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Towards Indices of Real Estate Value and Return

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§1. Introduction

IN THIS PAPER, the construction of an index of value and return for non-owner occupied industrial property is chronicled. Although real estate is an important investment vehicle (aggregate value is large in comparison to the stock market), relatively little is known of the historical holding period risk and return for equity owners of real property. In a related paper [Hoag, 1979], current empirical knowledge of real estate returns is summarized and found to be meager. Practically, there are *no available indexes* which attempt to measure price appreciation, cash flow or return from real estate. Actually, many observers question the existence of one national real estate market. With no easily observable market transaction prices, there is little wonder about the paucity of index numbers. Worse yet, with no information available on investment returns it is very difficult to utilize current investment management technology (the Capital Asset Pricing Model—CAPM) to estimate the risk entailed in a real estate investment.

In Section §2, a conceptual framework for estimating real estate value and return is developed and related to methods currently utilized in common stock risk/return analysis.

The method of analysis expounded herein leads naturally to a consideration of a property valuation function based on a vector of fundamental microeconomic and macroeconomic variables which affect property value. With certain reasonable approximations, the valuation model leads directly to an estimate of the market rate of return on real estate, the risk and return associated with each property and the market risk. In this paper, the analysis focuses on time series properties of risk and return estimates for real estate. Coefficients of responsiveness to the fundamental valuation characteristics which are analogous to a multifactor analysis of common stock risk and return can be computed. The responsiveness coefficients are analyzed further in Hoag [1979].

This technique is specialized to one particular property classification in Section §3: industrial real estate (consisting primarily of warehouses with some light manufacturing and distribution.) The valuation factors relevant to these properties are detailed and the sample is discussed in Section §4. Section §5 presents the estimated valuation function and the returns on a subsample of carefully checked observations. The estimates of the valuation function are performed

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using pooled cross-section time-series regressions with generalized least squares estimators. Many measurement and errors-in-variables problems are alleviated using these techniques which allow unbiased, consistent and efficient estimates of the market return. The results in Section §6 indicate that equity investment in industrial real estate over a short period in the recent past had risk and return comparable to the stock market.

A discussion of future development in Section §7 finishes this paper. Both the methodology and the empirical results will improve as additional data items on a wider class of properties become available. These developments should begin to fill the vacuum of knowledge and paucity of empirical investigation with respect to investment in real estate.

§2. Conceptual Framework for Index Construction from Property Valuation

Analysis of historical common stock returns typically calculates before tax holding period returns using transaction prices and actual cash disbursals for uniquely identifiable assets. Methodological issues in construction of market indexes usually involve discussions of sample size and representativeness, appropriate holding periods relative to investor horizons, policies for rebalancing, techniques for aggregating or averaging returns across time or cross-sectionally and rules for weighting individual sample returns (see, for instance, Fisher [1966]). There are a wide variety of indexes available for the stock and bond markets. Most of these indexes are transaction based and many are calculated at daily and sometimes hourly intervals. The same situation does not exist in real estate. Individual transactions are infrequent and information on their number is unavailable. The investment holding period is purported to be very long (on the order of several years, at minimum).

The rapidly growing presence of more institutional investors in the real estate market coincides with other evidence that suggests that a national market has developed in investment real estate (Wendt and Haney [1979]). This development motivates the construction of a real estate index.

The focus is on the holding period returns for investment real estate. One often hears the contrary argument suggesting that if the investment horizon is long, then intermediate fluctuations in value are not very important. Perhaps this holds true for investors who don't sell frequently, have complete discretion in timing their sales *and* match the maturity structure of their liabilities to these long-lived assets. Alternatively, consider any intermediary which sells participations in pooled real estate funds. The effective holding period is the (typically) quarterly period for reporting to investors. Since investors can increase or decrease positions at this time, they are interested in quarterly values and hence quarterly holding period returns.

Initially, return computations are estimated before tax as returns to tax-free investors. Later the nontaxable and taxable portions can be broken out analogously to unrealized capital gains and dividends in common stocks. Thus, our intention is to calculate quarterly before tax holding period compound rates of

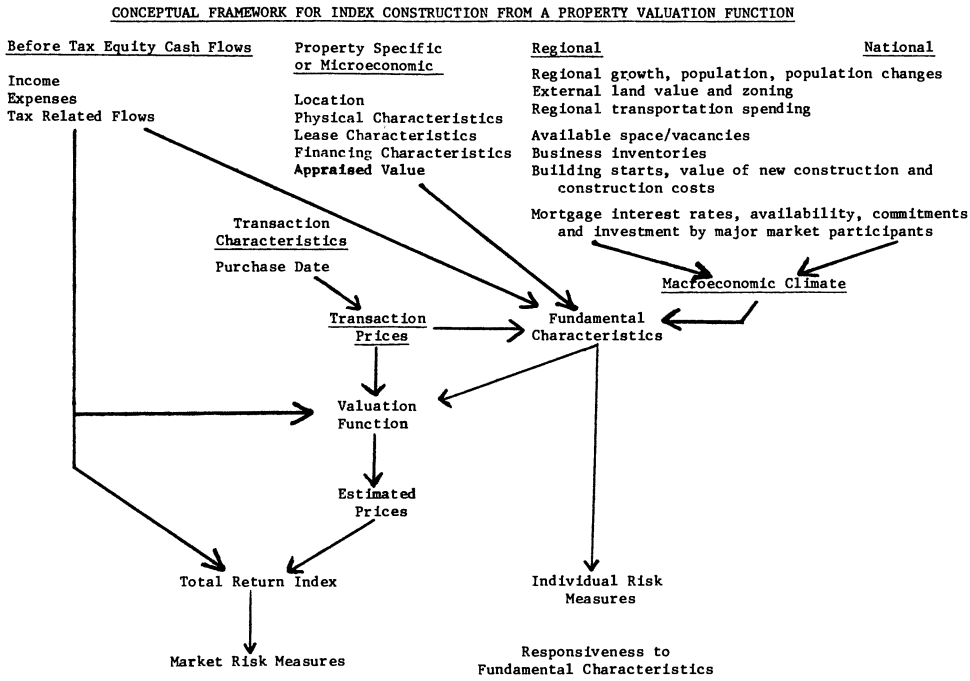

Figure I. Conceptual framework for index construction from a property valuation function

return. Given that the holding period and investment horizon are not known with certainty, compound returns are robust with respect to the relative lengths of these intervals (see Rosenberg and Marathe [1979]).

Note carefully that a real estate investment fund still has grave difficulties at the quarterly valuation point. A stock fund can easily value their assets, unless the stocks are infrequently traded.[1] Real estate funds faced with this valuation problem hire an appraiser who provides a (subjective) estimate of value, and thus a subjective estimate of return.

The technique proposed here uses fundamental characteristics to (objectively) estimate the value for a property at any point in time. The techniques used herein have been thoroughly developed for common stocks and have proved both useful and intuitively understandable for market participants. The technique outlined in Figure I requires fundamental valuation characteristics (such as location, property type, size and age), economic and demographic variables (such as business inventories, construction costs, transportation access and population), transaction prices and cash flows. This information is used to *estimate* a valuation function which is composed of weights for the value of each fundamental characteristic, that is, the responsiveness of property value to changes in the fundamental factors.

A real estate appraiser would call this the market comparison technique (see,

[1] For a discussion of valuation with infrequently traded stock assets using similar techniques to those proposed in Section §2, see Hoag [1980]. Dimson [1978], Schwert [1977] and Scholes and Williams [1977] also propose techniques for estimating systematic risk for infrequently traded assets.

for instance, Wendt and Cerf [1979]). But the technique is actually much broader than pure market comparison. Since the fundamental descriptors include cash flows, property type and location, all the raw elements are available for the equivalent of an income capitalization appraisal. Since construction cost indexes are included, the data for a replacement cost appraisal are also provided. Clearly then, a sufficient amount of information is available for an appraiser to make a judgment of value. The objective judgment of the valuation model simply supplants the subjective judgment of the appraiser.

This type of fundamental analysis is accomplished on a daily basis by security analysts in the stock market. Macroeconomic variables plus firm specific data (such as leverage and industry) are used to estimate the value of the firm. Furthermore, it is possible to use similar techniques to those proposed below to establish the contribution to security risk and return of various common factors (see, for instance, King [1966], Rosenberg [1974] and Rosenberg and Marathe [1976]).

Thus, the analogy is complete. Appraisers and security analysts use fundamental information to establish the *value* of their respective investments: real estate properties and common stocks and bonds. Portfolio managers bid on these investments based on these individual assessments of value, establishing a marketwide consensus[2] of value. If consensus expected returns reflect unbiased estimates of realized returns (rational expectations), then statistical techniques (such as those proposed below) should discern the elements of fundamental characteristic values.

Consider one potential improvement for the valuation scheme. If subjective evaluations of property values are available, consider adding them as a fundamental characteristic for the valuation function. If appraisers can systematically estimate value,[3] then these estimates will improve the valuation function.[4]

The valuation function is estimated using a sample of actual transaction prices from individual assets (data are described in Section §4), and fundamental characteristics collected about these properties (see Figure I, and Section §3 for a description of the fundamental characteristics).

At any point in time, a value for each nontransacting property is estimated from the valuation function applied to the fundamental characteristics at that

[2] One interesting question concerns the efficiency of the real estate market in processing fundamental information. Most real estate writers assert that the market is inefficient. The bulk of evidence for the stock market suggests that most public information is processed rapidly and efficiently. Of course, no evidence exists for the real estate market because no measures of return are available. Thus tests of market efficiency await completion of an index of market returns such as the one under construction herein. Until proven otherwise, a null hypothesis of efficiently established prices would seem prudent.

[3] The bulk of evidence in the stock market suggests that rewards for information processing are not consistently evident in returns to investment vehicles such as mutual funds. Thus, the null hypothesis is that if the model is adequately specified with fundamental characteristics, appraisals will *not* improve the valuation function.

[4] When the estimation of the valuation function is complete, an assessment of the value of appraisal information will be forthcoming. Given the breadth of the market data assembled for industrial properties plus the objective nature of the estimation procedure, it would seem unlikely that appraisers could have appraisals with consistently positive value.

time. From the valuation function, the individual compound rate of return can be estimated and the aggregate market value is estimated. From the aggregate market value and the cash flows, the total return index is calculated.[5] With the return estimate also comes an estimate of the standard deviation of market return. Further, it is possible to calculate the responsiveness of an individual property's risk and return to the fundamental characteristics of property valuation.[6]

In this section, the technique of fundamental valuation for properties has been compared to the same process in the stock market. The fundamental valuation process leads up to a market return estimate. Utilizing techniques developed from risk estimation for stocks (see King [1966], Sharpe [1973], Rosenberg [1974] and Rosenberg and Marathe [1979]), a fundamental valuation function is estimated in Section §5. (For details of the estimation process, see Hoag [1979, 1980]).

§3. Construction of an Industrial Real Estate Return Index

The success of the estimation of market return depends upon the choice of valuation characteristics. Any variable which estimates value should improve the efficiency of the estimation procedure. Indeed, econometric parsimony is *not* required here unless the model is unstable. Furthermore, intuitively understandable value measures should be preferred to technical value measures. Initially, the list of valuation characteristics should be very broad, but as experience grows, many candidate characteristics will be cast aside. Figure I lists a number of important characteristics for industrial properties.

One broad class of variables describes the general economic climate. These values fluctuate through time and provide a texture of time variation in the market rates of return for real estate (in conjunction with transaction prices). These variables attempt to capture the supply and demand for warehouse services, replacement costs and potential profits of warehouse ownership.

For industrial real estate, a number of specific or microeconomic characteristics can be examined. The physical characteristics literally describe the building, its surroundings and location. Notice that the location interacts with specific regional macroeconomic variables such as transportation spending to provide a context for regional valuation if it is warranted.

Next, the actual transaction price and any qualifications are analyzed. The qualifications are used to screen out any swaps or any partial transactions which are not reflective of *the* price paid for the property. At least initially, swaps and joint purchases (or packages) are avoided so that pure valuation characteristics for industrials can be identified.[7] In addition, any transaction costs paid to locate or purchase this property are included as part of the fundamental characteristics.

[5] Under certain assumptions, detailed in Lintner [1975], this market return is a value weighted index of the compound rates of returns for individual properties.

[6] The relationship of common stock risk and return to fundamental characteristics has been demonstrated in the stock market (see, for instance, Beaver, Kettler, Scholes [1970] and Rosenberg and McKibben [1973]).

[7] Later, it should be possible to value packages of properties or buildings with mixtures of property types in the same way that it is possible to value a conglomerate merger using value additivity.

If financing exists, a number of variables which are fundamental to the valuation process can be examined. Although leveraging for tax purposes is *not* common among institutional investors, these investors participate in a market which may include taxable investors. Therefore, it is possible that the tax effects, credit availability, and borrowing restrictions for other purposes influence the valuation of real estate properties. Another area where these effects are apparent (and potentially useful in valuation) is in the depreciation and amortization schedules. Although the main concern is with before tax rates of return, it is very possible that overall value is affected by the participation of individuals and institutions with diverse marginal tax rates.[8]

The cash flow stream is a very important part of the valuation process. Not only is the cash flow included directly in return calculations, but its components are potentially useful in the valuation function itself. For instance, a building with large maintenance expenses may be in need of massive repairs. Finally, it is necessary to examine the stability and variability of the cash flow stream. Crude measures of maturity and lessee credit ratings potentially provide useful valuation information.

The purpose of examining the fundamental characteristics of property valuation is to provide insight into the underlying valuation process. Many of the characteristics which seem to be intimately related to the valuation process may not have any empirical importance, whatsoever.

§4. Industrial Property Subindex: Sample Selection and Characteristics

The need to concentrate on one homogeneous property type is apparent when the number of potential real estate investments is considered. Of the many property types, industrial properties seem to be the most homogeneous and their valuation characteristics seem readily discernible. It is difficult to check this sample for representativeness. Any extrapolation to population parameters should be made with great care and attention must be paid to the problem of retrospective inclusion and survivorship bias. These problems tend to inflate the values of return estimated from a sample, and it is likely that our sample suffers from these biases to some (currently unknown) degree.

The sample used for calculations in this next section consists of 463 properties with transaction prices at some time during the twenty four quarter interval from first quarter 1973 through the fourth quarter 1978. This subsample was chosen because only these observations have been verified for accuracy and completeness. Only those locations and time periods where sufficient data existed could be used in the estimation process. As more information on industrial properties becomes available, the estimates of return and risk will change—perhaps dramatically at first. As the sample size increases, further changes should be small. From the little information analyzed from the *Site Selection Handbook* and

[8] For excellent analyses of this effect in the stock market, see Litzenberger and Ramaswamy [1978] and Rosenberg and Marathe [1979]. An analysis of the overall effect of taxation on relative asset prices appears in Hoag and Rosenberg [1979].

Table I

Industrial Property Sample Characteristics*

$\bar{P}_{it}$ = \$1,167,000
$\sigma(P_{it})$ = \$1,039,000
Max $\{P_{it}\}$ = \$8,241,000
where P_{it} = the price paid for i industrial property at time t ($i = 1, \ldots, 463$.)

Temporal Distribution of Transactions

	1973	1974	1975	1976	1977	1978
Quarter						
1	21	13	18	14	16	47
2	6	24	35	5	14	8
3	13	23	22	9	39	6
4	9	14	34	9	55	9
Annual	49	74	109	37	124	70

Geographic Distribution of Transactions

North East	40
Central	59
South	168
Mountain	13
West	183
	463

* The Industrial Property Sample at the University of California, Berkeley currently has information on 800 industrial properties with at least one transaction each over a period from 1970 through today. Institutional donors of this data have been especially generous with their time and information. This data base will be expanded and updated in future years.

Western Real Estate News (see Sand [1978]), the sample does not look wholly unrepresentative, but the results must be treated with care. A complete description of the sample appears in Table I.

§5. The Fundamental Valuation Function for Industrial Properties

To alleviate problems of substantial pointwise error in any cross-section, pooled cross section time series regressions can be estimated over the entire ensemble of observations of transaction prices. Essentially, estimation of the pooled data implies a stationary valuation function. It is relatively simple to decide on the validity of this procedure for any particular sample.

In Table II estimates of the parameters of the valuation function for industrial properties appear. The sign and magnitude of most of the coefficients in this model are reasonable. In particular, a great deal of importance is attached to the income capitalization rate which is also very significant (20 times its standard error[9]) in our regressions. All of the fundamental financial characteristics add to

[9] Interpretation of individual coefficient standard errors should be made with great care due to the multicollinearity of the independent variables. In Hoag [1980] as in Rosenberg [1974] factor analytic techniques are used to produce independent predictors of value. Alas, intuitive explanations of these factors are not possible and, hence, these techniques are not presented herein.

the explanatory power of the model. Additionally, the macroeconomic (regional and national) variables add further to the model. The locational variables detracted somewhat from the regional economic concomitants since each represents essentially a localized measure of value. The existence of significant coefficients for the location variables can be attributed to a lack of strong regional concomitants for industrial properties in the model or segmentation in the real estate market.

The overall performance of the model is quite reasonable with an adjusted R^2 = .89. Quite a large portion of the variance in transaction price can be explained through the relationship in the model in Table II. The goodness of fit of the fundamental valuation model improves the chances of providing reasonable estimates of the value and return of industrial real estate.

§6. Historical Risk and Return Estimates for Industrial Real Estate

Results based on the sample described in Table I and the valuation function estimates in Table II indicate that the average compound returns for the industrial real estate value weighted subindex over the period 1Q73 through 4Q78 were 3.38%/quarter with a quarterly standard deviation of 8.61%. The return is high and the risk is comparable to that obtainable on stocks and corporate bonds during that period, as can be seen in Table III. As is commonly observed in

Table II

Relative Asset Valuation Function for Industrial Properties*

$$P_{it} = \alpha_0 + \underline{\alpha}_f \underline{f} + \underline{\alpha}_n \underline{n} + \underline{\alpha}_r \underline{r} + \underline{\alpha}_l \underline{l} + \underline{\alpha}_q \underline{q} + \epsilon_{it}$$

$\bar{R}^2 = .89 \quad S(\epsilon) = 352. \quad \bar{F}(33, 429) = 108.6$

		α. Coefficient	*Standard Error*
	$\underline{f}$ *Fundamental Characteristics of Value*		
f_1:	income in year of purchase	9.8	0.42
f_2:	expenses in year of purchase	−1.65	.90
f_3:	net lease variable	79.3	41.8
f_4:	capital improvements in year of purchase	−.58	.14
f_5:	size measure	−.0081	.00086
f_6:	expense measure	.013	.00297
f_7:	lease attractiveness measure	.0086	.001
	$\underline{n}$ *National Economic Concomitants of Value*		
n_1:	business inventories in quarter of purchase	−3.1	.43
n_2:	nationwide volume of sales of industrial properties	6.22	2.06
	$\underline{r}$ *Regional Economic Concomitants of Value*		
r_1:	$ value of loans committed in the region of the property	3.09	2.85
r_2:	measured capitalization rate on property in the region	−65.5	62.3
r_3:	capitalization rate dummy variable for credit availability	722.8	633.8
r_4:	regional volume of sales of industrial properties	−8.4	2.8
	$\underline{l}$ *Locational Characteristics of Value***		
	$\underline{q}$ *Temporal Characteristics of Value***		

* The micro and macroeconomic characteristics of value are described in more detail in Hoag [1979] and the estimation of the valuation function for industrial properties is described in detail in Hoag [1980].

** See the discussion for a description of these variables and their effects on property value.

Table III

Comparative Historical Summary Statistics for Quarterly Compound Returns, 1973–1978*

	Mean	Standard Deviation**
i_t	.0196	.0061
r_{ft}	.0152	.0031
r_{Bt}	.0155	.0402
r_{St}	.0092	.1038
r_{REt}^{EW}	.0211	.0953
r_{REt}^{VW}	.0338	.0861

Cross Correlation Coefficients**

	i_t	r_{ft}	r_{Bt}	r_{St}	r_{REt}^{EW}	r_{REt}^{VW}
i_t	1	.68	−.50	−.41	.79	.50
r_{ft}		1	−.36	−.33	.39	.28
r_{Bt}			1	.64	−.49	−.31
r_{St}				1	−.21	−.07
r_{REt}^{EW}					1	.99
r_{REt}^{VW}						1

where

i_t = the rate of inflation as measured by changes in the Bureau of Labor Statistics Consumer Price Index

r_{ft} = the rate of return on U.S. Treasury Bills with 3-month maturity

r_{Bt} = the total rate of return on corporate bonds measured by the Salomon Brothers High Grade Long-Term Corporate Bond Index

r_{ST} = the total rate of return on the Standard & Poors' value weighted 500 Stock Index

r_{REt}^{EW} = estimated total rate of return on an equally weighted portfolio of industrial properties

r_{REt}^{VW} = estimated total rate of return on a value weighted portfolio of industrial properties

* Historical returns for bonds, stocks, treasury bills and the rate of inflation were obtained from Ibbotson and Sinquefield [1979].

** The variances and covariances presented have been adjusted for serial correlation due to random pricing errors. For details, see Hoag [1980].

common stock portfolios, the equally weighted industrial real estate index has a larger variance than the value weighted industrial real estate index.

It appears from this evidence that the cross correlations provide a sound basis for fulfilling the inflation hedge and diversification motives of investors. In Figure II, the time series behavior of the total rate of return on industrial real estate is displayed. There appear to be sizeable fluctuations which are, of course, corroborated by the 18% annual standard deviation for industrial real estate over this period. It does *not* appear that real estate was substantially *less* risky than common stock. However, the sample period was one of relative uncertainty in the investment real estate industry due to the virtual collapse of a number of

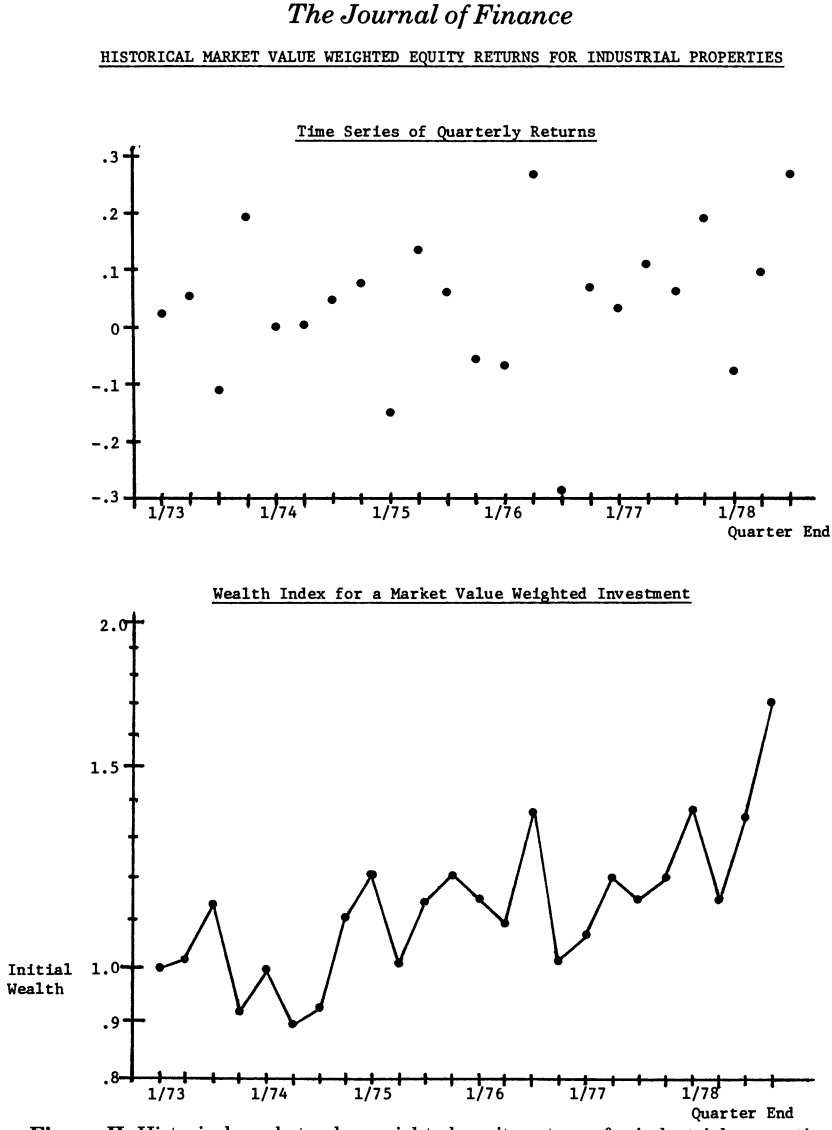

Figure II. Historical market value weighted equity returns for industrial properties

Real Estate Investment Trusts (REITS). More definitive results on real estate investment characteristics await further data collection and analysis.

§7. Potential Applications and Future Developments

Perhaps the best indication of the importance of this work is the breadth of potential applications in the real estate investment management arena. The availability of an index of returns permits the evaluation of realized returns on individual properties on an objective basis. The fundamental valuation characteristics permit measurement of historical risk characteristics for each property.

When properties are sold, it is possible to objectively evaluate performance compared to a broad based sample of industrial properties.

One classic objection to previous market indexes has been the lack of real estate representation. With the inclusion of our real property indexes, major objections to missing assets in the "market" portfolio are alleviated.[10]

Further, this new market index and its associated portfolio lead naturally to a redefinition of a passive investment strategy which would include market value weighted portions of all real estate assets. To say that this would be a change in investment strategy for institutions is an understatement. In addition to pursuing the passive strategy, it will be possible *to analyze* asset allocation strategies which differ from the passive strategy. Since industrial real estate appears to have a low correlation with stock returns, it should be a good diversifying asset. Once the matrix of covariances of returns between stocks, bonds *and* all real estate is available, investment managers can rationally explore the efficient frontier.

Last, but not least, the availability of this technique and the fundamental valuation parameters permits investment managers to perform objective evaluations of properties in their portfolio. Thus, in addition to hiring an appraiser, the valuation function can provide a computer based "appraisal." Clearly the fundamental valuation technique embraces *all three* commonly used appraisal strategies and combines these techniques with a broad data base for reference. It would only be natural to compare these two estimates of value to cross check and confirm the valuation. In fact, it would be interesting to look for appraisers that choose properties with positive abnormal returns, much as stock portfolio managers attempt to identify security analysts that pick winners. Regardless of the availability of superior selection ability in real estate, the index and valuation techniques can help in the active management process.

Finally, the real estate indexes are an indispensable tool in valuing contingent claims upon the equity returns of real property. For instance, mortgages, mortgage bonds, mortgage backed bonds and pass through certificates all rely upon the cash flow from real estate investments. In the same way that it would be difficult to evaluate risky bonds without the value of the underlying stock and company, it is harder to value these mortgage related instruments without knowing something about equity real estate returns.

Thus, the real estate index is potentially useful throughout the investment management process. Ongoing research in this area includes the completion of the industrial property data base, installation of an ongoing data collection mechanism and continual updating and reestimation (whe.. necessary) of the industrial real estate subindex. Further developments include an expansion of the

[10] Another use of the techniques of this paper which is related to the index issue is obtaining estimates of return for any large stock index which includes assets (such as real estate or OTC stocks) which trade infrequently (or nonsynchronously). This problem was first pointed out by Fisher [1966]. Our method calls for the introduction of fundamental factors into the valuation process coupled with smoothed time varying generalized least squares estimates (for a review of these techniques, see Rosenberg [1973]) of the logarithmic returns. Contrast this technique with those of Dimson [1978], Schwert [1977], and Scholes and Williams [1977] who use limited descriptor sets consisting of historical β and OLS estimates for nonsynchronous assets. Efficient, unbiased estimates can be obtained from the technique proposed in Hoag [1980].

data base and indexes to the other main areas of real estate returns and finally a link between all return subindexes to create an overall market index for investment real estate.

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