Commercial Property Transaction Price Indices: Some Perspective After
*The First Five Years…*

David Geltner
Professor of Real Estate Finance

MIT/CRE Partners Meeting
May 11, 2011
Outline for this morning:

1. Background & Introduction
2. What have we learned from the new transactions-based indices
3. Issues with transactions-based indices
4. Fun with RS indices…
A transactions-based real estate index: Is it possible?
Journal of Property Research
Volume 8, Issue 3, 1991, Pages 203 - 217
Authors: M. Miles³; D. Hartzell³; D. Guilkey³; D. Shears³
DOI: 10.1080/09599919108724038

Abstract
This paper examines both practically and statistically the possibility of creating a transactions-based real estate price index similar to the well-known stock and bond indices. While the necessary methodology is available, differences in the real estate asset (and hence in the markets in which it trades) are shown to prohibit the development of such an index even under 'ideal' circumstances. First, in an informationally inefficient market, it is not in the best interest of most decision-makers to engage in the kind of complete disclosure needed to produce an accurate index. Second, even with complete disclosure, the number of transactions needed statistically to adjust for property differences substantially exceeds the number of quarterly transactions in most markets. While the empirical work supporting these conclusions is based on US data, the authors believe that similar constraints exist in most of the world's major markets and that investment professionals will be forced to work with less than ideal real estate proxies in constructing the global mixed-asset portfolio.

(BTW, Miles et al were correct at that time.)
10 years ago...

Why we need a Transaction-Based Index for Commercial Real Estate

By
David Geltner
University of Cincinnati

Presentation prepared for
Homer Hoyt Institute
Weimer School of Advanced Studies

May, 2001
How do we put the three-legged stool together?

Data/Information Sources

Investment Industry

Academia

To produce a public good, a commercial transaction-based index & database...
Today…

- NCREIF-based “TBI” (publ qtrly since Feb 2006)
- Moody’s/REAL “CPPI” (publ mthly since Dec 2006)
- CoStar “CCRSI” (publ mthly since Aug 2010)

Major new information sources for the real estate investment industry & asset class, for academic & industry research, possibly ultimately to support synthetic trading.
Increasing reportage in the press, increasing usage in industry & academia. (e.g. 4/29/11 NYT article electronic & print versions...)

A Reversal for Real Estate After Some Mild Gains

By FLOYD NORRIS
Published: April 29, 2011

PRICES for both homes and commercial real estate are falling again. Meaningful improvement may have to wait until there are many fewer distressed properties for sale.

Indexes of the two markets showed this week that the latest declines had almost wiped out the mild gains the two markets had shown after prices appeared to have hit bottom.

The Standard & Poor's/Case-Shiller index of home prices ended February 3.3 percent below where it was a year earlier, and just 0.5
Commercial property transactions-based indices currently being published in the U.S. are a complementary set...

<table>
<thead>
<tr>
<th></th>
<th>“TBI”</th>
<th>“CPPI”</th>
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<tbody>
<tr>
<td>Data Source</td>
<td>NCREIF</td>
<td>RCA</td>
<td>CoStar</td>
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<td>Orig Publisher</td>
<td>MIT/CRE 2006</td>
<td>MIT &amp; REAL 2006</td>
<td>CoStar 2010</td>
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<td>Current Publisher</td>
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<td>CoStar</td>
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<tr>
<td>Coverage</td>
<td>NCREIF props (≈ $300 B)</td>
<td>All &gt; $2.5M (≈ $3000 B)</td>
<td>All &gt; $100k (≈ $4000 B?)</td>
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<tr>
<td>Frequency</td>
<td>Quarterly</td>
<td>Monthly etc</td>
<td>Monthly etc</td>
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<td>Indices</td>
<td>Price, Dem, Sup, Total Ret Natl level</td>
<td>Price (same-property) Natl &amp; Local</td>
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*NCREIF to take over TBI publication as of 2Q 2011.

Objective, econometrically rigorous, based on **consummated transactions**
**Why & How** transactions-based indices “make sense”…

- Based directly & purely on actually **consummated sales**
- Can “correct” appraisal smoothing & lagging bias
- More directly **comparable** to **stock & bond** indices
- More **objective** & **replicable** than appraisal-based indices
- Reflect actual timing of **cash changing hands** in the **free market** (dictum: “Follow the cash”, reflect contemporaneous market equilibrium).
- Can track property populations not regularly appraised (REIT properties, CMBS properties, *any* other than NCREIF)
- Useful **complement** (not substitute) for NPI, especially useful for **research** purposes (academic & industry).

→ raises the credibility and depth of understanding of private RE asset class among a broader constituency.
Once upon a time, there was only the NCREIF Index...

Index based on appraisals

Price Level Index Dec 2000 – Dec 2010
(NCREIF founded 1983, index inception 1978)

* NPI level set so lifetime AVG(NPI) = lifetime AVG(TBI).
Since 4Q 2005 MIT has published the TBI with NCREIF cooperation...

### Price Level Index Dec 2000 – Dec 2010

*Price Level Index over history back to 1984, here set to equate AVG levels over full history.*

<table>
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**Transactions prices of NCREIF properties sold**

*NPI level set so lifetime AVG(NPI) = lifetime AVG(TBI).*
Since Oct 2006 RCA-based CPPI published (since 2007 by Moody’s)…

Repeat-sales: First monthly CRE index, Reflects broader market:
All “institutional” property (> $2.5 million price)

NPI, TBI, & CPPI: (2000Q4=100)

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*NPI level set so lifetime AVG(NPI) = lifetime AVG(TBI).
Since June 2010 CoStar CCRSI published...

NPI, TBI, CPPI, & CCRSI:
(2000Q4=100)

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Index: Peak Pk-Trgh Recovery
NPI 77% -28% + 6%
TBI 95% -40% +19%
CPPI 92% -45% + 6%
CCRSI 98% -30% -

Repeat-sales method similar to CPPI:
Composite index (here) reflects smaller properties (down to $100k)

Monthly history back to 1998; ≈2/3 of all CRE transactions are below “institutional” threshold but account for <1/4 of dollar volume.

* NPI level set so lifetime AVG(NPI) = lifetime AVG(TBI).
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3. Issues with transactions-based indices

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**TBI vs De-Smoothed NPI:** TBI finer-grained but more noisy, Reverse-filter needs recalibration since 08 Fin Crisis, TBI more intuitive ("follow the cash!")…

De-Smoothed via "1-step" reverse-filter: $\frac{[NPI(t) - 0.6NPI(t-1)]}{0.4}$
Most TBI price movements are not noise:

- 1st-order autocorrelation is not negative, &
- Many short-run movements correspond to real historical events (not echoed in NPI)
What do the new transactions-based indices tell us about investment risk?

Trans-based indices do not indicate substantially greater volatility or “beta” than NPI. Trans-based indices do lead NPI (less so during 08-09 fin crisis), but lag securities mkts. Trans-based indices have greater cycle amplitude than NPI for institutional property (LR risk). Trans-based indices can indicate finer-grained price movements (avoid “smoothing”). Trans-based indices do suffer from greater transient “noise” than NPI (estimation “error”).
TBI & Corresponding NPI (EWCF) Price Indices: 1984-2009
TBI 1Q84=1, NPI set to = avg TBI level 84-09

TBI cycles...

Sep87-Dec92:
-27% nominal
-41% real

Mar04-Jun07:
+76% nominal
+59% real

Dec92-Jun98:
+47% nominal
+28% real

Jun07-Mar10:
-41% nominal
-43% real

+19%
2010
TBI & Corresponding NPI (EWCF) Price Indices: 1984-2009
TBI 1Q84=1, NPI set to = avg TBI level 84-09

NPI cycles...

Sep89-Dec93: -23% nominal -34% real

Dec93-Jun98: +24% nominal  +11% real

Mar04-Mar08: +68% nominal  +47% real

Mar08-Mar10: -28% nominal -30% real

+6% 2010
Issues with transactions-based indices:

• Noise

• Market segmentation

• TBI issues
Transactions based indices do have noise. Extreme example: RadarLogic daily & 28-day moving-average of Miami house prices...

But note that noise does not accumulate over time (unlike true volatility), so impact of noise is reduced over longer spans.
Regression coefficient standard errors probably exaggerate the effective magnitude or relevant error in transaction-based price indices…

(Note: Official CPPI historical std errs are lower than these due to index freezing.)
Regression coefficient standard errors probably exaggerate the effective magnitude of relevant error in transaction-based price indices (whether hedon or RS) …

- Coefficient std errors are an “asymptotic” measure. Even if index were perfectly accurate (true mkt avg), there would still be individual property price dispersion around the index (regression) predictions (reflecting true idiosyncratic drift of individ props around mkt), and this would cause positive coef SEs in any finite sample.

- Repeat-sales indices actual backward adjustments (historical revisions) random components are minimal; if error was as big as implied by coef SEs they would be much larger.

- Similarity across indices (TBI, CPPI, CCRSI) would not be possible if error was as big as implied by coef SEs.

- Most of the short run price movements in the trans-based indices seem historically plausible (associated with real historical events such as recessions, recoveries).

- Simulation analysis reveals that if error were really as large as implied by coef SEs then indices would have much higher volatility and lower 1st-order autocorrelation (AC1) than they actually have.

Nevertheless, regr coef SEs do provide relevant info, & an upper bound on err.
Regression coefficient standard errors probably exaggerate the effective magnitude of relevant error in transaction-based price indices (whether hedon or RS) …

Model true (unobservable) returns as random walk w 1%/mo volatility (very low). Alternative true model is smoothed version of actual CPPI history (very smooth). Apply actual CPPI regression std errors to generate random error around simulated “true” history to produce simulated “estimated index” over 122 month history (Jan2001-Feb2011). Resulting observed volatilities in the simulated indices are ALWAYS far above actual CPPI volatility.
Regression coefficient standard errors probably exaggerate the effective magnitude of relevant error in transaction-based price indices (whether hedon or RS) …

Model true (unobservable) returns as random walk w 1%/mo volatility (very low). Alternative true model is smoothed version of actual CPPI history (very smooth). Apply actual CPPI regression std errors to generate random error around simulated “true” history to produce simulated “estimated index” over 122 month history (Jan2001-Feb2011). Resulting observed AC(1)s in the simulated indices are ALWAYS far below actual CPPI AC(1).
Even “noise” is not just purely random; it can tell a story…

- Shortest month & reflects deals made December early-Jan: ➔ few closings.
- Dec & Early-Jan deals tend to be “renegade” & “opportunistic”; few “strategic” players (institutions, REITs) are doing deals in Dec & Early-Jan.
- Lately Feb has abnormally large # of distressed deals.

- Feb 08: anomalous uptick.
- Feb 09: anomalous flat mo.
- Feb 10: anomalous downtick.
- Feb 11: anomalously large down mo.

e.g., the “February Effect” in the CPPI
Even “noise” is not just purely random; it can tell a story…

Good trans-based indices & their understanding requires combination of:
- Good data & econometrics, with
- Good “in the trenches” knowledge of the markets (RCA, CoStar, NCREIF).
  Note a purely “academic” exercise.
Issues with transactions-based indices:

• Noise

• Market segmentation

• TBI issues
“Institutional” (aka “Investment Grade”) properties (larger, in primary mkts) exhibit different price behavior than smaller ("mom & pop") properties, as seen in CCRSI...

Reflects different sources of financing (non-bank vs bank), different owner/investor clienteles (local/users vs natl/intl instns), different asset mkt segments.
Even just within the “institutional” (> $2.5M) segment, the downturn has further split the market into three sub-segments: Trophy, Distress, & Other…

Segment Indices Compared to CPPI

"Trophy" index excludes distress & includes only prior sale > $10M & loated in NY,DC,BO,CH,LA,SF;
"Other"=not-trophy & not-distressed. All indices unfrozen QTM based on Apr2011 RCA data.
Institutional CRE Market has severely *segmented* since the downturn:

**Instl CRE Mkt Segmentation: "Trophies" & "Trash" since the "Crash"...**

Based on RCA repeat-sales data Jan2011, Pegged to CPPI in October 2007

**Since Oct 2007:**
- CPPI: -43%
- 3-city Trophy: -16%
- Distressed: -54%

**Oct07-09Bottoms:**
- CPPI: -44%
- 3-city Trophy: -38%
- Distressed: -58%

**Since 09Bottoms:**
- CPPI: +2%
- 3-city Trophy: +35%
- Distressed: +9%

Trophies have surged

While distress pulls down avg instl CRE prices

**Good trans-based indices & their understanding requires combination of:**

- Good data & econometrics, with
- Good “in the trenches” knowledge of the markets (RCA, CoStar, NCREIF).

Note a purely “academic” exercise.
CPPI recently weighed down by distressed sales in CRE mkt, preventing broad pricing recovery.

NCREIF properties are large, in primary mkts, and lack distress…
Issues with transactions-based indices:

- Noise
- Market segmentation
- TBI issues
CPPI & CCRSI are repeat-sales, TBI is hedonic

**Repeat-sales Regression:**
Database is properties selling more than once
Regress across same-property repeat-sale observations:

% Change betw Buy & Sell prices

\[ \% \text{ Change} = f(\text{Time dummies}) \]

**Hedonic Regression:**
Database is all property sales
Regress across all sales observations:

\[ \text{Sale Price} = f(\text{Hedonic Variables}, \text{Time dummies}) \]
Repeat-sales Regression:
Database is properties selling more than once

- Control for differences across properties between periods by only considering same-property sales
- Reflects actual experiences of investors.

Hedonic Regression:
Database is all property sales

- Control for differences across properties between periods by valuing “hedonic” variables (property quality attributes)
- Create index from “representative” property’s hedonic attributes.

CPPI & CCRSI are repeat-sales, TBI is hedonic
Hedonic Regression:
Database is all property sales
Regress across all sales observations:

\[
\text{Sale Price} = f(\text{Hedonic Variables}, \text{Time dummies})
\]

Typically the biggest challenge in constructing a good hedonic index is getting sufficiently complete & good quality **hedonic** data
Hedonic Regression:
Database is all property sales
Regress across all sales observations:

\[
\text{Sale Price} = f(\text{Hedonic Variables}, \text{Time dummies})
\]

But in the NCREIF database this problem can be finessed by using the recent NPI-reported (appraisal-based) valuations as a “catch-all” (composite) hedonic variable.
TBI Price Model:
Regress across all NPI sales (≈ 6000 obs):

\[
\text{Sale Price} = f(\text{NPI-reptd valuations, Time dummies})
\]
TBI Price Model:

Regress across all NPI sales ($\approx 6000$ obs): 

\[
\text{Sale Price} = f(\text{NPI-reptd valuations}, \text{Time dummies})
\]

The time-dummies don’t have to do much work; they just have to capture the *difference* each period between the average transaction price and the average NPI-reported valuation for the sold properties each period.
How the TBI as produced at MIT works...

Index returns are based on differences between periods in the hedonic **regression** price model's predicted price for the "representative property"...

**Rep Prop's Predicted Sale Price**

\[
\text{Rep Prop's Predicted Sale Price} = f(\text{Rep Prop's NPI-reptd Val}, \text{Time dummies})
\]

**Price model's estimated coefficients each period.**

Rep Prop's NPI-reptd Val ea period = NPI avg prop val @ index inception (1984) grown at NPI capital appreciation rate (EWCF) since then. Reflects evolution of appraised values as in official NPI.

All set = 1 every period to capture trans – apprsl differ ea period.
HOW NCREIF COULD PRODUCE A TBI without regression …

“NTBI” returns are based on NPI returns plus changes in the difference between transaction prices and appraised values among the NCREIF sold properties each quarter…

\[
\text{NTBI Price Level (Qtr t)} = \text{NPI Price Level (Qtr t-2)} \times \left( \frac{\text{Qtr t Sale Price/SF}}{\text{Qtr t-2 apprsd value/SF}} \right)
\]

Ratio averaged across all sold props in ea qtr

Convert appraisal-based index to transactions-based index by multiplying by ratio of transactions/appraised values among properties sold each quarter.
Simple, transparent ratio-based TBI closely approximates econometrically rigorous regression-based TBI...

MIT TBI, NCREIF TBI, & NPI Prices (4Q2010 data): 2001-2010 All-property

NPI EWCF set to proper value relationship in levels to TBI

MIT TBI (unfrozen) set to 4Q00=100 regression-based

NCREIF TBI set to 4Q00=100 ratio-based

NCREIF scheduled to take over TBI production & publication as an official NCREIF product as of 2Q 2011.
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New insights into the instl CRE mkt using repeat-sales indices (RCA data)…

Big vs Small Institutional Properties:
Same-property Transactions Prices (repeat-sales indices)

Peak-to-4Q2010:
- Small: -31%
- Big: -34%
- Super-Big: -33%

Bottom-to-4Q2010:
- Small: +1%
- Big: +24%
- Super-Big: +35%

Median 2nd-sale Price
(% Distressed since Dec2008)
- Small: $4.9M (20%)
- Big: $26.3M (29%)
- Super-Big: $61.0M (30%)

Based on RCA data, CPPI database as of March 2011.

“Small” (<$5M, >$2.5M) instl properties vs “Large” properties thru 2010:
Big +24%, Super-Big +35%, Small yet to recover but fell less…
Reflects differing sources of financing (e.g., regl banks & conduits vs non-bank sources)
New insights into the instl CRE mkt using repeat-sales indices (RCA data)...

REITs vs CMBS:
Same-property Transactions Prices (repeat-sales indices)

Peak-to-4Q2010:
REITs: -22%
CMBS: -45%

Bottom-to-4Q2010:
REITs: +16%
CMBS: +24%

Median 2nd-sale Price
(% Distressed since Dec2008)
REITs: $14.9M (13%)
CMBS: $15.2M (56%)

REITs vs CMBS”...
A “tortoise-&-hare” story reflecting debt underwriting, leverage, & asset mgt / operation?

Source: GA LLC, REAL, RCA
Based on RCA data, CPPI database as of March 2011.

*Caveat: Inception value arbitrary (segments not necessarily equal valued in 2000Q4).
New insights into the instl CRE mkt using repeat-sales indices (RCA data)...

CBD vs Suburbs, Supply-constrained mkts vs Unconstrained (thru 3Q10)...
Supply-constrained CBD more price growth, more volatility (big NYC share)

Commercial Real Estate (Excluding Apts) Same-Property Price Evolution, 2001-2010:
Land Value Dynamics (Constrained vs Unconstrained Dvlpt Mkts, CBD vs Non-CBD Locations)

Source: GA LLC based on RCA Jan2011 repeat-sales data. Includes Office, Industrial & Retail properties.
New insights into the instl CRE mkt using repeat-sales indices (RCA data)...

Boston vs New York Institutional Properties (all 4 sectors): 
Same-property Transactions Prices (repeat-sales indices)

Peak-to-4Q2010:
- Boston: -31%
- NY: -22%
- Manh: -27%

Bottom-to-4Q2010:
- Boston: +27%
- NY: +21%
- Manh: +27%

Median 2nd-sale Price:
(% Distressed since Dec2008)
- Boston: $ 9.4M (16%)
- NY metro: $ 6.3M (11%)
- Super-Big: $ 9.1M (13%)

* Caveat: Inception value arbitrary (segments not necessarily equal valued in 2000Q4).

Based on RCA data, CPPI database as of March 2011.

Just for fun... “New York vs Boston”...
Hmmm... But it is scientifically provable Boston has better sports teams!
Prototype monthly (2-stage “QTM”) “Responsible” Property Indices (RPI)...

Repeat-sales “Responsible Property” indices (a la Gary Pivo), PRELIMINARY.
RPs show greater price appreciation, but driven largely by walkable & transit-accessible locations (not so much energy efficiency), may be largely a CBD or New York City effect?