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The Other Side of Value: The Effect of Quality on Price and Return in Real Estate

Sara Kelly Anzinger[1] · **Chinmoy Ghosh**[2] · **Milena Petrova**[3]

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Abstract We examine the effect of quality on price and return in real estate. Quality real estate stocks generally trade at higher prices. However, similar to findings in the aggregate stock market (Asness et al. 2013), quality in listed real estate is not fully reflected in price. A long quality, short junk portfolio (QMJ) is found to produce average risk-adjusted returns of 3.6 % per quarter (14.4 % annually). QMJ has a significantly positive coefficient when added as a dependent variable to a 4-factor model explaining U.S. real estate excess returns, including market, size, value and momentum factors, and leads to a small improvement in the overall fit of the model. Further investigation of the components of quality shows that profitability has a consistently positive relationship with real estate excess returns, while higher dividend payout is consistently associated with lower returns, in contrast to findings for conventional firms.

Keywords Quality attributes · Firm performance · Real estate prices · Real estate returns

Profitability, investment and quality have received increased recent attention in the finance literature as potential factors explaining the cross section of average returns.

✉ Milena Petrova
mpetrova@syr.edu

Sara Kelly Anzinger
s.k@saraanzinger.com

Chinmoy Ghosh
Chinmoy.Ghosh@business.uconn.edu

1 S.K.Anzinger Consulting, Amsterdam 1094JL Noord-Holland, Netherlands

2 Department of Finance, School of Business, University of Connecticut, Storrs, CT 06269, USA

3 Department of Finance, Whitman School of Management, Syracuse University, Syracuse, NY 13244, USA

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Although the significance of profitability in explaining returns was documented in the literature more than 40 years ago (Ball and Brown 1968), subsequent studies have challenged these findings and shown that net income has little explanatory power when added as a factor in the Fama-French model (Fama and French 1993). Novy-Marx (2013) was the first to show that a different measure of profitability, namely gross profitability scaled by total assets has similar power as the book-to-market ratio in predicting the cross section of average returns. Ball et al. (2015) reconciled this recent evidence with Ball and Brown's (1968) findings and showed that an alternative measure of profitability, operating profitability, exhibits the strongest link with expected returns compared to net income and gross profit. Simultaneously, three other recent studies, Asness et al. (2013); Hou et al. (2015), and Fama and French (2015) document convincing evidence that profitability and investment (which are combined in a single quality factor in Asness et al.) are priced factors in explaining returns.

In light of the recent focus on quality (or its components) as a factor in asset-pricing models, this paper examines whether quality premium exists in the cross section of real estate equity returns. Multi-factor models rely on the proposition that there is sufficient number of securities to diversify away idiosyncratic risk. We assume that when real estate stocks are held in a well-diversified portfolio the idiosyncratic risk is diversified away. Therefore, the priced factors are the same as for conventional stock returns. However, given the regulatory requirements that REITs face and the distinct characteristics of real estate assets – tangibility, illiquidity, capital intensiveness, and long holding periods, we argue that the quality attributes – profitability, growth, safety, and payout – may be even more important in real estate than for conventional firms. Whether quality is fully reflected in real estate prices is an empirical question. To test this proposition, we examine: (1) whether higher quality real estate stocks trade at higher prices; (2) the price of each component of quality – profitability, growth, safety, and payout; (3) whether higher quality real estate stocks are associated with higher returns; (4) the performance of a portfolio of long high quality, short low quality real estate assets; and (5) whether inclusion of a quality factor yields a superior pricing model for real estate assets.

Our analyses are based on all real estate stocks listed in the U.S. from January 1999 to December 2013, totaling 341 companies covered by the SNL Financial database for which data is available, and 9968 quarterly firm observations.[1] We find that quality is a significant determinant of real estate prices and it is positively related to observed, real estate scaled prices (Price/Book ratios). When we break up the sample in 5-year increments, we find that quality induces a significant increase in scaled prices only during 1999–2003. During the period of 2009–2013 this relationship is insignificant, albeit positive, while during the period 2004–2008, which encompasses both the U.S. real estate bubble and the subsequent financial crisis, quality is generally not significantly associated with prices, except for during 2008 when we observe an opposite relation – lower quality stocks are associated with higher Price/Book ratios. The latter result could be due to the larger decreases in book value for low quality stocks during the financial crisis. Furthermore, we find that the positive relation between quality and prices during 1999–2003 is more pronounced for small- as opposed to large-market capitalization stocks. Overall, the results are consistent with the notion that greater

[1] The analysis is conducted on a quarterly basis, as quality data is only available quarterly.

quality induces higher prices in the cross section of U.S. real estate stocks for the sample period 1999–2013. However, the results also suggest that this relationship changes with market conditions.

Our next contention is that if quality is fully reflected in real estate prices, future returns of real estate assets will not be related to quality factors. To test this proposition, we calculate the time series of mean excess returns (over U.S. Treasury bill yield) of ten portfolios of real estate stocks categorized by quality scores.[2] We then estimate for each decile panel random-effects regressions of excess returns against market risk, size, value, and momentum factors. We focus on the difference in the spread between the returns of the highest quality portfolio (in decile 10) and the lowest quality portfolio (in decile 1). The analyses reveal that over the sample period 1999–2013, high quality real estate stocks outperformed low quality real estate stocks by 3.6 % quarterly, on average. Breaking up the sample in 5-year increments, we find that the results are largely driven by the period 1999–2003 when low quality stocks underperformed high quality stocks, on risk-adjusted basis, by 6.3 % per quarter. The spreads (high quality minus low quality portfolio returns) are also large and positive during 2007–2008. During the rest of the periods, the spreads remain positive, but small 0.8–1.8 % quarterly. Overall, these results are contrary to the notion that quality is fully reflected in the prices of assets. Indeed, our analyses provide compelling evidence that quality was not efficiently priced in the real estate sector and that the severity of the mispricing varied over time.

For a different perspective on the value of quality in real estate returns, we examine the magnitude of risk-adjusted returns attributed to higher quality versus lower quality real estate firms. We construct a long high quality, short low quality (junk) portfolio (QMJ) of real estate stocks. Similarly, we also construct portfolios for each of the four components of quality. Over the sample period 1999–2013, the QMJ portfolio earns significantly positive average quarterly excess returns and has positive average size factor loadings and negative market, value, and momentum factor loadings. This evidence contrasts with the negative loadings for size (SMB) and positive, although insignificant, loadings for momentum (UMD) reported for U.S. stocks (Asness et al. 2013). The positive size factor loading of QMJ and its components implies that quality real estate stocks are small stocks. The long/short portfolios of other quality attributes, with the exception of HpMLp, earn positive average risk-adjusted returns. When we examine the 4-factor alphas in QMJ portfolios by periods, we find the highest average quarterly excess returns to QMJ to be in the first five years of the sample period (1999–2003), which corroborates our earlier findings with returns to portfolios ranked by quality. During the bubble period, returns on QMJ on a risk-adjusted basis are negative. Upon further investigation, we note that the negative returns on QMJ during 2004–2006 are caused by underperforming safe and high payout stocks. It is also notable that the risk-adjusted returns on PMU (high minus low profitability portfolio) are consistently positive and significant during all sub-periods.

We next examine if the inclusion of the QMJ factor improves the power of the traditional 4-factor model. The Fama-French and momentum factors remain significant

[2] Quality scores are based on Asness et al. (2013) and described in detail in the Data & Variables section. Portfolios are formed with a one quarter lag to account for the delays in reporting and data availability as of the end of the quarter.

with comparable coefficients, as in the baseline 4-factor model, while the QMJ factor is significantly positive, which confirms that real estate returns are influenced by quality when controlling for the traditional Fama-French and momentum factors. R-squared increases by only about 0.1 % (0.8 % when annual regressions are used). These results indicate that inclusion of the quality factor (QMJ) only marginally improves the fit of the asset-pricing model for real estate.

Overall, our analyses provide compelling evidence that quality characteristics are persistent in real estate assets. The long investment horizon, and capital intensiveness of real estate which necessitate sustained high performance is consistent with persistence of quality attributes. Moreover, we find that quality and its components are significant factors in pricing and expected returns of real estate assets. However, payout ratio does not affect valuation of real estate stocks, which is attributable to the fact that REITs must pay out 90 % of net income by regulation. Finally, we find that quality is a significant factor explaining returns when controlling for traditional factors – market risk, size, value, and momentum, although contributing only marginally in improving the explanatory power of the model. We attribute the differences in findings between the real estate sector and the aggregate U.S. stock market to the uniqueness of real estate assets and regulatory requirements.

The rest of the paper proceeds as follows. Section II presents a review of the literature. The main hypotheses are developed in Section III, and the data and variables are described in Section IV. We present the results from the empirical analysis in Section V. Section VI offers discussion of the results and Section VII concludes.

Literature Review

The Capital Asset Pricing Model (CAPM) (Sharpe 1964; Lintner 1965; Black 1972) marks the point of departure for numerous studies documenting multiple asset-pricing anomalies and attempting to find additional priced factors. Specifically, the size effect (Banz 1981) indicates an inverse relationship between stock returns and market capitalization. The value effect represents a positive relationship between stock returns and the ratio of cash flow, earnings or book value to market value (Basu 1977; Reinganum 1981; DeBondt and Thaler 1985; Fama and French 1992; Lakonishok et al. 1992). Also relevant in this context is the literature pertaining to quality measures that predict future returns and firm fundamentals from the perspective of a discounted cash-flow model. Campbell and Shiller (1988) develop a dynamic version of the Gordon Growth Model using a dividend price ratio that predicts future stock returns moderately well. Cohen et al. (2009) report that prices are more relevant than returns in forecasting future returns, especially for long holding periods (such as with real estate), and that book-to-market values can be approximated well when prices rather than returns are used as a basis. Fama and French (2006) and Vuolteenaho (2002) extend this literature to show that prices of individual firms are driven more by cash-flow news than return news.

The Fama-French 3-factor and the Carhart 4-factor models are among the most widely used extensions of CAPM. Fama and French (1993) incorporate size and value as variables, which are empirically determined to help explain average returns to construct size (SMB) and value (HML) factors, and extend the single factor CAPM into what is commonly referred to as the Fama-French 3-factor model. A fourth factor, momentum, was later found to have additional explanatory power (Carhart 1997; Fama and French 2011). However, as recent research has revealed, these models fail to fully capture excess returns, and the search for additional sources of return anomalies continues.

An evolving theme from recent studies on asset returns is the superior performance of high profitability, conservative investment and high quality stocks. Asness et al. (2013) define quality as the special attributes of a stock for which an investor is willing to pay more, ceteris paribus. Examples of quality characteristics in extant literature include higher returns associated with stocks that advantageously time share repurchases (Baker and Wurgler 2002); higher returns generated by more profitable firms (Novy-Marx 2013); higher alpha for firms with lower leverage (George and Hwang 2010); better performance of firms with higher growth (Mohanram 2005); and lower returns associated with greater investment (Aharoni et al. 2013). Using a large sample of U.S. and international stocks, Asness et al. (2013) examine the effect of quality on stock prices, change in the price of quality over time, ability of the price of quality to predict future returns, and explanatory power of a unifying quality factor for excess returns. The authors find that high quality stocks have high risk-adjusted returns, a phenomenon they attribute to the observed modest impact of quality on price. In a similar vein, Hou et al. (2015) examine nearly 74 asset-pricing anomalies documented in the literature and conclude that an empirical q-factor model consisting of the market factor, a size factor, an investment factor and a profitability factor outperforms the Fama-French and Carhart models in capturing most of these anomalies. Finally, Fama and French (2015) also incorporate profitability and investment as additional factors in the Fama-French 3-factor model and show that the 5-factor model explains 69 to 93 % of the cross section of stock returns.

Mirroring the proliferation of research in mainstream finance to identify factors that contribute to persistent anomalies on common stock returns, a substantial body of literature has developed on the cross-sectional determinants of REIT returns, and interest in this line of research keeps growing. Chiang et al. (2006) apply the Fama-French 3-factor model to REITs, and find that better test specifications are provided and returns are more accurately captured when REIT-mimicking portfolios are used. The authors further show that when REIT-mimicking portfolios are used to create the Fama-French three factors, the resulting REIT betas converge to those indicated by the NCREIF Index which uses returns on direct real estate investment. This evidence is consistent with the presence of a link between REIT returns and those of an underlying real estate factor (Lee and Mei 1994; Ziering et al. 1997). Chui et al. (2003) and Derwall et al. (2009) find that momentum dominates REIT returns. Specifically, Chui et al. (2003) study excess returns of U.S.-listed REITs using the Fama-French 3-factor model, plus several additional factors, including turnover, volume, analyst coverage, and momentum, and find that turnover and momentum are significant determinants of REIT returns, while book-to-market ratio is not. Finally, divergence between REIT and non-REIT stock returns is evident in their differential relationships with the same set of variables including book-to-market ratio and institutional ownership, Fed interest-rate policy (Goebel et al. 2013), and systematic volatility. As DeLisle et al. (2013) show, the last factor is not priced in REIT returns. Notwithstanding the growing evidence, however, to the best of our knowledge, the significance of quality as an additional factor in explaining real estate returns remains unexplored with one exception. Glascock and Lu-Andrews (2014), motivated by Novy-Marx (2013), show that gross profit is positively related to the cross section of REIT returns.

Hypotheses

In general, real estate assets are associated with relatively long investment horizons. For instance, long-term leases frequently represent cash flows generated by investment-grade real estate, and it is common practice to match these long-term assets with long-term liabilities. As such, it is intuitive that during normal business cycles, real estate assets, on average, have more stable quality characteristics such as profitability, growth, and safety measures than the overall U.S. stock market.

H1: *Quality is a persistent characteristic in the performance of real estate assets.*

Under the premise that higher quality entails stability of profitability, growth, safety, and payout, it follows that higher quality implies lower risk, resulting in lower return and correspondingly higher price. In essence, since investors are expected to be willing to pay more for lower risk, higher quality real estate stocks are expected to command higher market prices, ceteris paribus. This leads us to our second hypothesis.

H2: *Higher quality of real estate stocks is reflected in higher prices.*

At the individual property level, investment-grade real estate represents the highest quality real estate stock. As previously noted, long-term holding periods and capital intensiveness of real estate assets require a high level of expertise and delivery of stable profitability, growth, and safety for sustained performance of real estate investment.[3] However, given that quality is already reflected in prices (H2), we expect that high quality real estate stocks are not associated with higher returns compared to low quality real estate stocks, which implies uniform risk-adjusted returns across all levels of quality.

H3: *Real estate risk-adjusted returns do not vary with quality.*

Extant research with non-real estate U.S. stocks reveals that high quality stocks have low correlation with the market risk factor, resulting in higher risk-adjusted returns than excess returns on a long high quality, short low quality portfolio (Asness et al. 2013). Hypothesis H3 implies that this anomaly will be corrected in our sample of U.S. real estate stocks. Note that rejecting H3 would imply that the observed differential returns may represent results of an anomaly, data mining, or quality being a priced factor. Furthermore, if H3 holds, the returns from a portfolio of long high quality, short low quality would not be associated with higher risk-adjusted returns. In contrast, higher

[3] Payout is excluded here as it is not directly related to successful property investment and management, but is rather a byproduct.

returns of the QMJ portfolio would suggest that returns to quality are either an anomaly, or due to an additional risk factor.

H4: *A long high quality, short low quality portfolio of real estate assets will not yield higher risk-adjusted returns.*

Finally, given a long high quality, short low quality real estate portfolio is not expected to produce a positive alpha, the addition of quality as a fourth factor in an asset-pricing model will have no additional explanatory power on the cross section of real estate returns. Accordingly, we state our fifth hypothesis:

H5: *Inclusion of a quality factor does not create a superior asset-pricing model for real estate stocks.*

Data & Variables

Our sample consists of all real estate stocks listed in the U.S. from January 1999 to December 2013, totaling 438 companies covered by the SNL Financial database. 387 of these stocks are Real Estate Investment Trusts (REITs) and 51 are Real Estate Operating Companies (REOCs). Monthly stock prices and returns, as well as accounting data are collected from the SNL Financial database. Accounting data is only available on a quarterly basis. Returns in SNL are presented in index form, so we calculate quarterly total returns $\ln(TIR_t/TIR_{t-1})$ where TIR_t represents the total return in quarter t in an index form.[4] Total quarterly returns include capital appreciation and reinvestment of dividends. We calculate excess returns as quarterly total returns, net of the quarterly yield on 1-month U.S. Treasury bills. We obtain the Fama-French factors – market risk (MKT), size (SMB), and value (HML), as well as the momentum factor (MOM) from Ken French's Data Library.[5] For consistency, we convert all returns in log form. The construction of the fifth factor in our model – high quality minus low quality (QMJ) – is described later in the paper. For each stock, we compute a quality score as described in the next section. Quality data is available for 346 of the 438 firms in the initial sample. We further drop 5 firms due to insufficient quarterly-return data. This yields a final sample of 341 firms and 9968 firm quarter observations. We also obtain lagged 12-month returns to control for momentum in the Price/Book models. When including lagged 12-month returns the sample is reduced to 9592 firm quarter observations.

Quality Metric

Quality measures are based on quarterly accounting values following Asness et al. (2013).[6] However, some modifications have been made to adapt the metrics to the uniqueness of

[4] There are several benefits of using log returns (log of the price relative). Assuming that prices are log-normally distributed, log returns are normally distributed. When returns are small (as in our case) $ln(1 + r) \approx r$.
[5] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
[6] For detailed description of the method, see Altman (1968), Ang et al. (2006), Daniel and Titman (2006); Penman et al. (2007); Campbell et al. (2008), Novy-Marx (2013); Frazzini and Pedersen (2014), and Asness et al. (2012).

real estate companies' accounting practice and to more accurately reflect their significance. Specifically, since real estate properties are the primary assets of the firms in our sample, for which depreciation expenses are significant, we exclude depreciation expense to avoid skewing profitability measures. Following extant research, we use funds from operations (FFO) as a more meaningful and appropriate profitability measure for real estate firms.

To measure profitability we use three different ratios: funds from operations (FFO) to total assets, FFO to book equity, and cash flow from operating activities to total assets (CFOA). The first two measures correspond to return on assets (ROA), and return on equity (ROE) for non-real estate firms. Book equity is defined as tangible common equity. Next, each stock is ranked each quarter by its ROA, creating a vector of ranks (r). The cross-sectional mean (μ) and the cross-sectional standard deviation (σ) of the vector of ranks (r) are then created. We then convert ROA for each stock to a standardized z-score following Asness et al. (2013) as follows: $z_{ROA} = (r_{ROA} - \mu_{ROA})/\sigma_{ROA}$. The same method is employed for the other two variables, ROE and CFOA. The total profitability score for each company in each quarter is calculated as the average of these three individual component z-scores: Profitability = $(z_{ROA} + z_{ROE} + z_{CFOA})/3$.

Growth is measured as the change in the profitability variable over the prior 3-year period. For example, change or growth in ROA is calculated as funds from operations in year t, minus funds from operations in year t-3, divided by total assets in year t-3 $((FFO_t - FFO_{t-3})/ TotAssts_{t-3})$. As with profitability, individual z-scores are averaged to compute an overall growth measure: Growth = $(z\Delta_{ROA} + z\Delta_{ROE} + z\Delta_{CFOA})/3$.

Safety is measured by leverage, volatility and bankruptcy risk. Leverage (LEV) is calculated as negative total debt divided by total assets (−TotDebt/TotAssts).[7] Volatility (VOL) is derived from the standard deviation of ROE (FFO/BkEq) over a 3-year period.[8] Bankruptcy risk (AZ) is assessed using a variant of the Altman Z-score (Altman 1968), as the weighted average of working capital (WC), retained earnings (RetEarns), earnings before interest, taxes, depreciation, and amortization (EBITDA), market value of equity (MktCap), and sales. Given that real estate companies report sales inconsistently, total revenue (TotRev) is used as a proxy for sales. Working Capital is generally calculated as current assets minus current liabilities. However, because these aggregate values are not available through the data provider, working capital is calculated as cash plus accounts receivables, plus trading-account securities, plus securities available for sale, plus current inventory, minus short-term debt (Cash + ARs + TAS + AFSS + CInv) – STD. Further, due to the inconsistent reporting of working capital among real estate companies, missing values are replaced with values in the previous quarter. The Altman (1968) Z-score is given by:

$$AZ = (1.2{*}WC + 1.4{*}RetEarns + 3.3{*}EBITDA + 0.6{*}MktCap + TotRev)/TotAssts$$

A safety z-score is computed by averaging the z-scores of leverage (LEV), volatility (VOL) and bankruptcy risk (AZ): Safety = $(z_{LEV} + z_{VOL} + z_{AZ})/3$.

[7] The negative sign signifies that leverage contributes negatively to the safety measure.

[8] The 1-year standard deviation of ROE was also calculated for comparison and indicated an aggregate mean of less than half that of the 3-year. However, once incorporated into the overall safety score and used in regressions, the resulting safety coefficients were not substantially different from those associated with the 3-yr. standard deviation.

Payout is measured as the average of the z-scores of payout of funds from operations (FFOP), dividend payout (DIVP) and dividend yield (DY): Payout = (z_{FFOP} + z_{DIVP} + z_{DY})/3.

Finally, the overall quality score for each company in each quarter is the sum of the z-scores of profitability, growth, safety and payout:

$$\text{Quality} = z(\text{Profitability} + \text{Growth} + \text{Safety} + \text{Payout})$$

Quality Portfolios

Each quarter, stocks are sorted by their quality scores as of the previous quarter (we use one quarter lag to account for lack of immediate availability of quarterly accounting data). Quality is then categorized into ten deciles – P1 is the decile with the lowest quality scores and P10 is the decile with the highest quality scores.

Analysis and Results

Persistence of Quality Characteristics of Real Estate Assets

We sort stocks into ten portfolios by their quality scores each quarter, and calculate the average quality score for each portfolio on a quarterly basis. The time series (moving) average of cross-sectional means of quality scores is reported at the time of portfolio creation (for the previous quarter scores) and every five years thereafter, spanning the fifteen years of the study period. Standard errors are adjusted for heteroscedasticity and clustered by firm. In the same manner, the persistence of each of the four components of quality (profitability, growth, safety, and payout) is calculated. Table 1 summarizes the persistence of quality by reporting cumulative average quality scores at time t (March 1999), t + 5 years, t + 10 years and t + 15 years. The spread between the highest and lowest quality portfolios is indicated by (P10 – P1) in the far right-hand column. Standard errors for the final period, t + 15 years, are shown in parentheses below the relevant quality scores. The results indicate that quality and its components are stable over time, especially over the 10-year period from t + 5 to t + 15. The mean quality scores for the full period, t + 15, are significantly different from zero.

Table 2 presents the contrasting persistence in quality between real estate stocks and the overall U.S. stock market as reported by Asness et al. (2013). The standard deviation of the spread between portfolios (from portfolio creation to ten years out (t + 10)) with the highest and lowest quality scores clearly highlights that the real estate sample has lower standard deviations for all quality attributes, and, therefore, stronger persistence, on average, than that of the aggregate U.S. stock market. This evidence is indicative of the homogeneity of the real estate sample relative to the heterogeneity of the sample used by Asness et al. (2013), and supports hypothesis 1 (H1) that quality is persistent in real estate and this persistence is stronger on average than that of the overall U.S. stock market. Payout, the least persistent quality characteristic in Asness et al. (2013) sample – based on its standard deviation over ten years – is the most persistent quality characteristic in our real estate sample. The high persistence of payout

Table 1 Persistence of quality scores & components

1999–2013		P1 *(Low)*	P2	P3	P4	P5	P6	P7	P8	P9	P10 *(High)*	P10-P1
Quality	t	-3.214	-1.217	-0.584	-0.193	0.018	0.255	0.543	0.869	1.210	2.007	5.221
Quality	t + 5	-3.398	-1.663	-0.862	-0.356	-0.022	0.265	0.598	0.991	1.452	2.434	5.832
Quality	t + 10	-3.279	-1.555	-0.818	-0.340	-0.010	0.290	0.625	1.017	1.511	2.458	5.737
Quality	t + 15	-3.317	-1.665	-0.894	-0.346	0.016	0.350	0.713	1.127	1.628	2.570	5.887
std errors	t + 15	(0.040)	(0.035)	(0.022)	(0.011)	(0.007)	(0.012)	(0.016)	(0.022)	(0.027)	(0.033)	
Profitability	t	-1.494	-0.839	-0.489	-0.393	-0.188	0.016	0.300	0.617	0.950	1.339	2.833
Profitability	t + 5	-1.442	-0.997	-0.616	-0.366	-0.094	0.087	0.328	0.551	0.870	1.305	2.747
Profitability	t + 10	-1.428	-1.019	-0.634	-0.356	-0.089	0.132	0.370	0.627	0.900	1.302	2.730
Profitability	t + 15	-1.433	-1.016	-0.631	-0.346	-0.068	0.154	0.406	0.677	0.956	1.341	2.774
std errors	t + 15	(0.009)	(0.009)	(0.009)	(0.007)	(0.010)	(0.010)	(0.011)	(0.013)	(0.012)	(0.013)	
Growth	t	-1.485	-1.131	-0.707	-0.354	0.000	0.283	0.636	0.990	1.273	1.556	3.041
Growth	t + 5	-1.470	-1.133	-0.817	-0.487	-0.154	0.164	0.491	0.833	1.169	1.511	2.981
Growth	t + 10	-1.427	-1.108	-0.802	-0.501	-0.171	0.146	0.468	0.803	1.125	1.473	2.900
Growth	t + 15	-1.406	-1.091	-0.768	-0.471	-0.163	0.125	0.455	0.793	1.102	1.432	2.838
std errors	t + 15	(0.013)	(0.012)	(0.012)	(0.012)	(0.014)	(0.016)	(0.013)	(0.016)	(0.015)	(0.014)	
Safety	t	-1.391	-0.819	-0.575	-0.311	-0.146	0.032	0.237	0.561	0.952	1.455	2.846
Safety	t + 5	-0.679	-0.371	-0.300	-0.241	-0.172	-0.056	0.081	0.306	0.664	1.245	1.924
Safety	t + 10	-0.700	-0.401	-0.288	-0.232	-0.130	-0.047	0.114	0.298	0.640	1.210	1.910
Safety	t + 15	-0.699	-0.396	-0.336	-0.217	-0.127	-0.039	0.126	0.311	0.633	1.214	1.913
std errors	t + 15	(0.017)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.013)	(0.012)	

Table 1 (continued)

1999–2013		P1 *(Low)*	P2	P3	P4	P5	P6	P7	P8	P9	P10 *(High)*	P10-P1
Payout	t	-1.468	-0.944	-0.657	-0.453	-0.160	0.191	0.475	0.654	0.947	1.299	2.767
Payout	t + 5	-1.381	-1.239	-0.768	-0.422	-0.111	0.183	0.439	0.680	0.959	1.301	2.682
Payout	t + 10	-1.411	-1.161	-0.699	-0.364	-0.052	0.214	0.461	0.691	0.944	1.291	2.702
Payout	t + 15	-1.386	-1.155	-0.722	-0.370	-0.058	0.217	0.465	0.701	0.950	1.292	2.678
std errors	t + 15	(0.007)	(0.017)	(0.012)	(0.010)	(0.008)	(0.006)	(0.007)	(0.007)	(0.006)	(0.009)	

Table 1 summarizes quality persistence by presenting time series of average quality scores at time t (first quarter in the sample), t + 5 years, t + 10 years and t + 15 years by quality scores deciles. Decile quality (profitability, growth, safety, and payout) portfolios are formed based on the distribution of quality (profitability, growth, safety, and payout) scores as of the first quarter in the analysis (ending March 31, 1999). Next, we track these portfolios' scores 5, 10 and 15 years later. The average of cross-sectional means for each portfolio is reported as of the quarter end of the time of portfolio creation and every five years thereafter, for fifteen years. The spread between the highest and lowest quality (quality component) portfolios is indicated by P10 – P1, in the far right-hand column. Standard errors are provided in parentheses

Table 2 Persistence in listed real estate vs. overall stock market

	Persistence in the Overall Stock Market (Asness et al. (2013))					Persistence in Real Estate				
	Profitability P10-P1	Growth P10-P1	Safety P10-P1	Payout P10-P1	Quality P10-P1	Profitability P10-P1	Growth P10-P1	Safety P10-P1	Payout P10-P1	Quality P10-P1
t	3.200	3.150	2.950	3.030	2.940	2.833	3.041	2.846	2.767	5.221
t + 5	1.900	0.510	1.460	0.860	1.200	2.747	2.981	1.924	2.682	5.832
t + 10	1.530	0.580	0.980	0.460	0.980	2.730	2.900	1.910	2.702	5.737
s.d.	0.877	1.504	1.027	1.383	1.074	0.055	0.071	0.536	0.044	0.329

Table 2 presents a comparison between the quality persistence results, reported by Asness et al. (2013), for the U.S. stock market and those based on our sample of real estate firms over 1999–2013. By examining the spreads between the highest and lowest quality scores portfolios and calculating their standard deviations (s.d.) from portfolio creation (t) to ten years out (t + 10), we note that our sample is characterized by lower standard deviations across the board, displays stronger persistence and, therefore, better predictability than in the overall stock market

in real estate sector relative to both Asness et al. (2013) sample and to other quality characteristics within our sample is attributable to the mandate that REITs must pay out at least 90 % of taxable earnings to maintain their tax status.

Is Higher Quality of Real Estate Stocks Reflected in Higher Prices?

Now that composite quality and its components have been established as persistent characteristics of real estate stocks, we focus on *how* quality is priced. To that end, we estimate the following cross-sectional regression:

$$P_{i,t} = \alpha + \beta_i \text{Quality}_{i,t} + \varepsilon_{j,t} \quad (1)$$

$P_{i,t}$ is the market-price-to-book-value ratio of firm i's stock at the end of quarter t. Quality is the composite quality score for firm i at the end of quarter t. The scaled price of each firm is regressed on its overall quality score on a quarterly basis. Standard errors are corrected for heteroscedasticity and clustered by firm.

We report the results in Table 3. Model 1 is estimated with quality as the only explanatory variable. In model 2, we add market capitalization, lagged 12-month returns of the stock, to control for size and momentum, respectively, and indicator variables representing time to control for market conditions. Market capitalization is measured in millions of dollars and lagged 12-month returns are measured in log form. We find that quality is a significant determinant of price-to-book-value ratio. Specifically, for one standard-deviation increase in quality, price-to-book increases by a highly significant 4.47 %. The effect of quality on scaled prices decreases slightly to 4.04 % when controlling for size, momentum, and market environment. Next, we estimate univariate regressions with each of the components of quality included as an independent variable separately. The results from these models are reported in columns 3 through 6. In column 7 we include each component of quality (profit, growth, safety, and payout) as independent variable, as well as controls for size, momentum, and market conditions.

Table 3 Regression results: price of quality and its components

Variables	(1) Price/Book	(2) Price/Book	(3) Price/Book	(4) Price/Book	(5) Price/Book	(6) Price/Book	(7) Price/Book
Market cap (size)		0.00694*** (0.00267)					0.00601** (0.00249)
12 mo. return (momentum)		59.64*** (5.464)					52.61*** (4.932)
Quality	4.473*** (1.048)	4.039*** (1.012)					
Profit			19.29*** (2.432)				17.27*** (2.973)
Growth				5.860*** (1.722)			-2.051 (1.871)
Safety					-18.54*** (4.681)		-29.35*** (6.125)
Payout						-2.762 (3.280)	-6.139* (3.414)
Constant	126.7*** (6.185)	136.1*** (6.273)	129.1*** (6.044)	121.8*** (10.95)	129.2*** (6.331)	126.8*** (6.307)	142.5*** (10.41)
R-squared	0.115	0.221	0.173	0.105	0.116	0.102	0.264
Wald	948	1682	912	1028	1012	964.9	1686
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 3 presents the results from univariate and multivariate regressions during the period of 1999–2013, based on a sample of 9968 firm quarter observations and 341 unique firms, using price-to-book ratio as the dependent variable, and quality and its components (profitability, growth, safety, and payout) as independent variables. Quality is the overall quality score for each individual firm (i) at the end of each quarter (t). The scaled price of each firm (Price/Book) is regressed on its overall quality score on quarterly basis. Standard errors are corrected for heteroscedasticity and clustered by firm. In order to further determine the explanatory power of quality on prices, market capitalization and returns over the previous year are added to control for size and momentum, respectively, and time dummies are employed to control for market conditions on a quarterly basis. Market capitalization is in million USD and 12-month lagged returns are in log of price relative form. Robust standard errors are provided in parentheses. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively

We find that profitability and growth are significantly positive in the univariate regressions. However, only profitability remains positive in the multivariate regression model including all components of quality (Model 7). The significantly negative coefficient of safety in both univariate and multivariate models, while counter-intuitive, resonates with similar results in Asness et al. (2013). Asness et al. (2013) attribute the negative contribution of safety to a flat security market line and leverage constraints (Black 1972; Frazzini and Pedersen 2014). The authors argue that when leverage is constrained, investors seek riskier (higher beta) assets, resulting in higher prices for riskier assets and lower prices for less-risky assets. Another potential explanation for the negative price of safety is that REITs are more prone to be dependent upon debt for growth and acquisition of new properties because of their requirement to pay out 90 % of net income in dividends. Because of this provision, declining leverage (increasing safety) may be perceived by the market as a negative signal of poor investment opportunity. Finally, the non-significance of payout in the univariate regression and marginal significance in Model 7 confirms our expectation that payout is not an important differentiating factor in the pricing of listed real estate, because of the regulatory requirement that REITs must pay out 90 % of taxable income. In essence, since payout is a predictable factor among REITs, the payout requirement behaves as a benchmark. The negative coefficient on the payout variable may indicate that REITs paying higher dividends than required by regulation (and thereby retaining less cash for investments) are penalized with a lower-priced stock.

To check the robustness of the price regressions over time, we break up the sample by firm size, and in 5-year increments. We also isolate the years of 2004–2006, the real estate bubble period, and 2007–2008, the financial crisis period. In Table 4, Panel A, we present price regressions on quality during each 5-year time period within the sample. From 1999 to 2003, a one standard-deviation increase in quality induces a significant 3.36 % increase in scaled prices. This gain in price is comparable to the price of quality for the overall 15-year sample period 1999–2013. During the period 2009–2013, the price of quality is still positive, though insignificant. However, during the period 2004–2008, which encompasses both the U.S. real estate bubble and the subsequent financial crisis, the price of quality is negative, albeit insignificant.

For greater insight on the behavior of real estate asset prices during the bubble and financial crisis periods, we estimate yearly regressions on quality over the years of 2004–2008, when controlling for size, momentum, and market conditions. The results of the annual regressions are reported in Table 4, Panel B. The analyses reveal an insignificant effect of quality on price during each year, with the exception of 2008, when the price of quality is negative. This analysis suggests that investors are less concerned about quality in an expansionary market. The negative price of quality in 2008 may derive from larger decreases in book values of low quality stocks. Real estate assets are carried on the books based on their historical cost adjusted for depreciation and capital expenditures. Upward revaluation of real estate due to its value increase over time is generally not allowed in the US. In contrast, significant decrease in the market price of investment in real estate may lead to impairment loss and decrease of the book value of the real estate. Given that a massive downward reevaluation occurred in 2008, if such reevaluation was larger for lower quality stocks than higher quality stocks, but it was not associated with the same scale decrease in market prices, that would lead to a negative price of quality.

Table 4 Price of quality over time and by firm size

Panel A Price of Quality in 5-yr. Increments

Variables	(1999–2003) Price/Book	(2004–2008) Price/Book	(2009–2013) Price/Book
Market cap (size)	0.00867 (0.00568)	0.00846*** (0.00325)	0.00723*** (0.00257)
12 mo. return (momentum)	54.32*** (9.895)	76.81*** (8.961)	38.72*** (6.009)
Quality	3.361*** (0.881)	-0.680 (1.628)	1.644 (1.319)
Constant	142.8*** (7.432)	173.8*** (8.488)	91.30*** (10.85)
Observations	3649	3037	2906
Firms	231	213	185
R-squared	0.137	0.208	0.191
Wald	416	727	759.5
p-value	<0.01	<0.01	<0.01

Panel B Price of Quality by Year, 2004–2008

	(2004)	(2005)	(2006)	(2007)	(2008)
Variables	Price/Book	Price/Book	Price/Book	Price/Book	Price/Book
Market cap (size)	0.0172*** (0.00334)	0.0136*** (0.00387)	0.0101** (0.00430)	0.0153*** (0.00318)	0.0160*** (0.00441)
12 mo. return (momentum)	72.56*** (21.85)	57.63** (25.12)	107.0*** (13.26)	89.12*** (19.41)	56.00*** (9.834)
Quality	0.0763 (1.437)	0.587 (0.991)	-1.258 (1.491)	1.442 (1.511)	-3.396** (1.479)
Constant	169.7*** (8.281)	175.5*** (9.432)	218.3*** (13.20)	209.3*** (13.45)	195.2*** (13.94)
Observations	649	665	632	550	541
Firms	172	181	170	151	141
R-squared	0.126	0.162	0.200	0.182	0.247
Wald	251.4	108.7	194.4	318.6	415.4
p-value	<0.01	<0.01	<0.01	<0.01	<0.01

Table 4 (continued)

Panel C Price of Quality in Small & Big Real Estate Stocks

	(1) 1999–2013 Small cap	(2) 1999–2013 Big cap	(3) 2007 Small Cap	(4) 2007 Big Cap	(5) 2008 Small Cap	(6) 2008 Big Cap
Variables	Price/Book	Price/Book	Price/Book	Price/Book	Price/Book	Price/Book
Market cap (size)	0.0943*** (0.0255)	0.00632** (0.00305)	0.169*** (0.0468)	0.0126*** (0.00374)	0.0520 (0.0417)	0.0115** (0.00506)
12 mo. return (momentum)	38.96*** (5.399)	97.12*** (8.442)	63.02*** (17.87)	116.7*** (31.46)	40.40*** (12.58)	113.8*** (19.77)
Quality	3.740*** (1.188)	2.266 (1.531)	-1.538 (1.479)	4.787 (2.967)	-1.423 (1.152)	-3.931 (2.913)
Constant	108.2*** (8.340)	163.0*** (10.42)	143.1*** (17.31)	225.6*** 225.6***	166.1*** (24.95)	221.4*** (20.21)
Observations	4783	4809	209	341	235	306
Firms	258	189	60	97	76	85
R-squared	0.127	0.174	0.105	0.112	0.146	0.213
Wald	1218	1841	91	333	166.2	313.3
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 4, Panel A presents the average quarterly price of quality during 1999–2003, 2004–2008, and 2009–2013, respectively. Panel B presents the price of quality by year during the period of 2004–2008. Panel C presents the price of quality for small vs. big stocks, where stocks are categorized relative to the median market capitalization for the sample. The dependent variable is price-to-book ratio. The variable of interest is quality. In addition, we control for market capitalization and lagged 12-month returns to control for size and momentum, respectively. Time dummies are employed to control for market conditions on a quarterly basis. Market capitalization is in million USD and lagged 12-month returns are in log of price relative form. Quality is the overall quality score for each individual firm (i) at the end of each quarter (t). Standard errors are corrected for heteroscedasticity and clustered by firm. Robust standard errors are reported in parentheses. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively

Table 4, Panel C shows the pricing of quality for small and big stocks. Over the whole study period (1999–2013), quality is positively related to price for both small and big stocks, though quality has only a significant impact on the pricing of small stocks. During the period around the financial crisis, we do not find differences in the price of quality of small vis-a-vis, large cap stocks.

The above results generally support the notion that greater quality induces higher prices in the cross section of U.S. real estate stocks. However, the price of quality varies over time, and it is especially volatile during the 5-year period that encompasses the real estate bubble and the financial crisis (2004–2008). Moreover, of the seven scaled price regressions presented in Table 3, the highest R^2 of 26.4 % is observed for the model which includes all four components of quality together with controls for size, momentum, and indicators for quarterly market conditions.

Is Quality a Significant Factor in Real Estate Returns?

If quality is fully reflected in real estate prices, future returns of real estate assets will not be related to quality factors. To test this hypothesis (H3), excess returns over U.S. Treasury bill yield and risk-adjusted returns, or alphas of real estate assets, are analyzed for portfolios categorized by quality. First, stocks are sorted by quality scores and ten decile portfolios are created each quarter (with one quarter lag). Then stocks are assigned to one of the ten portfolios by quality score. The time series of mean excess returns are calculated for each quality portfolio. Second, for each decile we estimate alphas, based on a pricing model including only the market factor, MKT, and a 4-factor model, adding size and value factors SMB and HML (Fama and French 1993). Standard errors are adjusted for heteroscedasticity and clustered by firm.

In Table 5, we report excess returns and alphas, with the corresponding robust standard errors in parentheses below. The far right-hand column, we report the difference or spread between the returns from high quality portfolio 10 and those from the low quality portfolio 1.[9] The analyses reveal that average excess returns generally increase with quality and the highest returns are observed for portfolios 8–10. We observe a similar trend in CAPM alphas, where the risk-adjusted return on portfolio 1 is the lowest, while the returns in portfolios 8–10 are the highest among the excess returns in the decile portfolios. The reported 4-factor alphas are largely negative. We do note that their magnitude decreases with deciles, and in deciles 8 and 9 we observe positive alphas. Moreover, the positive spread in the far right-hand column indicates that high quality stocks have higher average excess returns than low quality or junk stocks. In fact, while using a 4-factor model, the 10th decile portfolio alpha turns insignificant, the 1st decile portfolio alpha remains significantly negative. Therefore, the positive spread on a risk-adjusted basis is largely driven by the large negative returns observed in the 1st decile portfolio. This indicates that low quality stocks underperform in the future. Over the sample period 1999–2013, high quality real estate stocks outperformed low quality real estate stocks by 3.8 % per quarter, on average. When adjusted for systematic risk

[9] This is also the basis of the quality minus junk (QMJ) factor, which will be described in greater detail later on.

Table 5 Returns & alphas by quality portfolio

1999–2013	1 *(Low)*	2	3	4	5	6	7	8	9	10 *(High)*	P10-P1
Excess Returns	-0.0183	0.0146**	0.0147***	0.00855	0.0103	0.0140**	0.00553	0.0259***	0.0202***	0.0195***	0.038
	(0.014)	(0.007)	(0.005)	(0.006)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.007)	
CAPM alpha	-0.0264**	0.00943	0.00936*	0.00354	0.00543	0.00913	-0.00250	0.0231***	0.0169***	0.0122*	0.039
	(0.0128)	(0.00774)	(0.00502)	(0.00519)	(0.00825)	(0.00614)	(0.00592)	(0.00483)	(0.00518)	(0.00700)	
4-factor alpha	-0.0376***	-0.00436	-0.00518	-0.0158**	-0.0146	-0.0101	-0.0190***	0.00900	0.00443	-0.00145	0.036
	(0.0118)	(0.00891)	(0.00577)	(0.00629)	(0.0111)	(0.00679)	(0.00671)	(0.00563)	(0.00575)	(0.00708)	
R-squared (4-factor)	0.126	0.296	0.331	0.349	0.19	0.338	0.293	0.192	0.237	0.246	
Coefficients Based on 4-factor Model											
MKT	1.319***	0.917***	0.918***	0.903***	0.913***	0.789***	0.758***	0.527***	0.604***	0.762***	
	(0.179)	(0.106)	(0.0996)	(0.0978)	(0.116)	(0.0941)	(0.111)	(0.0679)	(0.0812)	(0.120)	
SMB	0.202 (0.325)	0.678***	0.397***	0.625***	0.708***	0.560***	0.527***	0.469***	0.407***	0.512***	
		(0.128)	(0.110)	(0.0991)	(0.234)	(0.101)	(0.102)	(0.127)	(0.114)	(0.111)	
HML	0.777***	0.815***	0.991***	0.966***	1.169***	1.129***	0.894***	0.762***	0.788***	0.832***	
	(0.287)	(0.142)	(0.106)	(0.130)	(0.142)	(0.0974)	(0.118)	(0.117)	(0.0785)	(0.118)	
MOM	0.0251	-0.237***	-0.0759	0.0178	-0.0125	-0.0399	0.00368	-0.0602	-0.0586	0.0341	
	(0.102)	(0.0911)	(0.0888)	(0.0718)	(0.0705)	(0.0656)	(0.0541)	(0.0648)	(0.0784)	(0.0598)	

Table 5 reports quarterly excess and risk-adjusted returns (alphas) by quality portfolio for the sample period 1999–2013. We sort stocks in deciles at the end of each quarter. Decile quality portfolios are formed quarterly, based on this sort, with a lag of one quarter (3 months) to account for the fact that data is likely not immediately available as of the end of the quarter. Coefficients or factor loadings from 4-factor regressions, including the Fama-French factors (Fama and French 1993) and momentum, are also presented in the table. The far right-hand column reports the average, quarterly difference, or spread, between the excess returns and alphas for the highest quality portfolio (10) and those for the lowest quality portfolio (1). Standard errors are adjusted for heteroscedasticity, clustered by firm, and reported in parentheses. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively with the CAPM model, the high quality portfolio outperforms the low quality portfolio by 3.9 % per quarter. When using a 4-factor model, the outperformance of high versus low quality real estate decreases to 3.6 % per quarter.

Next, we divide the sample in 5-year increments, and also isolate the real estate bubble years 2004–2006 and the financial crisis years 2007–2008. Table 6 reports excess returns and 4-factor alphas over four periods – 1999-2003, 2004–2006, 2007–2008, and 2009–2013. From 1999 to 2003, high quality stocks outperformed low quality stocks by 7.4 % per quarter in terms of excess returns, and by 6.3 % on a risk-adjusted basis using the 4-factor model. The spread between high and low quality stocks declines dramatically during the period 2004–2006 and 2009–2013, with 4-factor alphas of 1.8 % and 0.8 %, respectively. Nevertheless, we do note that the highest returns in both periods are observed in portfolios 8–10, although during 2004–2006, portfolio 4 is also associated with a large positive return. During 2007–2008 the spread of 5.5 % is similar in magnitude to the spread in risk-adjusted returns during 1999–2003. The highest risk-adjusted return of 7 % is observed in the 9th decile portfolio.

Contrary to hypothesis H3 that quality is fully reflected in the prices in real estate assets, our analyses reveal some evidence that quality is not efficiently priced. While returns do not increase monotonically with quality, we find clear evidence of a trend of higher returns to higher quality as reflected in generally higher returns in higher deciles and positive spreads of high quality stocks relative to low quality stocks. This evidence challenges limited market efficiency, and implies underpricing (overpricing) of high quality (low quality) in listed real estate assets.

Return on a Long High Quality, Short Low Quality Real Estate Portfolio

Given the rejection of hypothesis H3, we next seek to determine the economic magnitude and significance of differential returns to higher quality versus lower quality real estate firms. We construct a long high quality, short low quality (junk) portfolio of real estate stocks. The quality minus junk factor (QMJ) is constructed by subtracting the excess return on the lowest quality portfolio (P1) from the excess return of the highest quality portfolio (P10) for each quarter. The time series of average cross-sectional mean quarterly excess returns to QMJ is then calculated as follows:

$$QMJ = (r_{P10}) - (r_{P1}) \quad (2)$$

This simplified portfolio construction (without value-weighting), or spread, deviates from the methodology in Fama & French (1992, 1993, 2006) and Asness et al. (2013). The rationale for this divergence is specific to the real estate sample. Unlike the aggregate stock market in which individual stocks are heterogeneous in size, industry, and even country of origin, the sample of real estate stocks is relatively homogenous. All firms operate in the same industry and country and are comparable in size. To elaborate, compared to the median market capitalization of 21.3 % of the average value for firms listed on the New York Stock Exchange (NYSE), the real estate sample has a median market capitalization of 40.4 % of its average value, and the 75th percentile is

Table 6 Returns to quality over time and during the crisis

1999–2003	1 *(Low)*	2	3	4	5	6	7	8	9	10 *(High)*	P10-P1
Excess Returns	-0.0495* (0.0265)	0.00234 (0.0135)	0.0225*** (0.0061)	0.00924 (0.0074)	0.0217*** (0.0064)	0.0200*** (0.0064)	0.0161** (0.0070)	0.0334*** (0.0090)	0.0243*** (0.0074)	0.0244*** (0.0083)	0.074
4-factor alpha	-0.0575*** (0.0175)	-0.0120 (0.0160)	0.0101 (0.00886)	-0.00420 (0.00893)	0.00353 (0.00845)	-0.00783 (0.00914)	-0.00542 (0.00880)	0.00504 (0.0156)	-0.00410 (0.0113)	0.00544 (0.00926)	0.063
R-sq. (4-factor)	0.0586	0.116	0.092	0.197	0.148	0.199	0.149	0.0911	0.102	0.0891	
2004–2006	1	2	3	4	5	6	7	8	9	10	P10-P1
Excess Returns	0.0403*** (0.0153)	0.0339*** (0.0071)	0.0289*** (0.0066)	0.0264*** (0.0078)	0.0071 (0.0284)	0.0242*** (0.0064)	0.0199** (0.0078)	0.0336*** (0.0063)	0.0247*** (0.0057)	0.0493*** (0.0077)	0.009
4-factor alpha	0.00144 (0.0182)	0.00834 (0.00970)	-0.000794 (0.0108)	0.0255** (0.0117)	-0.0514 (0.0685)	0.00777 (0.0103)	0.00193 (0.0129)	0.00900 (0.00929)	0.0232** (0.0107)	0.0197 (0.0168)	0.018
R-sq. (4-factor)	0.031	0.253	0.274	0.210	0.0494	0.347	0.136	0.271	0.149	0.166	
2007–2008	1	2	3	4	5	6	7	8	9	10	P10-P1
Excess Returns	-0.169*** (0.0478)	-0.0590** (0.0296)	-0.103*** (0.0318)	-0.108*** (0.0318)	-0.118*** (0.0361)	-0.107*** (0.0321)	-0.121*** (0.0312)	-0.0601*** (0.0211)	-0.0602** (0.0277)	-0.0984*** (0.0346)	0.071
4-factor alpha	-0.0188 (0.0377)	0.000325 (0.0189)	0.0284 (0.0194)	0.0476*** (0.0180)	0.0244 (0.0197)	0.0145 (0.0192)	-0.00430 (0.0211)	-0.00337 (0.0174)	0.0701*** (0.0208)	0.0358 (0.0228)	0.055
R-sq. (4-factor)	0.224	0.446	0.549	0.569	0.620	0.542	0.405	0.254	0.487	0.436	
2009–2013	1	2	3	4	5	6	7	8	9	10	P10-P1
Excess Returns	0.0383*** (0.0138)	0.0444*** (0.0090)	0.0406*** (0.0098)	0.0393*** (0.0080)	0.0472*** (0.0107)	0.0447*** (0.0080)	0.0303*** (0.0058)	0.0439*** (0.0070)	0.0424*** (0.0059)	0.0368*** (0.0061)	-0.002
4-factor alpha	-0.00517 (0.0135)	-0.0105 (0.00838)	-0.00525 (0.0103)	-0.00298 (0.00820)	0.00792 (0.0115)	0.0115 (0.00907)	-0.00205 (0.00679)	0.0151** (0.00661)	0.0225*** (0.00697)	0.00298 (0.00533)	0.008
R-sq. (4-factor)	0.139	0.503	0.412	0.380	0.333	0.259	0.344	0.331	0.257	0.295	

Table 6 reports quarterly excess and risk-adjusted returns (alphas) by quality portfolio for the periods 1999–2003, 2004–2006, 2007–2008, and 2009–2013. We sort stocks in deciles at the end of each quarter. Decile quality portfolios are formed quarterly, based on this sort, with a lag of one quarter (3 months) to account for the fact that data is likely not immediately available as of the end of the quarter. Coefficients or factor loadings from 4-factor regressions, including the Fama-French factors (Fama and French 1993) and momentum, are also presented in the table. The far right-hand column reports the average, quarterly difference, or spread, between the excess returns and alphas for the highest quality portfolio (10) and those for the lowest quality portfolio (1). Standard errors are adjusted for heteroscedasticity, clustered by firm, and reported in parentheses. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively

107.8 % of its average market cap.[10] Given the relative homogeneity of the sample, sorting by size or value weighting is not very effective. Further, since our study focuses on the spread in returns among the ten quality portfolios, the simplified investment strategy of long high quality, short junk portfolio consistently captures returns to quality. Given that the actual QMJ portfolio is the time series average of quarterly cross-sectional difference in returns between high quality and low quality assets, the crude spread (P10 – P1) serves as a close approximation of the relation between quality and performance.

Following the same approach as for the QMJ, we also construct portfolios for each of the four components of quality: profitability, growth, safety, and payout. The portfolios of profitable minus unprofitable (PMU), growth minus mature (GMM), safe minus volatile (SMV), and high payout minus low payout (HpMLp) stocks, provide more granular information on the source of returns to long/short investment strategies focused on individual aspects of quality.

In Table 7, we report average quarterly excess returns and alphas to long/short portfolio QMJ and the corresponding statistics for long/short portfolios on quality components, PMU, GMM, SMV, and HpMLp. Standard errors are clustered by firm and adjusted for heteroscedasticity. All of the excess returns to long/short portfolios are significant, although the sign varies. Over the sample period 1999–2013, QMJ portfolio earns significant average quarterly excess returns of 3.2 %, and average quarterly risk-adjusted returns of 3.5 %. In keeping with the higher risk-adjusted returns, we find negative average market, value, and momentum factor loadings of −0.431, −0.035, and −0.485, respectively. Asness et al. (2013) find similar results for the aggregate stock market, except that they also document a negative exposure to the size factor.

The long/short portfolios of other quality attributes, with the exception of HpMLp, earn positive average risk-adjusted returns. PMU has the highest average quarterly alpha followed by GMM. Exposure to the factors is similar to the one observed for QMJ, except for exposure to HML, as indicated by its average positive HML coefficients in the PMU, GMM and SMV models.

We report the correlation of excess returns for each long/short portfolio in Table 8. All sub-component factor portfolio returns are positively correlated with the returns on the QMJ factor. A trade-off between payout and growth is implied in the negative correlation between GMM and HpMLp, suggesting that high payout is accompanied by low growth. In Table 9, we break out returns and alphas to QMJ in 5-year periods, and also isolate the 2004–2006 bubble period and the 2007–2008 financial crisis. The first five years of the sample period (1999–2003) produce the highest average quarterly excess returns to QMJ of 8.1 %, which corroborates our earlier findings with returns to portfolios ranked by quality. The average quarterly 4-factor alpha is 9.5 % for the same period. In the period during the real estate boom (2004–2006), average excess returns and risk-adjusted returns to QMJ are negative, with averages of −1.9 % and −0.34 % per quarter, respectively. This suggests overvaluation of low quality stocks during this period. Upon further investigation of the crisis years 2007–2008, excess returns and alpha to QMJ are found to be strong, averaging 5.8 % and 4.3 % per quarter,

[10] The NYSE's average and median market capitalizations are $8.9 billion and $1.9 billion, respectively (NYSE 2014). In contrast, the real estate sample has an average and median market capitalization of $1.867 billion and $755 million, respectively, with a 75th percentile of $2 billion.

Table 7 Returns & alphas to long quality, short junk portfolios

1999–2013	QMJ	PMU	GMM	SMV	HpMLp
Excess Returns	0.0323*** (0.001)	0.0423*** (0.001)	0.0262*** (0.001)	0.0199*** (0.001)	-0.00472*** (0.000)
CAPM alpha	0.0331*** (0.001)	0.0436*** (0.001)	0.0269*** (0.001)	0.0202*** (0.001)	-0.00339*** (0.000)
4-factor alpha	0.0351*** (0.001)	0.0421*** (0.000)	0.0225*** (0.001)	0.0147*** (0.001)	0.000 (0.000)
(Coefficients based on 4-factor model)					
MKT	-0.431*** (0.006)	-0.472*** (0.006)	-0.170*** (0.008)	-0.142*** (0.006)	-0.394*** (0.008)
SMB	0.314*** (0.009)	0.423*** (0.009)	0.164*** (0.015)	0.350*** (0.010)	0.147*** (0.009)
HML	-0.0354*** (0.004)	0.0742*** (0.009)	0.409*** (0.006)	0.250*** (0.006)	-0.324*** (0.006)
MOM	-0.485*** (0.010)	-0.384*** (0.006)	-0.179*** (0.008)	-0.104*** (0.007)	-0.112*** (0.002)
Observations	9968	9968	9968	9968	9968
Firms	341	341	341	341	341
R-sq. overall	0.243	0.296	0.105	0.089	0.153
Wald	6390	25,143	6484	8180	6701
p-value	<0.01	<0.01	<0.01	<0.01	<0.01

Table 7 presents quarterly excess returns and alphas to long/short portfolio QMJ and its components, PMU, GMM, SMV, and HpMLp for the sample period, 1999–2013. The quality minus junk factor (QMJ) is constructed by subtracting the excess quarterly return of the lowest quality portfolio (P1) from that of the highest quality portfolio (P10). Quality portfolios are formed with one quarter lag. In the same manner, long/short portfolios are created for each component of quality based on excess returns to profitability, growth, safety, and payout. CAPM alpha represents the alpha from a panel regression using only the market factor, MKT, as an independent variable, while 4-factor alpha represents the intercept coefficient in a 4-factor model, which adds, in addition to MKT, size and value factors SMB and HML (Fama and French (1993)) and momentum (MOM). Standard errors are clustered by firm and adjusted for heteroscedasticity. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively

Table 8 Long quality, short junk portfolio correlations

	QMJ	PMU	GMM	SMV	HpMLp
QMJ	1.000				
PMU	0.6884*	1.000			
GMM	0.5581*	0.5846*	1.000		
SMV	0.5605*	0.3251*	0.3028*	1.000	
HpMLp	0.4693*	0.2311*	-0.0916*	0.1311*	1.000

Table 8 presents the pairwise correlation coefficients of quarterly excess returns attributed to quality minus junk (QMJ) portfolio and those attributed to the components of QMJ, profitability minus junk (PMU), growing minus mature (GMM), safe minus volatile (SMV) and high payout minus low payout (HpMLp). The correlations are reported for the sample period 1999–2013. * indicates $p < 0.1$, or better

Table 9 Returns to QMJ in 5-yr. increments, isolating crisis

	QMJ	PMU	GMM	SMV	HpMLp
1999–2003					
Excess Returns	0.0809*** (0.000)	0.0764*** (0.000)	0.0802*** (0.001)	0.0508*** (0.001)	-0.00429*** (0.000)
4-factor alpha	0.0946*** (0.001)	0.0602*** (0.001)	0.0949*** (0.002)	0.0333*** (0.001)	-0.00216*** (0.001)
2004–2006					
Excess Returns	-0.0194*** (0.000)	-0.00721*** (0.000)	0.00243*** (0.000)	0.00912*** (0.000)	-0.00473*** (0.000)
4-factor alpha	-0.00339*** (0.001)	0.00433*** (0.001)	0.0223*** (0.001)	-0.00950*** (0.002)	-0.00597*** (0.001)
2007–2008					
Excess Returns	0.0583*** (0.001)	0.0941*** (0.001)	0.0237*** (0.001)	-0.0138*** (0.001)	0.0309*** (0.000)
4-factor alpha	0.0434*** (0.001)	0.0544*** (0.001)	0.00345*** (0.001)	0.0441*** (0.002)	-0.0197*** (0.001)
2009–2013					
Excess Returns	-0.00381*** (0.001)	0.0138*** (0.000)	-0.0255*** (0.000)	0.000557** (0.000)	-0.0188*** (0.001)
4-factor alpha	0.0250*** (0.001)	0.0350*** (0.001)	-0.0189*** (0.001)	0.0294*** (0.001)	0.00221*** (0.001)

Table 9 presents quarterly excess returns and alphas to long/short portfolio QMJ and its components, PMU, GMM, SMV, and HpMLp for the sample sub periods, 1999–2003, 2004–2006 (bubble period), 2007–2008 (crisis period), and 2009–2013. The quality minus junk factor (QMJ) is constructed by subtracting the excess quarterly return of the lowest quality portfolio (P1) from that of the highest quality portfolio (P10). Quality portfolios are formed with one quarter lag. In the same manner, long/short portfolios are created for each component of quality based on excess returns to profitability, growth, safety, and payout. CAPM alpha represents the alpha from a panel regression using only the market factor, MKT, as an independent variable, while 4-factor alpha represents the intercept coefficient in a 4-factor model, which adds, in addition to MKT, size and value factors SMB and HML (Fama and French (1993)) and momentum (MOM). Standard errors are clustered by firm and adjusted for heteroscedasticity. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively

respectively. More recently, from 2009 to 2013, alphas remained higher than returns, though their size of 2.5 % is reduced from the corresponding levels during the pre-boom period and the financial crisis.

Overall, results for the sample period 1999–2013 support the hypothesis that QMJ portfolio's risk-adjusted returns are economically significant and yield a risk-adjusted annual return of approximately 14 % on average. Given the performance of the QMJ strategy during the financial crisis it also emerges as an effective hedge against the market.

Does Inclusion of a Quality Factor Improve the Asset-Pricing Model for Real Estate Stocks?

In view of the significantly positive alpha generated by the QMJ portfolio, its inclusion as an additional factor in the asset-pricing model should further explain the cross section of real estate returns. To examine the validity of this premise, we first estimate the model below to ascertain the power of the traditional 4-factor model for real estate assets:

$$\mathrm{R_{it}} = \alpha + \beta^{MKT} MKT_{\mathrm{t}} + \beta^{SMB} SMB_{\mathrm{t}} + \beta^{HML} HML_{\mathrm{t}} + \beta^{MOM} MOM_{\mathrm{t}} + \varepsilon_{\mathrm{t}} \quad (3)$$

Quarterly excess returns are regressed on market risk, size, value and momentum factors. Table 10 shows the regression results from the 4-factor model in column (1). The coefficient on the market, size, and value factors are positive, while that of momentum is negative. All factors are significant at 5 % or better level. With the base model established, we add the QMJ portfolios as a fifth factor.

$$\mathrm{R_{it}} = \alpha + \beta^{MKT} MKT_{\mathrm{t}} + \beta^{SMB} SMB_{\mathrm{t}} + \beta^{HML} HML_{\mathrm{t}} + \beta^{MOM} MOM_{\mathrm{t}} + \beta^{QMJ} QMJ_{\mathrm{t}} + \varepsilon_{\mathrm{t}} \quad (4)$$

We report the results in Table 10, column (2). As in the 4-factor model, MKT, SMB, and HML remain significant with comparable coefficients. The momentum factor becomes insignificant, while the QMJ factor is significantly positive, which confirms that real estate returns are influenced by the quality of assets when controlling for the traditional Fama-French three factors plus momentum. The R-squared statistic improves, however, by only about 0.1 %. This result does not support the hypothesis that inclusion of the quality factor (QMJ) improves the fit of the asset-pricing model for real estate. Therefore, a pricing model adding QMJ as a factor does not seem to be superior, statistically speaking, than the traditional 4-factor Fama-French-plus-

Table 10 Adding QMJ as a fifth factor

Variables	(1) Excess Returns	(2) Excess Returns	(3) Excess Returns
MKT	0.842*** (0.0428)	0.878*** (0.0470)	
SMB	0.507*** (0.0458)	0.490*** (0.0461)	1.096*** (0.0558)
HML	0.915*** (0.0465)	0.919*** (0.0476)	0.687*** (0.0451)
MOM	-0.0373** (0.0189)	0.00354 (0.0234)	-0.313*** (0.0247)
QMJ		0.0905*** (0.0233)	-0.141*** (0.0199)
Constant	-0.0107*** (0.0028)	-0.0138*** (0.0030)	-0.00299 (0.0027)
Observations	9968	9968	9968
Firms	341	341	341
R-squared overall	0.216	0.217	0.124
Wald	580.9	635.9	534.6
p-value	<0.01	<0.01	<0.01

Table 7 presents the regression statistics for a 4-factor model (Model 1) and a 5-factor model adding QMJ as an additional factor (Model 2). The quality minus junk factor (QMJ) is constructed by subtracting the excess quarterly return of the lowest quality portfolio (P1) from that of the highest quality portfolio (P10). Quality portfolios are formed with one quarter lag. Standard errors are clustered by firm and adjusted for heteroscedasticity. ***, **, and * indicate p < 0.01, p < 0.05, and p < 0.1, respectively momentum model. We conclude that although a QMJ strategy produces economically significant results, the benefits of adding a fifth QMJ factor are only marginal.

A growing body of research suggests that the market factor is a weak predictor of expected returns, overestimating the market premium for high beta stocks and underestimating it for low beta stocks (Fama and MacBeth 1973; Fama and French 1992; Frazzini and Pedersen 2014). As such, the single-factor model will systematically underestimate excess returns for high beta stocks and overestimate it for low beta stocks. The higher risk-adjusted returns and negative average MKT coefficient (see Table 5) associated with the QMJ factor (long low beta stocks and short high beta stocks) implies that high quality real estate stocks are low beta stocks. The low risk of high quality stocks follows also from the implication that one measure of high quality is the stability of the four attributes of quality. This phenomenon raises the question: does the 4-factor and the 5-factor model including QMJ accurately predict alpha in real estate stocks? Fama and French (2015) propose that by assuming that all stocks have a beta of 1, and removing the MKT factor as an explanatory variable, a more efficient estimate of alpha can be achieved. Following this technique, the asset-pricing model can be re-estimated as follows:

$$\mathrm{r_{it}} = \alpha + \beta^{SMB} SMB_{\mathrm{t}} + \beta^{HML} HML_{\mathrm{t}} + \beta^{MOM} MOM_{\mathrm{t}} + \beta^{QMJ} QMJ_{\mathrm{t}} + \varepsilon_{\mathrm{t}} \tag{5}$$

As reported in column (1) of Table 10, prior to the inclusion of the QMJ factor, the 4-factor model reveals negative risk-adjusted returns (alpha) of −1.1 % per quarter. With the inclusion of the QMJ factor, the 5-factor model shows a significantly positive effect of quality, and alpha is significantly negative at −1.4 %. Based on column (3), removing MKT results in an insignificant alpha of −0.3 %. This result implies that using only the four factors - size, value, momentum, and quality – results in underestimation of expected return. In addition, the overall fit of the modified model declines significantly from 21.7 % to 12.4 % due to exclusion of the market factor. The results in column (3) also demonstrate that the QMJ factor coefficient changes with the inclusion/omission of the market factor. However, unlike SMB, which is positively correlated with the market factor such that the exclusion of the market factor causes this factor to have significantly larger coefficients, the QMJ factor, similar to HML and MOM factors, is negatively correlated with the market factor. Exclusion of the market factor leads to QMJ becoming significantly negative. Our tests with and without the market factor show that the quality factor does capture some additional market risk. However, among the factors SMB, HML, MOM, and QMJ, QMJ has the lowest correlation with the market. This is consistent with Asness et al. (2013) who point out that unlike the Fama-French factors, the quality factor is firm-specific. Therefore, it is more likely that the quality factor captures some idiosyncratic risk. However, the quality factor is not superior to the Fama-French factors in explaining returns, and only improves the fit of the models marginally.

Next, we estimate model (2) for each 5-year period and during the bubble period of 2004–2006 as well as the financial crisis of 2007–2008. We report the results in Table 11. Chronological trends reflect that REIT exposure to the market factor has increased since the mid-1990s. REIT exposure to the size factor (SMB) declines over the study period, while REIT exposure to the value factor (HML) increased through

2008, but decreased during 2009–2013. The coefficient on QMJ is significant in the periods of 2004–2006 and 2009–2013. This is consistent with our previous finding of quality not being significantly priced during these two periods. Finally, the explanatory power of the 5-factor model appears to increase after the 1990s.

Discussion and Interpretation

Based on our analyses, quality is a persistent and predictable characteristic in U.S. real estate returns. We find that from 1999 to 2013, the components of quality – profitability, growth, safety, and payout – are more persistent for real estate assets than for the aggregate stock market, as documented by Asness et al. (2013). Payout is the most predictable component, which is attributable to the regulatory requirement of 90 % payout by REITs.

Our analyses reveal several important patterns in the cross section of real estate returns. First, although quality is a significant determinant of price of real estate assets, the explanatory power of quality is limited to 11.5 %. Asness et al. (2013) also report low R-squared in their analyses of the impact of quality for the aggregate stock market and suggest three possible reasons: a) limited market efficiency, which implies underpricing of quality and higher risk-adjusted returns for high quality stocks; b) inadequate quality measure that does not capture the market's perception of quality, implying no relationship between returns and quality as measured by Asness et al. (2013); or, c) an inadequate quality measure that does not capture risk(s) associated with quality, implying that risk-adjusted returns are independent of quality. For our real

Table 11 Adding QMJ as a fifth factor; regression statistics by periods

Variables	(1999–2003) Returns	(2004–2006) Returns	(2007–2008) Returns	(2009–2013) Returns
MKT	0.384*** (0.0437)	0.578*** (0.137)	1.453*** (0.113)	0.827*** (0.0450)
SMB	0.578*** (0.0720)	1.394*** (0.152)	-0.949*** (0.262)	0.331*** (0.116)
HML	0.529*** (0.0539)	1.189*** (0.233)	1.683*** (0.179)	0.649*** (0.0758)
MOM	-0.037 (0.0318)	-0.834*** (0.122)	-0.204** (0.100)	-0.0286 (0.0627)
QMJ	0.0413 (0.0339)	0.285** (0.113)	-0.129 (0.160)	0.0797*** (0.0298)
Constant	-0.0118** (0.0050)	0.00459 (0.00978)	0.0257** (0.0121)	0.00201 (0.00279)
Observations	3803	2080	1125	2960
Firms	242	213	163	191
R-squared overall	0.0847	0.0899	0.4	0.255
Wald	214.7	177	278.9	474.9
p-value	<0.01	<0.01	<0.01	<0.01

Table 11 presents the regression statistics for a 5-factor model adding QMJ as an additional factor. Columns (1), (2), (3), and (4) display the estimated coefficients for the periods of 1999–2003, 2004–2006, 2007–2008, and 2009–2013, respectively. The quality minus junk factor (QMJ) is constructed by subtracting the excess quarterly return of the lowest quality portfolio (P1) from that of the highest quality portfolio (P10). Quality portfolios are formed with one quarter lag. Standard errors are clustered by firm and adjusted for heteroscedasticity. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively estate sample, high (low) quality stocks are generally associated with higher (lower) risk-adjusted returns, although the relationship is not monotonic. Specifically, using a 4-factor model, including the Fama-French factors and momentum, the relationship between high quality and high returns is strongest during 1999–2003 and 2007–2008. Even in periods when risk-adjusted returns are not higher than excess returns, the difference in alpha on high quality and low quality stocks remains positive, indicating superior performance by quality stocks. As such, reasons b and c proposed by Asness et al. (2013) can be rejected. It is therefore likely that reason a, limited market efficiency, is responsible for the limited explanatory power of quality on returns. In essence, quality is not fully priced in listed real estate stocks for the sample period 1999–2013.

Second, on average, we find a significantly positive price associated with quality of real estate stocks. Moreover, the price of quality in small real estate stocks is proportionately higher than in big real estate stocks during the sample period. However, quality is not a significant determinant of price during 2004–2006 and post-2009. This evidence suggests that quality is less valued in a boom market, especially one characterized by a real estate bubble. Asness et al. (2013) also report low price of quality in the period prior to the 2007 global financial crisis. Prior evidence on low price of quality preceding downturns includes the height of the internet bubble in February 2000, and just before the 1987 stock market crash (Asness et al. 2013).

Third, returns to QMJ portfolio are significant across time periods and are highest during 1999–2003 and the financial crisis. However, although QMJ is highly significant, the inclusion of QMJ as a right-hand side variable in the model explaining excess return does not discernibly improve the overall fit of the model. Finally, results from this study, specifically the higher risk-adjusted returns to QMJ and its negative market exposure, suggest that a long quality, short junk portfolio is a hedge against the market, as well as against the loss of diversification in times of financial crisis.

Conclusion

This paper contributes to the real estate literature by examining price and return behavior during the recent period that encompasses the real estate expansion that began in the 1990s, followed by the U.S. real estate bubble and subsequent financial crisis. To our knowledge, our study is the first to add a quality factor to the empirical asset-pricing model applied to REITs and REOCs. We closely follow the aggregate stock market studies by Asness et al. (2013) and, to a lesser extent, Fama and French (2015). However, we present unique results that contrast with the findings of these two papers. Specifically, in contrast with Asness et al. (2013), we find quality to be a more predictable characteristic in the valuation of U.S. real estate stocks than for the aggregate U.S. stock market. Similar to the findings for the aggregate stock market in Asness et al. (2013), quality in listed real estate appears to be underpriced as implied by the limited explanatory power of the price of quality and higher risk-adjusted returns to quality. However, a long quality, short junk portfolio (QMJ) of real estate stocks produced average risk-adjusted returns of 3.6 % per quarter, considerably higher than the risk-adjusted returns reported by Asness et al. (2013) for a long quality, short junk portfolio in the aggregate stock market.

Our findings should be of interest to the managers pursuing alpha and hedging strategies, as well as risk-adjustment. First, a long quality, short junk portfolio of real estate stocks is found to be a positive alpha strategy that has yielded, on average, 3.6 % per quarter on a risk-adjusted basis. The returns and factor loadings of other long/short portfolios (PMU, GMM, SMV, and HpMLp) can also be exploited in alpha strategies. Second, for the purpose of risk-adjusting real estate stocks, adding a quality factor to the 4-factor Fama-French-plus-momentum model does not result in a material increase in explanatory power.

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