

Risk and Return in Real Estate: Evidence from a Real Estate Stock Index

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The continued growth of the equity REIT market depends critically on investors' belief that the stock market provides fair and accurate valuations of real estate. An index of real estate stocks traded on the New York and American stock exchanges reflects changes in real estate market fundamentals in a more timely fashion than a widely used appraisal-based system. The index includes equity real estate investment trusts (REITs), real estate operating companies not organized in trust form, land subdividers and commercial developers, and general contractors.

A statistical examination of the relation between the stock-based and appraisal-based series finds that the lagged returns of the real estate stocks help explain the behavior of the current-period appraisal series. The stock market apparently impounds information about changes in real estate values in a more timely manner than appraisal-based series constrained by infrequent property appraisals.

Both practitioners and academics have become increasingly interested in the risks and returns of real estate ownership. In the absence of a centralized exchange to record sales, appraisal-based data such as the Russell-NCREIF Property Index (RNPI) are often used to analyze real estate returns. Such appraisal-based series are imperfect proxies for actual market conditions, however, largely because property valuations occur infrequently (quarterly at best), so appraisal-based series contain stale prices.¹ This shortcoming has been highlighted recently by the failure of appraisal-based return indexes to capture either the timing or the magnitude of the recent dramatic downturn in commercial real estate markets.

This article presents and analyzes the return behavior of a stock-market-based index of real estate performance. The index is composed of real-estate-related equities traded on the New York and American stock exchanges (NYSE and Amex). The firms in the index include owner-operators of existing properties as well as developers.

Previous real estate research has primarily examined the returns of equity real estate investment trusts (REITs). That work generated two findings of particular relevance to this article. First, there is no significant contemporaneous correlation between equity REIT and

appraisal series returns. Second, equity REIT returns are significantly positively correlated with broader stock market returns such as the S&P 500.²

Those findings have led many to conclude that share prices are not reliable guides to real estate values. It is important to realize that such a judgment implicitly assumes the superiority of the appraisal series. The lack of contemporaneous correlation between the two real estate series may simply mean that stale appraisal prices are not reflecting information about real estate fundamentals in a timely fashion. We present evidence of the timeliness of market-determined real estate returns; real estate stock prices more accurately captured the industry downturn in the late 1980s than the well-known RNPI series.

Despite the lack of a contemporaneous relation between appraisal and stock series, we conclude that there is an important connection between the two. This conclusion is based on a statistically and economically significant relation between lagged real estate stock returns and current-period returns on the appraisal-based RNPI. The evidence indicates that the two series incorporate similar information about real estate fundamentals, but the stock-based index does so in a more timely manner.

THE DATA

The traded real estate index includes the stocks of four types of real-estate-related firms—(1) equity real estate investment trusts (REITs); (2) property operating companies not organized in trust form; (3) land subdividers and developers; and (4) general contractors. The first

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group, equity REITs, has the largest representation in the index in terms of both number of stocks and market capitalization. REITs are investment trusts run by firms that own and operate real properties. Trust status exempts these firms from the corporate income tax if they follow various rules, including provisions on income pass-throughs to investors.³ Equity REITs are a subset of standard industry classification (SIC) 6799. We used Standard & Poor's *Handbook of Real Estate Securities* and various issues of the *REIT Fact Book* and the *REIT Source Book* to identify REITs and to separate equity REITs from mortgage and hybrid REITs.

Our selection of the three other types of firms is based on the notion that, because their core business is real estate, via either ownership or development, price fluctuations for these securities are driven primarily by real estate market fundamentals. We used Standard & Poor's *Handbook of Real Estate Securities* to help identify these additional stocks. Most closely related to the equity REITs are the operating companies not organized in trust form. These firms have SIC codes ranging from 6512 to 6519. Few traded owner-operators choose to organize without trust status. Prior to 1979, the sample contains only one such firm. Until 1987, the sample contains less than 10 listed real estate operating companies.

Two types of firms comprise the developer component of the index. One, a group of general contractors (SIC 1521-1542), includes mostly residential builders that build for contract, not on their own account as speculative developers.⁴ The second includes land subdividers and developers (SIC 6552). These firms are primarily commercial developers, and if they do own properties, they tend to relinquish them after development is finished.

The index does not include some other categories of stocks that might be considered real-estate-related. For example, some restaurant and vacation businesses have valuable real property holdings. Industry suppliers such as lumber and wood products firms are also dependent in part on real estate market fortunes. We focus on the four categories of firms described above because it is clear that their core business is real estate. The strength of the relation between these stocks and the real estate market provides an appropriate foundation for examining whether the stock market accurately reflects information about real estate fundamentals.

We obtained all return and market-capitalization information for our real estate stocks from the monthly files of NYSE and Amex stocks provided by the Center for Research in Security Prices (CRSP). The real estate index and all subindexes we present are value-weighted, and each includes firms that subsequently failed or were delisted for other reasons. (A complete list of stocks in the index is available from the authors on request.) The appendix provides a list of the monthly returns for the index from January 1975 to December 1991.

Two other real estate series are examined. One is the National Association of Realtors' (NAR) monthly

series of existing-home price appreciation, obtained from the WEFA Group. These data run from January 1966 through December 1991. The underlying prices are based on transactions in a large number of metropolitan areas throughout the United States. This series is based solely on rates of appreciation, because the implicit rent on owner-occupied housing is not observed. As a result, the NAR series does not represent the total return to residential ownership.

The last real estate series is the Russell-NCREIF Property Index (RNPI), a widely known appraisal-based series of commercial properties. The National Council of Real Estate Investment Fiduciaries' (NCREIF) *Annual Supplement to the NCREIF Real Estate Performance Report* describes the index in detail.⁵ Only quarterly returns are available for this series, beginning in the first quarter of 1978. These data run through the fourth quarter of 1991, corresponding to the final quarter for which we have stock return data. When comparisons are made with this index, all monthly stock (or bond) returns are compounded to create quarterly return data.

We also collected data on general equity market, interest rate, term structure and inflation movements. The S&P 500 and a small-stock index capture the broader equity market. The small-stock series is based on the returns of NYSE and Amex firms that are among the smallest 20% in market capitalization on the NYSE. All stock market returns include both dividends and capital gains. Bond market variables include the returns on a portfolio of long-term Treasury bonds, as well as one-month and three-month Treasury bills. With the exception of the three-month Treasury bill, which is from the CRSP government bond file, these stock and bond index variables are from Ibbotson and Sinquefeld through the end of 1987; updates through 1991 are from Ibbotson and Associates, Chicago.⁶

The inflation variables discussed are derived from consumer price index (CPI) data. Expected inflation is based on an estimated ARMA model. Experimentation showed that the structure of the ARMA model is not stable over time. Consequently, we estimated rolling forecasts with a new ARMA model specified each period. Unexpected inflation is the difference between actual inflation and the ARMA forecast.

RETURN CHARACTERISTICS OF THE INDEX

Table 1 provides a snapshot of the market value of the index and its component groups at year-end 1991. Of the \$14.10 billion aggregate market capitalization at year-end 1991, 64% is represented by the two owner-operator groups—the equity REITs and operating companies. The \$7.70 billion capitalization value of the equity REITs alone makes up almost 55% of total index value at the end of 1991.

The table also shows the distribution of the real estate index stocks at year-end 1991 across NYSE market-capitalization categories. The real estate stocks tend to be small-capitalization issues; 61% of the stocks in our index at year-end 1991 were in the smallest 20% of NYSE

Table 1. Market Capitalization of Real Estate Index Based on Year-End 1991 Data

| NYSE Decile Cutoffs | Market Cap. Values (\$mil) | No. of Stocks in NYSE Decile Category | | | | |
|-------------------------|-------------------------------|---------------------------------------|-----------------|----------------------|-----------------------------|------------------------|
| | | Composite Index | Equity REITs | Owners/ Operators | Subdividers & Developers | General Contractors |
| 1 | 75,653 | 0 | 0 | 0 | 0 | 0 |
| 2 | 5,008 | 0 | 0 | 0 | 0 | 0 |
| 3 | 2,230 | 0 | 0 | 0 | 0 | 0 |
| 4 | 1,108 | 4 | 2 | 0 | 1 | 1 |
| 5 | 653 | 7 | 4 | 1 | 1 | 1 |
| 6 | 402 | 9 | 4 | 1 | 0 | 4 |
| 7 | 243 | 8 | 4 | 1 | 2 | 1 |
| 8 | 147 | 10 | 7 | 2 | 0 | 2 |
| 9 | 87 | 7 | 6 | 0 | 0 | 1 |
| 10 | 42 | 55 | 21 | 8 | 17 | 9 |
| Total Number of Stocks | | 101 | 48 | 13 | 21 | 19 |
| Total Mkt. Cap. (\$bil) | | \$14.10 | \$7.70 | \$1.38 | \$1.86 | \$3.16 |

stocks. This is particularly true for the stocks in the two developer categories, 65% of which lie in the bottom 10% of NYSE stocks in terms of size.

Table 2 reports summary statistics for the monthly excess returns (defined as total return less the one-month T-bill return) on the index and its four component firm groups over the 1975–91 period. Because of the limited number of traded real estate firms prior to the mid-1970s, our findings begin in 1975. The overall index excess return averages just under 1% per month for the past 17 years. The associated monthly standard deviation is just over 7%.

In absolute terms, the general contractors' returns are the most volatile. Both absolutely and relative to mean excess returns, the equity REITs exhibit the lowest return variability. It is not surprising to find that the builders' stock returns exhibit the greatest variance. The demand for new construction activity is very procyclical.

As expected, the four types of real estate groups exhibit strong and statistically significant positive correlations with one another. The group of operating companies generally has the lowest correlations with the other groups. This partly reflects the small number of traded operating companies. (Recall that there is only one such firm prior to 1979.)

Including the developers (especially the residential contractors) tends to increase the variability of the composite index return. However, the overall *pattern* of the index's returns does not change with their inclusion, for two reasons. First, the small market capitalization of the developer firms makes their contribution to the returns of a value-weighted portfolio relatively small. Second, the business fortunes of both owners and builders of real properties are often affected in similar ways by the same market fundamentals.⁷ Given the similarity in the return patterns of the developers and owners, the remainder of

Table 2. Monthly Data on Real Estate Stock Index and Component Firm Groups, 1975–1991

| Asset Category | Monthly Percentage Excess Returns (Standard Deviation) | Simple Correlations (probability of observing larger ρ under null of $\rho = 0$) | | | |
|---|--|---|------------------------|-----------------------------|------------------------|
| | | Equity REITs | Operating Companies | Subdividers & Developers | General Contractors |
| Entire Index | 0.95 (7.16) | 0.84 (0.00) | 0.77 (0.00) | 0.87 (0.00) | 0.85 (0.00) |
| Equity REITs (SIC 6799) | 0.87 (4.86) | | 0.61 (0.00) | 0.80 (0.00) | 0.75 (0.00) |
| Operating Companies (SIC 6512-6519) | 0.81 (8.46) | | | 0.56 (0.00) | 0.59 (0.00) |
| Subdividers & Developers (SIC 6552) | 0.89 (8.43) | | | | 0.80 (0.00) |
| General Contractors (SIC 1521-1542) | 1.28 (10.53) | | | | |

Table 3. Monthly Data on Real Estate Stock Index and Other Assets, 1975–1991

| Asset Category | Monthly Percentage Excess Returns (Standard Deviation) | Simple Correlations (probability of observing larger ρ under null of $\rho = 0$) | | | |
|----------------------------|--|---|----------------|-------------------------------|------------------------------|
| | | S&P 500 | Small Stocks | Long-Term Government Bonds | Housing Appreciation Rate |
| Real Estate Stock Index | 0.95 (7.16) | 0.76 (0.00) | 0.90 (0.00) | 0.34 (0.00) | 0.29 (0.00) |
| S&P 500 | 0.71 (4.63) | | 0.79 (0.00) | 0.37 (0.00) | 0.26 (0.00) |
| Small Stocks | 1.20 (6.55) | | | 0.21 (0.00) | 0.30 (0.00) |
| Long-Term Government Bonds | 0.22 (3.43) | | | | -0.00 (0.94) |
| Housing Appreciation Rate | -0.10 ^a (1.55) | | | | |
| Inflation | 0.48 ^b (0.34) | | | | |
| 30-Day Treasury Bills | 0.64 ^b (0.22) | | | | |

^a The mean excess housing appreciation rate is negative, but note that average monthly total appreciation rate is a positive 0.55%.

^b Figure is a raw or total return.

this article focuses on the overall index. In a practical sense, including the developers in the index provides added diversification, without sacrifice of the essential real estate nature of the index's return.

Table 3 documents how the real estate stock index returns compare with a variety of stock, bond and housing returns. The real estate stock index's average monthly excess return (0.95%) is higher than that for all other reported asset categories except small stocks. The standard deviation of return (7.16%) is also the highest, however. The returns on the real estate stock index are strongly positively correlated with those of the broader stock market, particularly the small-stock index ($\rho = 0.90$). As Table 1 indicates, most of the firms in the real estate stock index are small-capitalization issues.

Given that our real estate securities are common stocks and that many are small-capitalization issues, the strong correlations with the S&P 500 and the small-stock index are expected. Indeed, much of the past research on real estate stock returns attributes the covariability solely to the fact that the real estate returns are computed from stocks. However, we believe that much of the common movement results from fundamentals that affect both the real estate stocks in our index and the returns on common stocks generally. Zeckhauser and Silverman report that roughly one-quarter of corporate value is related to real estate.⁸ This suggests that at least part of the variance in stock returns is related to changes in the value of corporate-owned land and structures. In general, we expect that the part of property market risk associated with the health of the economy should result in a positive correlation between property returns and returns on the broader market.

Supporting evidence for this can be found in the correlations of the other transactions-based real estate

measure with the broader stock index returns. The NAR appreciation rate is a market-determined, but unsecured, return measure. It, too, is significantly positively correlated with the S&P 500 ($\rho = 0.26$) and the small-stock index ($\rho = 0.30$), further suggesting that common forces influence both real estate and corporate value in qualitatively similar ways. As expected, the two transactions-based real estate returns, one capturing the nonresidential market and the other the residential market, are significantly positively correlated ($\rho = 0.29$).

The remainder of Table 3 provides information about the relation between real estate excess returns and bond market excess returns. The real estate excess returns are significantly positively correlated with excess returns on Treasury bonds. That correlation is slightly lower than the simple correlation between the excess returns for the bond market and the S&P 500. Unlike the real estate stocks, the housing appreciation series is virtually uncorrelated with long-term bond excess returns.⁹

Time Pattern of Returns

Figure A plots two compound excess return series for the real estate stock index. One series measures the compound value of the index return in excess of the return on the S&P 500. The second series measures the monthly compound value of the index in excess of the 30-day T-bill. Both series assume that \$1 is invested in the real estate index at the end of 1974, with all proceeds reinvested monthly.

Figure A shows that the relative performance of real estate firms listed on the NYSE and Amex has deteriorated substantially in past years. Relative to T-bills, the real estate stock index has been trending sharply down-

ward since March 1987. The December 1991 value reflects a 33% decline from that peak.

The real estate stock index also declined in value relative to the S&P 500. Measured net of the S&P 500, the index peaked in May 1983, declined steadily until November 1990, and remained relatively flat through the end of 1991. This decline represented a loss in value of nearly 63%. Because the real estate stocks in our index tend to be small stocks, the decline in the real estate stock index in 1983-91 may be confounded with the decline in small stocks relative to the S&P 500 over this period. As a check on this possibility, we measured the performance of the real estate stock index relative to small stocks. We found that, after accounting for the decline in small stocks during the late 1980s, the real estate stock index experienced an additional decline in value from a plateau in 1986 of approximately 25%. This is an economically significant decline that accords well with reported declines in commercial property values.

Figure A. Behavior of Monthly Real Estate Values as Reflected by Real Estate Index, 1978-1991

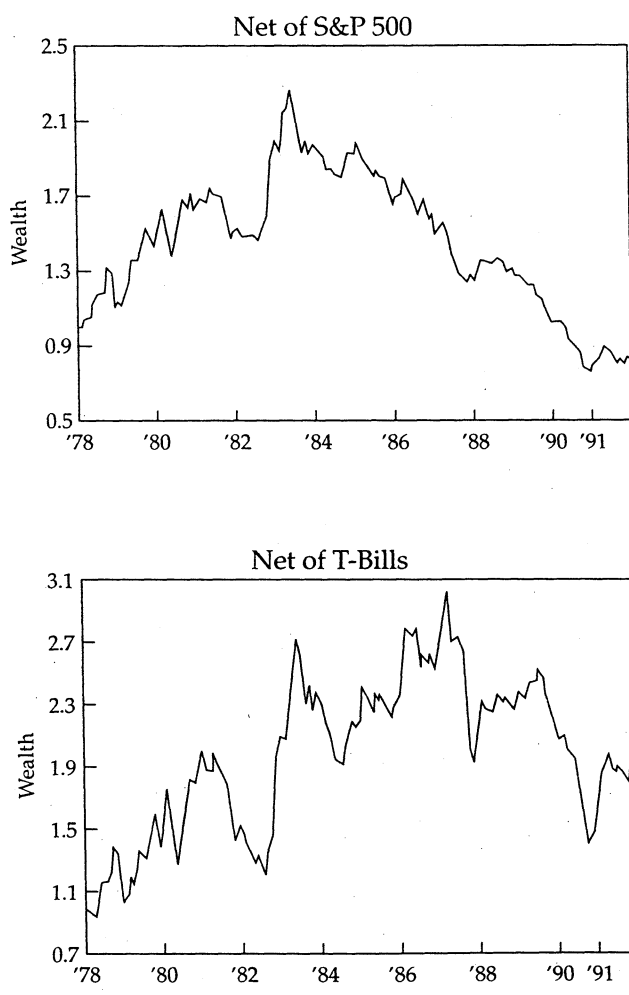


Figure B. Annual Real Estate Returns vs. Office Vacancy Rates, 1978-1991

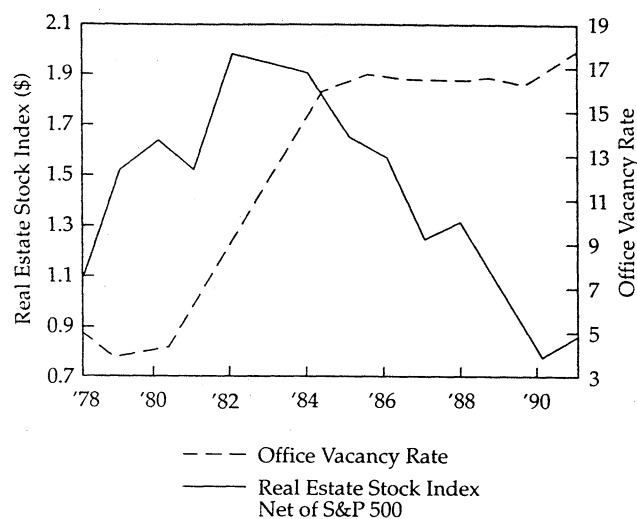


Figure B offers evidence on why the market penalized real estate firms. That figure plots the following series—(1) the annual cumulated value of the real estate index in excess of the S&P 500 and (2) the annual downtown-office vacancy rate compiled by CB Commercial (formerly Coldwell-Banker).¹⁰ The downtown vacancy numbers begin at 6.3% in 1978 and fall to a low of 3.7% in 1980. They rise slightly to 4.3% in 1981 and then rise rapidly in the next three years before plateauing at about 16% in the late 1980s. These vacancy rates track the commercial building binge that occurred in the United States during the 1980s. Vacancies have remained high in the 1990s because of overbuilding, compounded by declining demand.

The real estate stock index measured in excess of the S&P 500 was rising rapidly before vacancies hit bottom in 1980 and peaked well before vacancies peaked in the mid-1980s. This is precisely what one would expect of a well-functioning, forward-looking market. Stock market participants appear to have understood the implications of rising and then persistently high vacancies. Figure B shows that real estate firms began to be penalized relative to other stocks as early as 1983; when measured net of the risk-free rate, the real estate stock index began to increase at a much slower rate beginning in 1983, and actually began to fall in 1987 (Figure A).

The behavior of the real estate stock index over this period is consistent with a real estate market in which most tenants are locked into multiyear leases with a small percentage of leases expiring each year. By the latter part of the 1980s, tenants were able to obtain space very cheaply in a market with persistently high vacancies. In that type of market, real estate firms have trouble earning even the risk-free return, much less the average return earned by firms in other industries.

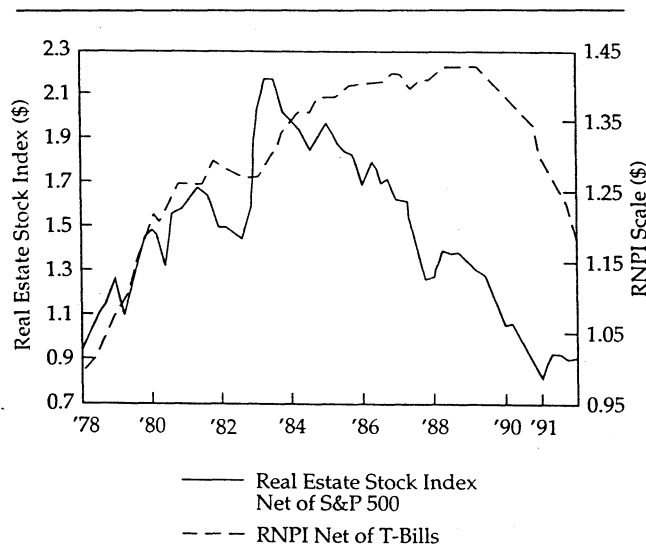
MARKET-BASED VS. APPRAISAL-BASED REAL ESTATE INDEXES

We now compare the abilities of the real estate stock index and the appraisal-based Russell-NCREIF Property Index (RNPI) to track movements in real estate values. The RNPI series suffers from two statistical shortcomings arising from the appraisal process. First, the smoothing inherent in the appraisal process results in an understated variation for the series.¹¹ Second, the infrequency of appraisals results in the index lagging changes in actual real estate values.

Although the low return variability of the RNPI series can be adjusted so the series better reflects market realities, the index's inability to capture major changes in real estate market trends in a timely fashion is more problematic. Figure C plots the quarterly compound values of the RNPI, measured in excess of the 90-day T-bill rate, along with the quarterly compound values of the real estate stock index, measured in excess of the S&P 500 index from the fourth quarter of 1977 through 1991. We report the real estate stock index net of the S&P 500 to capture "purer" value changes not confounded by general stock market movements.¹² Reporting the real estate stock index net of the S&P 500 implicitly nets out the T-bill rate, so we report the RNPI net of the T-bill rate for consistency.

The appraisal-based index rises continually until the third quarter of 1988. This is in marked contrast to the real estate stock index, which peaks in 1983. Thus, while the real estate stock index has been declining since 1983, the appraisal-based index rose by almost 8.5% between the first quarter of 1983 and the third quarter of 1988. Based on the pattern of vacancy rates shown in Figure B, the real estate stock index appears to reflect underlying fundamentals more accurately than the appraisal series.

Figure C. Behavior of Quarterly Real Estate Values, 1978–1991



We have suggested that the appraisal process itself is partially responsible for the sluggish nature of the RNPI. Even perfect appraisals, if they are made no more frequently than every quarter (and actual appraisals are often done only every six or twelve months), will result in a return index that incorporates changes in real estate market conditions only gradually. Our real estate stock index, which continuously (daily, at least) updates prices based on relevant information, should impound that information in a more timely manner.

This argument helps explain the lack of a significant contemporaneous correlation between the stock-based and appraisal-based index returns ($\rho = -0.05$ over the 1978–91 period). Combined with the visual evidence in Figure C, it also suggests that current-period real estate stock returns may be correlated with subsequent appraisal returns. We test for such a relation below by regressing current-period excess RNPI returns on lagged values of the real estate stock index return.

In order to analyze this relationship properly, it is important to account for the well-known persistence and seasonality in the RNPI returns.¹³ This is necessary because regressing a return series with strong persistence on lagged variables can result in spuriously significant explanatory power for the lagged variables. The RNPI returns exhibit very strong persistence, particularly at the first and fourth lags (denoted $RNPI_{t-1}$ and $RNPI_{t-4}$, respectively). Using quarterly excess returns (i.e., subtracting the 90-day Treasury bill return from the total RNPI return), Equation 1 documents the strong first and fourth-order autocorrelation:

$$RNPI_t = -0.0027 + 0.3342RNPI_{t-1} + 0.5468RNPI_{t-4} + \mu_t \quad (1)$$

(0.0018) (0.1365) (0.1432)

where μ_t is the standard mean-zero residual that by construction contains no persistence or seasonality. Estimated standard errors are in parentheses. The coefficients for both lagged terms are statistically significant at the 95% confidence level or better. The adjusted R-squared is 0.41.

Previous research suggests that the first-order correlation is indicative of appraisers reporting smoothed capital values in their valuation reports.¹⁴ It is possible that the strong influence of the fourth lag is also partially due to appraisers' smoothing. It is also possible that the fourth-order autocorrelation reflects an upsurge in appraisal activity at the end of the calendar year.¹⁵

To investigate whether the real estate stock index can explain variations in the RNPI series, we employ the residual (μ_t) from Equation 1 as the dependent variable. Its use eliminates the possibility that persistence in the RNPI will bias our results.¹⁶ To keep the specification as simple as possible, we use a single lagged value of the real estate stock index return as the independent variable. The lagged real estate stock index return ($RES_{y(-1)}$) is defined to be the compound index return in the four quarters constituting the calendar year immediately pre-

ceding current quarter t . The results of this estimation are given in Equation 2:

$$\mu_t = -0.0011 + 0.0166RES_{t-1} + \epsilon_t \quad (2)$$

(0.0016) (0.0054)

where ϵ_t is a mean-zero error term. The estimated standard errors are in parentheses. The real estate stock index variable is statistically significant at the 95% confidence level or better. The adjusted R-squared value is 0.14.

The adjusted R-squared implies that the lagged returns on the real estate stock index can explain 14% of the variance in the current-period RNPI return that has been purged of all its persistence and seasonality.¹⁷ Given the predictive nature of the regression, this level of explanatory power is significant.

Some of the persistence and seasonality in the appraisal data could be related to real estate fundamentals, so our findings almost certainly represent a lower bound on the predictive ability of the real estate stocks. Additionally, data limitations prevent us from accounting for leverage, and the return plots indicate that leverage is certainly adding variability to the real estate stock return series that is not present in the RNPI data.

CONCLUSION

The stock market provides a ready and useful source of transactions-based data for analyzing real estate market

risks and returns. From this admittedly *ex post* vantage point, the performance of real estate stock returns definitely looks more sensible and timely than does that of a prominent appraisal-based series. Important information about changing market fundamentals is incorporated into real estate stock returns before it is reflected in appraisal-based returns.

Our findings have important implications. They show researchers that the stock market provides reliable return measures for one of the most important, yet least studied and understood, asset categories. They show investors that decisions based on movements in appraisal indexes rely, in large part, on stale information. Asset allocation decisions based on stock-market-determined real estate prices will more accurately reflect current movements in real estate and other asset prices, yielding more sensible decisions. To the extent that market participants make investment decisions based on movements in appraisal data such as the RNPI, they are basing those decisions in part on stale information. Finally, reliable market-based prices are integral to the success of burgeoning real estate securitization efforts. Without investors' and sellers' faith that the stock market is providing sensible and fair valuations, equity securitization of commercial real estate is bound to fail. Our findings indicate that the stock market provides a reliable measure of real estate conditions.

Appendix. Monthly Returns for Real Estate Stock Index (%)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|------|-------|-------|--------|-------|-------|-------|-------|--------|--------|--------|-------|-------|
| 1975 | 42.08 | -0.36 | 14.97 | -6.55 | 4.46 | 7.56 | -3.64 | -6.63 | -11.37 | 1.63 | -1.34 | 4.53 |
| 1976 | 18.39 | 10.56 | 5.25 | -1.99 | -5.56 | 1.72 | -1.93 | -2.14 | 6.35 | -2.13 | 4.81 | 12.17 |
| 1977 | 0.37 | -2.96 | 0.45 | 2.42 | -2.22 | 7.27 | 0.74 | -2.72 | 1.70 | -5.94 | 9.60 | 0.41 |
| 1978 | -1.91 | -0.31 | 9.45 | 11.08 | 2.92 | -0.10 | 5.73 | 13.53 | -1.00 | -24.04 | 5.22 | 0.06 |
| 1979 | 11.36 | -1.66 | 14.88 | 3.93 | -2.42 | 9.95 | 4.96 | 9.08 | -1.77 | -11.60 | 6.22 | 8.42 |
| 1980 | 13.09 | -4.65 | -22.43 | 6.70 | 13.28 | 9.83 | 11.46 | -0.47 | 1.17 | 7.43 | 5.89 | -1.39 |
| 1981 | -2.84 | 0.81 | 8.00 | -2.36 | -0.52 | -1.15 | -1.36 | -10.84 | -9.34 | 2.23 | 6.96 | -1.91 |
| 1982 | -5.38 | -3.77 | -0.91 | 3.63 | -2.24 | -3.87 | 0.84 | 15.09 | 3.49 | 23.73 | 12.75 | 6.16 |
| 1983 | -0.11 | 6.14 | 10.95 | 8.54 | 4.80 | -2.40 | -8.29 | -3.45 | 5.59 | -5.89 | 6.10 | -1.40 |
| 1984 | -1.70 | -4.15 | 0.14 | -2.80 | -4.94 | 0.59 | -1.49 | 9.99 | 4.03 | 4.11 | -1.48 | 2.79 |
| 1985 | 10.58 | -1.39 | -2.97 | -1.22 | 5.77 | -0.44 | 1.51 | -2.49 | -3.24 | 2.87 | 3.03 | 2.12 |
| 1986 | 2.40 | 7.80 | 10.64 | -2.16 | 1.66 | 0.37 | -8.04 | 4.11 | -1.77 | 2.84 | -0.88 | -2.06 |
| 1987 | 6.72 | 7.67 | 5.45 | -5.12 | -5.52 | 0.86 | 2.00 | -0.71 | -4.07 | -22.21 | -2.42 | 3.08 |
| 1988 | 9.70 | 7.03 | -1.75 | 0.54 | -0.71 | 5.65 | 0.49 | -1.28 | 1.60 | -0.60 | -1.47 | 3.37 |
| 1989 | 3.19 | -1.49 | 0.97 | 3.08 | 2.87 | 0.35 | 4.43 | 0.32 | -0.87 | -5.93 | -2.11 | -2.43 |
| 1990 | -4.43 | 1.13 | 1.53 | -3.45 | -0.09 | -0.84 | -2.35 | -11.35 | -10.95 | -5.74 | 5.37 | 2.75 |
| 1991 | 11.43 | 8.16 | 7.54 | 2.48 | 2.61 | -5.60 | 1.34 | -1.21 | 1.99 | -2.37 | -1.19 | 14.39 |

FOOTNOTES

1. The first papers to detail the weaknesses of the appraisal-based series and to suggest ways to cleanse the data of appraisal-induced biases were S. Ross and R. Zisler, "Man-

aging Real Estate Portfolios. Part 2: Risk and Return in Real Estate, Addendum" (Real Estate Research, Goldman Sachs & Co., November 16, 1987) and "Managing Real Estate

- Portfolios. Part 3: A Close Look at Equity Real Estate Risk" (Real Estate Research, Goldman Sachs & Co., November 16, 1987).
2. *Ibid.*, also D. Hartzell and A. Mengden, "Real Estate Investment Trusts—Are They Stocks or Real Estate" (Real Estate Research, Salomon Brothers, August 27, 1987).
 3. These provisions are detailed in the National Association of Real Estate Investment Trusts (NAREIT), *REIT Fact Book* (Washington, DC: NAREIT), various years.
 4. Major contractors for bridges and other infrastructures are not included in this group. The government classifies them elsewhere.
 5. National Council of Real Estate Investment Fiduciaries (NCREIF), *Annual Data Supplement to the NCREIF Real Estate Performance Report* (New York: NCREIF and the Frank Russell Company, 1989).
 6. R. Ibbotson and R. Sinquefeld, *Stocks, Bonds, Bills and Inflation: Historical Returns (1926–1987)* (Charlottesville, VA: Institute of Chartered Financial Analysts, 1989).
 7. For more detail on the performance of the real estate index subgroups and for extensive references on previous research, see J. Gyourko and D. B. Keim, "What Does the Stock Market Tell Us About Real Estate Returns?" *Journal of the American Real Estate and Urban Economics Association*, Fall 1992.
 8. S. Zeckhauser and R. Silverman, "Rediscover Your Company's Real Estate," *Harvard Business Review*, January-February 1983.
 9. Although we do not report correlations with inflation, our data provide mixed evidence on the ability of real estate to hedge against inflation. The real estate stock index monthly excess returns are insignificantly negatively correlated with inflation. This relationship masks two very different results with respect to expected and unexpected inflation. The excess return is significantly positively correlated with expected inflation (a rho of 0.15) and significantly negatively correlated with unexpected inflation (a rho of -0.19). The housing appreciation series is weakly but insignificantly positively correlated with inflation, however measured.
 10. Vacancy data for the office sector are the most widely available. Although the office sector is probably more overbuilt than (say) the retail sector, it is generally reflective of conditions in real estate markets regardless of property type.
 11. There are actually two reasons for the low variance of the RNPI series. One is that the underlying RNPI properties are not levered. They were purchased by institutions on an all-cash basis. If one were to artificially lever these properties to the same extent that the average firm in the S&P 500 is levered, the return variance of the RNPI series would increase to roughly half that of the S&P 500. (See J. Gyourko and P. Linneman, "Analyzing the Risks of Income-Producing Real Estate," *Urban Studies*, August 1990.) Second, infrequent and staggered appraisal times across properties will smooth measured returns, even in the presence of debt. (See Ross and Zisler, "Managing Real Estate Portfolios, Part 2" and "Part 3," *op. cit.*)
 12. We simply subtract the monthly return of the S&P 500 from the monthly return of the real estate stock index.
 13. Ross and Zisler, "Managing Real Estate Portfolios. Part 2" and "Part 3," *op. cit.*
 14. *Ibid.*
 15. The end of the year obviously occurs every four quarters, and that is why end-of-year effects may show up as strong autocorrelation at the fourth lag.
 16. It is worth noting that it is unclear whether the full effect of the fourth-order autocorrelation should be purged as it has been from μ_t . As we have noted, some of that effect may be due to an upsurge in end-of-year appraisal activity. If so, that seasonality is not simply artificially induced "appraisal smoothing," but is reflective of new information about real estate market fundamentals that appraisers happen to be impounding into the RNPI index during the fourth quarter. If market fundamentals are involved, we would ideally like to test whether lagged real estate stock returns reflect that information before appraisers impound it into the RNPI. Because we cannot be sure just what the content of the fourth lag is, we decided to purge the index of all persistence and seasonality before testing whether lagged real estate stock index returns can explain some of the variation in the cleansed appraisal return series. This ensures a very stringent test and implies that any predictability found for the real estate stock series indicates that the stock market really is reflecting information about market fundamentals before the appraisal series does.
 17. It is slightly more efficient to estimate Equations 1 and 2 jointly. A joint estimation, however, does not change the key result about the predictive ability of the lagged stock index returns. Sequentially estimating Equations 1 and 2, as we have done, permits a clearer picture of just how much of the variance of the purged RNPI residual μ_t return can be explained by the real estate stocks. When the influence of the two lagged RNPI returns from Equation 1 and the lagged real estate stock index returns from Equation 2 are combined in the joint estimation, the adjusted R-square is 0.51 (51%). That is, half the current-period appraisal-based return can be explained just by referring to previous-period stock market returns and exploiting the persistence and seasonality of the index.