vis-à-vis U.S. and global equities during a 12-month period marked by complete market uncertainty.

Among the wealth of existing research on real estate mutual funds, the emphasis on evaluating exchange-traded funds is significant due to their unique offerings in accessing the real estate market. In navigating these investment options, investors frequently face the decision of whether to hire money managers for optimal returns. Comparing ETF performance to broader stock market indices such as the Russell 3000 Index, the FTSE All World Ex U.S. Index, and the Dow Jones U.S. Real Estate Index serves as a litmus test for ETF portfolio managers' value addition. Outperformance against these benchmarks on a consistent basis validates the value-added proposition; on the other hand, underperformance may prompt consideration of passive index funds as a viable alternative. Furthermore, consistent with the findings of Elyasiani et al. (2022), which indicate that managers specializing in specific asset classes can achieve commendable outcomes despite limited experience, this study aims to investigate whether a fund's superior risk-adjusted performance can be attributed to the manager's adept investment approach specifically in terms of market timing and the prediction of asset returns.

The structure of this study is as follows: Section 2 provides a summary of previous research on ETF performance. Section 3 elucidates various models for evaluating performance. Section 4 delves into the data employed in this study. Section 5 presents a summary of empirical findings. Finally, Section 6 offers the summary and conclusions of our study.

2. Previous Studies

Real estate exchange-traded funds (REETFs) have received limited attention in the existing literature. Goodwin et al. (2021) conducted an assessment encompassing 34 real estate exchange-traded funds between May 2003 and September 2019 by employing the Sharp, Sortino, and Omega ratios. Their investigation unveiled that, despite real estate exchange-traded funds demonstrating higher monthly returns compared to S&P 500 ETFs (IVV and RSP), they also exhibited slightly heightened volatility. When considering various risk measures, IVV and RSP consistently displayed superior risk-adjusted performance. Notably, during the 2007–2009 financial crisis, REETFs experienced escalated risk and substantial losses.

In contrast, recent research on real estate mutual funds has presented inconclusive findings regarding their performance. Malhotra (2023) employed three-, four-, and five-factor models to assess the performance of real estate mutual funds and observed a significant influence of the stock market on real estate mutual fund performance, contradicting prevailing investor beliefs. This study highlighted that real estate mutual fund monthly returns were contingent on systematic factor exposures, indicating a substantial impact from equity-market-related factors.

Chou and Hardin (2014) discovered that real estate mutual fund returns tended to exceed benchmarks pre-expenses, but during the financial crisis, they failed to maintain parity or surpass benchmarks. Despite this, well-established funds consistently exhibited superior returns regardless of fund turnover.

Bond and Mitchell (2010) reported limited evidence of real estate mutual fund managers generating excess risk-adjusted returns without any discernible performance persistence. Kaushik and Pennathur (2012) concluded that while real estate mutual fund managers did not outperform the market from 1990 to 2008, they exhibited outperformance until 2006, excluding the 2007–2008 downturn.

Moreover, recent investigations by Lantushenko and Nelling (2020) observed a decline in activity among real estate fund managers, with geographically diversified real estate mutual funds failing to outperform. MacGregor et al. (2021) did not find substantial evidence supporting the outperformance of global real estate mutual funds compared to other actively managed funds, even in the long term. Despite the exponential growth of real estate mutual funds highlighted by Malhotra's study (Malhotra 2020) due to low interest rates and increased real estate demand, the average turnover ratio for real estate mutual funds decreased significantly after 2009, indicating reduced portfolio management activity.

Kaushik and Pennathur (2013) identified that real estate mutual fund managers exhibited positive timing ability in bull markets but failed to do so in bear markets, implying an ability to identify and invest in outperforming real estate assets during bullish periods but not during bearish phases. Additionally, Elyasiani et al. (2022) found that while some real estate mutual fund managers generated alpha through asset selection, the average real estate mutual fund manager did not outperform the market. The risk-adjusted performance of real estate mutual funds presented mixed results.

Given the divergent findings on risk-adjusted performance, market timing, and selectivity of real estate mutual funds in the existing literature, this study aims to reassess these aspects by evaluating the monthly average returns of real estate exchange-traded funds (ETFs) spanning a 23-year period from February 2000 to July 2023. This reassessment extends prior research by examining the risk-adjusted performance of real estate ETFs during significant economic events such as the 2007 economic crisis and the COVID-19 pandemic, which notably affected sectors like commercial leasing, apartment rentals, and shopping malls due to widespread lockdowns and closures.

3. Data

The dataset utilized in this study was sourced from Morningstar Direct, encompassing monthly returns for real estate ETFs spanning from February 2000 to July 2023. It is imperative to note that our dataset did not include any real estate ETFs before February 2000. Over this period, the number of real estate ETFs increased from 2 in February 2000 to 36 by July 2023, indicating the expanding landscape of real estate ETF offerings in the market.

The inclusion criteria for these ETFs centered around actively traded ETFs, displaying an average turnover ratio of 32.72% as of July 2023. It is notable that the median turnover ratio stood at 18.50%, with a range between a minimum of 2% and a maximum of 120%. Additionally, the average expense ratio across these ETFs amounted to 0.41%, which was accompanied by a standard deviation of 0.20%. These metrics provide insights into the trading activity and cost structures associated with the selected real estate ETFs.

The evolution of total assets under management (AUM) underscores a substantial growth trajectory, surging from USD 17.26 million in January 2000 to USD 30.13 billion by December 2022. While this growth pattern is indicative of a remarkable expansion within the real estate ETF market, it's crucial to explore and evaluate the implications of such significant changes in AUM on its potential impact on ETF performance under varying market conditions. Table 1 examines the absolute and relative performance of real estate ETFs from February 2000 to July 2023 based on their monthly returns.

Based on the average monthly returns from February 2000 to July 2023, real estate ETFs outperformed all three benchmark indices in terms of absolute returns as well as returns per unit of risk with an average monthly return of 0.96% and a return per unit of risk of 0.17%. On the other hand, the Russell 3000 Index and FTSE All World Ex U.S. Index delivered an average monthly return of 0.55% and 0.51% in absolute terms, respectively. The return per of risk for the Russell 3000 Index and the FTSE All World Ex U.S. Index was 0.12% and 0.10%, respectively. The Dow Jones U.S. Real Estate Index also outperformed U.S. and global equities with an average absolute return of 0.91% and a return per unit of risk of 0.16%.

We found a similar trend in performance when we examined the monthly returns for the sub-period of February 2000 to July 2007, with real estate ETFs outperforming U.S. and global equities. However, monthly returns from August 2007 to July 2023 show that U.S. equities outperformed the real estate ETFs, Dow Jones Real Estate Index, and FTSE All World Ex U.S. Index in terms of absolute returns as well as return per unit of risk.

During the economic crisis period of August 2007 to August 2009, monthly returns turned negative on average. The Dow Jones U.S. Real Estate Index had the lowest negative return relative to real estate ETFs and U.S. and global equities.

Table 1. Summary statistics of the average monthly rates of returns and standard deviation in monthly returns for real estate ETFs, the Russell 3000 Index, the FTSE All World Ex U.S. Index, and the Dow Jones U.S. Real Estate Index for the period of February 2000 to July 2023.

	Real Estate ETFs	**Dow Jones U.S. Real Estate Index**	**Russell 3000 Index**	**FTSE All World Ex U.S. Index**
February 2000 to August 2022				
Mean	0.96	0.91	0.55	0.51
Standard deviation	5.68	5.86	4.57	5.17
Average return per unit of risk	0.17	0.16	0.12	0.10
February 2000 to July 2007				
Mean	1.55	1.45	0.20	0.56
Standard deviation	4.34	4.30	4.07	4.13
Average return per unit of risk	0.36	0.34	0.05	0.14
August 2007 to August 2022				
Mean	0.68	0.66	0.72	0.49
Standard deviation	6.20	6.46	4.78	5.60
Average return per unit of risk	0.11	0.10	0.15	0.09
August 2007 to August 2009				
Mean	−1.01	−0.89	−1.15	−1.01
Standard deviation	11.84	12.87	6.77	8.70
Average return per unit of risk	−0.09	−0.07	−0.17	−0.12
January 2020 to January 2021				
Mean	0.35	0.29	2.63	2.05
Standard deviation	9.72	7.71	7.64	7.16
Average return per unit of risk	0.04	0.04	0.34	0.29
February 2021 to July 2023				
Mean	0.84	0.39	0.74	−0.23
Standard deviation	5.28	6.07	5.16	3.44
Average return per unit of risk	0.16	0.06	0.14	−0.07

In the context of real estate ETFs, we undertook an analysis of monthly returns in two specific phases: the period characterized by the lockdowns triggered by the COVID-19 pandemic and the subsequent post-COVID-19 era. The COVID-19 crisis ushered in considerable market turbulence in the real estate market, leading to the adoption of options as risk management tools. Through our return analysis, our objective was to gain insights into the evolution of market sentiment across various phases of the pandemic and its aftermath within the real estate ETF landscape.

It is important to emphasize that the performance of real estate ETFs is strongly influenced by fluctuations in volatility. Examining the results of exchange-traded funds (ETFs) associated with real estate may provide valuable insights into the dynamics of volatility during crisis periods and how this subsequently impacts real estate ETFs.

Our evaluation encompassed the average monthly returns over two distinct timeframes: from January 2020 (marking the commencement of the initial lockdowns) to January

2021 (which coincided with the commencement of the first vaccination campaigns) and from February 2021 to April 2023. Notably, during the COVID-19-induced lockdowns and before the rollout of vaccinations, real estate ETFs demonstrated significant underperformance when compared to both U.S. equities and global equities.

The average monthly returns for ETFs stood at 0.35%, while the Russell 3000 and FTSE All World Ex U.S. indices boasted average monthly returns of 2.63% and 2.05%, respectively. Furthermore, it is worth noting that the volatility of average monthly returns for ETFs was markedly higher in comparison to the volatility of monthly returns for the Russell 3000 and FTSE All World Ex U.S. indices. ETFs performed significantly lower relative to U.S. and global equities during the COVID-19-induced lockdowns and before the start of vaccinations in terms of absolute returns. In terms of return per unit of risk, ETFs underperformed U.S. and global equities.

Following the commencement of vaccinations (post-COVID), the average monthly returns of ETFs notably exceeded those of U.S. and global stocks. Real Estate ETFs recorded an average monthly return of 0.84%, while the Russell 3000 and FTSE All World Ex U.S. indices averaged 0.74 and −0.07%, respectively.

In terms of return per unit of risk, ETFs outperform both U.S. and global stocks during this period. This contrasts with the lockdown period when ETFs performed worse than U.S. and global equities.

4. Model

This study proceeded to evaluate the risk-adjusted performance of real estate ETFs in relation to the Dow Jones U.S. Real Estate, Russell 3000 (used as a proxy for U.S. stocks), and FTSE All World ex U.S. (utilized as a proxy for global equities) indices. This evaluation was based on monthly returns recorded between February 2000 and July 2023. The Russell 3000 is a broad index that includes approximately 3000 of the largest publicly traded U.S. stocks. It covers a wide spectrum of U.S. companies, including large-, mid-, and small-cap stocks. This makes it a comprehensive benchmark for U.S. equities, reflecting the overall performance of the U.S. stock market. The FTSE All World ex U.S. Index represents global equities (excluding the U.S.). By using this index alongside the Russell 3000, we created a well-rounded benchmark that accounts for both domestic and international exposure. This diversification can be important for investors seeking to assess the performance of real estate ETFs within a global context. Furthermore, using the Russell 3000 as a benchmark allowed us to evaluate how well these ETFs are capturing the movements of the U.S. equity market.

We used the Sharpe ratio (Sharpe 1966), Sortino ratio (Sortino and Van Der Meer 1991), and Omega ratio (developed by Keating and Shadwick (2002)) to measure risk-adjusted performance. Additionally, we computed Carhart four-factor models to determine if alternative exchange-traded funds generated positive alphas. The utilization of the Carhart four-factor model in assessing real estate ETFs is justified due to its ability to offer a comprehensive and multifaceted framework for evaluating their performance. This model incorporates variables beyond market risk, allowing for a more nuanced analysis. This may provide further information on an ETF's risk-adjusted returns and the efficacy of its investment strategy. Traditional performance assessment methods, such as CAPM, sometimes depend entirely on market risk (beta). In addition to market risk, the Carhart model considers size, value, and momentum, offering a more thorough evaluation of the ETF's risk-adjusted returns.

The Carhart model adds size, value, and momentum factors to standard models, which can help to capture factor-based anomalies or trends in ETF returns. The momentum factor can be used to assess the effectiveness of different investment strategies in generating returns.

4.1. The Sharpe Ratio

A portfolio might yield higher returns, but such gains could be a result of assuming greater risk. To address variations in performance attributed to risk, we computed the Sharpe ratio (Sharpe 1966), which evaluates an investment's efficiency in compensating investors for each unit of risk they assume. The higher the Sharpe ratio, the greater the success of the investment. The Sharpe ratio (Sharpe 1966) is calculated as the risk premium divided by the standard deviation in the portfolio return. Equation (1) shows the Sharpe ratio.

$$Sharpe\ Ratio = \frac{\left(R_p - R_f\right)}{\sigma_p} \tag{1}$$

where:

R_p = the portfolio return;
R_f = the risk-free rate;
σ_P = standard deviation of the portfolio.

The Sharpe ratio assesses the performance of an equity investment concerning a risk-free investment while accounting for the heightened risk associated with maintaining the equity. A negative Sharpe ratio suggests that opting for a risk-free investment would offer a superior risk-adjusted return for the investor. A Sharpe ratio equal to or greater than one is commonly recognized as indicative of a commendable risk-adjusted return rate.

In addressing the challenge of evaluating performance breadth, the Sharpe ratio correlates increased diversification with a reduction in the standard deviation in portfolio returns. As diversification expands, incorporating various securities aids in offsetting company-specific effects, thereby decreasing the standard deviation. Consequently, the Sharpe ratio encompasses the breadth of performance, representing the overall portfolio performance.

The Sharpe ratio is also subject to a benchmark issue, since the standard deviation in the market portfolio is influenced by the chosen proxy. Consequently, both the Sharpe measure of the benchmark portfolio and its comparison with the Sharpe measure of the portfolio in issue will be affected.

4.2. The Sortino Ratio

The Sortino ratio (Sortino and Van Der Meer 1991), operating within the framework of the Sharpe ratio, differentiates between favorable and adverse volatility. By discerning between upward and downward volatility, this metric enables the computation of risk-adjusted returns, providing a performance measure for investments without penalizing positive returns. Similar to the Sharpe ratio, a higher Sortino ratio signifies superior portfolio performance. Equation (2) illustrates the Sortino ratio.

$$Sortino\ Ratio = \frac{\left(R_p - R_f\right)}{\sigma_d} \tag{2}$$

where R_P and R_f are described as above and σ_d is the standard deviation in the portfolio's negative returns.

The Sortino ratio, a variation of the Sharpe ratio, specifically focuses on downside or negative volatility, in contrast to the broader consideration of overall volatility in the traditional Sharpe ratio calculation. It operates on the premise that upward volatility benefits the investment and should therefore be excluded from the risk assessment. Consequently, the Sortino ratio omits the contribution of upside volatility and solely calculates the downside standard deviation, unlike the Sharpe ratio, which accounts for the entire standard deviation.

Analysts commonly employ the Sharpe ratio to assess low-volatility investment portfolios while turning to the Sortino variation to evaluate high-volatility investment portfolios.

4.3. The Omega Ratio

The Omega ratio, devised by Keating and Shadwick (2002), serves as a measure for evaluating the performance of financial assets by gauging the extent of returns they yield in relation to the investment risk. It operates as a ratio between weighted gains and weighted losses. This metric categorizes projected returns into gains and losses, distinguishing returns above and below the anticipated rate, known respectively as the upside and downside.

In simpler terms, the Omega ratio represents the proportion of positive returns (considered favorable) to negative returns (considered unfavorable). While the Sharpe ratio focuses solely on the first two moments of the return distribution—mean and variance—the Omega ratio encompasses all moments of the return distribution. This broader scope of analysis provides investors with insights that the Sharpe ratio may not offer.

$$\Omega = \frac{\int_r^b (1 - F(x))dx}{\int_a^r (F(x))dx} \tag{3}$$

where $F(x)$ is the cumulative probability distribution (i.e., the probability that a return will be less than x), r is a threshold value selected by the investor, and a and b are the investment intervals. It is effectively equal to the probability of weighted gains divided by the probability of weighted losses after a threshold.

4.4. Carhart Four-Factor Model

When evaluating the performance of real estate exchange-traded funds, we applied the Carhart four-factor model to compute the alpha (α). Although Elton et al. (2011) have recommended the frequent use of the three-factor model established by Fama and French (1993) for assessing portfolio performance, we prefer the Carhart four-factor model for its inclusion of the momentum (MOM) factor, which provides an additional dimension to our analysis.

The Fama and French three-factor model includes the excess market return, the size factor, and the value-versus-growth factor, collectively accounting for around 90% of diversified portfolio returns, primarily attributed to risk, as per their research. Davis (2001) suggests that if these three factors do indeed quantify risk, fund managers should be capable of generating returns that adequately compensate for this risk. Furthermore, the premiums linked to these factors can be acquired through a passive strategy involving the purchase of a diversified portfolio of stocks with similar sensitivities to these factors. Hence, active fund management must demonstrate economic value by surpassing the performance of these passive strategies.

Carhart's (1997) four-factor model, serving as our performance benchmark, expands upon the Fama–French three-factor model by incorporating the momentum (MOM) factor. This added factor assesses the performance difference between a portfolio of past 12-month winners and a portfolio of past 12-month losers. As a result, the four-factor model aligns with a market equilibrium model that encompasses four distinct risk factors. Equation (4) provides the Carhart four-factor model and is estimated using monthly returns.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \times \left(R_{m,t} - R_{f,t}\right) + \beta_s \times SMB_t + \beta_v \times HML_t + \beta_M \times MOM_t + \varepsilon_{i,t} \tag{4}$$

where:

$R_{i,t}$—the percentage return for firm i in month t.

$R_{f,t}$—the yield on the U.S. Treasury bill month t.

$R_{m,t}$—the return on Center for Research in Security Prices (CRSP) value-weighted index for month t.

$\left(R_{m,t} - R_{f,t}\right)$—the variable under consideration is the market risk factor, which denotes the surplus return of the entire market and encompasses the overall risk affiliated with investments in the stock market.
SMB_t (Small minus Big)—the small-cap return minus large-cap return for month t, and it is the capitalization factor realization. The SMB factor measures the historical performance difference between small-cap stocks and large-cap stocks. It is calculated as the return of a portfolio of small-cap stocks minus the return of a portfolio of large-cap stocks. A positive SMB suggests that small-cap stocks have outperformed large-cap stocks.
HML_t (High minus Low)—the HML (High minus Low) factor signifies the performance distinction between value and growth stock returns during a specific period, denoted as month 't'. This factor, termed the value factor realization, measures the difference between the returns of value stocks and growth stocks. Specifically, it is calculated by subtracting the return of a portfolio composed of value stocks (characterized by a low price-to-book ratio) from that of a portfolio consisting of growth stocks (marked by a high price-to-book ratio). A positive HML value indicates that value stocks have exhibited superior performance compared to growth stocks.
MOM_t—the momentum factor at time t represents the performance of stocks that have exhibited strong past performance. This factor captures the propensity for stocks with recent positive returns to continue performing well and for stocks with recent negative returns to continue underperforming.
$\varepsilon_{i,t}$—an error term.

SMB, which represents the difference between small-cap returns and large-cap returns, will exhibit a positive slope denoted as β_s for small-company stocks, while large-company stocks will display a negative slope. A positive estimate for β_v indicates a sensitivity to the value component, whereas a negative estimate indicates sensitivity to the growth factor. A positive intercept (α) suggests superior performance compared to the three-factor model, while a negative intercept (α) indicates inferior performance.

The momentum factor seeks to capture the tendency where assets that have demonstrated strong recent performance continue to perform well while those with poor recent performance continue to underperform. Typically, this factor relies on the past 6 to 12 months of returns to assess momentum.

4.5. Conditional Factor Models

Most studies assessing the performance of managed funds employ criteria that can be influenced by the inherent temporal volatility of risks and risk premia. Ferson and Schadt (1996) introduced a conditional performance measure designed to mitigate this bias by considering common variations. Their research suggests that incorporating lags in public information components known to influence stock returns, such as interest rates and dividend yields, yields superior results compared to conventional methodologies. To estimate the conditional performance measure, Ferson and Schadt introduced a modification to the traditional Jensen alpha model. They incorporated a vector of lagged public information variables into their approach. These adjustments involved replacing unconditional betas with time-varying conditional expected returns and betas. The selected variables used in their analysis are readily available and have a track record of successfully predicting stock returns. The variables encompassed in their model include:

- The three-month Treasury bill rate (TR3M);
- The term structure slope, calculated as the difference between the 30-year Treasury bond yield and the three-month Treasury bill yield (SLOPE);
- The corporate bond market quality spread, determined as the yield difference between Moody's BAA-rated corporate bonds and Moody's AAA-rated corporate bonds (QS);
- The dividend yield on the S&P 500.

Notably, all these variables were lagged by one month in their analysis. The resulting conditional model is shown in Equation (5), where $Z_{j,t-1}$ is the demeaned value of the unconditional elements.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \left(R_{m,t} - R_{f,t}\right) + \delta\left\{z_{t-1} \times \left(R_{m,t} - R_{f,t}\right)\right\}_2 + \beta_s \times SMB_t + \beta_v \times HML_t + \beta_M \times MOM_t + \epsilon_{i,t} \quad (5)$$

4.6. Market Timing and Selectivity

Selectivity refers to an investment manager's ability to pick stocks that will provide the projected returns in the future. Market timing, on the other hand, refers to an investment manager's capacity to adjust their portfolio holdings to anticipate changes in the asset portfolio or market price movement in general. The exploration of mutual fund market timing and selectivity has been previously examined by researchers such as Treynor and Mazuy (1966), Kon and Jen (1979), Henriksson and Merton (1981), and Lee and Rahman (1990). Previous research found that mutual fund managers had only minimal performance in market timing and selectivity. To account for market timing and selectivity, Treynor and Mazuy (1966) included a quadratic term in the capital asset pricing model (CAPM). Treynor and Mazuy (1966) introduced a quadratic term in another CAPM-based model that has become a standard for gauging timing skill to address managers' abilities to foresee market swings. Treynor and Mazuy (1966), Kon and Jen (1979), Henriksson and Merton (1981), and Lee and Rahman (1990) found that mutual fund managers were only moderately successful in terms of market timing and selectivity. We used two models to examine market timing and selectivity. The basic model was designed by Treynor and Mazuy (1966). This model adds a quadratic component to the CAPM or the market model to represent market timing and selectivity. The formula is as follows:

$$R_{i,t} - R_{f,t} = \alpha_s + \beta_1 \left(R_{m,t} - R_{f,t}\right) + \beta_2 \times \left(R_{m,t} - R_{f,t}\right)^2 + \varepsilon_{i,t} \quad (6)$$

The coefficient β_2 reveals if the manager can properly anticipate market performance by assessing whether the relation between the portfolio return and the market return is non-linear. A β_2 that is both positive and significant implies superior market timing abilities. A negative and significant β_2 suggests poor market timing. If β_2 is not greater than 0, the manager lacks market timing abilities. Similarly, αs denotes selectivity.

The second model, which was developed by Henriksson and Merton (1981), replaces the quadratic term with a variable Max (0, R_m). The equation is as follows:

$$R_{i,t} - R_{f,t} = \alpha_s + \beta_1 \times \left(R_{m,t} - R_{f,t}\right) + \gamma\left[D_t\left(R_{m,t} - R_{f,t}\right)\right] + \varepsilon_{i,t} \quad (7)$$

where D_t = 0 if $R_{m,t} > R_{f,t}$ (-1 otherwise).

Here, γ measures market-timing ability, whereas αs measures selectivity.

4.7. Conditional Market Timing and Selectivity

To further evaluate the security selection and marketing timing skills of real estate ETF portfolio managers, we developed conditional marketing and selectivity models to discern market timing and selectivity based on publicly available information. Following Ferson and Schadt (1996), Equation (5) illustrates the conditional market timing and selectivity of these funds.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \left(R_{m,t} - R_{f,t}\right) + \delta\left\{z_{t-1} \times \left(R_{m,t} - R_{f,t}\right)\right\} + \beta_2 \times \left(R_{m,t} - R_{f,t}\right)^2 + \varepsilon_{i,t} \quad (8)$$

The conditional Henriksson and Merton (1981) is given in Equation (9) below.

$$R_{i,t} - R_{f,t} = \alpha_s + \beta_1 \times \left(R_{m,t} - R_{f,t}\right) + \delta\left\{z_{t-1} \times \left(R_{m,t} - R_{f,t}\right)\right\} + \gamma\left[D_t\left(R_{m,t} - R_{f,t}\right)\right] + \varepsilon_{i,t} \quad (9)$$

where $D_t = 0$ if $R_{m,t} > R_{f,t}$ (-1 otherwise). All other variables have been defined earlier in the paper.

5. Empirical Analysis

5.1. Correlation

Our empirical analysis commences with an examination of the correlation between monthly returns of options ETFs and the average monthly returns on U.S. equities (represented by the Russell 3000 Index) as well as global equities (represented by the FTSE All World Ex U.S. Index). The findings of this correlation analysis are summarized in Table 2.

Real estate ETFs have consistently mirrored the performance of the DJ U.S. Real Estate Index, showcasing a strong correlation coefficient of 0.94 in their monthly returns. Moreover, our analysis in Table 2 reveals that real estate ETFs, U.S. equities, and global equities all exhibited a notable and positively skewed correlation in their monthly returns and that the correlations are statistically significant at a 1% significance level. The observed correlations were not merely due to chance or random fluctuations. Instead, they were considered statistically significant at the 1% significance level. This means there is a high level of confidence that the correlations observed in the data were indeed present and not a result of random variation

Digging deeper into our examination, which spanned from February 2000 to July 2023, we uncovered that the correlation between ETF monthly returns and the Russell 3000 Index registered at 0.64. Meanwhile, the correlation between real estate ETFs and the FTSE All World Ex U.S. Index stood at 0.55. These correlations provide valuable insights into the interplay between real estate investments and broader market dynamics, underscoring potential investment strategies and risk considerations.

The correlations between the monthly returns of real estate ETFs and both U.S. and global equities displayed lower values, standing at 0.33 and 0.31, respectively, during the sub-period from February 2000 to July 2007. However, these correlations underwent a notable shift in the subsequent period from August 2007 to July 2023. Specifically, the correlation of monthly returns between ETFs and U.S. equities surged to 0.74, while the correlation with global equities rose to 0.61.

Notably, during the economic crisis that unfolded from August 2007 to August 2009, the monthly returns of real estate ETFs exhibited a significant uptick in correlation with U.S. equities, reaching a substantial 0.87. Similarly, their correlation with global equities remained relatively high, registering at 0.77. These findings underscore the dynamic nature of correlations within the investment landscape, particularly during periods of economic turbulence, when real estate ETFs demonstrated a heightened alignment with both domestic and global equity markets.

Amid the COVID-19-induced lockdowns, there was a striking surge in the correlations between the monthly returns of real estate ETFs, the Russell 3000 Index, and the FTSE All World Ex U.S. Index, with these correlations surpassing a remarkable 0.93. This period of extreme market volatility and uncertainty led to a convergence in the performance of these financial instruments.

However, in the post-COVID-19 vaccination era, we witnessed a substantial shift in these correlations. Specifically, the correlation between monthly returns of real estate ETFs and the Russell 3000 Index dwindled to a more modest 0.47, reflecting a departure from the tight coupling observed during the pandemic. Similarly, the correlation between monthly returns of real estate ETFs and the FTSE All World Ex U.S. Index also receded to 0.47, indicating a decoupling from the heightened synchronization witnessed during the pandemic. These changes in correlations suggest a changing landscape of market dynamics and investor sentiment as the global economy navigated through the pandemic and its aftermath.

Table 2. Correlations among monthly returns of real estate ETFs, U.S. equity markets, and global equity markets from February 2000 to July 2023. T-statistics are in parentheses.

	Real Estate ETFs	**Dow Jones U.S. Real Estate Index**	**Russell 3000 Index**	**FTSE All World Shares Ex U.S. Index**
February 2000 to July 2023				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	0.94 (44.92 *)	1.00		
Russell 3000 Index	0.64 (13.85 *)	0.69 (15.77 *)	1.00	
FTSE All World Ex U.S. Index	0.55 (13.37 *)	0.60 (13.10 *)	0.82 (25.84 *)	1.00
February 2000 to July 2007				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	0.99 (72.76 *)	1.00		
Russell 3000 Index	0.33 (3.25 *)	0.37 (3.78 *)	1.00	
FTSE All World Ex U.S. Index	0.31 (3.11 *)	0.35 (3.53 *)	0.86 (15.73 *)	1.00
August 2007 to July 2023				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	0.93 (33.58 *)	1.00		
Russell 3000 Index	0.74 (14.95 *)	0.78 (17.19 *)	1.00	
FTSE All World Ex U.S. Index	0.61 (13.74 *)	0.65 (12.92 *)	0.84 (21.26 *)	1.00
August 2007 to August 2009				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	1.00 (62.44 *)	1.00		
Russell 3000 Index	0.87 (8.74 *)	0.86 (8.39 *)	1.00	
FTSE All World Ex U.S. Index	0.77 (6.02 *)	0.76 (5.82 *)	0.93 (12.52 *)	1.00
February 2020 to January 2021 (COVID-19-Induced Lockdowns and Before the Start of Vaccinations)				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	0.99 (22.59 *)	1.00		
Russell 3000 Index	0.92 (7.55 *)	0.94 (8.51 *)	1.00	
FTSE All World Ex U.S. Index	0.95 (11.48 *)	0.95 (10.03 *)	0.96 (11.09 *)	1.00
February 2021 to July 2023 (Post-Vaccination Period)				
Real Estate Exchange-Traded Funds	1.00			
Dow Jones U.S. Real Estate Index	0.46 (2.79 *)	1.00		
Russell 3000 Index	0.47 (2.85 *)	0.88 (9.89 *)	1.00	
FTSE All World Ex U.S. Index	0.03 (2.87 *)	0.44 (2.94 *)	0.52 (3.54 *)	1.00

* Statistically significant at 1% significance level.

The Cumulative Wealth Index (CWI) serves as a measure to evaluate the growth of an initial investment over time while considering dividend reinvestment. We established CWI values for each investment category by calculating the return on a hypothetical USD 1000 investment made at the beginning of February 2000. Furthermore, CWI values were computed for the benchmark indices mentioned in Figure 1, enabling an assessment of cumulative returns based on an initial investment. If an individual had invested USD 1000 in real estate ETFs at the onset of February 2000, their investment would have grown significantly, reaching USD 9127 by July 2023. In contrast, a similar USD 1000 investment in the Dow Jones U.S. Real Estate Index during the same period would have yielded a total wealth of USD 7839.

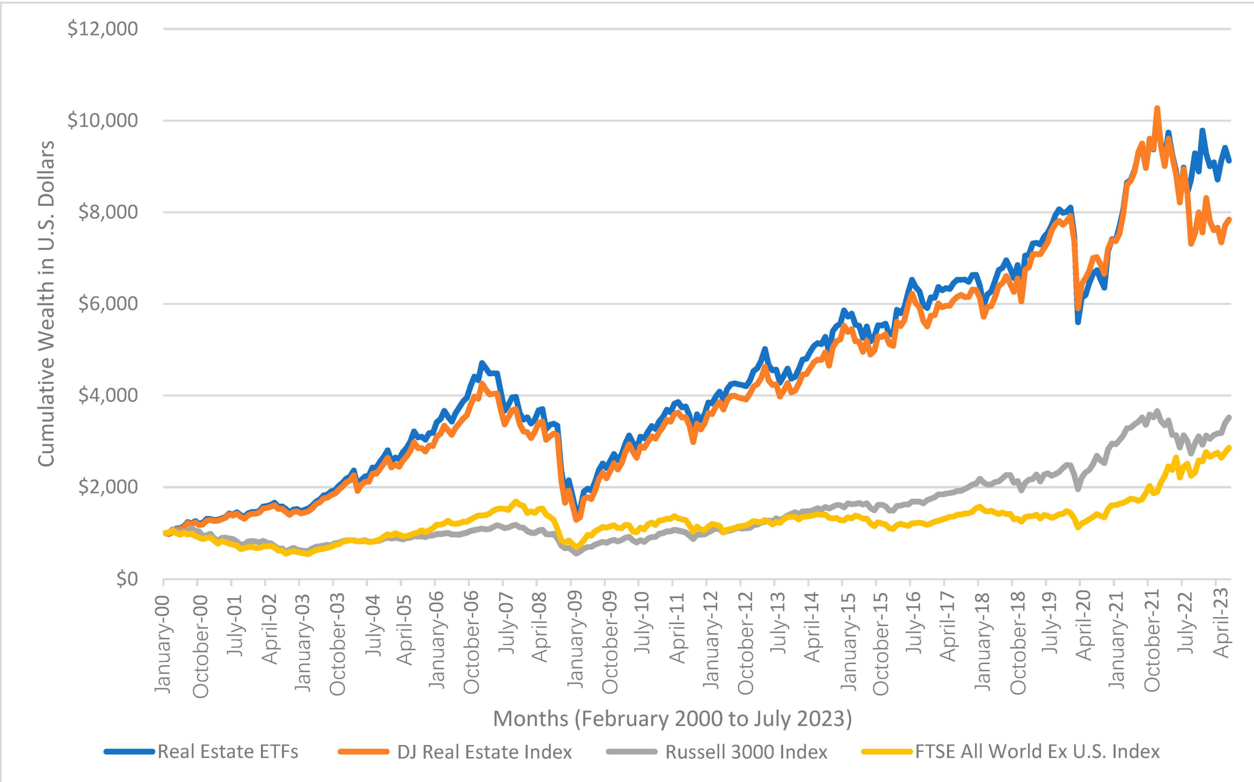

Figure 1. Cumulative wealth effect based on monthly returns of real estate exchange-traded funds, the Dow Jones U.S. Real Estate Index, the Russell 3000 Index, and the FTSE All World Ex U.S. Index. The analysis is based on monthly returns from February 2000 to July 2023.

Comparing these figures with alternative investment choices underscores the substantial differences in growth. For instance, allocating USD 1000 to the Russell 3000 Index in February 2000 would have led to a more modest accumulation of USD 3523 by July 2023. Similarly, an investment of USD 1000 in the FTSE All World Ex U.S. Index over the same timeframe would have grown to just USD 1473.

In absolute terms, real estate ETFs clearly outperformed all other indices in generating cumulative wealth from February 2000 to July 2023. These data highlight the compelling value proposition of real estate exchange-traded funds for investors seeking strong returns over the long term.

5.2. Empirical Analysis of Sharpe Ratio, Sortino Ratio, and Omega Ratio

Table 3 summarizes the results for the Sharpe ratio, Sortino ratio, and Omega ratio based on monthly returns from February 2000 to July 2023.

Table 3. Summary of the risk-adjusted performance of real estate ETFs using the Sharpe ratio, Sortino ratio, and Omega ratio. Risk-adjusted performance is based on monthly returns from February 2000 to July 2023.

	Sharpe Ratio	Sortino Ratio	Omega Ratio
February 2000 to July 2023			
Real Estate Exchange-Traded Funds	0.15	0.20	1.56
Dow Jones U.S. Real Estate Index	0.13	0.19	1.56
Russell 3000 Index	0.09	0.13	1.29
FTSE All World Ex U.S. Index	0.07	0.10	1.23
February 2000 to July 2007			
Real Estate Exchange-Traded Funds	0.30	0.46	2.14
Dow Jones U.S. Real Estate Index	0.28	0.42	2.06
Russell 3000 Index	−0.02	−0.02	0.96
FTSE All World Ex U.S. Index	0.07	0.10	1.17
August 2007 to July 2023			
Real Estate Exchange-Traded Funds	0.10	0.13	1.38
Dow Jones U.S. Real Estate Index	0.09	0.13	1.40
Russell 3000 Index	0.14	0.20	1.46
FTSE All World Ex U.S. Index	0.07	0.10	1.26
August 2007 to August 2009 (During Economic Crisis)			
Real Estate Exchange-Traded Funds	−0.10	−0.12	0.78
Dow Jones U.S. Real Estate Index	−0.08	−0.10	0.81
Russell 3000 Index	−0.19	−0.22	0.65
FTSE All World Ex U.S. Index	−0.13	−0.17	0.79
COVID-19-Induced Lockdowns to First Vaccinations (February 2020 to January 2021)			
Real Estate Exchange-Traded Funds	−0.03	−0.03	1.00
Dow Jones U.S. Real Estate Index	−0.03	−0.03	0.94
Russell 3000 Index	0.24	0.32	1.80
FTSE All World Ex U.S. Index	0.14	0.18	1.57
February 2021 to July 2023 (Post-COVID-19 Vaccination Rollout Period)			
Real Estate Exchange-Traded Funds	0.13	0.26	1.78
Dow Jones U.S. Real Estate Index	0.04	0.09	1.80
Russell 3000 Index	0.12	0.21	1.43
FTSE All World Ex U.S. Index	−0.11	−0.13	0.93

During the period spanning from February 2000 to July 2023, the Russell 3000 Index, representing U.S. equities, boasted a Sharpe ratio of 0.09, while the FTSE All World Ex U.S. Index, which encapsulates global equities while excluding the U.S. market, displayed a lower Sharpe ratio of 0.07. In contrast, real estate ETFs, which were assessed based on their average monthly returns, exhibited a Sharpe ratio of 0.15 over the same duration. This indicates a higher level of risk-adjusted performance compared to U.S. and global equities. During this period, the DJ U.S. Real Estate Index recorded a Sharpe ratio of 0.13.

When we assessed the Sortino ratios, which focused on downside risk, for the same timeframe (February 2000 to July 2023), the Russell 3000 Index boasted a ratio of 0.13, while the FTSE All World Ex U.S. Index had a ratio of 0.10. In contrast, real estate ETFs presented a Sortino ratio of 0.20, significantly higher than U.S. and global equities. Meanwhile, the Sortino ratio for the DJ U.S. Real Estate Index stood at 0.19.

Furthermore, when evaluating the Omega ratio, which measures the ratio of positive returns to negative returns, for the period of February 2000 to July 2023, real estate ETFs garnered an Omega ratio of 1.56. In comparison, the Russell 3000 Index held an Omega ratio of 1.29, while the FTSE All World Ex U.S. Index posted a ratio of 1.23. Real estate ETFs did not surpass U.S. equities in terms of the Omega ratio, and they exhibited a slightly better performance than global equities.

Shifting our attention to the DJ U.S. Real Estate Index, its Omega ratio for the same period was 1.56. Thus, analyzing monthly returns during this period revealed that the real estate ETFs demonstrated superior risk-adjusted performance, outpacing all other benchmark indices.

When we analyzed the monthly returns for the sub-period of February 2000 to July 2007, real estate ETFs outperformed all benchmark indices with a Sharpe ratio, Sortino ratio, and Omega ratio of 0.30, 0.46, and 2.14, respectively. The Russell 3000 Index delivered a Sharpe ratio, Sortino ratio, and Omega ratio of −0.02, −0.02, and 0.96, respectively, over the same period. Similarly, the FTSE All World Ex U.S. Index generated a Sharpe ratio, Sortino ratio, and Omega ratio of 0.07, 0.10, and 1.17, respectively, over the same period. Similar trends continued when we analyzed the monthly returns from August 2007 to July 2023.

For the turbulent period of August 2007 to August 2009, which was characterized by a severe economic crisis, we conducted an evaluation of various investment options using three pivotal metrics: the Sharpe ratio, Sortino ratio, and Omega ratio. These metrics offered valuable insights into how effectively these investments managed risk and yielded returns.

The presence of negative Sharpe ratios across all these investments underscored their inability to deliver favorable risk-adjusted returns during the crisis. Ideally, investors seek positive Sharpe ratios, which signify superior returns relative to the assumed level of risk.

Furthermore, the negative Sortino ratios highlight that these investments not only failed to provide satisfactory returns but also exposed investors to significant downside risk. In challenging market conditions, a higher Sortino ratio is the preferred outcome, as it signifies a better trade-off between returns and downside risk.

The Omega ratios provided insights into the performance of these investments during the economic crisis from August 2007 to August 2009. An Omega ratio below 1 signifies poor performance, indicating that the gains did not outweigh the losses.

Amid the outbreak of COVID-19 and the subsequent lockdowns, global stock markets experienced increased volatility and witnessed a decline. Our analysis, which covers the period of January 2020 (when the World Health Organization and the United States declared a public health emergency) to January 2021 (when vaccinations commenced) evaluated the risk-adjusted performance of real estate ETFs (DETFs). The results, which are presented in Table 4, are as follows.

The DJ U.S. Real Estate Index demonstrated a concerning level of risk-adjusted performance, with a negative Sharpe ratio of −0.08, a negative Sortino ratio of −0.10, and an Omega ratio of 0.94. In stark contrast, real estate ETFs, as indicated by the Sharpe ratio, posted a somewhat improved ratio of −0.03 during the period of January 2020 to January 2021. The Sortino ratio for the same duration remained at −0.03, while the Omega ratio reached 1.0. When we compared these results with those of other indices, the Russell 3000 Index exhibited a considerably more favorable risk-adjusted performance, with a Sharpe ratio, Sortino ratio, and Omega ratio of 0.24, 0.32, and 1.80, respectively. Similarly, the FTSE All World Ex U.S. Index displayed better risk-adjusted performance, featuring a Sharpe ratio, Sortino ratio, and Omega ratio of 0.14, 0.18, and 1.57, respectively. These metrics clearly highlight that during the COVID-19 induced lockdowns until the advent of vaccinations, real estate ETFs significantly underperformed both U.S. equities and global equities from a risk-adjusted perspective.

A subsequent analysis of monthly returns during the post-COVID-19 rollout period, which spanned from February 2021 to July 2023, revealed a continued trend of real estate

ETFs lagging in terms of risk-adjusted performance relative to U.S. and global equities. During this period, real estate ETFs demonstrated a Sharpe ratio of 0.13, a Sortino ratio of 0.26, and an Omega ratio of 1.78. In contrast, the Russell 3000 Index exhibited a marginally lower Sharpe ratio, a somewhat higher Sortino ratio, and an Omega ratio of 1.43. Meanwhile, the FTSE All World Ex U.S. Index displayed a notably higher Sharpe ratio, albeit with a negative Sortino ratio and a lower Omega ratio of 0.86. Simultaneously, the S&P Cryptocurrency Broad Digital Assets Index revealed a concerning negative Sharpe ratio, a negative Sortino ratio, and an Omega ratio of 0.94.

Table 4. Summary of the results for net monthly alphas of real estate ETFs based on the Carhart four-factor model used in this study. Risk-adjusted performance was measured based on monthly returns from February 2000 to July 2023.

	February 2000 to July 2023	February 2000 to July 2007	August 2007 to July 2023	August 2007 to August 2009	January 2020 to January 2021	February 2021 to July 2023
Adjusted R^2	0.46	0.24	0.54	0.85	0.85	0.21
alpha	0.29	0.51	−0.05	−0.29	−0.39	0.52
Mkt-RF	0.72 ***	0.45 ***	0.85 ***	1.04 ***	0.89 ***	0.61 ***
SMB	0.20 **	0.33 ***	0.12	0.79 *	−0.02	−0.13
HML	0.42 ***	0.58 ***	0.24 ***	0.69 **	0.62	−0.05
MOM	−0.02	−0.05	−0.10	−0.15	−0.03	0.40 *

*** Statistically significant at 1% significance level; ** statistically significant at 5% significance level; * statistically significant at 10% significance level.

These findings suggest that even in the post-COVID-19 period, real estate ETFs continued to struggle in terms of risk-adjusted performance compared to U.S. and global equities. While their performance improved relative to the earlier COVID-19 lockdown period, they still trailed behind other asset classes, indicating ongoing challenges in generating favorable risk-adjusted returns.

5.3. Empirical Analysis of Carhart Four-Factor Model

Carhart's four-factor model results are summarized in Table 4, which shows that the alpha for ETFs was positive at 0.29 but was not statistically significant.

The findings presented in Table 4 reveal that 46% of the variation in fund returns can be accounted for by four-factor models. Real estate ETFs exhibited both statistically and economically significant exposure to the overall stock market, which is evident through their positive coefficients on excess market returns. Typically, these funds have a stock market beta ranging from 0.45 to 1.04, indicating a substantial exposure to the stock market. Consequently, these funds are not insulated from the fluctuations in the stock market. While their diversification can aid in risk reduction, it also implies that they cannot entirely escape the volatility in the stock market. Moreover, during the post-vaccine rollout period, the coefficient on momentum was negative and statistically significant, suggesting a notable shift in their performance dynamics.

The coefficient on SMB was positive, and this suggests that small-cap stocks started to outperform large-cap stocks on average. The positive coefficient suggests that all else being equal, investing in smaller-cap stocks would have resulted in higher returns compared to larger-cap stocks during this period. These findings can also be used to inform investment strategies. For example, during a period of positive SMB coefficients, investors might consider allocating more of their portfolio to small-cap stocks in anticipation of potential outperformance, whereas during a period of negative coefficients, they might favor larger-cap stocks for relative stability. During COVID-19-induced lockdowns as well as the post-COVID-19 vaccine rollout period, the SMB coefficient was negative, which means small-cap stocks generated lower returns relative to large-cap stocks.

The HML coefficient was positive and statistically significant. A positive and statistically significant HML coefficient implies that high book-to-market (value) stocks were outperforming low book-to-market (growth) stocks on average. Investors may have been favoring value stocks during this time, possibly due to economic conditions or other factors that made value investing more attractive.

The positive coefficient suggests that all else being equal, investing in high book-to-market stocks would have resulted in higher returns compared to low book-to-market stocks during this period. The coefficient on momentum was negative under every market condition but was statistically significant only in the post-vaccine roll out period.

Table 5, which we have provided below, offers a comparative analysis of the alphas generated by real estate ETFs, the DJ U.S. Real Estate Index, the Russell 3000 Index, and the FTSE All World Ex U.S. Index.

Table 5. Net monthly alphas of real estate exchange-traded funds, the Russell 3000 Index, the FTSE All World Ex U.S. Index, and the Dow Jones U.S. Real Estate Index based on monthly returns from February 2000 to July 2023.

	Net Alphas			
	Real Estate ETFs	**Dow Jones U.S. Real Estate Index**	**Russell 3000 Index**	**FTSE All World Ex U.S. Index**
February 2000 to July 2023	0.29	0.26	−0.17 ***	−0.20
February 2000 to July 2007	0.51	0.40	−0.12 ***	0.08
August 2007 to July 2023	−0.05	−0.07	−0.20 **	−0.32
August 2007 to August 2009 (During Economic Crisis)	−0.29	−0.22	−0.21 ***	0.26
COVID-19-Induced Lockdowns to First Vaccinations (February 2020 to January 2021)	−0.39	−2.05 *	−0.17 *	−0.78
February 2021 to July 2023 (Post COVID-19 Vaccination Rollout Period)	0.52	0.04	−0.30	0.73

*** Statistically significant at 1% significance level; ** Statistically significant at 5% significance level * statistically significant at 10% significance level.

During the period of February 2000 to July 2023, both real estate ETFs and the DJ U.S. Real Estate Index exhibited positive alphas. However, it is noteworthy that these alphas did not achieve statistical significance. This implies that while these financial instruments performed relatively well, their outperformance could be attributed to factors other than those captured by the Carhart four-factor model.

Subsequently, alphas for both real estate ETFs and the DJ U.S. Real Estate Index turned negative during various sub-periods, including August 2007 to August 2023, August 2007 to August 2009, and January 2020 to January 2021. Notably, only the DJ U.S. Real Estate Index displayed a statistically significant negative alpha during the period of January 2020 to January 2021. This suggests that during certain market conditions, these real estate investments may have underperformed in a manner that exceeded what could be explained by the model's factors.

When we considered the post-COVID-19 vaccine rollout period, both real estate ETFs and the DJ U.S. Real Estate Index showed positive alphas during this period. However, once again, these alphas lacked statistical significance. This implies that while there might have been some recovery in performance during this specific time frame, it may not have been robust or consistent enough to be considered statistically significant.

In contrast, the alphas for U.S. equities represented by the Russell 3000 Index displayed a consistently negative trend throughout the entire observation period (February 2000 to July 2023) and during all the sub-periods examined. Importantly, these negative alphas were statistically significant, indicating that U.S. equities underperformed relative to the factors in the Carhart model.

Lastly, the alpha for global equities fluctuated between positive and negative values throughout the sample period. However, like the real estate investments, these alphas did not reach statistical significance. This implies that global equities exhibited mixed performance that could not be confidently attributed to the factors in the Carhart four-factor model.

Table 6 provides valuable insights into the performance of real estate exchange-traded funds (ETFs) concerning publicly available information. Notably, it reveals that these ETFs yielded a positive alpha of 0.20. However, it is worth mentioning that this alpha did not attain statistical significance.

Table 6. Summary of the results for net monthly alphas based on the conditional Carhart four-factor model used in this study. Risk-adjusted performance is measured based on monthly returns from February 2000 to July 2023.

	Four-Factor	**Adjusted R-Square**
February 2000 to July 2023	0.20	0.51
February 2000 to July 2007	0.23	0.26
August 2007 to July 2023	0.05	0.61
August 2007 to August 2009 (During Economic Crisis)	0.85	0.86
COVID-19-Induced Lockdowns to First Vaccination (February 2020 to January 2021)	1.21	0.87
February 2021 to July 2023 (Post COVID-19 Vaccination Rollout Period)	0.71	0.45

Delving further into the assessment of real estate ETF performance under different market conditions, a conditional Carhart four-factor model was employed. The results indicated positive alphas across various scenarios, but none of these alphas could be deemed statistically significant.

During the tumultuous period of the COVID-19 pandemic (encompassing lockdowns and the time preceding the commencement of vaccination efforts), the ETFs demonstrated an alpha of 1.21. Yet, it is crucial to emphasize that this alpha, while positive, lacked statistical significance.

As the vaccination campaigns commenced, the alpha continued to remain positive, reaching a value of 0.71. However, akin to the previous findings, none of these alphas reached the threshold of statistical significance. This absence of statistical significance implies that there was no compelling evidence to support the existence of abnormal returns during these specific timeframes. Essentially, the performance of real estate ETFs during these periods appears to align with what would be expected based on the factors encompassed by the Carhart model rather than suggesting any significant deviations from the norm.

Part A of Table 7 summarizes the results of Treynor and Mazuy's market timing and selectivity model, while part B summarizes the results of Henriksson and Merton's market timing and selectivity model.

Table 7 shows that, based on monthly returns from February 2000 to July 2023, the alpha for real estate ETFs was positive and statistically significant, which implies superior security selection skill on the part of fund managers. Table 7 also shows that β_2 was negative and statistically significant, which indicates poor market timing on the part of fund managers. We also examined market timing and security skill by dividing the data into two sub-periods—February 2000 to July 2007 and August 2007 to July 2023. We found superior security selection skills during the period of February 2000 to July 2007 on the part of fund managers in a statistically significant manner. We also found poor market timing on the part of fund managers for the period of August 2007 to July 2023 in a statistically significant manner. Similar results were obtained through the Henriksson and Merton model regarding the market timing and security selection skill of ETF portfolio managers.

Table 7. A summary of results from the Treynor and Mazuy (1966) and Henriksson and Merton (1981) models. For the Treynor and Mazuy (1966) models, α_s measures selectivity, whereas β_2 measures market timing. Similarly, for the Henriksson and Merton (1981) models, α_s measures selectivity, whereas γ measures market timing. T-stats are in parentheses. The results are based on the monthly returns from February 2000 to July 2023. We also evaluated market timing and selectivity by dividing the sample into pre-economic-crisis and post-economic-crisis periods.

Treynor and Mazuy (1966) Model		
	α_s	β_2
February 2000 to July 2023	0.79 (2.49 ***)	−0.02 (−2.29 **)
February 2000 to July 2007	1.35 (2.46 **)	−0.004 (−0.23)
August 2007 to July 2023	0.36 (0.98)	−0.02 (−−2.59 ***)
Henriksson and Merton (1981) **Model**		
	α_s	γ
February 2000 to July 2023	0.92 (2.16 **)	−0.29 (−1.59)
February 2000 to July 2007	1.44 (1.96 **)	−0.10 (−0.28)
August 2007 to July 2023	0.59 (1.19)	−0.40 (−1.95 **)

*** Significant at 1%; ** significant at 5%.

Table 8 summarizes the results of the conditional market timing and security selection skills of portfolio managers.

Table 8. A summary of results from Treynor and Mazuy (1966) and Henriksson and Merton (1981). For the Treynor and Mazuy (1966) models, α_s measures selectivity, whereas β_2 measures market timing. Similarly, for the Henriksson and Merton (1981) models, α_s measures selectivity, whereas γ measures market timing. The results are based on the monthly returns from February 2000 to July 2023. T-stats are in parentheses.

Treynor and Mazuy (1966) Model		
	α_s	β_2
February 2000 to July 2023	0.76 ***	−0.03 ***
February 2000 to July 2007	1.22 **	−0.02
August 2007 to July 2023	0.50	−0.03 ***
Henriksson and Merton (1981) **Model**		
	α_s	γ
February 2000 to July 2023	1.08 ***	−0.49 ***
February 2000 to July 2007	1.54 **	−0.43
August 2007 to July 2023	0.79 *	−0.47 **

*** Significant at 1%; ** significant at 5%; * significant at 10%.

The conditional model's results were very much consistent with the results of unconditional models. Table 8 shows that, based on monthly returns from February 2000 to July 2023, ETF portfolio managers displayed superior security and poor market timing skills in a statistically significant manner.

6. Summary and Conclusions

Real estate exchange-traded funds (REETFs) offer an alternative investment avenue for individuals seeking exposure to the real estate market without direct property ownership. By acquiring shares in REETFs, investors can engage in real estate market participation while bypassing the intricacies associated with property ownership. Additionally, investors in REETFs may benefit from proficient portfolio management and research conducted by fund managers, who levy a fee for their services, thereby reducing individual investor returns. This research conducted a comparative assessment of real estate exchange-traded funds (REETFs) and several benchmark indices from February 2000 to July 2023. The assessment spanned a duration of 23 years and was based on monthly returns.

To assess the risk-adjusted performance of REETFs comprehensively, the sample was stratified to account for pre- and post-economic-crisis periods. In terms of risk-adjusted returns, REETFs demonstrated a performance superior to both U.S. and global equities on average across the entire sample period, yet they did not outperform the Dow Jones U.S. Real Estate Index. These findings align with prior research on real estate mutual funds based on risk-adjusted ratio analysis.

Real estate ETFs displayed positive alphas in their performance, indicating they outperformed benchmark indices in terms of absolute returns. Real estate ETFs have generated returns that are better than what would be expected given their level of risk, but this outperformance cannot be confidently attributed to the skill or strategy of the fund managers.

During the COVID-19 pandemic, real estate ETFs underperformed U.S. and global equities in terms of both absolute returns and risk-adjusted performance, indicating the challenges faced by these funds during economic crises. Real estate ETFs showed better risk-adjusted performance compared to U.S. and global equities over the long term. However, during specific periods, such as the pandemic-induced lockdowns, their risk-adjusted performance lagged.

The use of the Carhart four-factor model revealed that real estate ETFs exhibited both statistically and economically significant exposure to the overall stock market, indicating a strong correlation with stock market movements.

The study also assessed market timing and security selection skills of ETF portfolio managers using conditional models. It found that portfolio managers displayed superior security selection skills but poor market timing skills, and these results were statistically significant.

Real estate ETFs have shown resilience and attractiveness as an investment avenue over the long term, consistently outperforming other indices in generating cumulative wealth. However, their risk-adjusted performance, while superior in some instances, has exhibited fluctuations during economic downturns and recovery phases. Portfolio managers displayed skill in security selection but struggled with market timing, especially during turbulent market conditions. The correlations between real estate ETFs and equities fluctuated, reflecting the evolving dynamics within the investment landscape.

The study found that real estate ETF performance is intricately influenced by various market conditions and factors. These ETFs have demonstrated periods of strong performance, notably in terms of absolute returns. Furthermore, they displayed a pronounced correlation with the stock market, suggesting their susceptibility to market shifts. The COVID-19 pandemic presented unique challenges for real estate ETFs, resulting in a period of struggle. Nevertheless, their performance rebounded following the vaccine rollout.

These findings underscore the importance of considering various market conditions and understanding the nuances in correlation dynamics when evaluating real estate ETFs as part of a diversified investment portfolio.

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