US commercial real estate indices: transaction-based and constant-liquidity indices

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Abstract

This paper discusses commercial price indices, focusing on transaction-based indices. It discusses the problems created by using transactions as the basis for a price index and solutions to the problems. It also introduces a recently derived index that provides measures of the value of commercial property in an environment where "liquidity" is held constant. Various transaction-based indices and the constant-liquidity index are compared with an appraisal-based index.

Introduction

Indices of the price performance of commercial real estate are important to multiple groups ranging from private market investors to pension funds. As described in a paper by Jeffrey Fisher at this conference ("US commercial real estate indices: The NCREIF property index"), the traditional method of valuing commercial properties has been to use appraisals. However, as Fisher notes, there are multiple problems with appraisal-based indices. These problems include the use of "stale" appraisals (ie dated appraisals) and inaccurate appraisals due to lack of current market information about the value of commercial properties. The latter problem causes appraisal-based indices to lag behind market changes in the value of commercial property. Further, Fisher notes that appraisal-based indices are smoothed compared with actual changes in market values. Thus, measures of the volatility of the value of commercial property are underestimated using appraisal-based indices. This mismeasurement could be important when attempting to optimally balance a portfolio of assets that contains commercial property. Fisher notes that "unsmoothing" techniques have been developed to attempt to counter this problem.

Standard transaction-based indices

An alternative to constructing an index of commercial property values based on appraisals is to use the prices recorded in transactions. Indices based on residential transactions are well known and have been created and used for over three decades. The methods for constructing these indices are well developed and thus a natural application is to commercial property.

There are various methods of using transactions to construct a price index. The most frequently used are the "hedonic-price" method, the "repeat-sales" method and the "hybrid" method. Each method uses econometric regression methods to explain price levels or price changes and then uses the results to create an index of changes in price for a "typical" property. Thus, this method "holds constant" the quality of the property, a requirement for creating a price index for a heterogeneous good.

The hedonic method has been in existence for over 70 years (Rosen (1974)) and was first used to evaluate price changes in automobiles. The fundamental relationship that is estimated is the link between the price of an asset and its characteristics. Examples include estimating the link between the transaction price of a property (commercial or residential) and characteristics such as its land area, structural area, quality of the structure, and locational attributes. Lists of characteristics included in estimations can often be extensive, depending on the amount of data describing the property.

If a dataset includes observations of transaction prices from multiple periods (months, quarters or years), then the hedonic-price method can be applied separately to each period. The result is a set of valuations of each of the characteristics of properties in each time period. These time-varying

valuations can then be applied to a particular set of property characteristics (often the sample's average values), yielding an estimate of property value for each time period. Next, these values for the selected constant-quality property can be transformed into a price index, which reveals the changes in the price of property over time. An often used alternative method is to pool all of the data and estimate a single set of valuations of the property characteristics, but include a set of variables that indicate the period in which the property sold (so called "dummy variables"). If the price is transformed into a natural logarithmic scale, the coefficients of these time period variables trace out a price index for properties.

The above technique is frequently applied to residential property because the needed data are available from both public and private sources and there are many transactions; however, it is more difficult to apply to commercial property. There are a relatively small number of large commercial properties and, of course, not all transact in a particular year. Further, one must collect an extensive set of descriptors of the property. Thus, while there are hundreds of hedonic-price studies of residential properties, there are only a handful of hedonic-price studies of commercial properties.

An alternative to the hedonic-price estimation method is the repeat-sales method. This technique, available for about 40 years, has been used to create house price indices, particularly in the last 10 years. A price index compiled using Freddie Mac and Fannie Mae data (the Conventional Mortgage Home Price Index) is available quarterly for the United States, its regions, states and major metropolitan areas. It is currently based on 17 million property valuations obtained when residential mortgages are purchased. The advantage of this method is that the dataset does not have to describe property characteristics when creating the index; rather, one need only observe the transaction prices for the same property from two periods. Based on the assumption that the property does not change quality, a price index can be created using the econometric technique developed by Bailey et al (1963). The repeat-sales technique is, in practice, impossible to apply to existing commercial property datasets. There are an insufficient number of repeat sales to create a reliable index due to the relatively small number of recorded property transactions.

The repeat-sales technique has been criticised because of its assumptions that properties do not change over time. All properties age and depreciate, and some are renovated. To account for these changes, Case and Quigley (1991) developed a hybrid technique that modifies the repeat-sales method to include selected property characteristics (similar to the hedonic technique) in the estimation model. Again, due to the lack of data, this technique can be applied to commercial property only with great difficulty.

The conclusion drawn from the above is that the most feasible method to create transaction-based commercial price indices is the hedonic-price method. The required data include transaction prices, characteristics of the property, and the date of sale.

Problems with the hedonic-price method of creating a transactions-based commercial property price index: the issue of sample selectivity

An important problem encountered when using the hedonic-price method to create an index of variations in prices over time is bias created by not using a random sample of properties for the estimation. This problem is known as sample selection bias. The basic problem is that not all properties transact during a particular period. If the properties that transact are not representative of the entire stock of properties, then the standard econometric techniques may yield biased estimates of the coefficients in the hedonic model and this may lead to a biased price index. Research by Gatzlaff and Haurin (1997, 1998) showed, using a sample of residential properties, that sample selection could induce biases in residential price indices. The analogy to commercial property is direct. If the commercial properties that transact systematically differ over time in ways not controlled for by the set of explanatory variables (ie property characteristics), then a commercial price index created from transacted properties may be biased. This problem is likely to be particularly acute for commercial property because only a small percentage of the stock of properties transact during any particular time period. The nature of the bias depends on the specifics of how transacted properties change over the real estate or business cycle.

Both formal search theories and intuition suggest that transacted properties may not be representative of the stock of properties. For example, in a normal market, the real values (ie deflated values) of

some properties will rise while others may decline. If the owners of properties with falling values tend to choose not to sell their properties, while owners of properties with rising values tend to choose to sell (or vice versa), then the sample of transacted properties is clearly not random and is biased towards a particular price outcome. It is also plausible that the choices of whether to sell properties with rising and falling values change over the real estate cycle and thus the nature of the sample selection bias will change over time. This changing bias results in an estimated transaction-based price index that differs from a price index that tracks the market value of the *stock* of properties.

Only through empirical testing can it be determined whether bias exists in a particular sample. There is a well known multi-step statistical technique that corrects for possible sample selection bias (Heckman (1979)). The first step develops a model of which properties sell in a particular time period, followed by the creation of a variable that corrects for the bias. The final step is to estimate the hedonic-price equation with this correction variable included (this variable is known as the inverse Mills ratio). This technique was followed by Gatzlaff and Haurin (1997, 1998), who used a sample of residential properties, and Judd and Winkler (1999) and Munneke and Slade (2000, 2001), who used samples of commercial properties. The data requirements are, in addition to the data needed for a hedonic estimate, knowing the factors that influence the likelihood of a property selling.[1]

Problems with the hedonic-price method of creating a transactions-based commercial property price index: the issue of time-varying liquidity

A price index should measure changes in the value of a representative property, where this property's characteristics remain constant over time. This requirement is similar to standard consumer price indices, where the requirement is that the market basket of goods remains constant over time. When creating the index based on the hedonic method, the method enforces the requirement that the observed property characteristics are unchanged. However, there is another important aspect of the transaction that should be held constant, but is difficult to do so in practice. This aspect is the "liquidity" of the market.

Market liquidity refers to the ease, or speed, with which properties transact, or are expected to transact. One measure of the liquidity of a market is the reciprocal of the transaction frequency. More commonly, market liquidity is measured as the expected time required for a particular property to transact. Thus, market liquidity depends on the relative number of buyers and sellers in the market at a particular time - reflecting the conditions of the market and other factors affecting purchase/sale decisions. It is important to note that the relative change in the number of sellers and buyers is fundamental to changes in market liquidity.

Market liquidity and transaction prices are related. Property owners can sell any given asset quicker and easier (holding price constant) when there are more buyers in the market (ie the market is more "liquid"). Alternatively, a property owner can sell a given asset in the same amount of time at a higher price when there are more buyers in the market. This relationship also holds when one aggregates the transactions in a market. Thus, transaction frequency (and liquidity) is positively correlated with the asset market "cycle". Controlling for market size, transaction frequency is typically greater when the property prices are relatively high and/or rising, and lower when prices are relatively low and/or falling. Relative to the general economic conditions, changes in the frequency of transactions are typically found to be procyclical and persistent. During "up" markets, capital flows into the real estate sector, there is a greater volume of trading, and it is easier to sell assets. Just the opposite typically occurs in "down" markets.

The relationship between transaction frequency and property appreciation is shown in Graph 1 below (reproduced from Fisher et al (2003)). The annual appreciation rate of the capital component of the National Council of Real Estate Investment Fiduciaries index (NPI) is denoted by the solid line for the period 1984 to 2001. The grey bars chart the percentage of properties in the NCREIF portfolio that transacted each year. A strong positive correlation between periodic movements in the annual

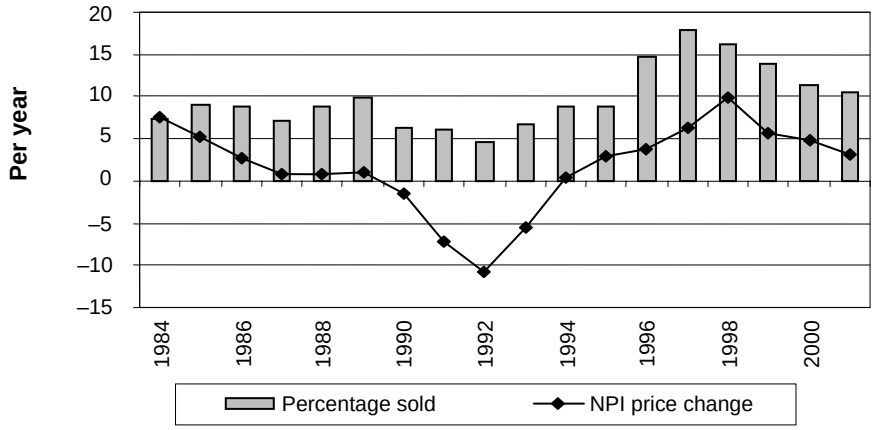
[1] One of the first fairly complete empirical models of a commercial property's probability of sale is in Fisher et al (2004).

transaction frequency and the rate of appreciation is noted. During the economic downturn of the early 1990s, both the percentage of transactions and the annual rates of appreciation experienced persistent declines from 1990 to 1992. Transaction frequency and appreciation rates then rose consistently until peaking in 1997 and 1998, respectively.

Graph 1

Transaction volume and capital appreciation in the NCREIF index

1984-2001, in per cent



The conclusion drawn is that transaction prices reflect not only property characteristics, but also market liquidity. While the issue of heterogeneous property characteristics can be addressed with the hedonic-price technique, it has to be modified to address the issue of intertemporal variations in market liquidity. Otherwise, variations in the price index reflect not only true changes in commercial property values, but also changes in market liquidity.

The solution to purging transacted prices of time-varying liquidity is fairly complex. Fisher et al (2003) developed a search model where a property owner has a reservation price below which he or she will not sell the property and potential buyers have an offer price that they will not exceed. Some matches of sellers and buyers are successful and transaction prices are negotiated. The frequency of these successful matches in the market during a particular period of time yields information about the liquidity of the market, and this information can be used to adjust the hedonic estimates of prices to hold liquidity constant. The method involves a three-step procedure where the first two steps are similar to the correction for sample selection bias. The final step fully identifies all of the parameters of the model, thus allowing for a correction to be made for time-varying liquidity.

The intuition of the above discussion is that the liquidity of the market affects transaction prices and prices in the market affect transaction frequency. Thus, there is simultaneous determination of prices and the probability of a property selling. Empirically, we observe both transaction prices and which properties sell, providing enough information for the analyst to separate these effects. This separation allows the possibility of creating a new price index, one in which liquidity effects are held constant.

An application to the NCREIF Commercial Real Estate Database

The results of a study by Fisher, Gatzlaff, Geltner and Haurin (FGGH (2003)) of the NCREIF Commercial Real Estate Database are discussed below. They created multiple indices of commercial property prices including an appraisal-based index, an index based on transaction prices, an index based on transacted prices but which includes a correction for selection bias, an index that holds liquidity constant, and a stock exchange based index (NAREIT).

Their database includes property-specific information on over 8,500 investment grade properties. These data have been used to construct an appraisal-based price index (NPI) since the fourth quarter of 1977. For 2001, quarter four, the NCREIF portfolio of properties includes 3,311 properties, with an aggregate appraised value of just over $100 billion. Properties included in this database are generally well distributed across the four major regions of the nation (East, Midwest, West and South represent 22%, 16%, 33% and 29% of the number of properties in the database, respectively). The database includes four property types: office (29%), industrial (29%), apartment (24%) and retail (18%). During the period 1982:2 to 2001:4, 3,138 properties sold and there are 27,254 observations of properties that did not sell during a particular year.

Results of the NCREIF application

FGGH's (2003) results are reproduced in Table 1 and Graph 2 below. The table presents a statistical summary comparing five capital return indices and the graph depicts the cumulative log value levels of these indices. All five commercial real estate value indices reviewed here present a similar general pattern, characterised by a very notable cycle, peaking in the mid- to late 1980s and again in the late 1990s (or possibly 2001). All five indices present a very similar long-run trend or average growth rate over the entire cycle. At a more detailed level, the five indices display interesting differences.

The appraisal-based NPI presents a smoothed and lagged appearance compared to the other indices. This is not surprising, given the nature of the appraisal process, and the way the NPI is constructed (including some "stale appraisals" each quarter).

Table 1

Annual return for five alternative commercial price indices

Annual return statistics (continuously compounded returns), 1984-2001

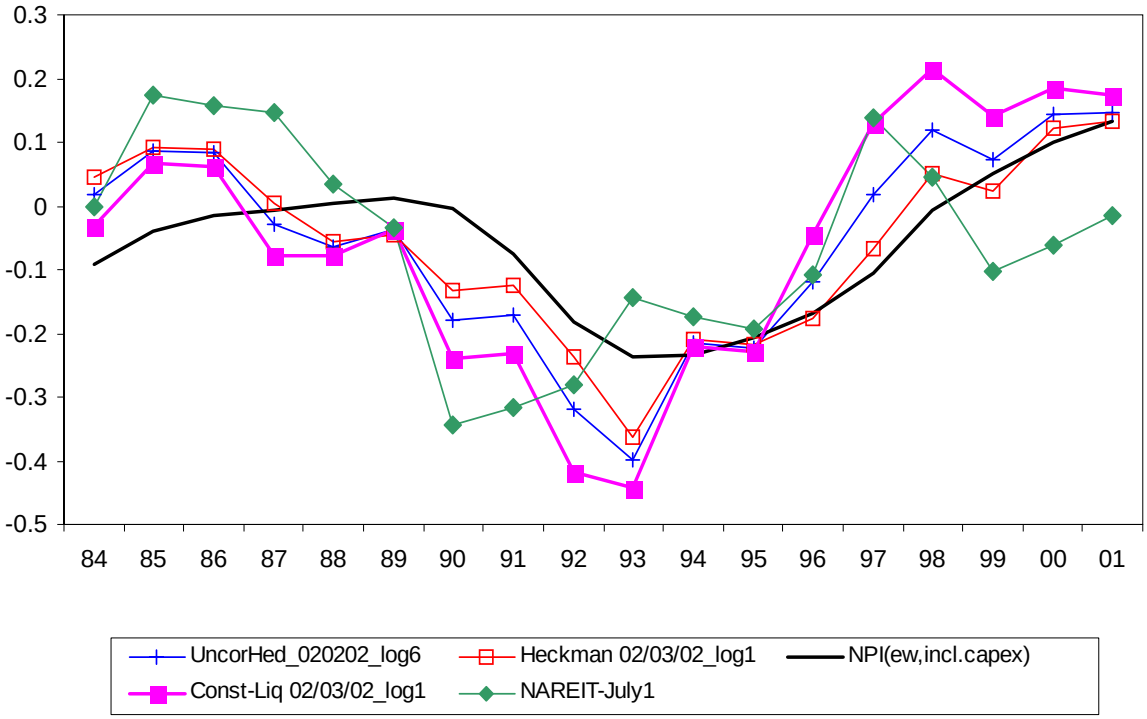
Index	NPI	Transaction-based	Selection-corrected	Constant-liquidity	NAREIT
Mean	1.32%	0.76%	0.52%	1.22%	–0.08%
Std dev (volatility)	5.22%	9.61%	8.33%	12.07%	12.99%
Autocorrelation (1st order)	0.801	0.081	0.066	0.088	0.102
Correlation coefficients					
NPI	1	0.584	0.631	0.495	0.024
Transaction-based		1	0.951	0.966	0.403
Selection-corrected			1	0.838	0.260
Constant-liquidity				1	0.502
NAREIT					1

Graph 2

Various indices of commercial price movements, 1984-2001

Transaction-based value indices of NCREIF vs appraisal-based NPI and securities-based NAREIT indices

Estimated log value levels (Set AvgLevel = Same 84-01)

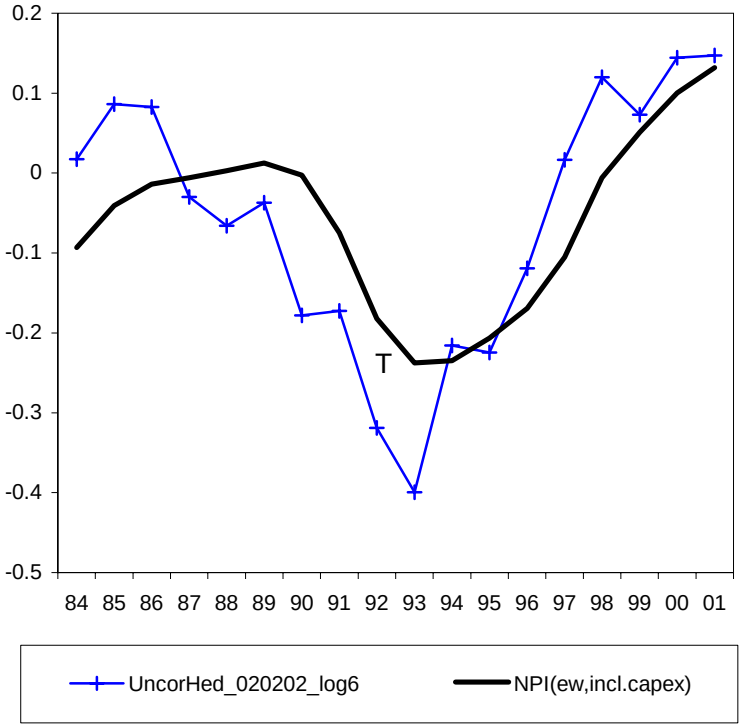


Notes:
The "uncorHed" index is the standard transaction-based index.
The "NPI" index is the NCREIF appraisal-based index.
The "Heckman" index is the sample selection corrected price index.
The "Const-Liq" index is the constant-liquidity index.
NAREIT is a stock market based index of REITs.

The three transaction-based indices (uncorrected transaction-based, selection bias corrected, and constant-liquidity) behave in a generally similar way, tracing out a pattern roughly in between those of the REIT-based index (stock) and the appraisal-based index. The uncorrected transaction-based index displays greater volatility and greater cycle amplitude than the appraisal-based index (see Graph 3), and it appears to temporally lead the NPI. Specifically, the peak in the mid-1980s is earlier (and similar to the NAREIT peak) and the rise out of the early 1990s trough steeper. Unlike the appraisal-based NPI, but like the NAREIT index, all transaction indices depict a down market during 1999, a period when commercial real estate securities suffered setbacks due to the 1998 financial crisis and recession scare, choking off a major source of capital flow into commercial real estate markets.

Graph 3

Transaction-based (uncorrected) vs the NCREIF (appraisal-based) price index



The selection-corrected transaction-based index lags slightly behind the uncorrected index (see Graph 4). Recall that the transaction-based index is the observed index, while the selection-corrected index is representative of the change in prices of the stock of commercial properties. This finding suggests that NCREIF members tended to sell their "losers" during the downturn of the early 1990s and sell their "winners" during the upswing of the late 1990s. Lower-quality properties would tend to suffer the worst performance during a severe real estate slump. Conservative institutional investors such as the pension funds whose capital is managed by NCREIF members may prefer to sell underperforming real estate during such a period, even though such a disposition policy makes their investment performance look worse during the down market. They may then try to recoup the performance hit by selling star properties in the upswing.

Graph 4

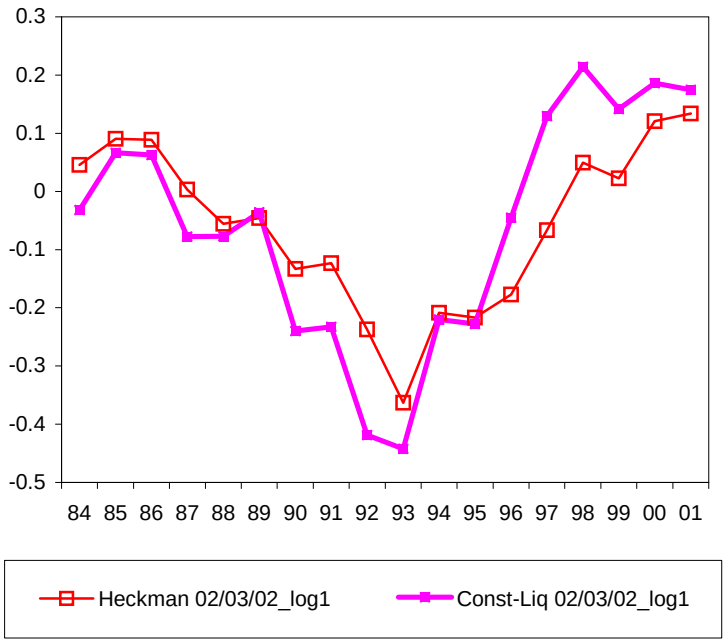
Sample selection corrected transaction-based vs the uncorrected transaction-based value index

The constant-liquidity value index displays greater cycle amplitude and greater volatility compared to the variable-liquidity transaction price indices (see Graph 5). Indeed the constant-liquidity value index has annual volatility almost equal to that of the NAREIT index (12% for the constant-liquidity index versus 13% for NAREIT, compared to less than 10% for the variable-liquidity price indices), and it has a cycle amplitude even greater than NAREIT in the 1990s upswing (see Graph 6). There is also evidence that the constant-liquidity value index leads the variable-liquidity transaction price indices in time, for example in the earlier peak in 1998 and the slightly faster fall in the late 1980s. The increased amplitude and volatility of the constant-liquidity index are consistent with buyers changing their reservation prices more so than do sellers in response to news.[2] Specifically, the temporal lead in the constant-liquidity index is consistent with "quick buyers" and "sticky prices" for sellers' reservation prices. A comparison of the constant-liquidity value index with the selection-corrected variable-liquidity price index suggests that both of these behaviours are present to some degree in the institutional commercial real estate market.

[2] Fisher et al (2003) derive a theoretical model that shows the relationship of the buyer and seller behaviour to the constant-liquidity and variable-liquidity indices.

Graph 5

Constant-liquidity index vs selection-corrected variable-liquidity index



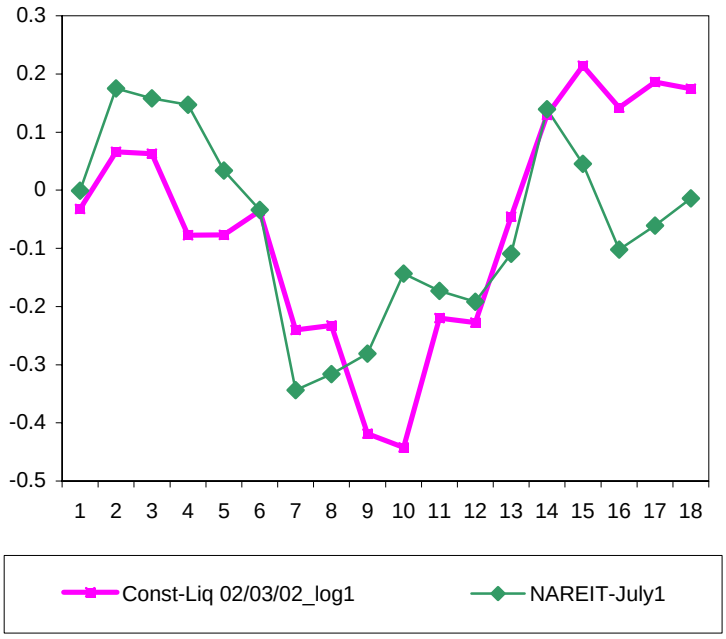
The stock exchange based NAREIT index presents a bit of an "odd man out" appearance, with some movements that are not echoed in any of the other indices. In part, this may reflect fundamental differences between REITs and direct property investments.[3] It may also reflect the effect of the different type of asset market in which REIT shares are traded. Obviously, the market microstructure and functioning of the public stock exchange are very different from those of the private real estate market, in which whole properties are traded. In addition, the investor clienteles are different between these two types of asset markets. There is some evidence of a lack of complete integration between the stock market and the private real estate market.[4] It is interesting to note that, in Graph 2, the NAREIT index shows some evidence of leading the private market indices in time, particularly in its turning points at the bottom of the cycle in 1990 and subsequent peak in 1997. This may reflect the greater informational efficiency of the public stock exchange mechanism, compared to private asset markets.

[3] The types of properties held by REITs are not exactly identical to the types of properties represented in the NCREIF database. In addition, REIT management policies and considerations (including property trading, development projects, and financial strategy) add a layer of investment performance results on top of that of the underlying "bricks and mortar" represented by operating property assets in place.

[4] See Ling and Ryngaert (1997) and Ling and Naranjo (1999).

Graph 6

NAREIT (stock) index vs constant-liquidity value private market index



Summary

This paper describes alternative indices of price changes for commercial property. The "traditional" measure of commercial property price change is based on appraisals. An advantage of this method is that all properties can be appraised relatively frequently (although this is costly). However, there are significant disadvantages, including the use of old (stale) appraisals. More importantly, appraisal-based indices tend to lag price shifts over the real estate cycle, this lag being substantial at times. Further, appraisal-based indices tend to be smoothed compared to other, more accurate measures of price change. A recent study by Fisher, Gatzlaff, Geltner, and Haurin (2003) of the NCREIF database confirms the existence of these problems. The appraisal-based NCREIF price index is both smoothed and less volatile than actual changes in commercial property prices.

An alternative method of constructing a commercial price index is to use data on observed transactions. Problems of smoothing and lagged measures of price changes are addressed with this method. The creation of a transaction-based index requires the use of a technique to adjust for quality differences among transacting properties. The most feasible method of controlling for property differences is to use the hedonic-price method. This method requires that the characteristics of transacted properties be recorded, a requirement that is typically met. Using NCREIF data, the feasibility of creating a transaction-based index was demonstrated.

A transaction-based index created with the hedonic-price method is also subject to particular problems. One is that the sample of properties that transact may not be a random sample of the stock of commercial properties. In this case it is possible that the index created from transacted properties is biased. FGGH (2003) found evidence of the presence of this bias, but the impact on the estimated commercial price index was relatively slight. A second problem is that the liquidity of the market varies over the real estate cycle. Thus, some transactions occur when it is relatively easy to sell a property (a liquid market) and others sell when it is relatively difficult to sell (an illiquid market). Holding the liquidity of the market constant is relatively difficult; however, FGGH present a two-equation model that allows for liquidity to be held constant.

The constant-liquidity market shows greater volatility than the simple transaction-based index. Changes in values in the constant-liquidity index tend to lead changes in the transaction-based index. It is sensible to argue that the desired measure of the value of commercial property is one where the

ease of selling a property is held constant over time. Our findings suggest that a constant-liquidity index is much more volatile than the commonly used appraisal-based indices. Also, the appraisal-based index lagged the constant-liquidity index by a substantial amount.

FGGH (2003) also compared the transaction-based indices to the NAREIT index of publicly traded REITs. The NAREIT index appears to be slightly more volatile and to temporally lead the constant-liquidity value index. The general pattern of price discovery seems to involve the NAREIT index typically moving first, followed by the constant-liquidity value index, then by the variable-liquidity transaction-based indices, and last by the appraisal-based NCREIF index. The total time lag between NAREIT and NCREIF can be several years, as measured by the timing of the major cycle turning points.

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Going where the data is

TWR's experience with real estate values

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Going where the data is: Torto Wheaton Research's experience with commercial real estate values

Torto Wheaton Research (TWR) has developed products to analyse the rent and vacancy forecast for commercial markets, but it has usually been left up to the client to translate this information into specific property incomes and values to inform pricing.[2] For several years, TWR has increasingly been doing this translation for clients, in consulting assignments and through software such as TWR Outlook Interactive. This paper provides a detailed explanation as to how rents and vacancies are connected to the investment variables that are of concern to investors, and how this information can be customised to specific assets. In this way Torto Wheaton Research develops its own valuation database.

NCREIF information on income, appreciation, and returns since 1978 provides a good benchmark of institutional-based real estate performance; however, this information is limited from a research/ econometric perspective in several ways. The data cover institutional real estate only, provide a limited sample size for most metropolitan areas by property type, and are not usually "market representative".

Additionally, NCREIF investment data are divorced from space market fundamentals. By this we mean that it is rarely clear how the income and appreciation variables in NCREIF connect to market rents and vacancies. For instance, a sample of office properties within a specific market might show great performance, but one does not know if this performance is due to rents, occupancy, or cost leverage. What is known is only how the properties in the NCREIF database in that specific market performed - not why.

While there are data available on space markets, and from NCREIF a second body of data on investment returns, both data sets exist in separate, unconnected worlds. As a subsidiary of C B Richard Ellis, Torto Wheaton Research has access to their information on rents and vacancy, which are already closely tracked by the brokerage community. Torto Wheaton Research's models "tie" together the investment measures (NOI growth, values, cap rates and returns) to the current and future fundamentals market (rents and occupancy). The *Torto Wheaton Research Investment Database* essentially integrates market fundamentals of economic demand, rents, and occupancy with a property by property dataset, including expenses, lease rollovers, and the like, to estimate gross and net income, future capitalisation rates, and values.

Discounted cash flow and the translation to investment variables

Once an understanding has been developed of our methodology for forecasting rents and vacancies in the different property types, some explanation is still in order to better understand how those rents and vacancy rates are transformed into investment fundamentals, such as net operating income, value, and total return.

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[2] There is a paucity of pricing data for commercial real estate partly due to market inefficiencies and partly due to the nature of the asset. Those unfamiliar with these issues should see, for example, Fisher et al (1999).

Discounted cash flow analysis (DCF) is often used to arrive upon a price of an asset by creating cash flows and discounting them back using a discount rate to create a price. In this case, TWR uses DCF to determine the likely internal rate of return (IRR) given the current price and the future cash flows.

The outline of the methodology will follow the format of popular valuation software such as ARGUS or ProJect.[3] In fact, TWR's valuation methodology can be thought of as a simplified version of these tools. However, the methodology has the advantage of using TWR rent and vacancy forecasts to formalise the analysis of future cash flows using econometrically derived values instead of broad assumptions. The differences between TWR's year-by-year forecasts and the common market assumptions (for example, that rent will grow by 3% each year), create varying IRRs and other investment statistics across markets, property types, and buildings. These statistics allow for comparison of investments and ranking and descriptions of markets to find opportunities in real estate investment.

Discounted cash flow

Schedule of prospective cash flow[1]

For the years ending	Year 1 Mar 2002	Year 2 Mar 2003	Year 3 Mar 2004	Year 4 Mar 2005	Year 5 Mar 2006	Year 6 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
Absorption and turnover vacancy		–426,600	–469,734	–430,100	–462,550	–487,850
Effective gross revenue	2,151,380	2,191,686	2,263,117	2,308,021	2,305,666	2,369,693
Total operating expenses	870,000	870,000	891,750	914,043	936,894	960,317
Net operating income	1,281,380	1,321,686	1,371,367	1,393,978	1,368,772	1,409,376
Leasing and capital costs						
Tenant improvements						
Capital improvement reserves						
Total leasing and capital costs	230,000	230,000	235,750	241,644	247,685	253,877
Cash flow before debt service and taxes	$1,051,380	$1,091,686	$1,135,617	$1,152,334	$1,121,087	$1,155,499
Cap rate	8.9	10.1	10.4	10.0	9.8	9.7
Value	$14,470,407	$13,084,510	$13,243,632	$13,899,439	$13,999,372	$14,514,676
Yield	7.3%	8.3%	8.6%	8.3%	8.0%	8.0%
Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

[3] ARGUS and ProJect assist with cash flow analysis by automating many of the calculations necessary once data has been entered.

The methodology is simplified from an ARGUS run by virtue of the detail that is covered. Under ARGUS, there are myriad possibilities in DCFs for details on the leases, expenses, additional income, and so forth; In contrast, the TWR valuation only concentrates on the basics of what drives net operating income and value in general - rent growth, vacancies, and costs.

The following pages outline the different components of the TWR valuation line by line. The methodology for each item is explained so that clients have a better understanding of the assumptions behind the valuations, and with this understanding can determine the relation to properties in their portfolio or under consideration.

For all of the line items, there are two cases to discuss. First, there is what is done in determining the investment statistics for a "prototypical" building in the market, and secondly how the methodology is specified to take into account more collateral specific attributes of the building.

DCF - revenue

Schedule of prospective cash flow[1]

For the years ending	Year 0 Mar 2002	Year 1 Mar 2003	Year 2 Mar 2004	Year 3 Mar 2005	Year 4 Mar 2006	Year 5 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
Absorption and turnover vacancy	–400,000	–426,600	–469,734	–430,100	–462,550	–487,850
Effective gross revenue	2,151,380	2,191,686	2,263,117	2,308,021	2,305,666	2,369,693
Total operating expenses	870,000	870,000	891,750	914,043	936,894	960,317
Net operating income	1,281,380	1,321,686	1,371,367	1,393,978	1,368,772	1,409,376
Leasing and capital costs						
Tenant improvements						
Capital improvement reserves						
Total leasing and capital costs	230,000	230,000	235,750	241,644	247,685	253,877
Cash flow before debt service and taxes	$1,051,380	$1,091,686	$1,135,617	$1,152,334	$1,121,087	$1,155,499
Cap rate	8.9	10.1	10.4	10.0	9.8	9.7
Value	$14,470,407	$13,084,510	$13,243,632	$13,899,439	$13,999,372	$14,514,676
Yield	7.3%	8.3%	8.6%	8.3%	8.0%	8.0%
Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

From TW rent and vacancy forecasts

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

By determining the NOI, cash flow, yield, total returns, and IRR of a prototypical building, we are taking attributes that are averages across all buildings in the property type, for example that office leases have five-year terms, and applying it to a fictional building in the market. The result is that the prototypical building should be a good representation of the investment figures for buildings in that market. The better the understanding of the assumptions that go into the prototypical building, the

better investors will be able to apply the general results shown in the investment variables to buildings that differ from the prototypical. The relationship to the average result in the market is a more complex one, and will be discussed later in this paper in comparing the methodology for deriving NOIs to NOI histories in the NCREIF database.

Buildings where more collateral-specific information is available have the advantage of additional attributes being applied to TWR's DCF formulation. Examples might be current data on rents and costs, the pattern of future turnover, or an existing cap rate. Any of these variables would narrow the distance between the prototypical valuation and a more detailed DCF run, thus requiring the user to make far fewer assumptions about the relation between the two.

The first and most important piece in the TWR valuation is determining building revenue given market rents and vacancies. For rents in the prototypical office building, we use the fact that leases in our exclusive database from C B Richard Ellis average five years in length quite consistently across office markets. If we further assume that these leases were signed evenly over the past five years at market rate, then the average of market rents over the period times the square feet of rentable space in the building gives us our potential rent. In absence of additional information, we take a standard 100,000 square foot building for each market to represent the prototypical building.

As leases turn over, their rents that were signed five years ago are replaced with current market rents. This continues in future years and even the leases signed at today's rents re-sign at a new rate five years from today.

In the case where more information about the building is known, the average of historical market rents across time can be replaced with an average existing rent throughout the building to form a starting point for gross potential revenue. The building's average existing rent can be affected by both the quality of the building and the timing of past lease signings. It may be the case that rents are consistently above the market average, like in a Class A tower, or it may be that the building has leases that were all signed in 2000 when rents were generally near their peak. Any change in the average existing rent number will normally need to be accompanied by a change in the current market rent number. Here, current market rent refers to the building's peer market rather than the metropolitan area as a whole. The current market rent for a building can be estimated by looking at a current lease signing or by examining average current rents in a peer group of buildings. Together, the two numbers sort out whether rents might be higher in a building because of a permanent premium due to quality or a more temporary premium because management has timed leases well.

The second component in determining gross revenue is building vacancy. The TWR valuation methodology has building vacancy affected by market vacancy through a calculation of downtime as leases turn over. As a lease expires, the current tenant either renews at the new rent, or the space is put on the market. The amount of time the space spends on the market without being leased, or downtime, is determined by the market vacancy. When market vacancy is high downtime can last for years. When the market is tight, downtime is short and building vacancy remains low.

For the prototypical building, it should not be surprising that average building turnover each year and average renewals lead prototypical building vacancy to equal market vacancy. Building vacancy where collateral specific information is available can differ from the market in that higher turnover in a year will lead to higher building vacancy than the market and vice versa. Renewals in a building can also be set to differ from the market average to create a more permanent advantage or disadvantage in comparison to the market vacancy rate.

Rent and vacancy together provide a basis for gross revenue, but what really determines the health of real estate is Net Operating Income, or NOI. The starting point for NOI is determined by subtracting out the sum of operating costs from gross revenue. For the prototypical properties, this starting point is determined using industry data to determine a relationship between rents and operating costs. For example, prototypical office buildings use data publicly available from the Building Owners and Managers Association (BOMA) to create an equation that relates rent to operating costs. The TW Rent Index is then applied to this equation to determine the starting level for operating costs in the prototypical building.

DCF - costs

Schedule of prospective cash flow[1]

For the years ending	Year 1 Mar 2002	Year 2 Mar 2003	Year 3 Mar 2004	Year 4 Mar 2005	Year 5 Mar 2006	Year 6 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
Absorption and turnover vacancy		–426,600	–469,734	–430,100	–462,550	–487,850
Effective gross revenue	2,151,380	2,191,686	2,263,117	2,308,021	2,305,666	2,369,693
Total operating expenses	870,000	870,000	891,750	914,043	936,894	960,317
Net operating income	1,281,380	1,321,686	1,371,367	1,393,978	1,368,772	1,409,376
Leasing and capital costs						
Tenant improvements						
Capital improvement reserves						
Total leasing and capital costs	230,000	230,000	235,750	241,644	247,685	253,877
Cash flow before debt service and taxes	$1,051,380	$1,091,686	$1,135,617	$1,152,334	$1,121,087	$1,155,499
Cap rate	8.9	10.1	10.4	10.0	9.8	9.7
Value	$14,470,407	$13,084,510	$13,243,632	$13,899,439	$13,999,372	$14,514,676
Yield	7.3%	8.3%	8.6%	8.3%	8.0%	8.0%
Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

BOMA data adjusted to match revenue in TWR's prototypical building

Grown with inflation

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

This starting level is incremented over time by our forecasted inflation rate. Examining our sources of operating data, long-run trends clearly show a close correlation between growth in operating expenses and general CPI inflation. The exception to this is in the hotel sector where operating expenses are managed on a day-to-day basis depending on advance reservations. So, in periods where occupancy is low, costs are generally lower because maids are not brought in, etc. This is captured by a multi-equation system for the hotel sector that has been derived from hotel-level operating statements collected by our product partner Hospitality Research Group.

The implication for all property types is that a higher ratio of operating costs to rents produces greater risk for the property. TWR often refers to this ratio as the operating leverage of the property. Like leverage from taking on debt, operating leverage increases risk because for an equal increase or decrease in gross revenues, NOI will experience a bigger shift. For an extreme example, in the case where expenses are 95% of revenues a 5% decrease in rents will lead to a 100% loss of NOI. Similarly, a 5% increase in rent will double NOI. This often leads to more risk in smaller markets where rents tend to be lower and there is less wiggle room to allow for drops in rents.

There are also additional costs beyond operating expenses which appraisals treat as "below the line" expenses. Subtracting these expenses, capital expenses and tenant improvements, from NOI give us an income number we label as Cash Flow.

The TWR methodology treats capital expenses not so much as occasional expenses that are recorded in one period, but in terms of a capital reserve account that needs to be paid into each year. To determine this number, TWR uses the NCREIF data to analyse the long term ratios of capital expenses to NOI in each property type. These ratios are used to determine a capital expense value.

Tenant Improvement information is gathered from data sources similar to the operating expense information. These TI costs are applied only to leases that are not renewing. As a result, these costs are incurred only on the non-renewing leases that are turning over. As this is a small percentage of the total leases in the building, TI costs are often a smaller factor than is the capital reserve payment in subtracting from NOI. As for all costs, both starting values and growth over time can be altered from the prototype where more information on the collateral is available.

DCF - cap rates

Schedule of prospective cash flow[1]

For the years ending	Year 1 Mar 2002	Year 2 Mar 2003	Year 3 Mar 2004	Year 4 Mar 2005	Year 5 Mar 2006	Year 6 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
Absorption and turnover vacancy		–426,600	–469,734	–430,100	–462,550	–487,850
Effective gross revenue	2,151,380	2,191,686	2,263,117	2,308,021	2,305,666	2,369,693
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Leasing and capital costs						
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Cap rate	8.9	10.1	10.4	10.0	9.8	9.7
Value	$14,470,407	$13,084,510	$13,243,632	$13,899,439	$13,999,372	$14,514,676
Yield	7.3%	8.3%	8.6%	8.3%	8.0%	8.0%
Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

Starting cap rates use NCREIF income and ending market values for best available estimate.

Forecast uses the econometric model to generate changes to future cap rates.

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

So far, the methodology has given us a stream of NOIs and a stream of Cash Flows as measurements for the income streams of a building, either prototypical to describe the market or more asset specific where more information is available. At this point, these income streams can be used to determine value. There are two ways this can be accomplished. Determine a starting value from a discount rate or determine a return from a starting value. Both methods are discussed to contrast the goal of the usual appraisal with the goals of the TWR methodology.

In the usual appraisal, the goal is often to arrive upon a normative value for the asset in question. In this case, the DCF valuation is trying to determine the price that should be paid in accordance with the return expectations (or discount rate) and views of income growth of the buyer. Given a discount rate and income stream (and usually a selling price that is assumed at the end of the holding period), the appraiser determines the appropriate value to pay for the asset.

However, as there are usually multiple bidders for an asset, there are also multiple appraisals. As a result, if there are five bidders, four of the appraisals are wrong about the price! Given that the TWR methodology is shorthand for more robust programs such as ARGUS, it is unlikely that the TWR system would be the one that could come out with the right value. This is not to say that the TWR rent and vacancy forecasts cannot be brought into the ARGUS system to improve the valuations there, but this done better by porting TWR information to ARGUS than the other way around. The positive, as apposed to normative, price is determined by the bidder that has the most aggressive combination of assumptions on rents, vacancies, and discount rate, given their additional information on revenues and costs.

The TWR approach is to compare investments by forecasting the results of these positive values. For our prototypical building, the starting positive value is determined by using the capitalisation rate for each market and property type. Where available, the NCREIF data is used as it usually has the most observations and by virtue that the database is filled with stabilised properties that correspond most closely to our prototypical example. These cap rates represent the culmination of assumptions and information that the individual appraisers have used to develop a value. They represent a market average of the assumptions that have gone into the appraisers' DCF analyses. By using the market cap rates, we are using our best estimates of what the market believes to be future income and the appropriate discount rate for assets in the area and property type. This will always differ from what TWR believes to be appropriate.

The market cap rate is used on the prototypical property to determine a starting value. Going forward, the differences between the market beliefs about future income, which are not observed but summarised in the cap rate, and the TWR forecast of future income and cash flow will lead to differences in IRR.

But first, the TWR methodology must determine a selling price for the asset. Again, this assumption is likely to differ from the winning appraisal in a market bidding contest. The TWR methodology does this through an econometric forecast of cap rates. The econometrics behind this forecast are summarised in "The Determinants of Appraisal Based Capitalisation Rates", which is listed in the Bibliography. The end result is that one of the biggest influences on market cap rates over time is the performance of the fundamentals, particularly rent. This can be translated as a capital flow argument. Capital flows into the real estate sector or market when it has recently done well, driving down cap rates. When rents are weak, however, cap rates tend to increase. All else not being equal, of course, other factors can play a role, as has happened recently when interest rate changes were large enough to have a countering impact on cap rates despite weak fundamentals. By and large though, the cycle for cap rates is the inverse of the cycle for rents.

This is important because it draws another contrast with what is common in appraisals. Namely, that exit capitalisation rates are not necessarily 50 basis points higher than entry rates. A common conservative assumption in appraisals is that the building will depreciate from the standpoint of the ratio of its value to income. The econometric analysis suggests, however, that the cap rate is more likely to be determined by whether the asset is sold into a hot market or cool market for real estate.

The cap rate forecast combined with the other information could filter into a normative value that differs from other appraisals. The information provided by this difference would suggest that the buyer overpaid or underpaid and by how much. Given that this difference may be driven by small details of the lease that are not analysed in TWR's shortcut methodology, it is our feeling that this is not the most appropriate way to present the information. Instead, taking the starting cap rate as a given and calculating an IRR over the forecast provides a number that will more universally apply to buildings. That is, given a starting value, income stream, and closing value, what is the discount rate that matches the latter to the former? The discount rate is equivalent to TWR's expected IRR.

DCF - internal rate of return

Schedule of prospective cash flow[1]

For the years ending	Year 1 Mar 2002	Year 2 Mar 2003	Year 3 Mar 2004	Year 4 Mar 2005	Year 5 Mar 2006	Year 6 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
Absorption and turnover vacancy		–426,600	–469,734	–430,100	–462,550	–487,850
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Net operating income	1,281,380	1,321,686	1,371,367	1,393,978	1,368,772	1,409,376
Leasing and capital costs						
Tenant improvements						
Capital improvement reserves						
Total leasing and capital costs	230,000	230,000	235,750	241,644	247,685	253,877
Cash flow before debt service and taxes	$1,051,380	$1,091,686	$1,135,617	$1,152,334	$1,121,087	$1,155,499
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Yield	7.3%	8.3%	8.6%	8.3%	8.0%	8.0%
Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

IRR discounts future years' cash flow including profits from sale in the fifth year.

Note that the result is similar but not equivalent to average total return.

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

The IRR itself is equivalent to an expected return for a stated holding period. As such it is the first component to comparing the results of assets across markets and property types. This number alone can provide a means of comparison between markets and property type or even between assets. The real payoff occurs in the speed of the analysis compared to the more in depth appraisal tools. The paper "Real Estate Risk: Equity Applications" (cited in the Bibliography) describes using this approach in a Monte Carlo format to come up with a range of IRRs, thus giving a forward-looking estimate of risk as well as return.

Also, the effect of changing any of the inputs and comparing the results to the prototypical property in the market can be quickly done through our consultants or through the Outlook Interactive software. This allows a greater understanding of the impact of different property operating characteristics or management strategies on the expected return over the holding period.

While the IRR is an important measure of expected return, an important feature of the TWR methodology is the ability to break down that return, even to the point of being able to trace the process all the way back to the rent growth and vacancy change that eventually lead to the IRR. In a simpler exercise, the IRR can be examined by year as an annual total return number, which itself can be disaggregated into income and appreciation return.

DCF - valuation and return

Schedule of prospective cash flow[1]

For the years ending	Year 1 Mar 2002	Year 2 Mar 2003	Year 3 Mar 2004	Year 4 Mar 2005	Year 5 Mar 2006	Year 6 Mar 2007
Potential gross revenue						
Base rental revenue	$2,262,200	$2,257,400	$2,246,000	$2,252,200	$2,295,200	$2,373,200
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Appreciation		–9.6%	1.2%	5.0%	0.7%	3.7%
Total return		–1.2%	9.8%	13.2%	8.7%	11.6%
IRR	7.86%					

Value = NOI/cap rate

Yield = cash flow/value

Appreciation = change in value from last year

Total return = yield + appreciation

[1] In inflated dollars for the fiscal year beginning 1 January 2002.

Source: Torto Wheaton Research.

Year-by-year, the total return is the combination of yield (the cash-on-cash return from holding the property) and appreciation (the change in the value of the asset from the previous period). This being real estate, even how this breakdown is done is a matter of some controversy. In the standard TWR methodology, we define yield as cash flow, as opposed to NOI, divided by value. Most importantly, this means that the capital reserve payments are subtracted out when calculating the income return. Appreciation is then simply the change in value without any complex adjustments.

While this is consistent with common definitions of yield and appreciation for the stock market, the same calculations are controversial in real estate because of the widespread use of the NCREIF index. Because the NCREIF index is based on operating data and valuations from the holdings of pension funds, capital improvements are recorded as they are made rather than spread out over time as payments. To avoid dips in yield whenever a large capital improvement is undertaken, the NCREIF approach is to subtract the capital improvements from the appreciation return, rather than the income return (yield). This keeps the income and appreciation returns from jumping around in quarters where there are capital improvements, but also has implications for users of the index who are trying to determine long term trends.

Specifically, if capital improvements average 2% per year, when looking over a number of years, income returns will be equivalent to the cap rate, but the appreciation returns will be lower by the 2% per year. So, if a view of sales prices would show an increase of 5% per year, NCREIF appreciation

would only count 3% per year as “appreciation not due to improvements”. In the long run, and given that we are dealing with future estimates rather than the messiness of a changing dataset, we think it is better to treat capital improvements as a cost that decreases income returns rather than the more complicated idea that appreciation returns that result from those costs should not count. In either case, total returns for the period will be the same, which suggests that TWR returns and IRRs are comparable to NCREIF forecasts, albeit on a different set of buildings.

Comparisons to NCREIF data

The question remains, even if each of the inputs into the TWR methodology is accurate, will putting all these accurate pieces together give an accurate picture of investment variables as a whole? To address this question, we have used the TWR methodology not only to forecast prototypical properties going forward, but also used the methodology going backward in time. With this data, we can compare the results of the methodology to the NCREIF database, which averages the results of buildings owned by pension fund advisors.

The NCREIF numbers have been adjusted in these comparisons for the differences in accounting for capital improvements costs. In the end we get a comparison of an indexed NOI number where 2001 is equal to the same value in both series. Looking at individual markets and property types is instructive.

Starting at the national level for the office market, if any pattern emerges from the comparison, it is that the TW series tends to be slightly more volatile over the cycle from the NCREIF series. While it is gratifying that the two histories match up well, there are differences between the series. Our explanation boils down to two differences between the methodologies of the series. First, the rents, vacancies, and operating costs that form the basis of the TWR series represent an average of the entire market. If we were to formulate data that goes into the methodology that more closely matched the generally Class A buildings in the NCREIF database, we can get a closer match between the series. Operating leverage is particularly important in this comparison as our data suggests that lower class properties tend to operate “closer to the bone” and present more volatility from that perspective.

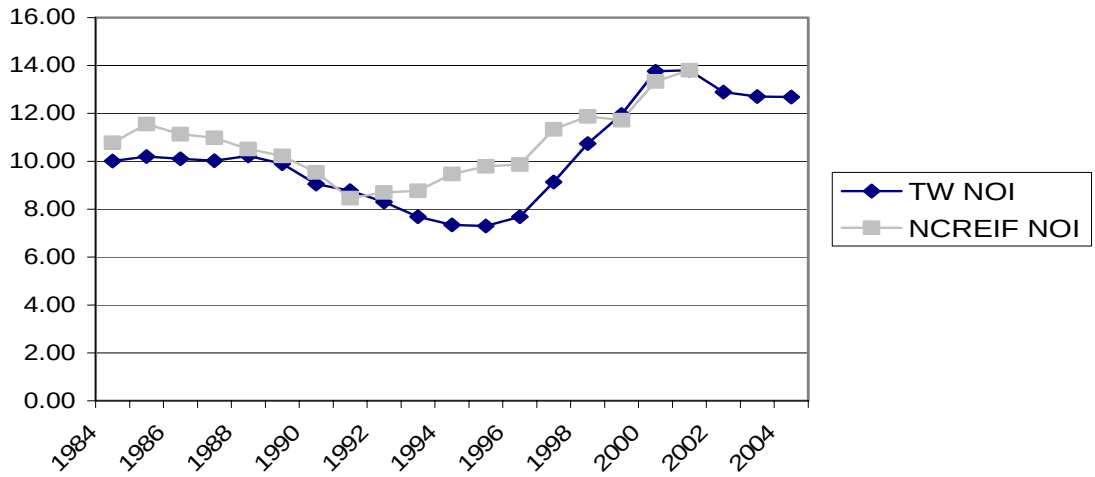
The second difference is that the TWR methodology sets rules such that the prototypical buildings have turnover spread perfectly evenly each year. NCREIF data, being managed properties, not only have uneven turnover, but also show some evidence that such management can be used to smooth out the cycle. For example, the national model might suggest that once the downturn became evident in 1992, NCREIF properties locked in their leases so that NOI would not fall further than it already had for the buildings. Meanwhile, in the “unmanaged” TWR index, leases continued to roll into a weaker and weaker market.

If this is the case, it suggests a limitation of the TWR index as a benchmark in the way that it is used. It should be made clear that the purpose of the TWR index is not to replace the NCREIF index, but to supplement it. This is particularly the case when looking at smaller markets and/or property types where there are few or no properties in the NCREIF database, but rent and vacancy data is plentiful. NCREIF data also lacks the ability to “get under the hood” as to why the index is moving the way it does, in comparison to the ability to trace back the TWR index as outlined in this paper.

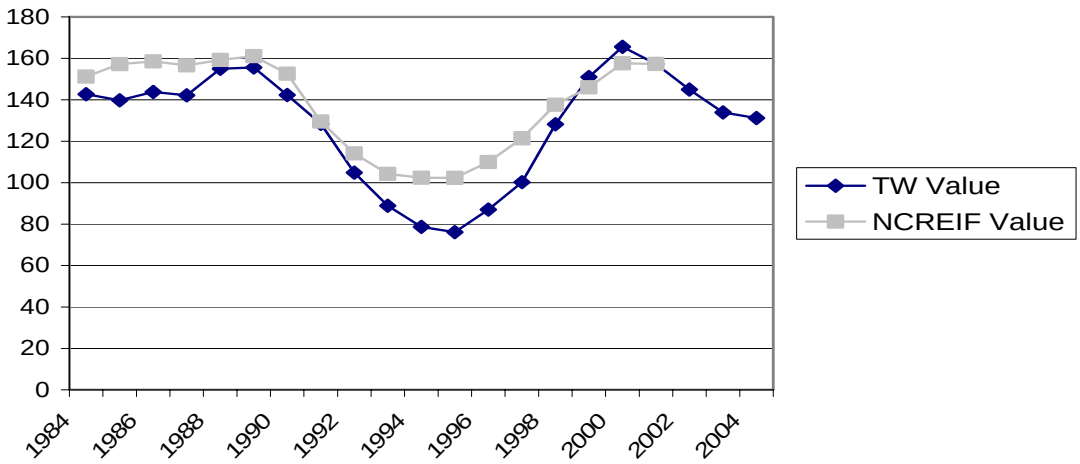
Looking at the data in some of these smaller markets, we can see the advantage of using the more plentiful rent and vacancy data. The Tampa industrial market, for example, has 10 warehouses tracked by the most recent NCREIF data, with even less in some historical periods. This is not a huge sample and an analyst may have some questions about using the NCREIF data as representative of the full Tampa industrial market. Compare this to the TWR data on vacancies done from a sample of the full market. In this case, the NCREIF data appears to be more volatile than the market, but likely because of the small sample size captured. That said, this is how the average property in their database has performed and it would be wrong for NCREIF to report anything different.

The most important aspect of this comparison is that it provides some understanding of the strengths and weaknesses of using the TWR investment data. First, it is incredibly important to keep in mind that the TWR market data represents what would happen to an unmanaged prototypical property based on the market rents and vacancies. While this information may or may not be a perfect predictor for an individual property in the market, it certainly gives some quick insights into what is likely to drive the investment performance of the properties in the market being examined. Furthermore, one can be assured that the index will be available in any market where rent and vacancy information is available from TWR. This proves very helpful in using the data for market selection purposes, for example.

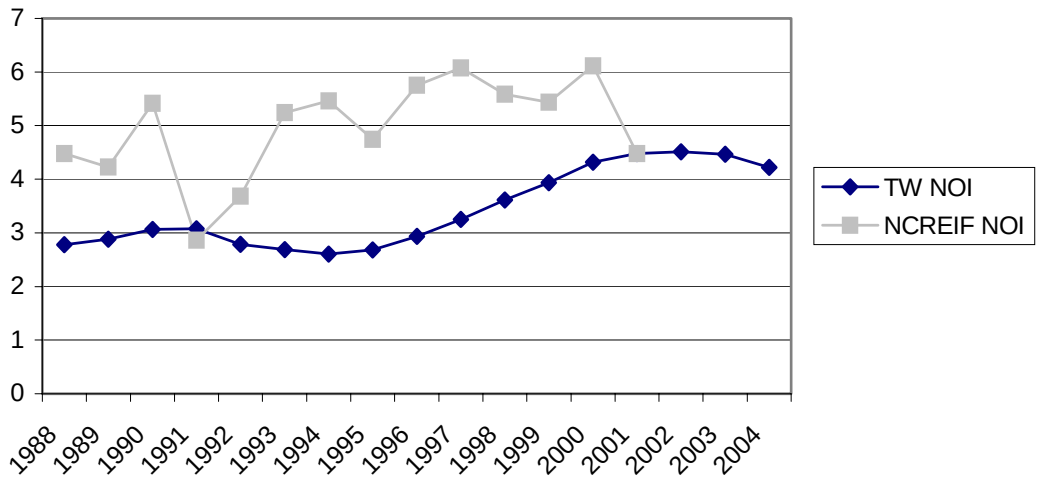
National office NOI



National office value



Tampa industrial market



Conclusion: uses of the database

Given that investment data exists in the marketplace, most prominently from the NCREIF database, why did Torto Wheaton Research choose to create the Investment Database? The answer lies in the broader availability of data and the ability to detail the reasons why value has moved the way that it has. Because the Investment Database includes every market where TWR has rent and vacancy data, its ability to provide market representative NOI and value streams (including forecasts) provides a powerful tool for targeting market and property type combinations. The addition of an estimate of risk on these valuations provides a methodology for comparing markets with even more depth.

In addition, in the same way the database has been created using typical building properties, we have created databases that use non-typical assumptions to compare the impact of leasing and management decisions. Both comparing the effect of non-standard leasing decision to the baseline and comparing across markets using non-standard leasing decision have been useful for clients in thinking through strategies.

For example, if leases are not spread evenly but instead grouped in the latter years of a five-year holding period, the timing creates NOI movements that increase the importance of rent levels in the later years while taking out the effect of rents in the early years. If rents are falling in the first year but quickly cycle upwards, the strategy that avoids rollovers in this down year will outperform the market. However, if rents continue to fall through the fourth year, rents will be locked in at a lower rate, harming NOI. Running such a strategy through the TWR methodology allows investors to compare across markets the effects of strategies that differ from the baseline.

Investigating the effects of the combination of leasing strategy and market forecast has its ultimate culmination in the use of the Investment Database in the monitoring of existing portfolios. Knowing that an existing portfolio already has a leasing strategy in place that can be gleaned from timing of expirations of current leases, TWR's Investment methodology can combine this information with the rent and vacancy forecast to create asset-specific investment data. The asset-specific forecasts can then be used to compare to a benchmark, or to categorise assets in the portfolio for future management and disposition decisions. The information on the existing expectations for portfolio returns can also be used to shape additional acquisition decisions.

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