Is a True Transactions-Based Real Estate Index Possible?

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- Technically, a true transactions-based real estate index is possible to create; in practice, however, it would be nearly impossible to produce such an index.

- The major logistical obstacle to making such an index is the value of information to key market participants. In the relatively inefficient markets in which real estate trades, market participants have good reasons for not fully disclosing all transaction details.

- Even if key market participants regularly divulged all the details of their transactions (and if pricing formulas were highly accurate), the confidence interval for the resulting transactions-based real estate index would be too large for the index to have practical value as either a performance benchmark or a portfolio planning tool.

The Nature of the Need

Since society first developed a surplus (savings), there has been a need to invest and a related need to monitor investment performance. Since real estate is the oldest (and the most internationally common) form of wealth, it naturally follows that investors want to track its performance. Today, the Department of Housing and Urban Development tracks housing prices, the Department of Agriculture tracks farmland prices and most securities firms track the prices of publicly traded mortgage instruments. However, the housing and farm price series are aggregate indexes and, unlike a stock or bond index, their underlying components cannot be purchased in financial markets. Most of the mortgage series report performance more similar to fixed income than to equity investment. As investors attempt to diversify efficiently across asset classes, they seek an equity real estate measure that is comparable to the commonly quoted stock and bond indexes (both foreign and domestic).

There is a series of contenders for the role of real estate proxy in investor’s asset allocation models. The major measures are the Frank Russell Company Property Index and the returns from the Prudential Property Investors Separate Account (PRISA) portfolio. Both are widely reported measures of appreciation and income returns for large portfolios of investment-grade real property, but for both, quarterly property values are estimated by using appraisal techniques that are known to provide “smoothed” return series. The ultimate effect of this smoothing is to reduce standard deviations of returns and impart a bias of indeterminable direction on correlation coefficients. The combination of these two measurement errors leads researchers to question whether informed asset allocation decisions can be made by using appraisal-based returns.

The obvious problem in constructing a return series for real estate is that properties simply do not trade on a frequent basis; thus, prices that represent a “meeting of the minds” cannot be observed regularly within this asset class. Because “identical” financial assets trade frequently, these prices are available, and holding period return calculations can be made using actual transactions. This method is inapplicable in real estate (for example,
the same or an "identical" property does not trade every quarter), so alternative techniques for constructing a return series from market transactions must be developed.

In this paper, we test the viability of using a hedonic pricing model to derive a true transactions-based real estate index. The technique involves identifying and pricing attributes of the property and is in widespread use in residential housing studies. We apply this methodology to the commercial real estate market. An indexing technique is included for converting the results of the hedonic pricing model to a measure of changes in value.

We have tested the feasibility of this technology by using the Charlotte, North Carolina, industrial market as our model. Clearly, the construction of an index for each major market would be expensive, but successful implementation would have a dramatic impact on asset allocation decisions and, hence, on capital markets in general.

A Transactions-Based Property Performance Index

Quantification of equity real estate returns came of age when institutional investors, particularly pension funds, moved into real estate equities in the 1970s. A series of major return indexes is currently available to the investor seeking either a real estate proxy for his asset allocation model, a real estate performance benchmark, an appraisal comparison, or other investment-oriented data (see Appendix A). Today's best decisions probably result from a combined use of several measures.

Reviewing these options for alternative return measures, most mixed-asset investors seem to agree that the creation of a quarterly commercial real estate equity index that is both current and transactions-based would be a great step forward. The transactions-based index proposed here uses a two-stage approach: The first step uses information from actual sales to determine which property characteristics explain the price variation across sales of a particular property type in a given local market; the second formulates a price index from this information. The first step produces a homogeneous product, such as the price of a square foot of industrial space in our specified area, Charlotte, while the second constructs the index from changes in the price of this homogeneous product. Such an index could be easily used with other sources, particularly the FRC Index, which offers the income component of the total return, and certain regional models, which are useful when translating ex post returns into ex ante projections.

The Hedonic Pricing Model

The underlying notion for the first stage in the price index formulation comes from hedonic pricing models, where each of the model's coefficients represents the contribution to total value or the rent provided by a particular property attribute. The general formula that is used in commercial property hedonic models is:

\[
\text{Rent per square foot} = f(X_1, X_2, \ldots, X_k, b_1, b_2, \ldots, b_k, e) \tag{1}
\]

where the \( X_i \) (i=1,2,...,k) represent property characteristics, such as location, the age of the structure and the quality of amenities, the \( b_i \) are the coefficients (hedonic prices) that must be estimated by a regression analysis and \( e \) is an error term (it is seldom possible to predict the dependent variable perfectly). To specify the model, it is necessary to determine the appropriate property characteristics, because the model defines the data requests that will be made from the relevant market participants, and the variability of the measures of these characteristics will determine the precision (the size of the confidence intervals) of the computed index.
The limited number of commercial property studies that are available focus on office properties in select metropolitan areas. There is no consensus in these studies concerning which independent variables should be included in the model. Also, the surveyed studies examine rental rate variation, not actual prices. Finally, the specific model formulation that is considered the "best" varies across the studies. In short, the literature is inconclusive in regard to both the correct functional form and the appropriate set of independent variables that should be used.

Our methodology follows that used in previous studies. However, we consider the entire building as the unit of observation, and we model the value per square foot. The change in price per square foot leads naturally to a price change index. The most important logistical consideration in creating the transactions-based price index is the estimation of the value coefficients (noted as \( b \) in the model above), a step that demands a thorough and accurate compilation of independent variables from several sources in the surveyed market. The data collection must include information on the following:

- **Locational Characteristics (L):** relevant locational parameters for each property in the local market, including such information as the census tract, the square feet of similar space within the surrounding "X" miles or blocks, the driving times to city centers and so on;

- **Structural Characteristics (S):** age, number of floors, amenities, prestige proxy, GLA per tenant and the like;

- **Financial Characteristics (F):** number of tenants, expected NOIs, vacancy levels, original lease length, weighted average number of months left on lease, types and terms of leases (percentage rents, escalations and net versus gross), and lease guarantees; and

- **Time/Date of Sale.**

Rewriting the model, the first stage of the index construction is the estimation of the following equation:

\[
P = f(L, S, F, b; e)
\]  

(2)

where \( P \) is the price per square foot; \( L, S, \) and \( F \) represent the groups of variables described above; \( b \) represents a set of unknown regression coefficients; and \( e \) represents an error term. The dependent variable (the sales price, \( P \)) is adjusted for time by using the Consumer Price Index (CPI).\(^3\)

For this test, data were collected on all industrial property transactions in Charlotte for the period from January 1, 1983, to December 31, 1985.

The first step of the process is to adjust the reported sales price for seller financing, extra land and other characteristics. Such adjustments to the

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2. Final model specification depends on the availability of data in the sample market, as well as the determination of appropriate value characteristics for each property type. In all cases, a thorough and accurate collection of data is essential, because major data errors can cause severe distortions in a regression framework.

3. Ideally, there would be adequate sales each quarter so that the values of the independent variables could be established solely from data on sales in the preceding quarter. Because the average number of sales per quarter is seven, several quarters must be aggregated to obtain a sufficient sample size. Such aggregation requires a price-level adjustment of the dependent variables; without it, the change calculated in our formula would channel the impact of inflation from the midpoint of the estimation period to the end of the most recent quarter. With a price-level adjustment and the assumption of stable coefficients over the estimation period, the change measure that is subsequently developed properly picks up only the current quarter's appreciation.
sales price are relatively straightforward and include the present value of
the difference between seller financing and "market" financing, the market
value of any excess peripheral land and other factors that could reduce the
reported sales price. This adjusted price is divided by the usable square feet
(not the figure for the rentable area, which varies with leasing strategy) to
obtain the "homogeneous" pricing element — the adjusted price per usable
square foot in a local market at date t.

The Price Index

Given the model estimated in the first stage, several potential avenues exist
to derive the objective, the price index. Hedonic price indexes in housing
literature use the "typical" house in the area surveyed and "price" the house
by multiplying "reference values" for the typical home by the estimated
coefficients from the first stage hedonic model. This generates an estimated
value, which is then used in studies of supply and demand, house price
inflation, depreciation, and the like. Adjusting to the current situation, we
estimate the values of the independent variables over a four-quarter
period. These are the underlying data for the first stage estimation, which
produce the estimates for the $b$ coefficients in equation (2). In the
subsequent quarter, actual transactions are surveyed to measure the
characteristics of value for properties that have been sold. The measures of
the characteristic variables are then multiplied by the estimated first stage
coefficients to generate expected price per square foot, which we express as:

$$p^E = f(L,S,F,b^*)$$

(3)

where $b^*$ is the set of estimated coefficients, $p^E$ is the expected price per
square foot, and the other variables are as previously defined. The
difference between the actual observed selling price (in the fifth quarter)
and the estimated expected selling price is the change in value over the
quarter, or

$$\Delta P = P_t - p^E_t$$

(4)

where $\Delta P$ is the change in price, $p^E_t$ is the price expected in period t from
equation (3) and $P_t$ is the actual price observed in period t. This change in
value is obtained for each of the surveyed properties that sold in time t. In
other words, $p^E_t$ is the price that would have been appropriate, given all
available information in the period prior to the index period, whereas $P_t$ is
the actual price in the index period. The difference then, is the change in
price over the index period. An index of the change in value is then
obtained by weighting each of the price changes by property square footage
to obtain a size-weighted index change. Although an estimate of value is
clearly being used (the expected price in time t), it is drawn from actual
sales and is compared to an actual sale. The FRC Index compares two
estimates that are both based on comparable sales which typically span
multiple measurement periods.

Testing the Efficacy of the Index

The quality of the index greatly depends on the quality and quantity of
data employed in the estimation process. Estimation of the hedonic
equation requires four quarters of data. For the Charlotte test, information

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4 All sales prices in both the four-quarter rolling regression and the current period are adjusted for
"nonmarket" seller financing before the model estimation is made. Although the possibility of a bias in
such adjustments always exists, the probability of systematic error over four quarters is reduced by the
spread of the data, and the extensive literature on the value of seller financing offers evidence that those
adjustments are reasonable. Adjustments are also made, where practical, for income guarantees, options
and profit-sharing agreements. When these items are too complex to provide a straightforward adjustment,
the observation is deleted from the data base.

5 Because the regression-estimated value of each characteristic will lag the true estimate of value during any
period of change, the length of estimation period used should be as short as possible. When a greater
number of transactions occur per quarter, the parameter estimation period can be made shorter.
on all known sales of industrial properties was collected for the period spanning from the first quarter of 1983 through the fourth quarter of 1985. Using this information in formula (3) provides the $b^*$ coefficients (for each four-quarter period) that will be used in the second step.

All transactions for the first quarter of 1984 were surveyed to determine the value characteristics. Each value characteristic was multiplied by its $b^*$ coefficient, and the results were summed to generate the expected price per square foot ($P_{1E}$) for each sale. The change in price that will be used as the input to the price index is derived from both these values and the observed actual transaction price.

Several methods are available for producing the weighting used to calculate the Metropolitan Statistical Area (MSA) wide price change for each property type. For this report, weighting is calculated on a size basis, although a value- or equally weighted basis could also be used. The MSA price change index is determined by the following formula:

$$TP_t = \frac{\sum_{n=1}^{N} P_n x sf_n}{\sum_{n=1}^{N} sf_n}$$

(5)

where $n = 1, \ldots, N$ represents the properties surveyed in the fifth quarter, and $TP_t$ is the total weighted price. The use of this weighted price as a percentage of the total expected price per square foot of the properties surveyed in the fifth quarter, gives a percentage change. Starting at a level of 100 in the fourth quarter of 1983, this percentage can be applied to generate a new index value for the first quarter of 1984.

To update the index, the first stage model is re-estimated by using the second quarter of 1983 through the first quarter of 1984. The new indexing period for which all transactions and value characteristics are surveyed is the second quarter of 1984. By using the process defined above to calculate $TP_t$, a new percentage price change per square foot is derived to update the value index. This type of rolling regression is repeated in each subsequent quarter to generate a time series of index values and the price appreciation component of a total return index.

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**Data Collection**

The application of this index construction technique requires an extensive amount of data acquired through close cooperation with the local real estate development and brokerage communities in the subject market. The industrial property market in Charlotte was selected because of its homogeneity and simplicity. Charlotte is a growing distribution center and, thus, offers more industrial transactions than cities of comparable size. Further, given our extensive local contacts in this market, we believed that:

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6 Value-weighted or equally weighted indexes could also be generated for other purposes. Beginning property values are used in the weighting to avoid the obvious bias toward successful properties that would result from using end-of-period values.

7 The issues surrounding the use of averages when compounding rates of return are deferred to future work. This price change index could be combined with the income component of the FRC Index to obtain a total return index. However, because the greatest variance in the returns is expected to derive from a price change, analysts might choose to simply compare this index with corresponding price change indexes for stocks and bonds.

8 Charlotte's simplified concentric circle growth pattern clearly facilitates this research. Consider such regions as Las Colinas near Dallas or the sprawl of New York/Newark. These markets would be more difficult to analyze, because the available observations would be limited to the submarket or would combine several submarkets, which would necessitate use of additional explanatory variables to distinguish the effect of the particular submarket.
the collection of data would be a relatively inexpensive and simple task, at
least relative to similar efforts in other markets. Clearly, the city's industrial
property is easier to model than several other markets. Thus, a successful
model for Charlotte might not be universally applicable, but a negative test
would cast doubt on our overall ability to create such models.

The Procedure

Property-specific data were collected on all sales over the 12-quarter period
in the Charlotte industrial market (a sample survey is listed in Appendix B
on pages 13 and 14). The city is a close approximation to a "normal"
concentric circle growth pattern, which limits the need for additional
locational variables to describe submarket relationships beyond relative
ranking. The selection of industrial properties also theoretically reduced the
proliferation of descriptive variables, because industrial properties have
fewer qualitative variables to quantify and fewer quantifiable variables to
collect.

The properties used in our data base were limited to industrial properties
that were valued at more than $500,000 on county tax assessment records.
This value was arbitrarily selected to limit the range of properties to those
of institutional investment grade and size. This $500,000-parameter was
applied to all publicly recorded industrial transactions conducted between
1983 and 1985. REDI Data, a real estate data collection firm, was
employed to differentiate properties by usage. Properties zoned for
industrial use, with secondary classifications listed as warehouse,
manufacturing or research laboratory, were included in our search.
Following these criteria, our data base consists of the sales of 23, 48 and 80
properties in 1983, 1984 and 1985, respectively. Charlotte tax records noted
many of the variables that could be incorporated into the regression model;
the remaining variables that were deemed relevant to this analysis were
collected through onsite inspections of each property. During the inspection
process, properties that could not be adapted through the creation of
logical variable additions or that were misrepresented on county tax
records were excluded from our sample, including properties that were:

(1) heavy manufacturing facilities that lacked a cost-efficient means of
conversion to an alternative use; (2) storefront warehouse that functioned
primarily as retail space and demanded rents far above reasonable
industrial levels; (3) actual office space which may have received favorable
tax classification as research space; (4) land and structure purchases in
which the original structure was demolished; (5) sales that were
predominantly land purchases for future development; (6) intercorporate
transfers in merger or divestiture actions; and (7) interfamilial transfers of
legal ownership.

Some of these cases lack a true transaction price. Others stray from the
parameters that define the property type. If we included these transactions
in our model, they would greatly distort the results. Sales to investors,
tenants or users, and sale/lease-back transactions could be incorporated by
using dummy variables to represent the various "seller/purchaser"
relationships. Our screening yielded 81 properties over the three-year period
that were sufficiently homogenous to determine a series of variables that
could be used in our model.

Beyond data collection problems on the independent variables, significant
problems were encountered in obtaining complete specification of the
selling prices. In general, industrial brokers in Charlotte were not willing to
provide information beyond "a general selling price." Further, only one half
of the industrial transactions were conducted through a major developer or
broker in the area. For the transactions-based model to be indicative of
general market performance, each nonmarket financial characteristic serves as a necessary adjustment to the actual price $P_1$ in formula (4). It is clear that the collection of information on "price adjustments" requires far more than an appraiser "calling for comparables."

Of the 81 transactions chosen for our model, only 12 verified sales prices with necessary adjustments were obtained after 15 months of effort and, at least initially, a great deal of goodwill on all sides. Clearly, a total of 12 observations is insufficient to use in any type of sophisticated multivariate analysis. The list of independent variables exceeds the number of observations, which leaves no degrees of freedom in the data. In this case, the only recourse would be to drastically reduce the number of explanatory variables, which counters our preliminary findings that more rather than fewer variables are needed to compute price differences across properties.

Because few multivariate studies based on transactions data have been conducted, it is difficult to judge the sample size necessary to achieve results that possess a high degree of accuracy. Based on previous research, we believe that a sample size of between 50-100 transactions is needed to obtain enough diversity in the explanatory variables so that significant $t$ statistics for regression coefficients can be obtained.\(^9\) Even a significant $t$ statistic may not ensure the tight confidence intervals required if the derived index is to be useful in performance evaluation.

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**The Confidence Interval Issue**

Although the foregoing description of data accessibility problems casts a rather dark cloud over the research effort, an examination of the "what if" question brings the probability of creating a reliable transactions-based index to near zero. The exercise presented below uses actual Charlotte data to answer the "what if" question — what if true sales prices (with all necessary adjustments) had been obtained on the majority of the Charlotte sales?

Our hypothetical "best case" assumes that the local investment community provided full details on sales transactions of 50 Charlotte properties for the four-quarter estimation period (the actual number for the whole three-year period was 12). We also assume that a simple two-variable (distance to interstate, and functionality) pricing model explains 90% of the observed variation in selling prices. (We use only two independent variables to simplify the mathematics.) Finally, we assume that five new properties will be sold in the "next" quarter and that full information is available on each transaction. As the following calculations from the Charlotte data base indicate, the resulting price appreciation index would offer such a wide "confidence interval" that the measure would be highly unreliable as a tool for either performance evaluation or portfolio diversification planning.

Based on a random sample of 50 properties in the Charlotte data, the descriptive statistics for the two independent variables are as follows:

<table>
<thead>
<tr>
<th></th>
<th>$X_1$ (Interstate)</th>
<th>$X_2$ (Functionality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.57</td>
<td>7.10</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.67</td>
<td>2.05</td>
</tr>
<tr>
<td>Variance</td>
<td>2.78</td>
<td>4.20</td>
</tr>
<tr>
<td>Covariance</td>
<td>-0.83</td>
<td></td>
</tr>
</tbody>
</table>

---

The variance of functionality is higher, because it is measured on a scale of one to ten, while the distance to interstate highways is measured on a one-to-three scale (adjacent, within one mile, or greater than one mile). The negative covariance between the two characteristics is expected, because the more modern structures tend to be located closer to interstate access points.

The preceding table reports the actual descriptive statistics on the two independent variables. We use this information along with the specified explanatory power of 90% to calculate a set of mutually consistent values for coefficients, standard errors and t statistics for coefficients, and for the disturbance variance. These assumptions can then be used to generate confidence intervals.\textsuperscript{10} If we set the intercept term to 20, the price prediction equation (per square foot) is:


P_E = 20 - 1.0 \times X_1 + 1.0 \times X_2
\begin{align*}
&(-1.65) \\
&(2.03)
\end{align*}

\text{(6)}

The t statistics (noted in parentheses) indicate that \( b_1 \) (the coefficient of distance to interstate) is significant at the 10% level, while the t statistic for \( b_2 \) (the coefficient of functionality) is significant at the 5% level. These values are indicative of a well-defined pricing equation.

In the observation period (the current quarter in 1985), we observe the \( X \) variables for the five properties sold and can easily calculate a weighted-average predicted sales price per square foot (most importantly, we can estimate a variance for this prediction). The price appreciation is the difference between the actual weighted-average sales price (which is assumed known) and the predicted price. During the prediction period, the weighted average \( X \) variables from the actual data were 1.4 and 7.3 for interstate and functionality, respectively, for these five properties (these were selected at random from the remaining Charlotte database — the original 81 less the 50 already chosen).

Inserting these values in the pricing equation yields a predicted price of $25.90 per square foot (20 - 1.4 + 7.3 = $25.90). Assuming that the actual weighted average sales price for this quarter was $26.30, the appreciation is $26.30 - 25.90 = 0.4, or 1.54%.\textsuperscript{11}

We will assume a variance of 100 (or a standard deviation of ten) for the intercept term in the pricing equation, because this produces a t statistic of 2.0 (this is significant at the 5% level). Combined with the variances of the interstate and functionality coefficients, this figure yields a variance of 113.96 or a standard deviation of 10.675 for the predicted selling price that is derived from the model.

This implies that the 95% confidence interval around the predicted sales price of $25.90 per square foot is 5.0 to 46.8.\textsuperscript{12} This result produces a related confidence range on the quarterly appreciation from:

\[
\begin{array}{c}
26.3 - 5.0 \\
5.0 \\
\hline
26.3 - 46.8 \\
46.8
\end{array}
\]

or

\[
\begin{array}{c}
426.0\% \\
\hline
-43.8\%
\end{array}
\]

\textsuperscript{10} Calculation details are available from the authors upon request.

\textsuperscript{11} For comparative purposes, the warehouse component of the appraisal-based FRC index showed total appreciation of 6.1% for all four quarters of 1984; thus, 1.54% for one quarter is within a reasonable range.

\textsuperscript{12} A standard deviation of 10.675 times plus or minus 1.96 produces the 95% confidence interval around the predicted price of $25.90 per square foot:

\[
\begin{align*}
25.9 + 10.675 (1.96) &= 46.8 \\
25.9 - 10.675 (1.96) &= 5.0
\end{align*}
\]
Obviously, this range provides little confidence when applied to issues of performance evaluation or portfolio diversification.

Even if the variance of the constant term was zero (that is, if the term was known with certainty or if it could be suppressed with no loss of efficiency), the standard deviation of the expected price would be 3.74 and the confidence interval would range from 18.6 to 33.2.

Inserting these values in the appreciation index we obtain:

\[
\begin{align*}
\frac{26.3 - 18.6}{18.6} \quad \text{to} \quad \frac{26.3 - 33.2}{33.2} \\
41.4\% \quad \text{to} \quad -20.8\%
\end{align*}
\]

which is still a large interval and implies an unreliable index.

To arrive at an index with a confidence interval that is small enough to be useful, an interesting “catch 22” situation arises. The variances and covariances of the coefficients are inversely related to the variance and covariances of the explanatory variables. Thus, a greater variability in the explanatory variables results in more accurate coefficients for use in the prediction equation and, therefore, a more accurate prediction. Unfortunately, the variables’ values during the prediction period also affect the variance of the predicted selling price — as they increase, the variance of the predicted value increases. Of course, as the sample size increases, all problems are mitigated as the variances of the coefficients are driven to zero. However, the number of properties sold in any quarter in any market is hardly likely to approach “a very large number” in the near term.

Conclusions and Implications

Several conclusions can be drawn from this research: First, there is a genuine need for a transactions-based index. Second, a well-recognized methodology is in place that is adaptable for application to various sectors of the real estate market. Finally, because of the large amount of data required, it makes sense to test the model in a local market — the expense is limited and verification of sample variables is easier to establish. Overall, the technique is reasonable, and the project is testable. However, the base elements needed to construct the index are (1) expansive and potentially not cost effective to collect, (2) information that is not publicly available and (3) contrary to the day-to-day operations and thought processes of the individual market players.

There is no incentive for brokers or individual investors to provide the information (primarily, the transaction price and all the related financial terms of a transaction) that is needed to compute the index. Brokers, developers and individual investors are predominantly “micro-oriented.” The larger, nationally oriented companies, such as the Trammell Crow Companies and Coldwell Banker, are rarely sufficiently dominant in one market to assist in a “centralized” collection. (Only half of the Charlotte transactions involved any major broker/developers.)

This micro perspective creates a short-term outlook in which the benefits of a transactions-based index in terms of enhanced long-term institutional investment are lost.
Traditional concepts of vacancy and average rents are useful tools for both local and national players, and indexes based on these data have been easier to establish. Importantly, these are one- or two-variable measures that, in general, are easily defined and somewhat comparable across markets.

The cost, in time and dollars, for the staff in local firms to contribute to a transactions-based performance index would probably surpass the possible returns created by an incremental increase in institutional investment in the market (assuming that institutional investors are not waiting for the creation of such an index before they enter a given market). If investors demanded such an index, it would be a primary incentive for local market players to participate in the collection of transaction information; the lack of such an incentive seriously questions the viability of a transactions-based index.

An additional characteristic of real estate markets that serves as a barrier to the establishment of the index is the practical perspective of real estate as an "inefficient information" market, where information beyond the observable structural and locational characteristics is required. Brokerage is basically a knowledge business, where participants need to know the answers to questions, such as who needs what space, who wants to purchase what set of attributes, who wants to invest in what type of product, and who is paying what, besides the other aspects of real estate information. With the business based on this knowledge, it is against the nature of the market to simply give the information away. Given the current number of players in institutional real estate, which includes insurance firms and investment banks, it is doubtful that any national organization could "sell" a local market player on the idea that he should share the knowledge that he uses to compete in the local marketplace with a potential rival.

Even if market participants could be encouraged to provide accurate, detailed transactions data, the prospects for creating a true transaction-based market index would be dim. The catch-22 situation that was described previously suggests that the number of transactions needed to obtain a sufficiently tight confidence interval on the predicted sales price would vastly exceed the number of sales in any given market. Without tight confidence intervals on the predicted price, the resulting index would not be useful for either performance evaluation or strategic diversification analysis.

In summary, although there is a great intellectual appeal to establishing a transactions-based real estate index, it is, in reality, impractical. Based on the evidence here — the industrial segment of the Charlotte market does not even come close to "confering an index" — it is unlikely that today's institutional investors will be afforded a transactions-based commercial real estate index for all real estate markets. Thus, we believe that investors will take the "leap of faith" and use a combination of the available indexes with, for example, "Transactions Driven Returns" in their asset allocation models, or else they will continue to arbitrarily adjust risk parameters for the real estate asset class to bring them more into line with intuition.\footnote{See Real Estate as an Asset Class: A 25 Year Perspective, Mike Miles, Salomon Brothers Inc, January 1989; "Toward an Assessment of the Reliability of Commercial Appraisals," R. Cole, M. Miles and D. Guille, The Appraisal Journal, July 1986; and Real Estate Risk and Return: Results of a Survey, David J. Hartzell, Salomon Brothers Inc, March 23, 1989.}

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Appendix A: Sources of Real Estate Performance Data

Total Rate of Return Indexes

_The National Association of Real Estate Investment Trusts (NAREIT) Equity Index_

The NAREIT Equity Index is the longest-running series that is derived from equity real estate performance. Although the underlying shares of beneficial interest could be purchased in the market, the returns are not property specific and, collectively, they suffer from the traditional underpricing of closed-end mutual funds.

_The Frank Russell Company (FRC) Index_

The quarterly FRC Index is the most quoted measure of institutionally owned equity real estate. It is a property-specific total return index, but the values are based on appraisals (and, hence, are both smoothed and lagged), and the properties included vary from quarter to quarter.

Price and Value Measures

_Standard and Poor’s Property Performance Index_

Standard and Poor’s Property Performance Index is a relatively new participant in the area of real estate indexing and was previously published by the Liquidity Fund. The index purports to collect information from a wide variety of institutional sources, but the actual techniques used to construct the price index are not defined. For example, it appears that important value characteristics, such as property quality, size, and location within an urban area, are not taken into consideration. Thus, the comparison of the index from quarter to quarter, and from market to market, is unreliable.

_National Census Data_

The national census provides several measures on property value, but the information is outdated and is based on returns from surveys. Real estate-related information provided by the Bureau of Labor Statistics and the Bureau of Economic Analysis is generally of the same quality.

_Multiple Listing Services_

Multiple listing services report on the properties sold in most major markets. The data are timely but do not provide the terms of sale, and the sampling is incomplete, particularly for larger commercial sales.

Real Estate Market Data

_The Coldwell Banker Vacancy Report_

The Coldwell Banker Vacancy Report offers current and market-specific — such as city — information; however, vacancies are not a perfect measure of value, particularly with the increasing incidence of free rent and other tenant concessions. Also, this composite series is unweighted, and the cities included vary from quarter to quarter.
Regional Bank and Business Bureau Data
Several sources produce regional market models that combine various supply and demand factors to estimate a particular market's near- and/or long-term health. These data are useful, but they rely on secondary sources and thus are not always current, because their focus is oriented toward longer-term forecasting, rather than immediate reporting. The most common producers of this type of data are major regional banks and university-related bureaus of business research.

Private Data Services
Over the past few years, various private data service firms have been established to survey current market activity on a direct, ongoing basis. Some of the more ambitious are now in receivership, while others do not report real estate transaction details.

Local Government Data
Various local governments report property tax and/or title information. However, the information is usually not current, and the terms of sale are not documented in detail.
Appendix B: Survey Questions

Property Performance Index — Charlotte Industrial Property Sales Data

Property Type - Industrial
City - Charlotte, North Carolina

Background: Address of Sold Property ________________________________
(City and Street)

Reporting Broker ____________________________
Telephone ________________________________

Please rank the following qualities of the property on a scale of 1 (worst) to 10 (best):

(1) Relative Location Quality

Include commuting time, access, and view.

10 (Best) 177 & Billy Graham Exp.
1 (Worst) North Trion & Sugar Creek

(2) Relative Construction Quality Office

Includes amenities and landscaping (construction features that either reduce operating costs or enhance rent).

Rating of 10: A natural stone exterior, in-building parking, dining and health club facilities.

Rating of 1: A dryvit exterior, no raised floors and a lack of amenities.

(3) Industrial Functionality

Includes ceiling clearance and load-bearing capacity.

Rating of 10: Dock-high loading, extensive landscaping, 20% or more finished office space, fully air conditioned, 22 foot ceiling allowance, high quality single membrane roof, skin, and concrete in track parking.

Rating of 1: Grade-level loading, no landscaping, no office space, a metal or cinder block skin, and stone parking.

(4) Design Aesthetics

Includes architectural awards and historic landmarks.

The Seagrams Building is a 10.
Attractive, but without awards, is a 5.
A featureless box is a 1.

(5) Shared-Tenant Services

Rating of 10: All features available.
Rating of 1: No features.

(6) High-Tech Features

(7) Relative Quality of Tenants

Rating of 10: IBM.
Rating of 5: a local law firm with three partners.
Rating of 1: your ne'er-do-well cousin who sells gold coins.
(8) Relative Quality of Leases
Rating of 10: Long-term lease with 100% expense passthrough and full CPI base escalation.
Rating of 5: Short-term lease of up to two years.
Rating of 1: Long-term lease with no pass-through or escalation.

(9) Describe all key elements of any owner or owner-affiliate financing as well as any seller income guarantees or related items:

(10) Describe any major contingencies, options or repurchase agreements:

(11) Estimate the market value of any extra land, such as land that could be sold separately:

(12) List the number of usable (as often distinguished from gross and rentable) square feet in project.

If this is a mixed-use project, give the square footage by use:

(13) What percentage of the property was vacant at the date of sale (such as space with no signed lease and/or major acreage)?

(14) What is the net operating income expected for the current year (after property tax and insurance, but before major reserves and financing)?

(15) Date of Closing:

(16) Sale Price:

(17) Any other factors affecting the property’s value:

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