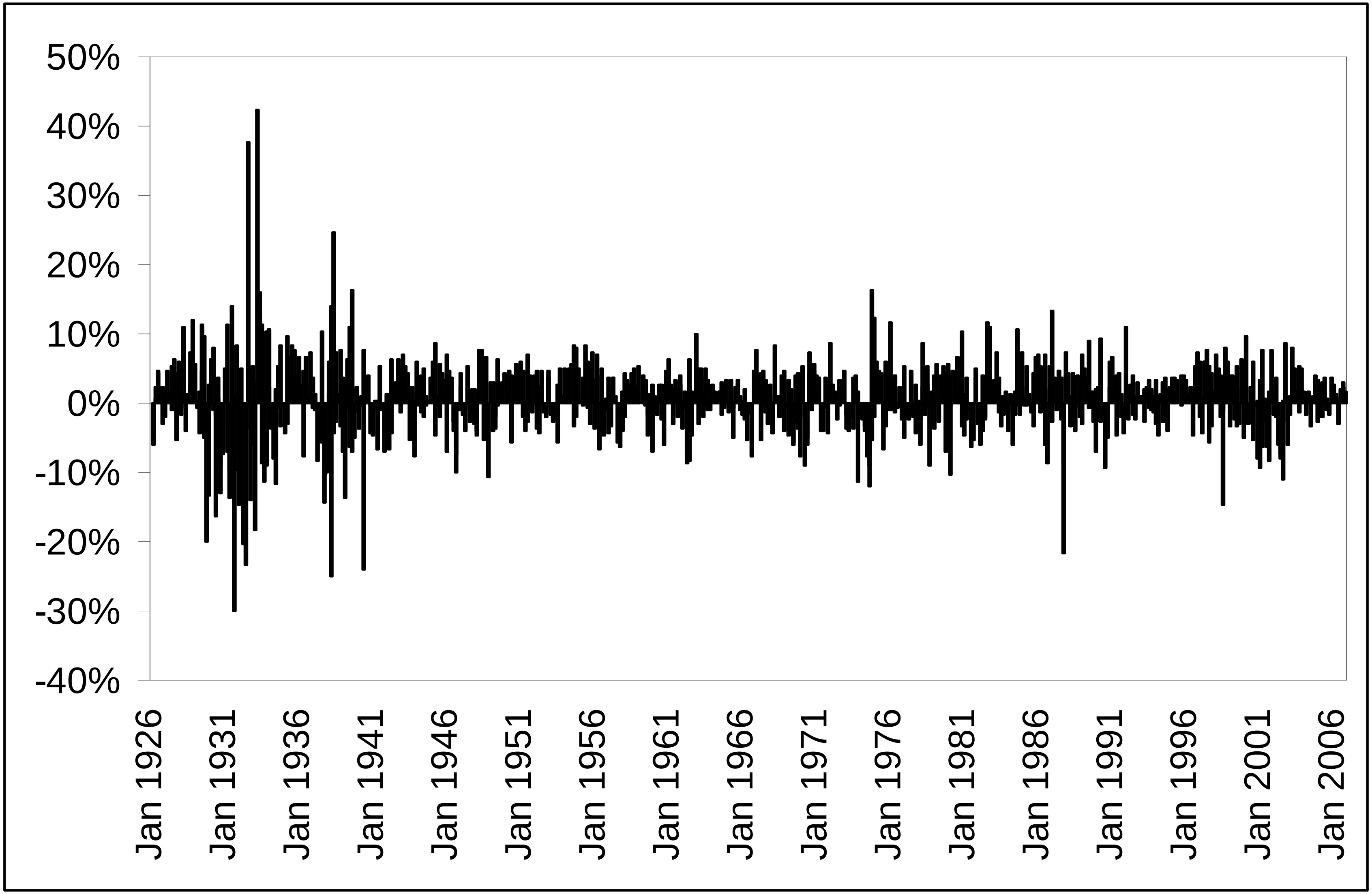
Real Estate Indexes

References:

- Geltner & Miller 2e (text), Chapter 25 & appendices (see CD)
- Geltner & Ling, *JRER* 28(4):411-444 (2006)
- Geltner & Pollakowski, *MIT white paper* (Dec 2006)
- Fisher, Geltner & Pollakowski, *JREFE* 34(1):forth. (2007)
- Fisher,Gatzlaff,Geltner & Haurin, *REE* 31(2):269-303 (2003)

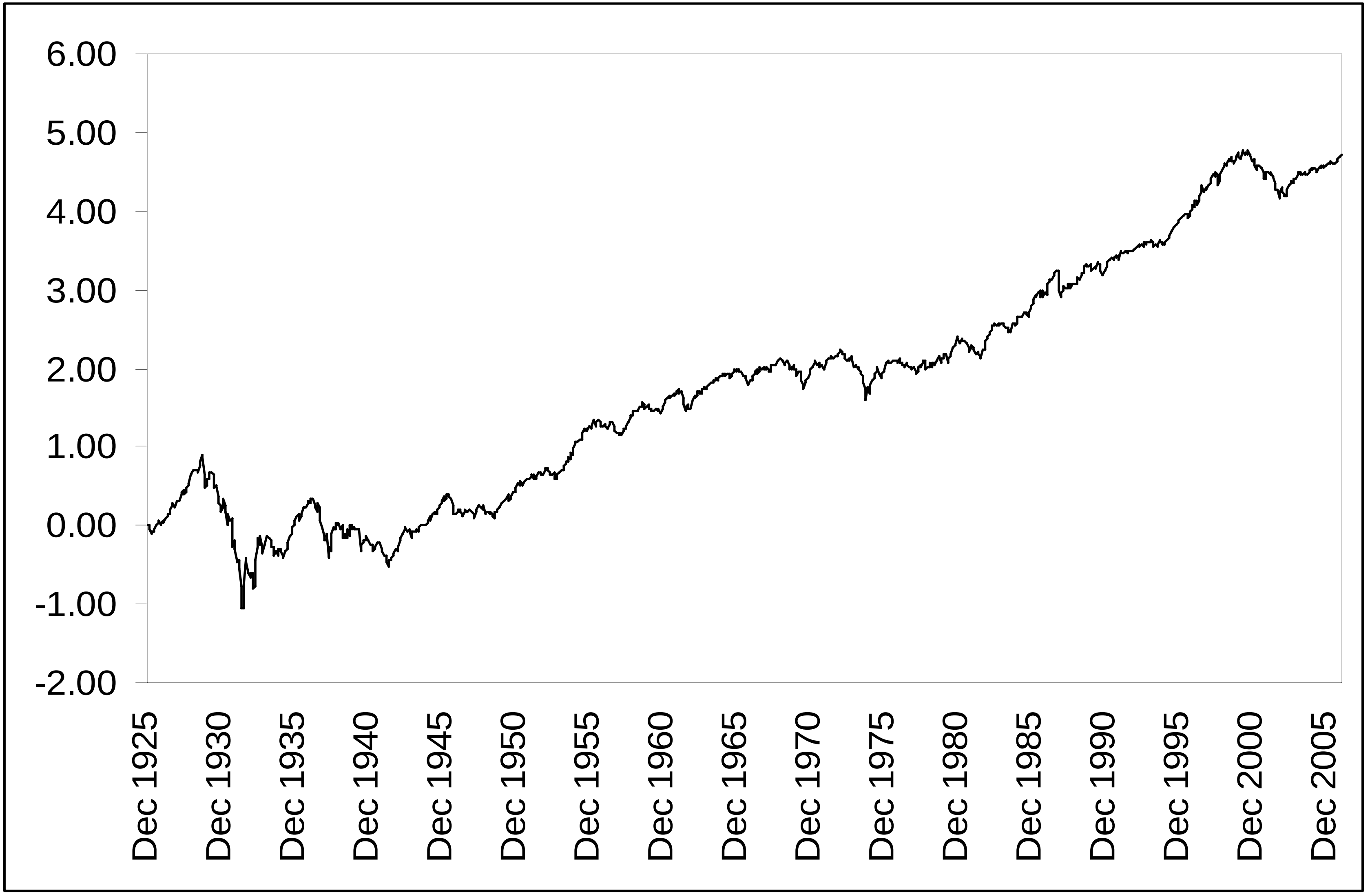
The ideal: *S&P500 Index*

Monthly returns since 1925



The ideal: *S&P500 Index*

Cumulative log value since 1925



Issues in R.E. Indexes

Index return in period t :

$$r_t = \frac{V_t - V_{t-1}}{V_{t-1}}$$

Two Issues:

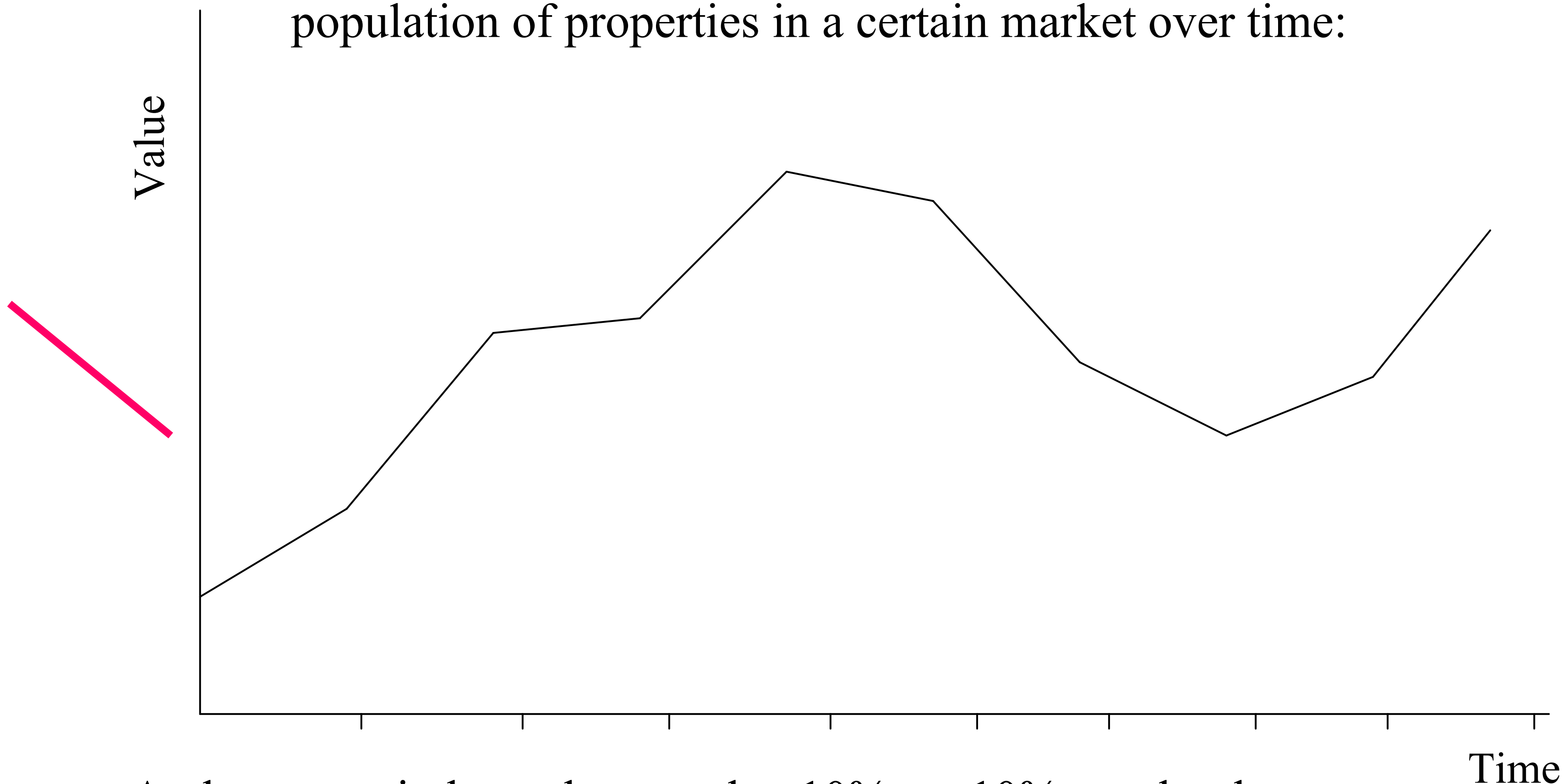
- ***"Noise"*** → Index value level V_t randomly dispersed around theoretical population value (P_t):

$$V_t = P_t \pm \tilde{\eta}_t$$

- ***"Lag"***, → Index value level V_t tends to be a blend of current and recent past population values, *e.g.*: $V_t = (1/2)P_t + (1/2)P_{t-L}$.

What does "noise" look like in an index of real estate values over time? . . .

Suppose this is the history of the values of the underlying population of properties in a certain market over time:



And suppose index value equals +10% or -10%, randomly over time dispersed around the theoretical population value, as if from the flips of a coin…

Noise adds excess apparent volatility, that is transient *("mean-reverts")* over time:

Appraisers face a *NOISE vs. LAG TRADE-OFF*

Example:

You own a property. Would you rather have an estimate of value that is accurate to within ± 10% with no lag bias, or to within ± 2% but whose most likely value is what the property was worth 6 months ago?…

Your answer probably depends on how you are going to use the appraisal:

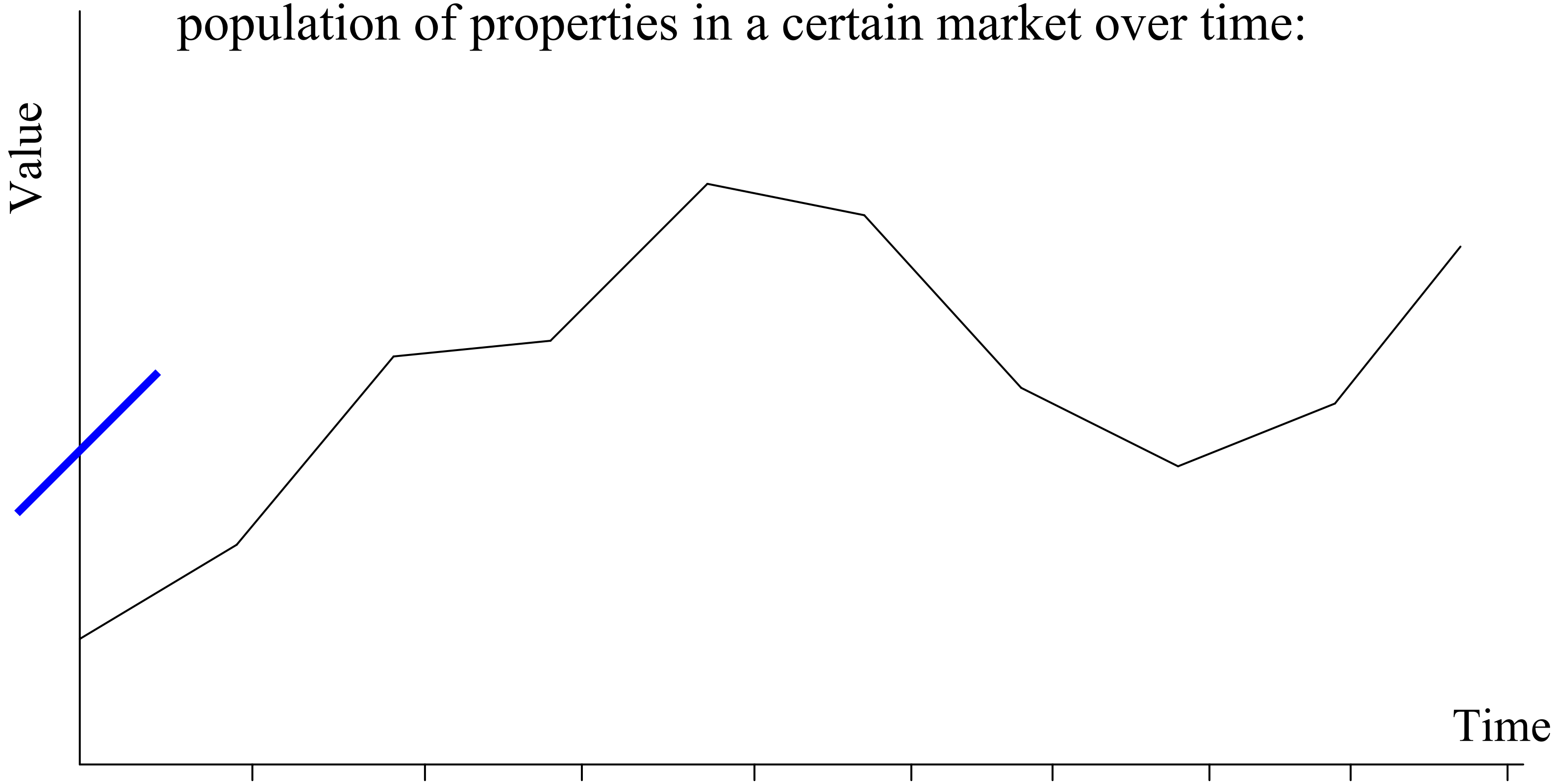
- ***Are you just interested in the value of that one property?***
- ***Or will you be combining that property's valuation with many others to arrive at the value of an entire portfolio or index?***

In the latter case, the purely random error in the property valuation estimate will tend to cancel out with other errors and diversify away, but the temporal lag bias will not go away.

But most appraisals are done for the former purpose, and that is what appraisal procedures are based on: → *Lag bias*.

What does lag bias look like in an index of real estate values over time? . . .

Suppose this is the history of the values of the underlying population of properties in a certain market over time:



And suppose appraisers use two comps which they weight equally to estimate the current period's value, one comp is current, the other from the previous period (& ignore noise to focus on the pure temporal aggregation effect).

Temporal aggregation results in an apparent index that is both lagged and smoothed (less volatile) compared to the contemporaneous population values:

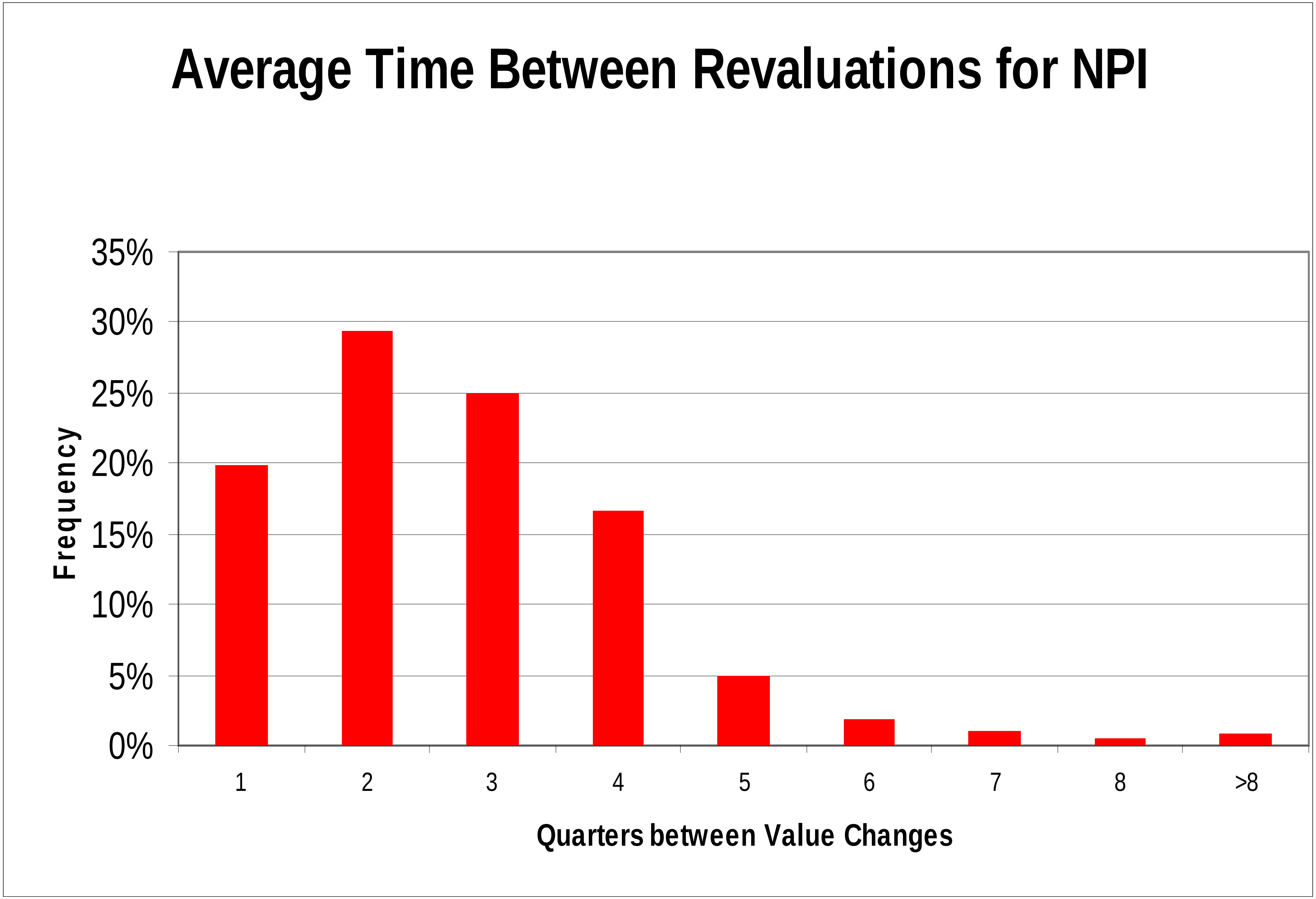
Two Types of R.E. Indexes

- Appraisal-based (e.g., NCREIF)
  - Track a particular sub-population in which ALL properties are appraised EVERY period (or almost)
  - Use the avg appraised value to represent V_t in the index return $A_t \approx V_t : r_t \approx (A_t - A_{t-1})/A_{t-1}$.
- Transaction Price-based (e.g., "repeat-sales")
  - Base index directly and purely on contemporaneous transaction prices of the ***sample*** of properties that happens to sell each period
  - Use statistics/econometrics to ***estimate*** population return (price change) each period.

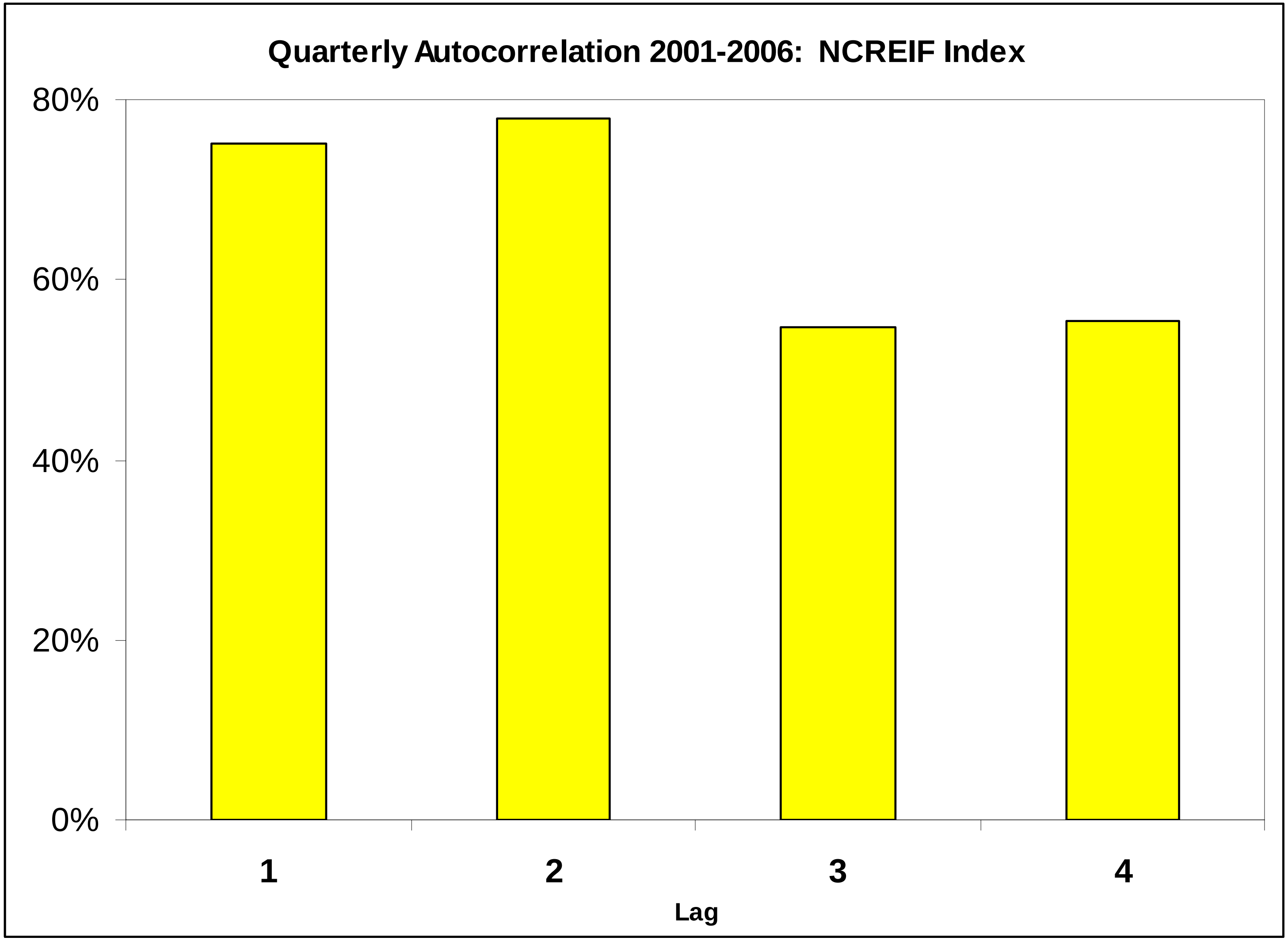
Appraisal-based Indexes

- Constructed similar to the way many institutional "core" funds are "marked to market" and report returns to investors.
- NCREIF Index is a near "universe" (totality) of U.S. pension fund "core" property holdings.
- Hence, great "benchmark" for "core" institutional investment managers (but at *property level*: excludes fund-level effects – leverage, mgt fees).
- NCREIF population is somewhat "narrow" (<$30B sales vs >$300B in RCA database).
- Appraisals are subjective and backward-looking (induces lag).
- Not all properties reappraised every quarter ("stale appraisal" effect adds to lag).
- Seasonality in index due to 4th-qtr reappraisals.

Appraisal-based index (NPI)



Autocorrelation in the NCREIF Index



Transactions Price Based Indexes Can Make Good Bases for R.E. Derivatives,

Provided:

- They are carefully constructed based on sufficient data & state-of-art econometric procedures:
  - To control for "apples-vs-oranges" differences in properties trading in different periods;
  - To minimize "noise" (random deviations from population prices).
- Two major procedures:
  - *"Hedonic"* (e.g., MIT-developed "TBI")
  - *"Repeat-Sales"* (e.g., S&P/Case-Shiller Hsg)

Basic problem: scarce valuation observations.

- Each individual R.E. asset is unique, different.
- ➔ “Apples vs oranges” problem in averaging or comparing prices of different assets at the same point in time.
- Each individual asset transacts only rarely and irregularly in time.

So how can we observe “apples vs apples” $V_t - V_{t-1}$?

Two statistical methodologies are most widely used…

1) The “Hedonic Regression” (HR). This is based on the hedonic value model (property value is a function of property characteristics...):

$$V_{it} = f\left(X_{1it}, \ldots, X_{nit}\right)$$

V_{it} = Value of property “i” at time “t”
X_{jit} = Value of hedonic (property quality characteristic) variable “j” for property “i” as of time “t.

Thus, HR controls for differences across individual properties by modeling the value effects of those differences.

Re-estimate model every period to produce index of periodic returns.

Problem: requires enough transactions every period. There is never this much data for commercial property.

Solution: Court-Griliches intertemporal price model...

$$\ln P_{it} = \sum_{j=1}^{J} \beta_j \ln X_{jit} + \sum_{t=1}^{T} c_t D_{it} + e_{it}$$

where: P_{it} = Transaction price of house "i" at time "t"
$X_{j\,it}$ = Value of jth hedonic characteristic
D_{it} = Time dummy (=1 if sale “I” occurred in period “t”, 0 o.w.)
c_t = Price index (log level)

2) The “repeated measures regression” (RMR) or “repeat-sales regression” (RSR).

➔ Use only properties for which we have valuation observations at least twice.

The periodic returns are then estimated only from the percentage changes in the valuation observations across time within the same assets.

Thus, differences across assets are controlled for by only using price-change information from assets that are the same assets.

CD Appendix 25A

Comparing the HR and RSR:

HR problems are with RHS variables:
- ➔ Specification errors in the model,
- ➔ Omitted variables,
- ➔ Measurement error in the variables,

These problems are especially severe for commercial property.

The result is that all HR price indexes estimated so far for commercial property have been rather "noisy", that is, lots of spurious random volatility.

RSR problems:
- ➔ Data availability,
- ➔ Sample selection bias

Data problem is most severe for commercial property, because there are fewer commercial properties to begin with.

Advantages & Disadvantages of RMR & Hedonic Specifications	
RMR	**Hedonic**
Advantages:	**Advantages:**
(1) Does not require detailed data on property characteristics.	(1) Greater number of usable transaction price observations per period (especially for shorter histories), as all observations can be used (not just repeat-sales).
(2) Produces appreciation returns that automatically include the effect of depreciation (investment returns), assuming major capital improvement expenditures are controlled for.	(2) Avoids "backward adjustments" of historical returns when index is re-estimated with new subsequent transactions data.
(3) Relatively robust to specification error.	(3) Allows analysis of components of the property value "bundle", including depreciation-free "market price" index construction (as distinct from investment returns).
Disadvantages:	**Disadvantages:**
(1) Data scarcity, especially for short histories (can only use repeat-sales).	(1) Requires good data on numerous "hedonic" (property and location characteristics) variables, unless Clapp-Giacotto (1992) "Assessed Value" (composite hedonic variable) specification is possible.
(2) Updating of index produces "backward adjustments" in the historical returns series as new "second sales" link back to earlier "first sales" in estimation history.	(2) Vulnerable to specification error (e.g., omitted variables) unless composite hedonic variable specification is possible.

The MIT/CRE Transactions-Based Index

Based on the NCREIF Index database.
All (and only) properties sold from that database.
Hence: a "pure" institutional real estate index.

Underlying Model is a classic hedonic price model:

$$P_{it} = \sum_{j} a_j X_{ijt} + \sum_{t} \beta_t Z_t + \varepsilon_{it}$$

Where:

P_{it} = *Log of Transaction Price Property i Period t;*

X_{ijt} = *Vector of j hedonic variables;*

Z_t = *Time dummies (= 1 in Period t, 0 otherwise).*

The MIT/CRE Transactions-Based Index

We substitute the property's most recent ***Appraised Value*** for the vector of hedonic variables (like a "composite" hedonic variable:

$$P_{it} = aA_{it} + \sum_t \beta_t Z_t + \varepsilon_{it}$$

Where:

P_{it} = *Log of Transaction Price Property i Period t;*

A_{it} = *Appraised value of Property i just prior to t;*

Z_t = *Time dummies (= 1 in Period t, 0 otherwise).*

[See Clapp & Giacotto, *JASA* 87: 300-306 (1992)]

Actually, we use the appraisal (NCREIF value report) 2 quarters prior to sale date, to avoid appraisal "contamination" by knowledge of sale price.

The MIT/CRE Transactions-Based Index

Estimated $\boldsymbol{\beta_t}$ coefficient captures systematic difference between transaction prices and appraised values in Period $\boldsymbol{t}$:

$$\hat{P}_{it} = \hat{a} A_{it} + \sum_{t} \hat{\beta}_t Z_t$$

The MIT/CRE Transactions-Based Index

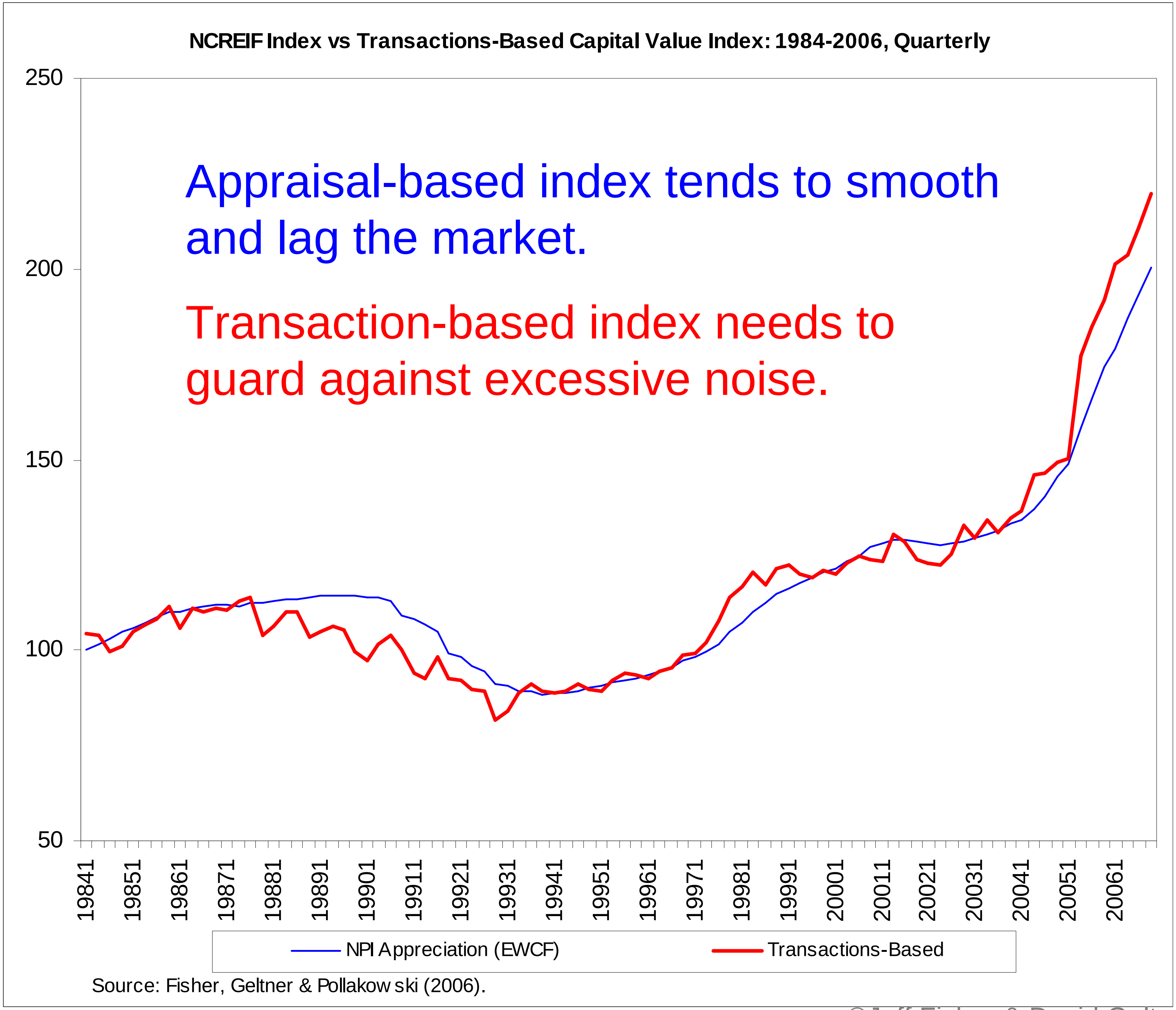
We can also estimate a ***Constant Liquidity*** version of the transactions-based index:

- Price movements to keep expected time on the market constant across the liquidity cycle

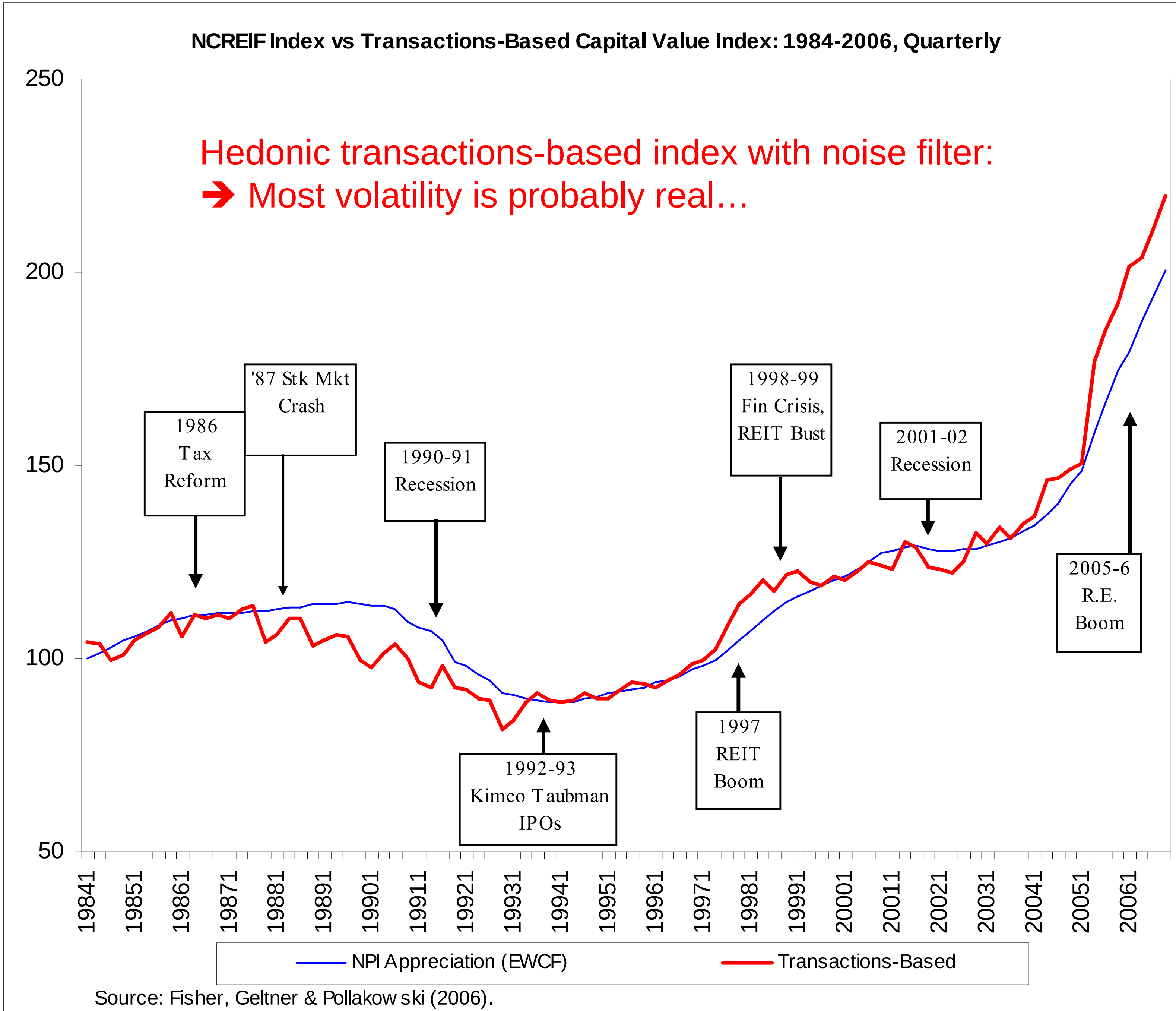
  (See Fisher et al, Real Estate Econ. 31(2) 2003.)

- Based on model's ability to separately identify *demand side* and *supply side* movements in the market. (Demand side movements are *"Constant Liquidity Index"*.)

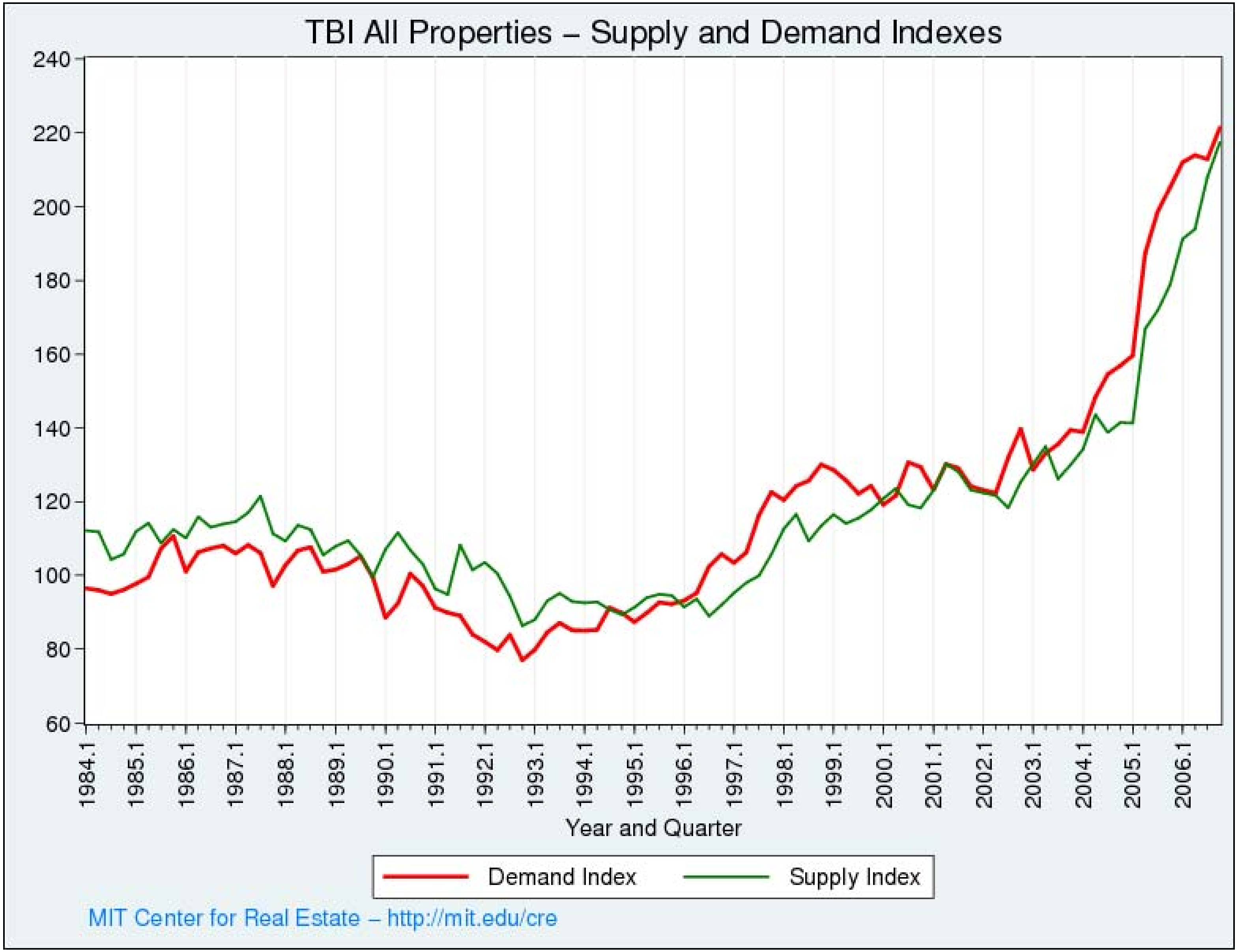
- Demand & Supply indices depict something like a *"Bid-Ask Spread"* in institutional commercial property market.



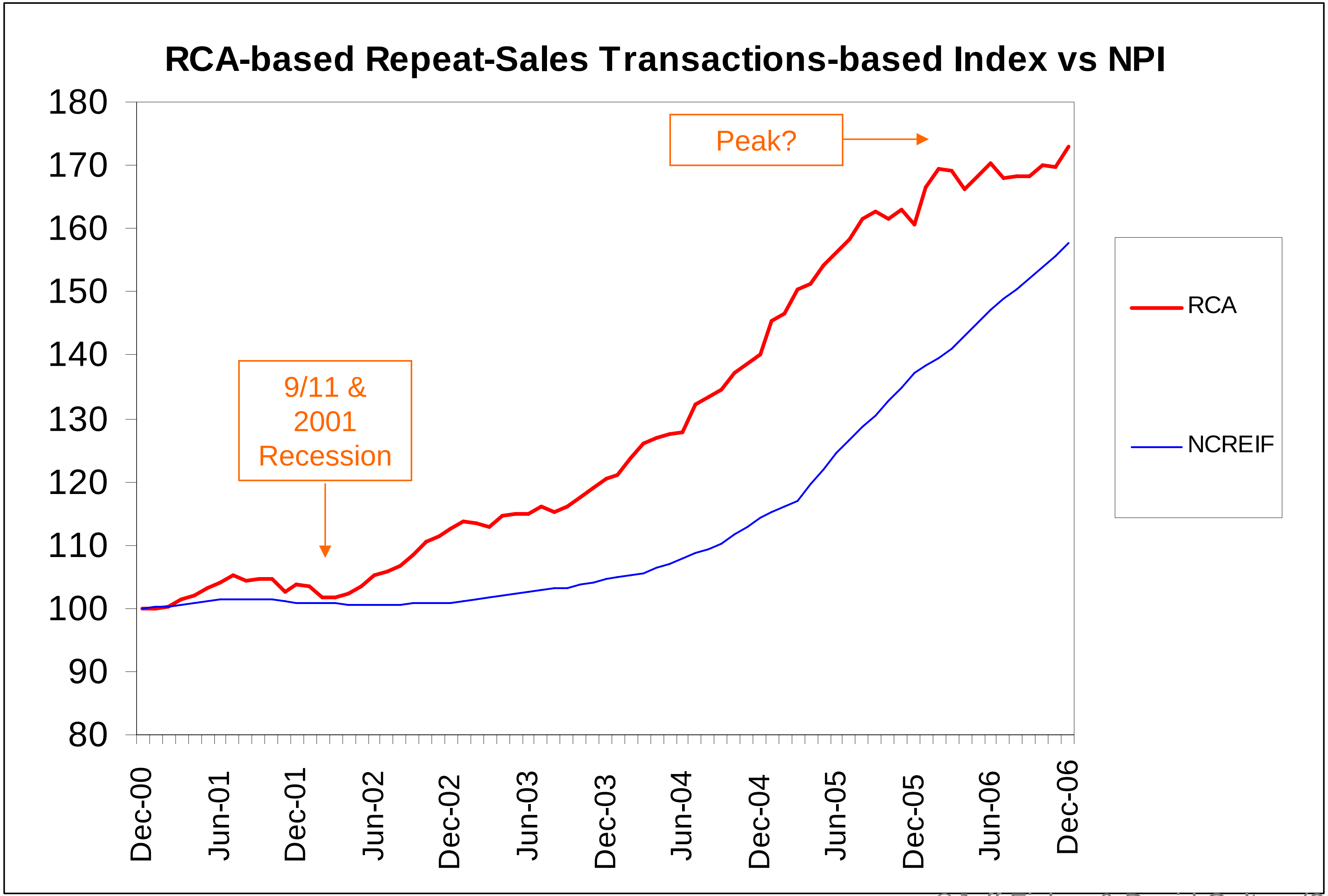
NCREIF Index vs Transactions-Based Capital Value Index: 1984-2006, Quarterly
Appraisal-based index tends to smooth and lag the market.
Transaction-based index needs to guard against excessive noise.
250
200
150
100
50
19841
19851
19861
19871
19881
19891
19901
19911
19921
19931
19941
19951
19961
19971
19981
19991
20001
20011
20021
20031
20041
20051
20061
NPI Appreciation (EWCF)
Transactions-Based
Source: Fisher, Geltner & Pollakowski (2006).


NCREIF Index vs Transactions-Based Capital Value Index: 1984-2006, Quarterly
Hedonic transactions-based index with noise filter:
➔ Most volatility is probably real…
250
200
150
100
50
1986 Tax Reform
'87 Stk Mkt Crash
1990-91 Recession
1992-93 Kimco Taubman IPOs
1997 REIT Boom
1998-99 Fin Crisis, REIT Bust
2001-02 Recession
2005-6 R.E. Boom
19841
19851
19861
19871
19881
19891
19901
19911
19921
19931
19941
19951
19961
19971
19981
19991
20001
20011
20021
20031
20041
20051
20061
NPI Appreciation (EWCF)
Transactions-Based
Source: Fisher, Geltner & Pollakowski (2006).

Here are the ***Supply Side*** and ***Demand Side*** movements:



A different kind of transactions-based index:
The RCA-based ***Repeat-Sales*** index…



The RCA-based National All-Property Monthly Index

Exhibit 3: Quarterly Capital Return Summary Statistics: RCA and NCREIF, 2001Q-2006Q3		
	RCA	NPI (EWCF)
Geometric Mean	2.30%	1.84%
Volatility	2.41%	1.96%
Serial Correlation	15.75%	76.74%
Cross-Correlation:	15.89%	

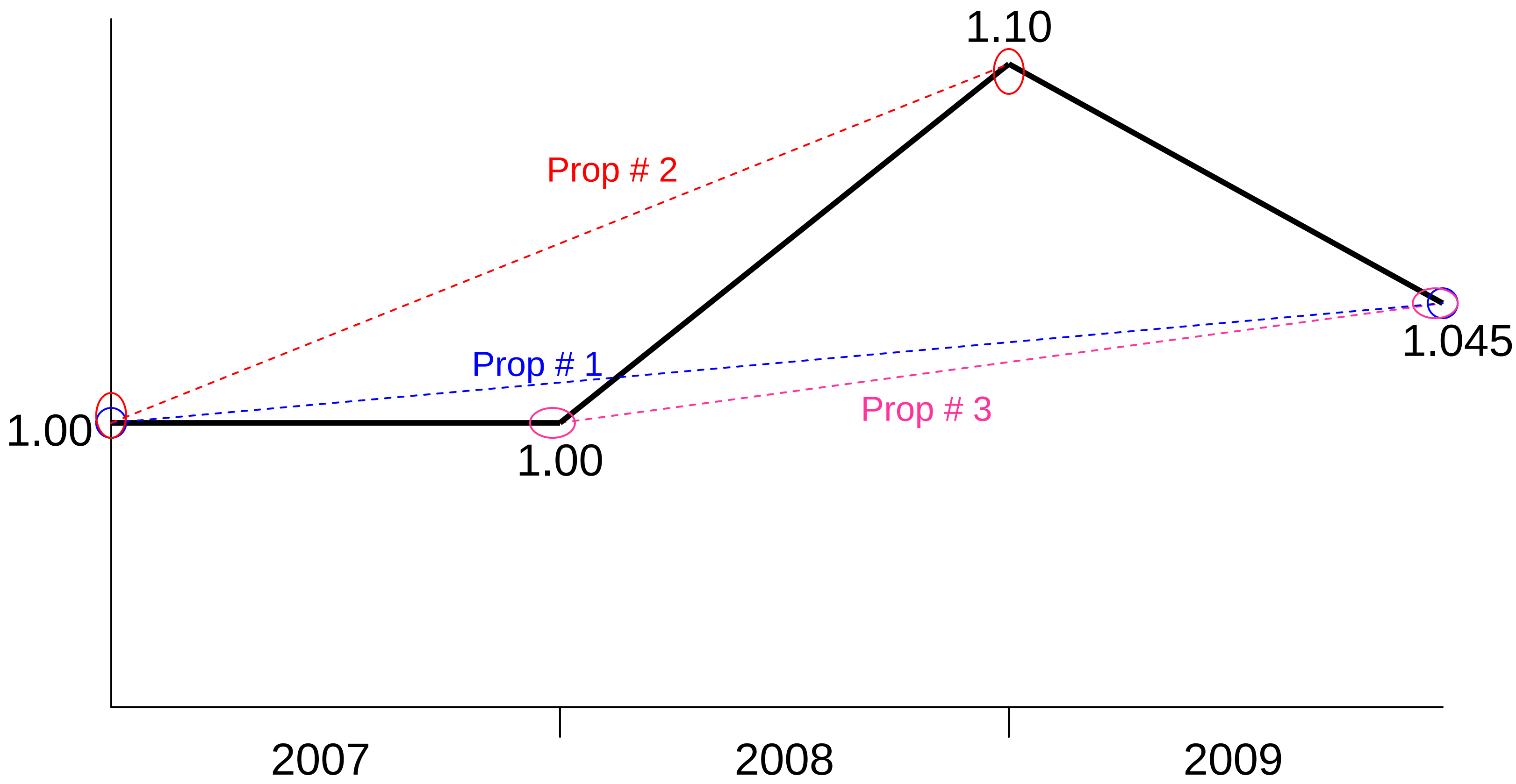
Exhibit 4: Correlation of RCA with lagged NPI: (Based on 19 to 23 quarterly returns: 2001-2006)	
	NPI (EWCF)
NPI lead 4 qtrs ahead of RCA	-32%
NPI lead 3 qtrs ahead	7%
NPI lead 2 qtrs ahead	-6%
NPI lead 1 qtrs ahead	23%
Contemporaneous	16%
NPI lag 4 qtrs ahead of RCA	62%
NPI lag 3 qtrs ahead	44%
NPI lag 2 qtrs ahead	62%
NPI lag 1 qtrs ahead	45%

Figure by MIT OCW.

Optional slide

Numerical Example of Repeat-Sales Regression Model

	Prices Observed at Ends of Years:			
	2006	2007	2008	2009
True Price Index	1.00	1.00	1.10	1.045
True Capital Return		0%	10%	-5%
Property # 1	$100,000	No Data	No Data	$104,500
Property # 2	$200,000	No Data	$220,000	No Data
Property # 3	No Data	$300,000	No Data	$313,500



Optional slide

Numerical Example of Repeat-Sales Regression Model

Regression model: $Y = a_{2007}(X2007) + a_{2008}(X2008) + a_{2009}(X2009)$

Y = Log price difference (LN of ratio 2nd sale price / 1st sale price).

Xyr = Dummy variable (= 1 if yr betw 1st & 2nd sales; yr during investr holding).

a_{yr} = Parameters to be estimated = True log price ratio during yr.

	RSR Estimation Data			
	Y value = $LN(P_s/P_f)$	X2007 value	X2008 value	X2009 value
Observation # 1	LN(1.045)	1	1	1
Observation # 2	LN(1.10)	1	1	0
Observation # 3	LN(1.045)	0	1	1

Estimation: Solve simultaneous equations (1 eq per obs):

$$LN(1.045) = a_{2007}(1) + a_{2008}(1) + a_{2009}(1) \quad\Rightarrow\quad LN(1.045) = a_{2007} + a_{2008} + a_{2009} \quad \text{Eq.(1)}$$

$$LN(1.100) = a_{2007}(1) + a_{2008}(1) + a_{2009}(0) \quad\Rightarrow\quad LN(1.100) = a_{2007} + a_{2008} \quad \text{Eq.(2)}$$

$$LN(1.045) = a_{2007}(0) + a_{2008}(1) + a_{2009}(1) \quad\Rightarrow\quad LN(1.045) = + a_{2008} + a_{2009} \quad \text{Eq.(3)}$$

Eq.(2) ➔ $a_{2008} = LN(1.1) - a_{2007}$

Eq.(2&3) ➔ $a_{2009} = LN(1.045) - LN(1.1) + a_{2007}$

Sub into Eq.(1) ➔ $LN(1.045) = a_{2007} + [LN(1.1) - a_{2007}] + [LN(1.045) - LN(1.1) + a_{2007}]$

➔ $a_{2007} = 0 = LN(1/1)$. Sub back into (2)&(3) ➔ $a_{2008} = LN(1.1) = LN(1.1/1)$, $a_{2009} = LN(1.045/1.1)$. Exponentiate to retrieve true index price ratios: 1.00, 1.10, 1.045/1.1.

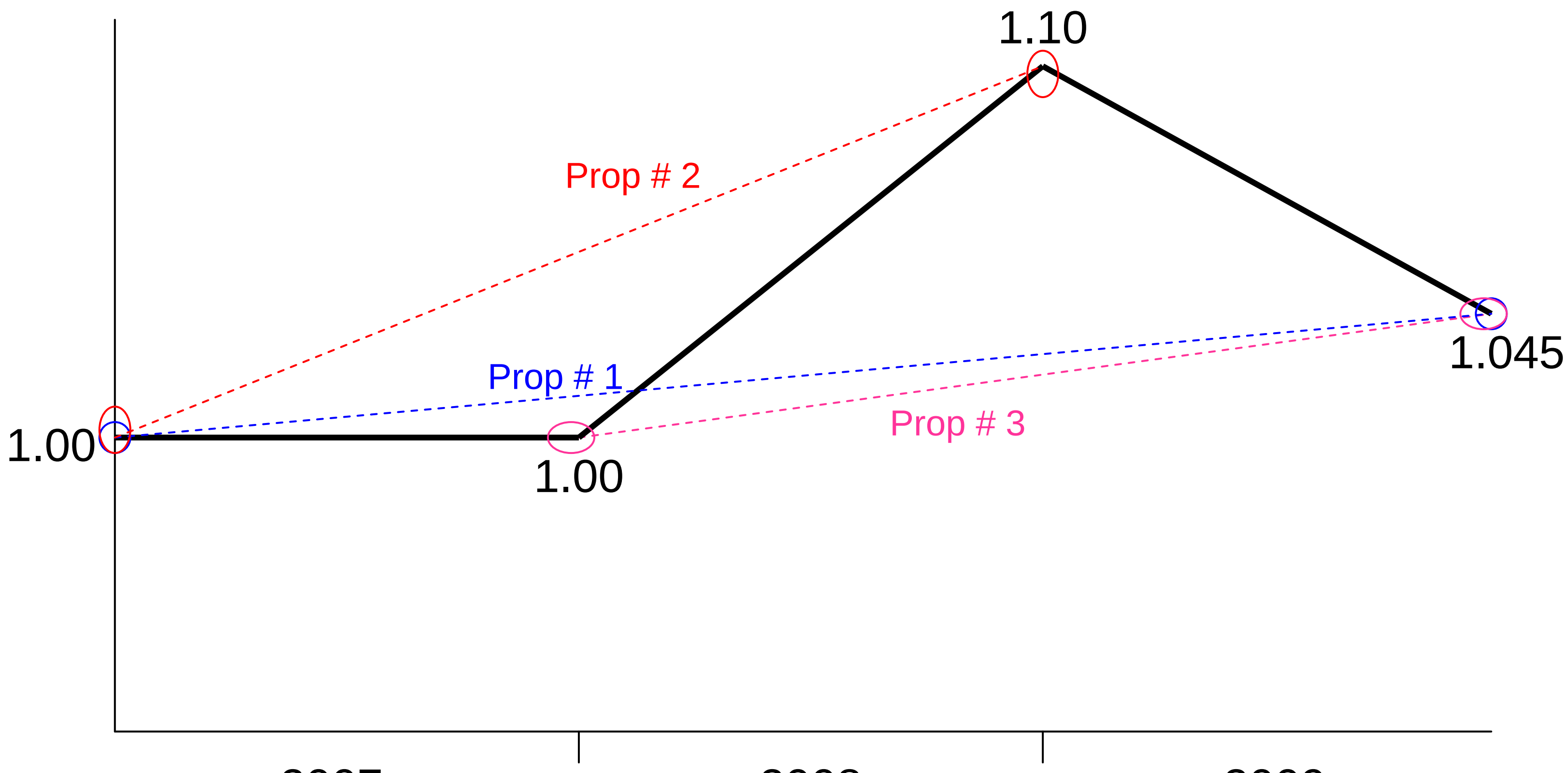
➔ Retrieved returns: 0% (2007), 10% (2008), -5% (2009).

Numerical Example of Repeat-Sales Regression Model

Thus, model retrieves true returns (including 2009 negative):

2007	0%
2008	10%
2009	-5%

Even though no single repeat-sale observation reveals any one return, and none of the investments had a price decline…



Numerical Example of Repeat-Sales Regression Model

Thus, model retrieves true returns (including 2009 negative):

2007	0%
2008	10%
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Even though no single repeat-sale observation reveals any one return, and none of the investments had a price decline…

This is a general result:

As long as data contains at least one sale (obs) per period,

model can find return in each period.

In real world, there will also be random dispersion of individual transaction prices around market price.

But there will also be more than one observation per period.

Statistical techniques can optimize the resulting estimates

(e.g., OLS, WLS, ridge, time-wtd dummies).

- A basic set of 29 indexes.
- National, Regional (NCREIF Regions), and MSA-levels.
- Four property usage type sectors.
- Top-10 MSAs indexes by sector
- Indexes can be combined and weighted as desired by users.

Exhibit1: Initial Set of RCA Indexes for Derivatives Trading

Index:	Frequency:*	Avg Obs/Period:**
National Indexes		
All property	Monthly	310
Apartments	Quarterly	370
Industrial	Quarterly	180
Office	Quarterly	231
Retail	Quarterly	150
Regional Indexes		
East Apartments	Annual	215
East Industrial	Annual	148
East Office	Annual	238
East Retail	Annual	92
South Apartments	Annual	388
South Industrial	Annual	127
South Office	Annual	192
South Retail	Annual	156
West Apartments	Quarterly	204
West Industrial	Quarterly	88
West Office	Quarterly	100
West Retail	Quarterly	76
Top 10 MSAs Indexes:		
Apartments	Quarterly	258
Industrial	Quarterly	126
Office	Quarterly	151
Retail	Quarterly	81
MSA-level Indexes		
Florida Apartments***	Annual	223
New York Office	Annual	81
Washington DC Office	Annual	74
San Francisco Office	Annual	79
Southern California Office****	Annual	142
Southern California Apartments****	Annual	290
Southern California Industrial****	Annual	174
Southern California Retail****	Annual	120

Note: Regions refer to NCREIF multi-state regions. Index histories begin in 2001.

* Annual frequency indexes will be published four times per year in four seasonal versions, one each beginning in January, April, July and October, respectively, in order to facilitate trades that may occur at various times throughout the year. Only the January index will correspond exactly to the calendar years.

** Based on 2005 average number of second-sales observations per index reporting period (e.g., per month, quarter, or year, as appropriate).

*** Includes Miami, Ft Lauderdale, West Palm Beach, Tampa/St Pete, and Orlando MSAs.

**** Includes LA, Orange, Riverside, and San Diego MSAs.

Figure by MIT OCW.

National Level Indexes

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National indexes:		
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Retail	Quarterly	150

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South Office	Annual	192
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**Based on 2005 average number of second-sales observations per index reporting period (e.g., per month, quarter, or year, as appropriate).

Figure by MIT OCW.

MSA Level Indexes

Exhibit 1: Initial Set of RCA Indexes for Derivatives Trading

Index:	Frequency:*	Avg Obs/Period:**
MSA-level Indexes:		
Florida Apartments***	Annual	223
New York Office	Annual	81
Washington DC Office	Annual	74
San Francisco Office	Annual	79
Southern California Office****	Annual	142
Southern California Apartments****	Annual	290
Southern California Industrial****	Annual	174
Southern California Retail****	Annual	120

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**** Includes LA, Orange, Riverside, and San Diego MSAs.

Figure by MIT OCW.

The Top-10 MSAs Indexes by Sector (Qtrly)

Exhibit 1: Initial Set of RCA Indexes for Derivatives Trading		
Index:	**Frequency:***	**Avg Obs/Period:****
Top 10 MSAs Indexes:		
Apartments	Quarterly	258
Industrial	Quarterly	126
Office	Quarterly	151
Retail	Quarterly	81

** Based on 2005 average number of second-sales observations per index reporting period (e.g., per month, quarter, or year, as appropriate).

Figure by MIT OCW.

Top 10 based on RCA total transaction volume.

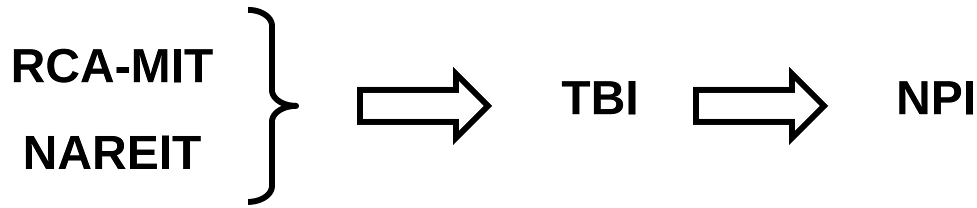
Cities composing indexes will be updated every two years.

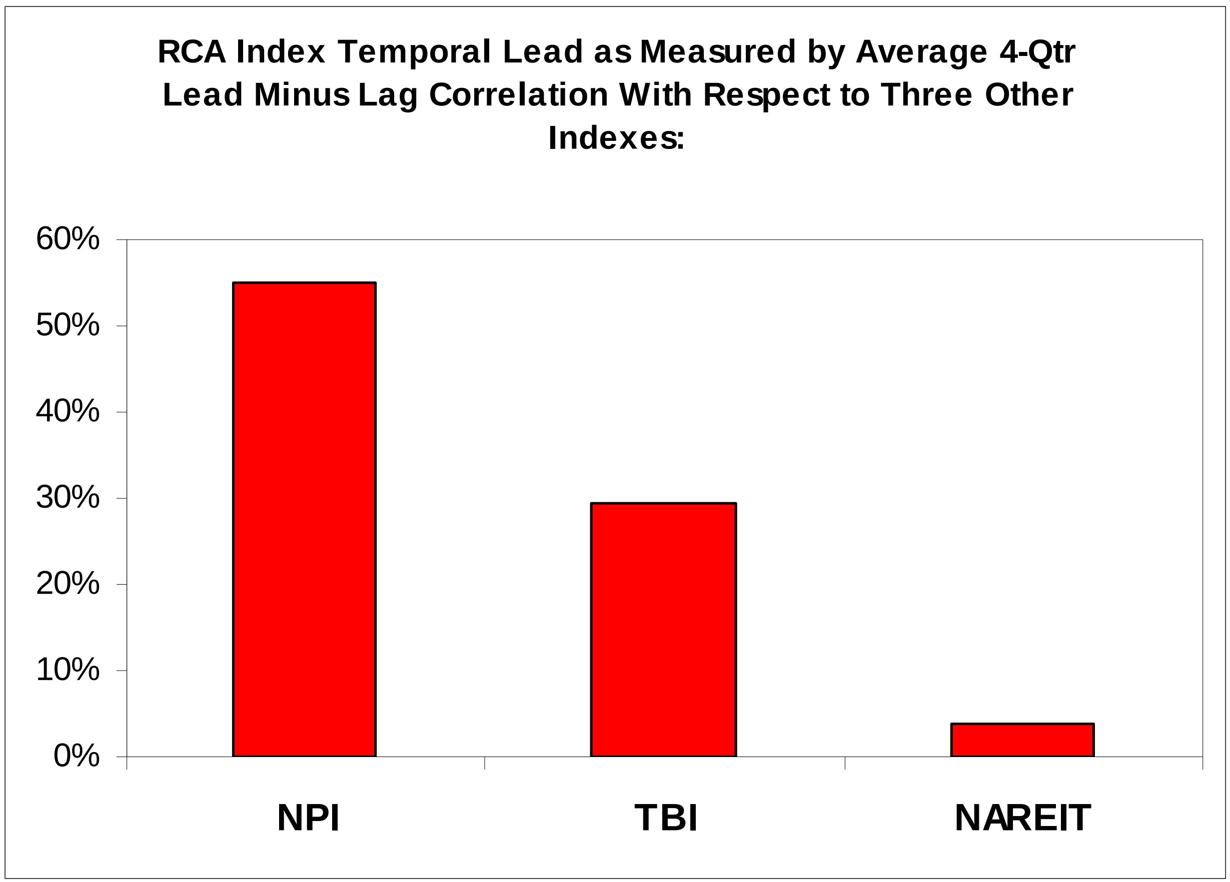
The Temporal Relationship of RCA with Other R.E. Indexes:

Lead/Lag Correlation betw RCA and NCREIF & NAREIT:

	w TBI	w NPI	w NAREIT
RCA lag 4 qtrs behind	-20.89%	-31.56%	-9.67%
RCA lag 3 qtrs behind	20.81%	6.98%	26.65%
RCA lag 2 qtrs behind	-34.38%	-5.91%	7.01%
RCA lag 1 qtr behind	19.88%	23.35%	9.06%
Contemporaneous	29.00%	15.89%	10.78%
RCA lead 1 qtr ahead	45.15%	61.97%	-25.22%
RCA lead 2 qtrs ahead	36.94%	44.01%	14.72%
RCA lead 3 qtrs ahead	15.18%	61.52%	33.70%
RCA lead 4 qtrs ahead	5.71%	44.86%	25.69%
AVG lag	-3.64%	-1.78%	8.26%
AVG lead	25.75%	53.09%	12.22%
Lead Minus Lag	29.39%	54.87%	3.96%

The Temporal Relationship of RCA-MIT with Other R.E. Indexes:

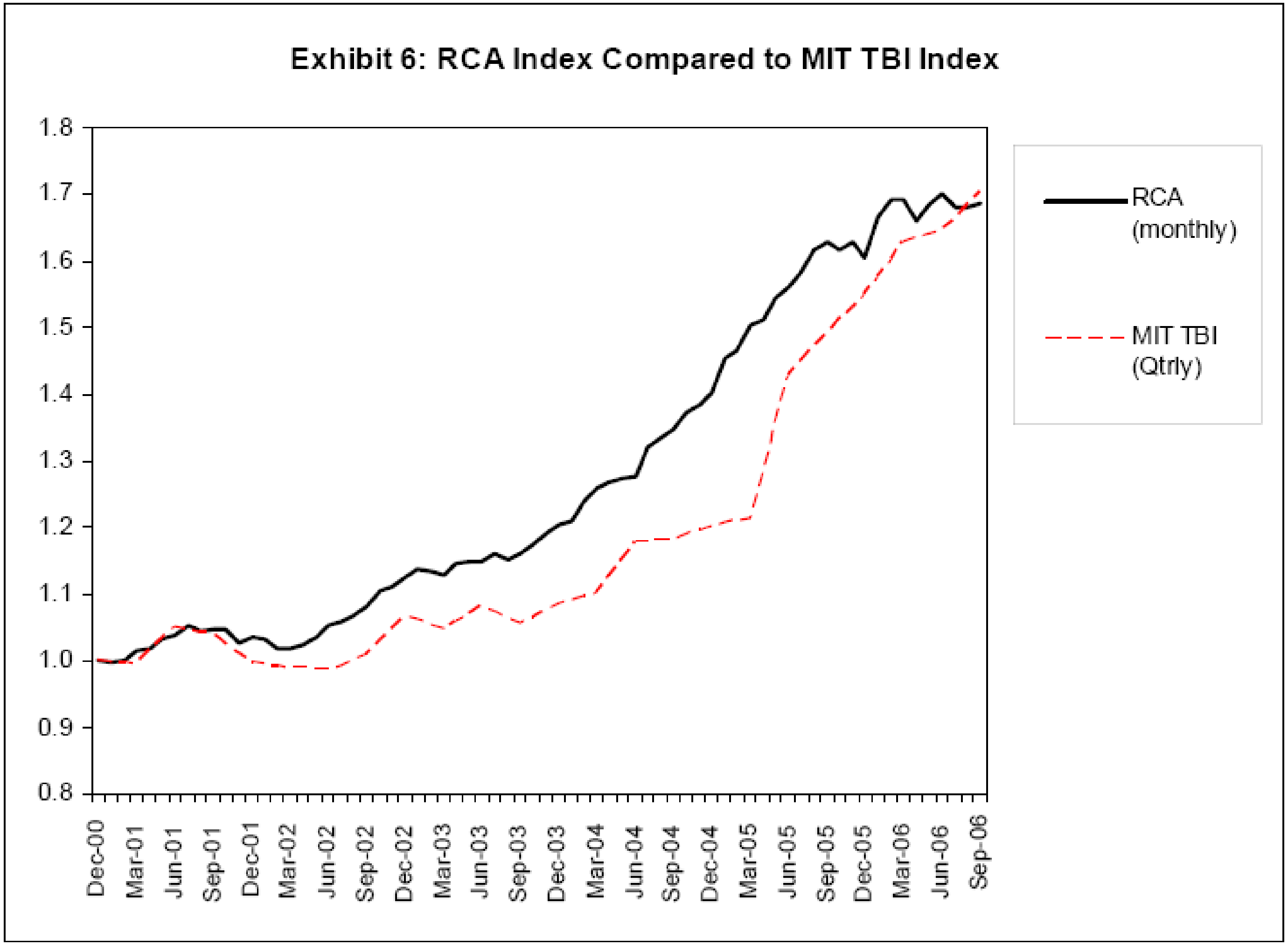




The National All-Property Monthly Index

Summary Statistics for Quarterly Capital Returns for Nine Series of Interest, 2001Q1-2006Q3 (23 obs)									
	RCA	MIT TBI	NPI	NAREIT (eq)	CPI Inflation*	T-Bills*	ovt Bonds*	S&P500*	GRA/CREX
Mean	2.30%	2.34%	1.84%	3.25%	0.70%	0.61%	0.39%	0.05%	1.73%
Volatility	2.41%	4.37%	1.96%	7.22%	0.88%	0.36%	4.61%	8.50%	10.14%
Serial Correla	15.75%	1.54%	76.74%	-31.38%	-39.48%	91.80%	-24.67%	-17.62%	-48.64%
Beta wrt S&P	0.00	0.11	0.04	0.47	-0.03	-0.01	-0.22	1.00	0.15
Correlations:									
RCA	100%	29%	16%	11%	26%	-22%	13%	-1%	32%
MIT TBI	29%	100%	64%	25%	4%	12%	15%	22%	17%
NPI	16%	64%	100%	20%	14%	36%	1%	19%	-5%
NAREIT (eq)	11%	25%	20%	100%	-12%	-4%	-4%	58%	25%
CPI Inflation*	26%	4%	14%	-12%	100%	18%	-22%	-30%	-6%
T-Bills*	-22%	12%	36%	-4%	18%	100%	-5%	-20%	-4%
LT Govt Bond	13%	15%	1%	-4%	-22%	-5%	100%	-43%	-11%
S&P500*	-1%	22%	19%	58%	-30%	-20%	-43%	100%	14%
GRA/CREX	32%	17%	-5%	25%	-6%	-4%	-11%	14%	100%
* CPI Inflation, 30-day Treasury Bills, Long-Term Government Bonds, and the S&P500 Index returns data are from Ibbotson A									
**GRA/CREX through 2006Q2 only.									

The National All-Property Monthly Index



Quarterly correlation (2001-2006Q3) RCA-TBI = +29% contemporaneous, +45% TBI lagged 1 qtr, +37% TBI lagged 2 qtrs.

➔ Small private investors (RCA) lead institutional investors (NCREIF)?

The National All-Property Monthly Index

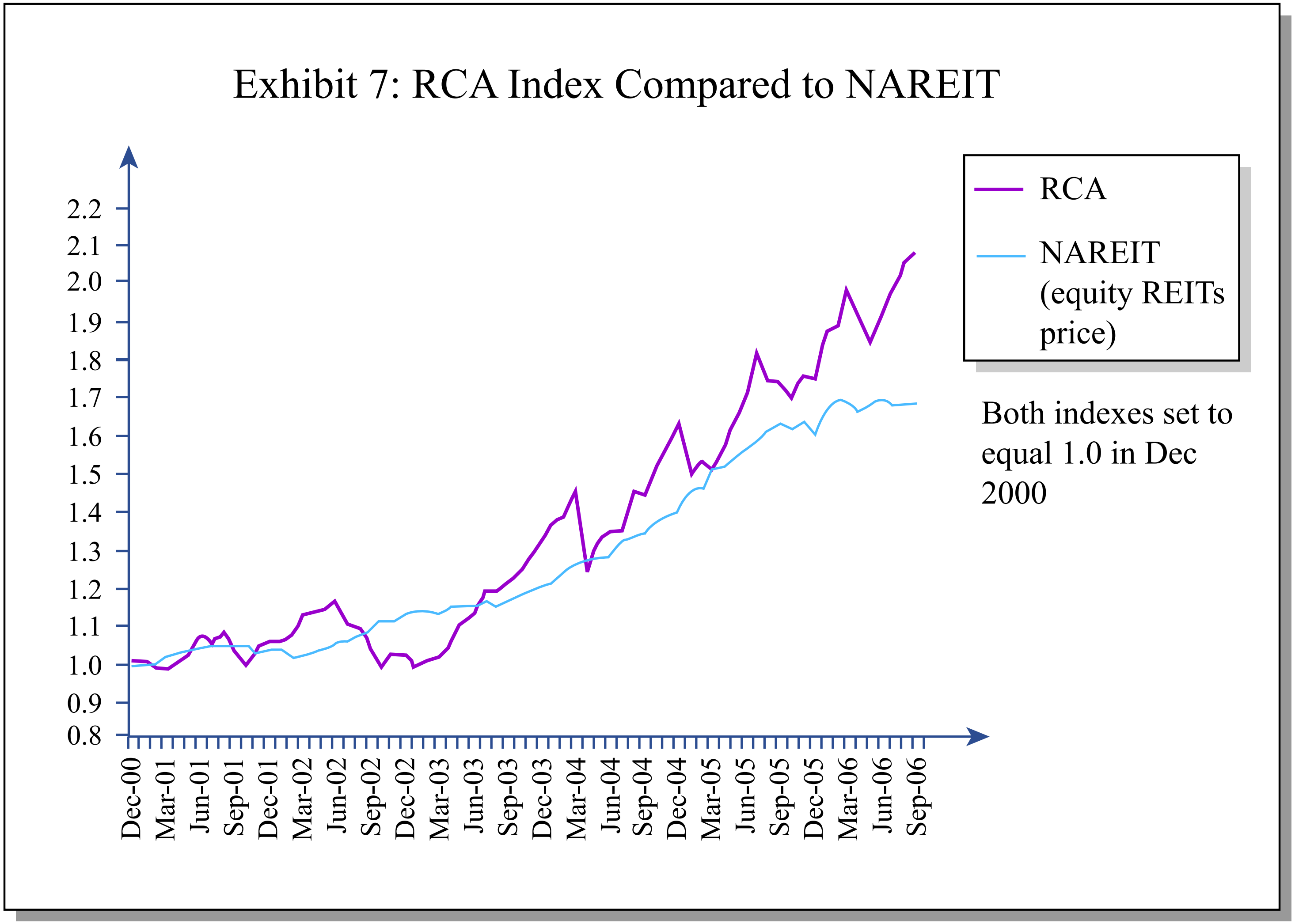


Figure by MIT OCW.

No particular lead/lag relationship apparent between the two indexes.

The National Property Type Sector Indexes (Qtrly)

Exhibit 8: RCA National Property Sector Indexes, Quarterly Capital Returns Statistics: 2001Q1-2006Q3 (23 obs)				
	Apartments	Industrial	Office	Retail
Mean	2.40%	2.43%	1.94%	2.68%
Volatility	3.92%	3.77%	3.31%	2.33%
1st-order autocorrelation	2.00%	4.70%	22.32%	-5.42%
4th-order autocorrelation	-24.87%	7.72%	19.20%	11.77%
Cross-correlation:				
Apartments	100%	31%	-21%	28%
Industrial	31%	100%	1%	-3%
Office	-21%	1%	100%	49%
Retail	28%	-3%	49%	100%

Figure by MIT OCW.

The National Property Type Sector Indexes (Qtrly)

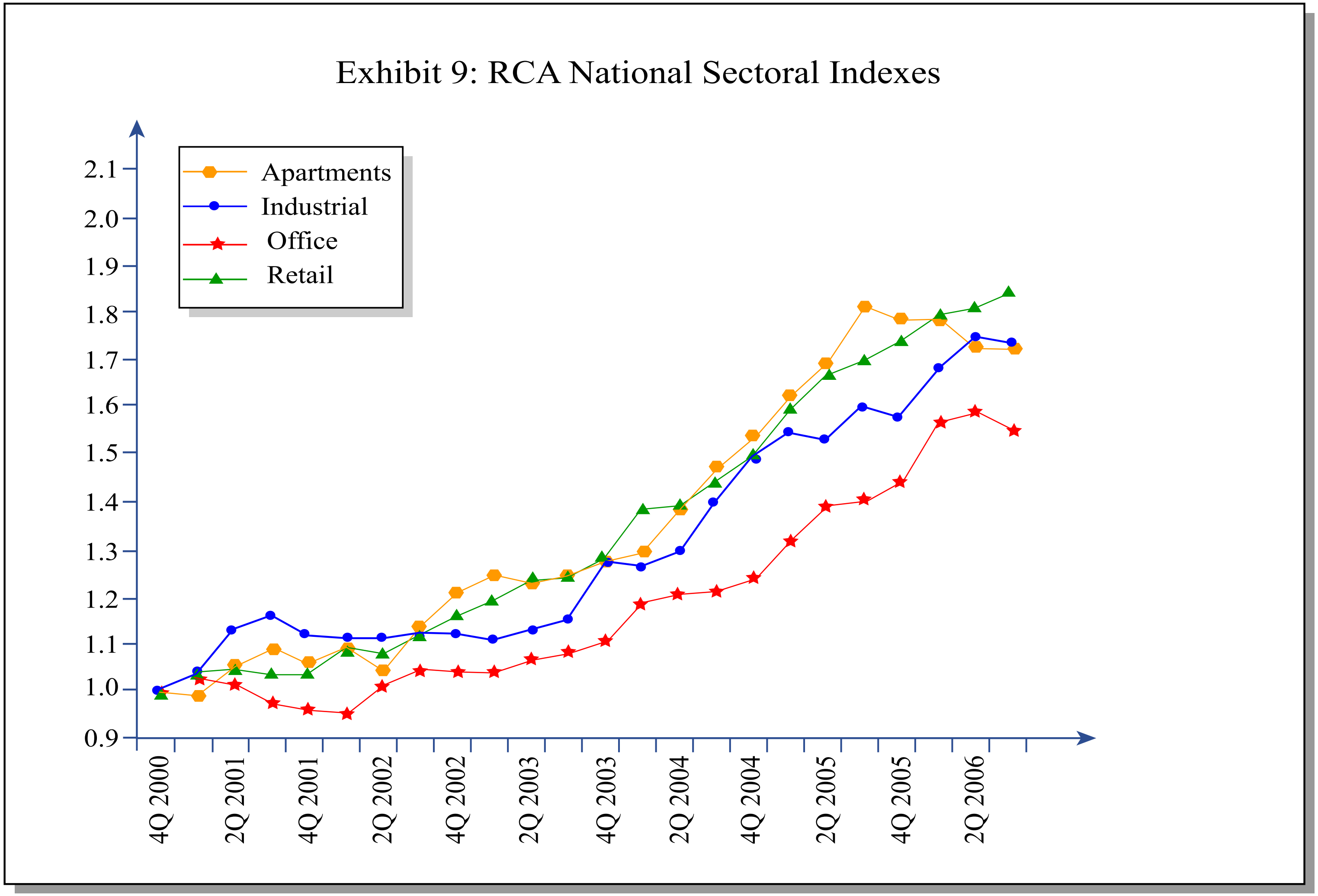


Figure by MIT OCW.

Regional Indexes - West (Qtrly)

Exhibit 10: West Region Quarterly Return Statistics by Sector, 2001Q1-2006Q3 (23 obs)				
	Apartments	Industrial	Office	Retail
Mean	2.39%	2.24%	1.59%	2.98%
Volatility	3.31%	3.24%	5.98%	1.82%
1st-order autocorrelation	14.07%	18.29%	-5.20%	22.70%
4th-order autocorrelation	13.92%	10.37%	0.92%	-5.97%
Correlations:				
Apartments	100%	42%	-10%	11%
Industrial	42%	100%	31%	44%
Office	-10%	31%	100%	32%
Retail	11%	44%	32%	100%

Figure by MIT OCW.

Regional Indexes - West (Qtrly)

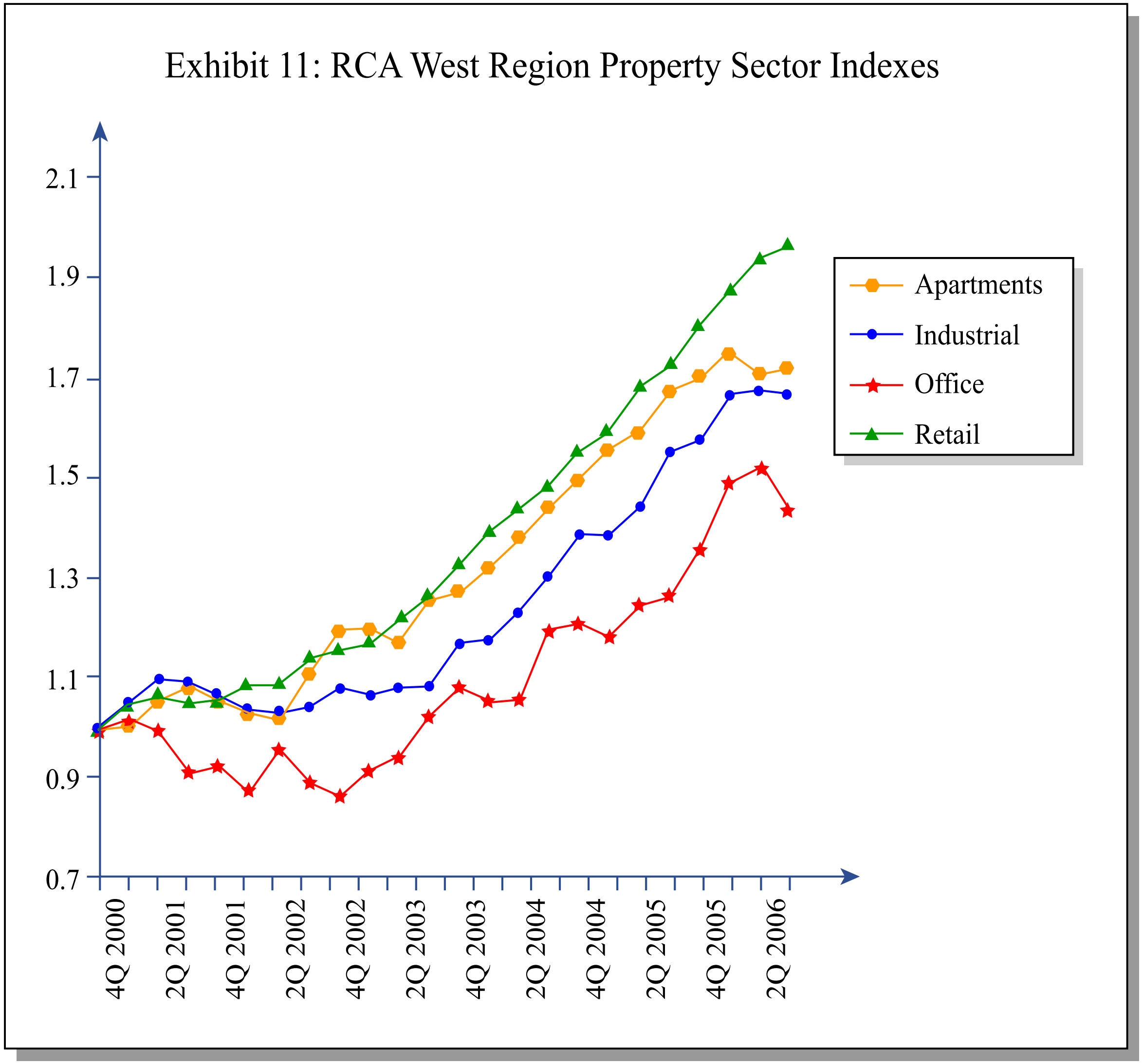


Figure by MIT OCW.

Regional Indexes – East & South (Annual)

Exhibit 12: RCA Indexes East and South Regions Annual Capital Returns Statistics: 2001-2006 (FYS Indexes Yrs Ending Sept, 5 obs)	East Apts	South Apts	East Indust	South Indust	East Office	South Office	East Retail	South Return
Mean	12.6%	9.8%	11.0%	11.6%	10.4%	12.4%	13.3%	10.6%
Volatility	11.7%	17.9%	7.8%	6.8%	3.4%	7.8%	6.6%	8.4%
Serial corr.	-73.5%	-60.6%	-9.3%	41.0%	8.9%	-17.8%	-40.9%	-20.0%
Correlation:								
East apts	100%	82%	62%	2%	13%	-3%	90%	27%
South apts	82%	100%	51%	37%	65%	42%	78%	32%
East indust	62%	51%	100%	60%	31%	-31%	82%	90%
South indust	2%	37%	60%	100%	80%	32%	25%	79%
East office	13%	65%	31%	80%	100%	58%	30%	48%
South office	-3%	42%	-31%	32%	58%	100%	-23%	-28%
East retail	90%	78%	82%	25%	30%	-23%	100%	60%
South retail	27%	32%	90%	79%	48%	-28%	60%	100%

Figure by MIT OCW.

Regional Indexes – East (Annual)

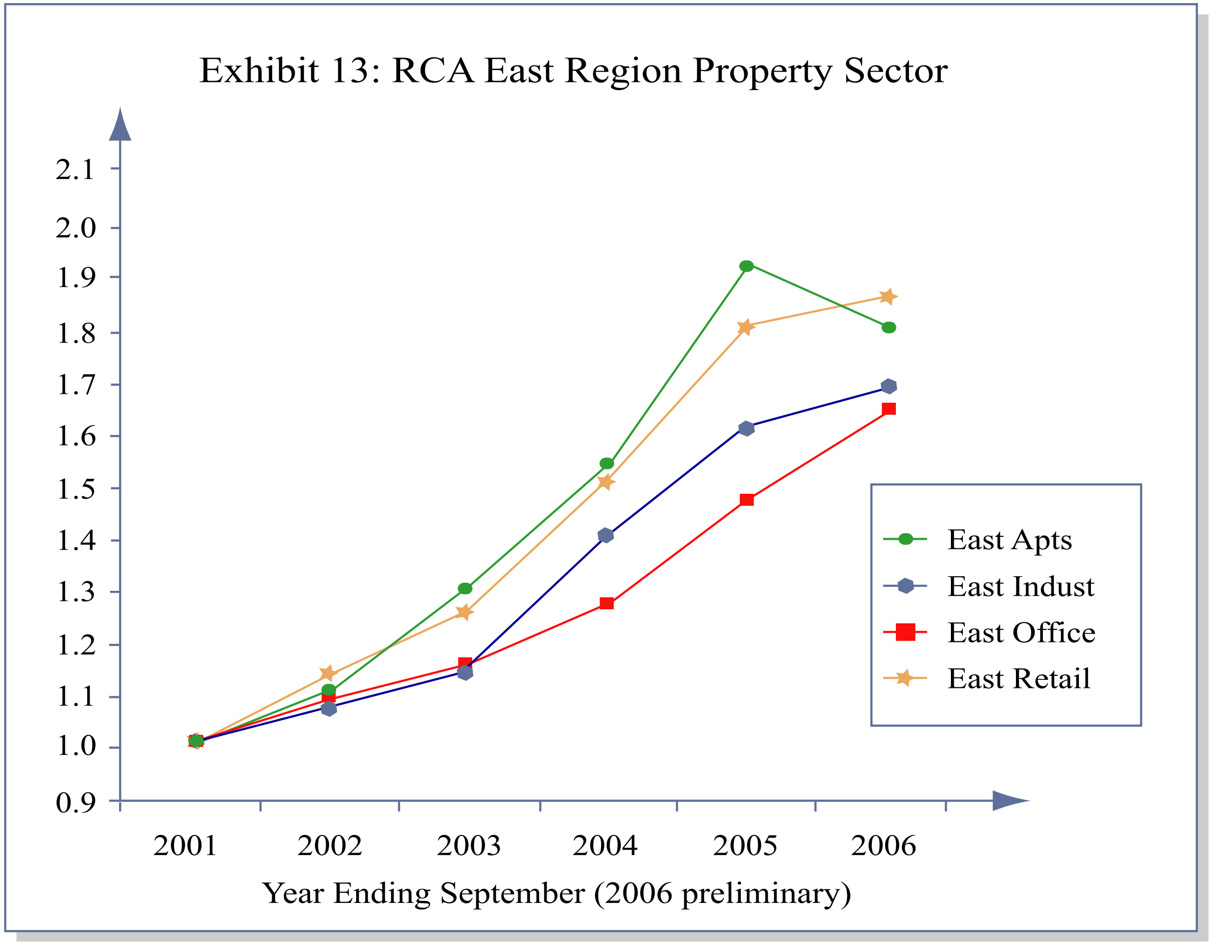


Figure by MIT OCW.

Regional Indexes – South (Annual)

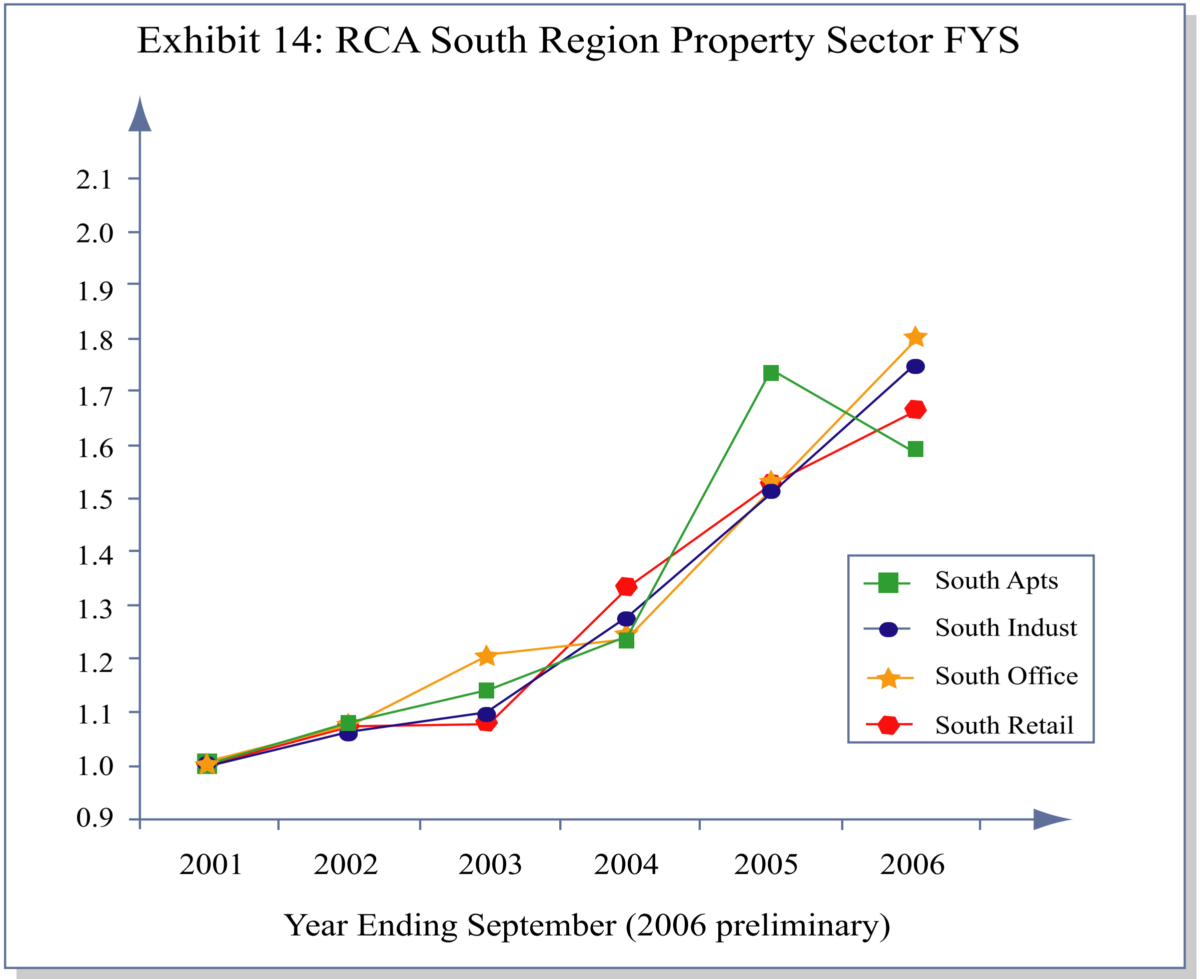


Figure by MIT OCW.

Initial MSA-level Indexes (Annual)

Exhibit 15: RCA Indexes at the MSA Level Annual Capital Returns Statistics: 2001-2006 (FYS Indexes Yrs Ending Sept, 5 obs)								
	FL Apts	SoCal Apts	SoCal Indust	SoCal Retail	SoCal Office	SF Office	NYC Office	DC Office
Mean	17.9%	15.7%	13.9%	18.3%	11.9%	2.6%	13.6%	11.4%
Volatility	15.7%	5.8%	6.9%	3.8%	9.7%	7.3%	4.6%	5.9%
Serial corr.	-45.1%	31.3%	66.1%	98.0%	-4.1%	89.7%	-25.4%	-25.4%
Correlation:								
FL apts	100%	-21%	52%	13%	76%	27%	59%	83%
SoCal apts	-21%	100%	-61%	-83%	24%	-27%	-46%	-55%
SoCal indust	52%	-61%	100%	84%	51%	82%	59%	58%
SoCal retail	13%	-83%	84%	100%	5%	73%	29%	30%
SoCal office	76%	24%	51%	5%	100%	59%	24%	36%
SF office	27%	-27%	82%	73%	59%	100%	4%	7%
NYC office	59%	-46%	59%	29%	24%	4%	100%	90%
DC office	83%	-55%	58%	30%	36%	7%	90%	100%

Figure by MIT OCW.

Southern California (LA+SD) Indexes (Annual)

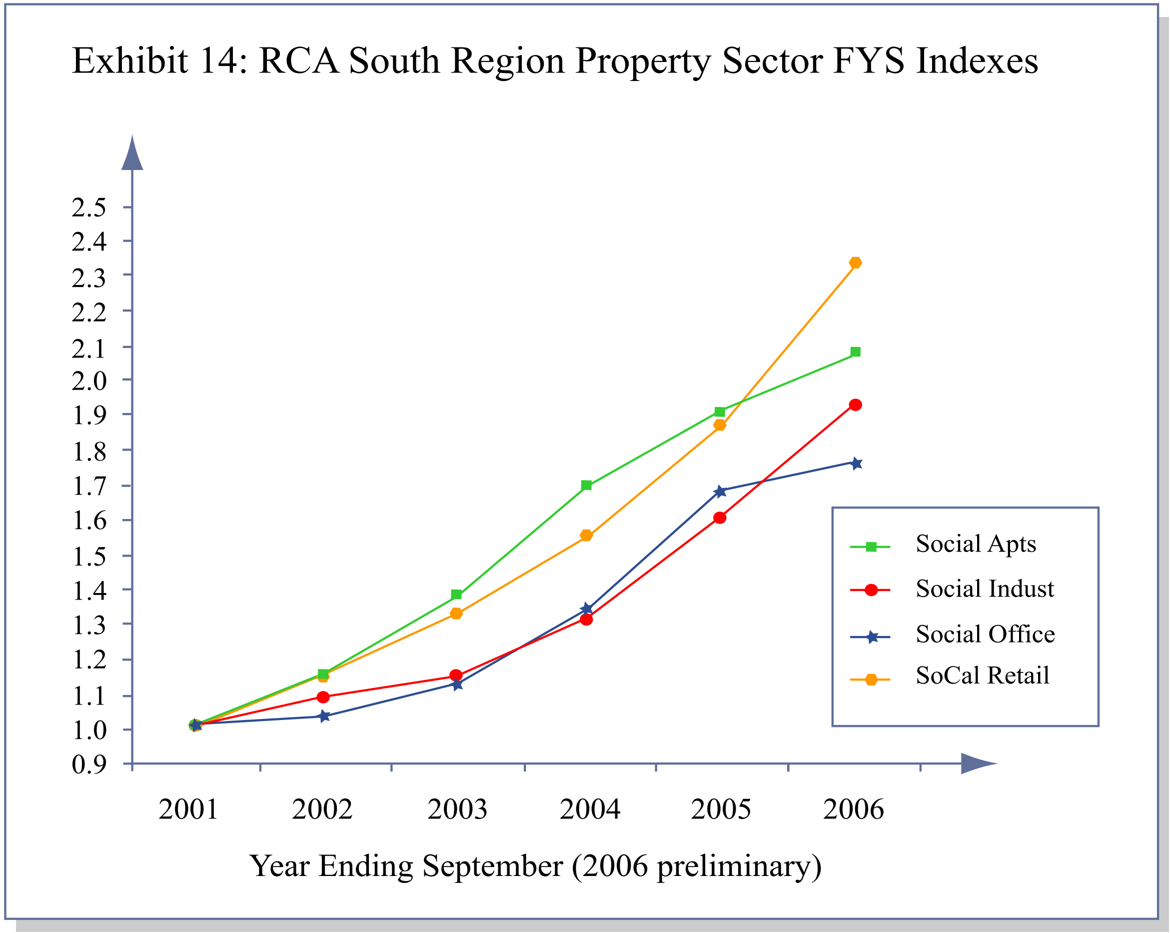


Figure by MIT OCW.

MSA-level Office Indexes (Annual)

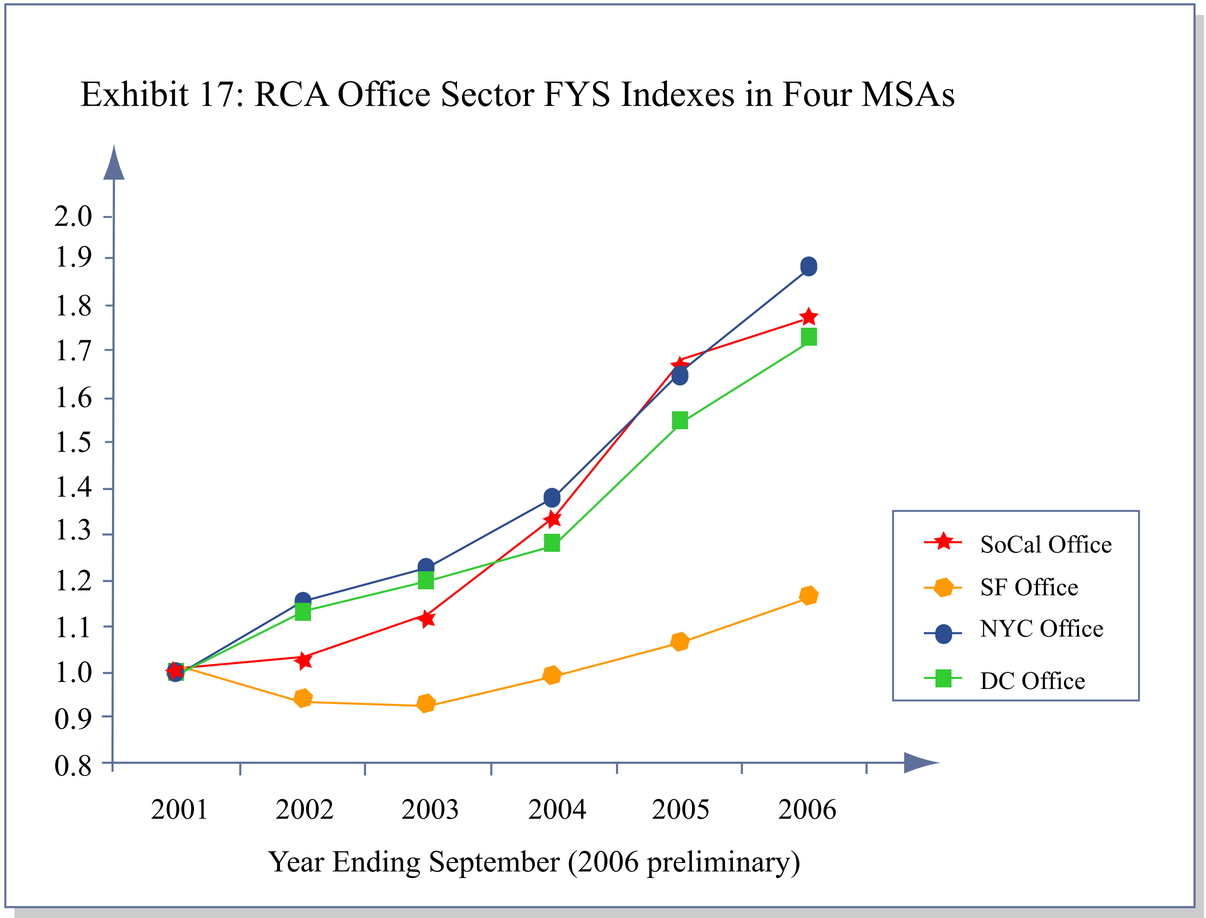


Figure by MIT OCW.

MSA-level Apartment Indexes (Annual)

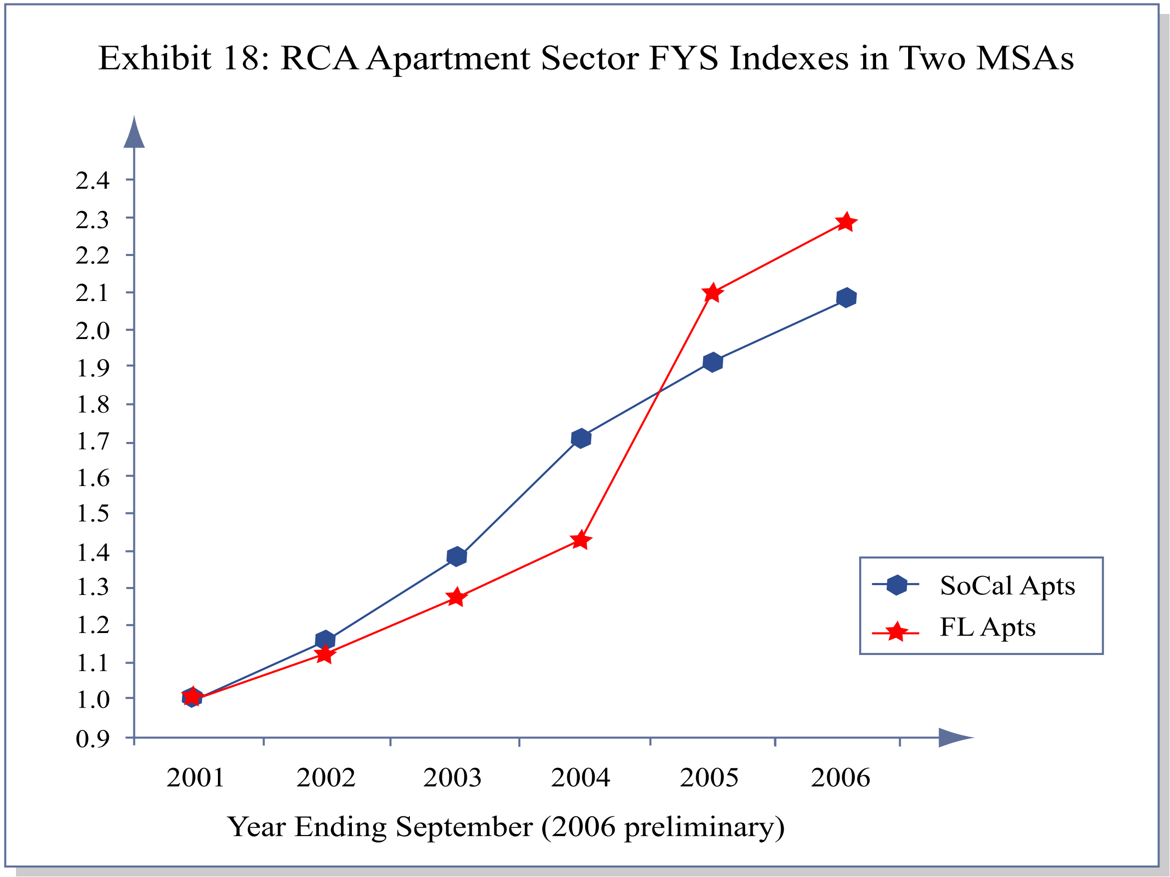


Figure by MIT OCW.

Annual Indexes: Four Different Base Months

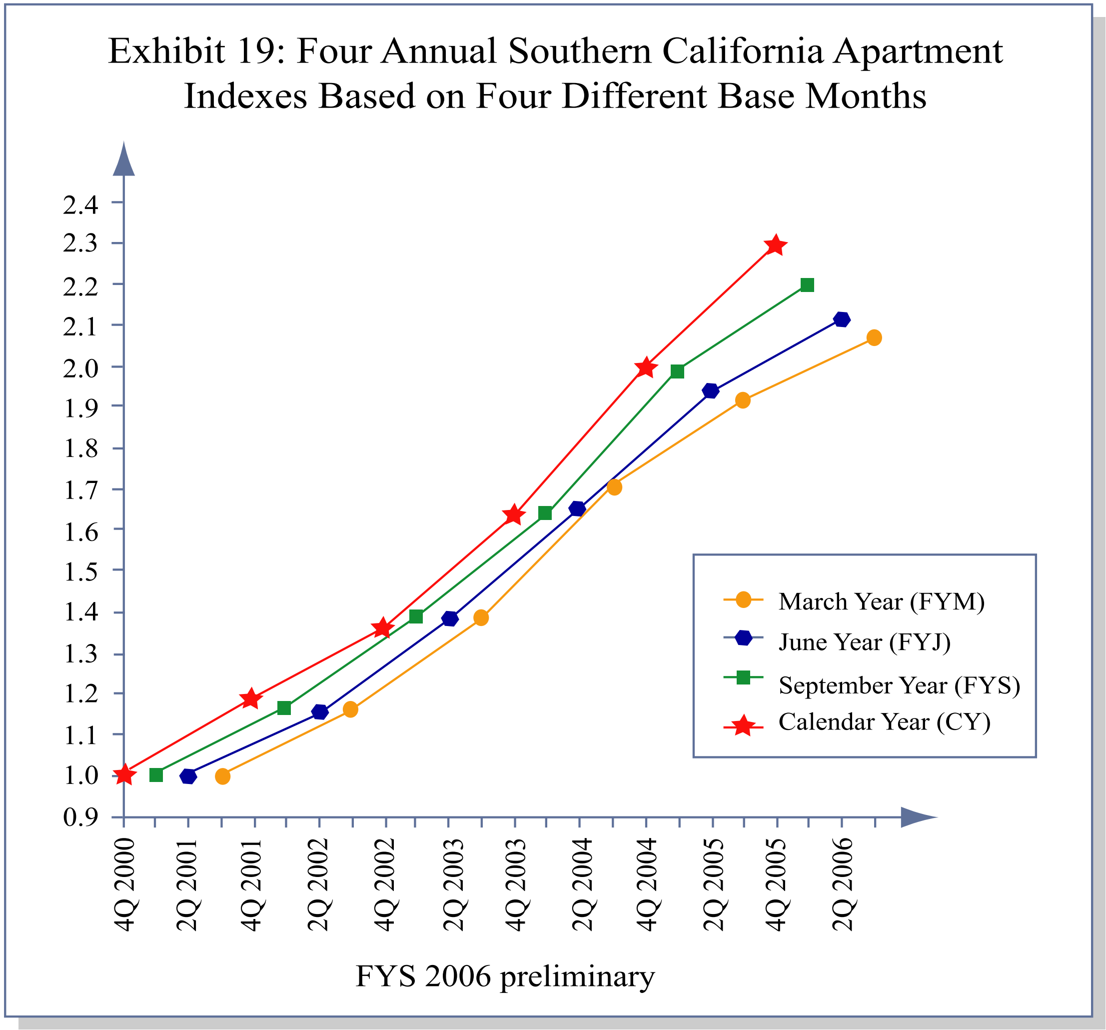


Figure by MIT OCW.

The Top-10 MSAs Indexes by Sector (Qtrly)

Exhibit 20: MSAs Included in Top-10 Indexes			
Apartments	Industrial	Office	Retail
Atlanta	Atlanta	Atlanta	Chicago
DC	Chicago	Boston	DC
LA	DC	Chicago	Denver
New York	LA	DC	Houston
Orlando	New York	LA	LA
Phoenix	Phoenix	New York	New York
San Fran	San Diego	Phoenix	Phoenix
Seattle	San Fran	San Diego	San Fran
SoFlorida	Seatle	San Fran	Seattle
Tampa	SoFlorida	SoFlorida	SoFlorida

Figire by MIT OCW.

Top 10 based on RCA total transaction volume.

Cities composing indexes will be updated every two years.

The Top-10 MSAs Indexes by Sector (Qtrly)

Exhibit 21: Top-10 MSAs Quarterly Return Statistics by Sector, 2001Q1-2006Q3 (23 obs)				
	Apartments	**Industrial**	**Office**	**Retail**
Mean	2.90%	2.65%	1.95%	2.68%
Volatility	5.44%	2.76%	2.77%	4.58%
1st-order Autocorrelation	-24.68%	19.07%	24.97%	-20.86%
4th-order Autocorrelation	-0.05%	2.19%	23.97%	-43.43%
Correlations:				
Apartments	100%	32%	15%	37%
Industrial	32%	100%	22%	-5%
Office	15%	22%	100%	8%
Retail	37%	-5%	8%	100%

Figure by MIT OCW.

The Top-10 MSAs Indexes by Sector (Qtrly)

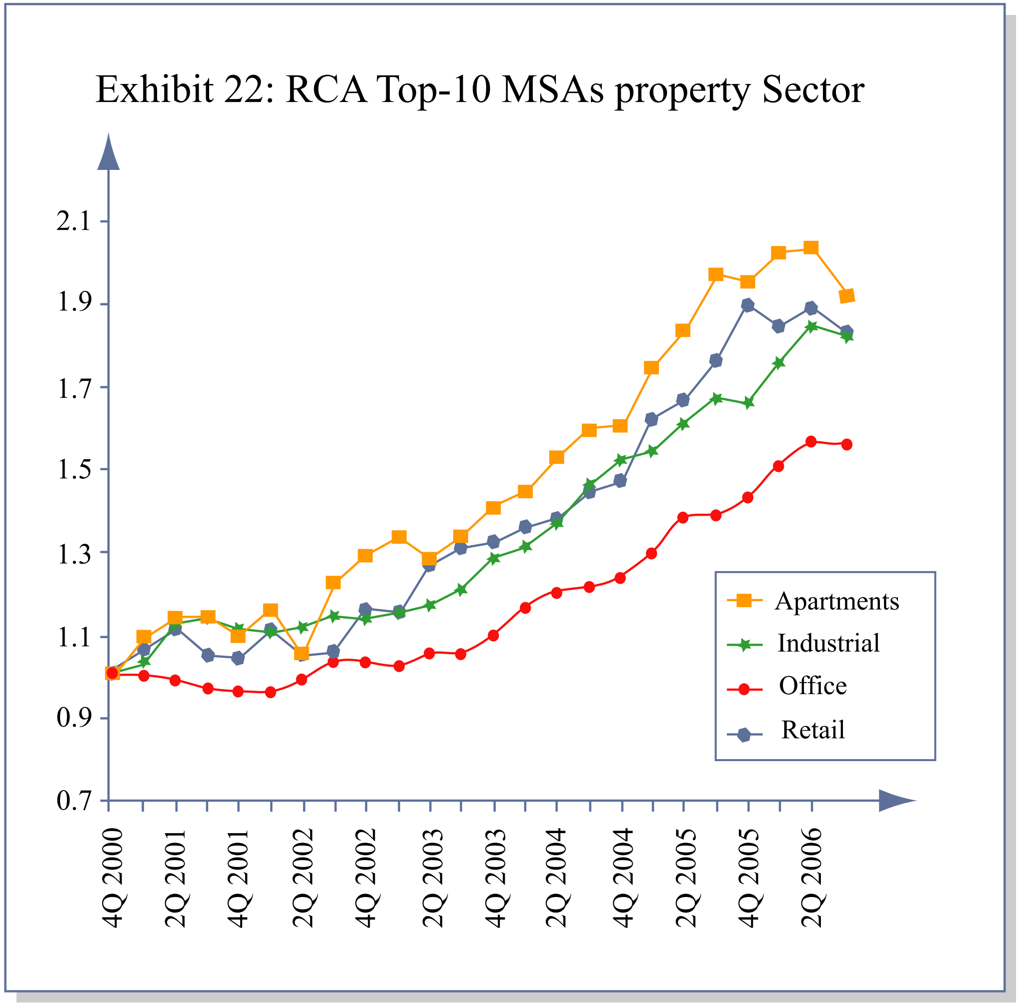
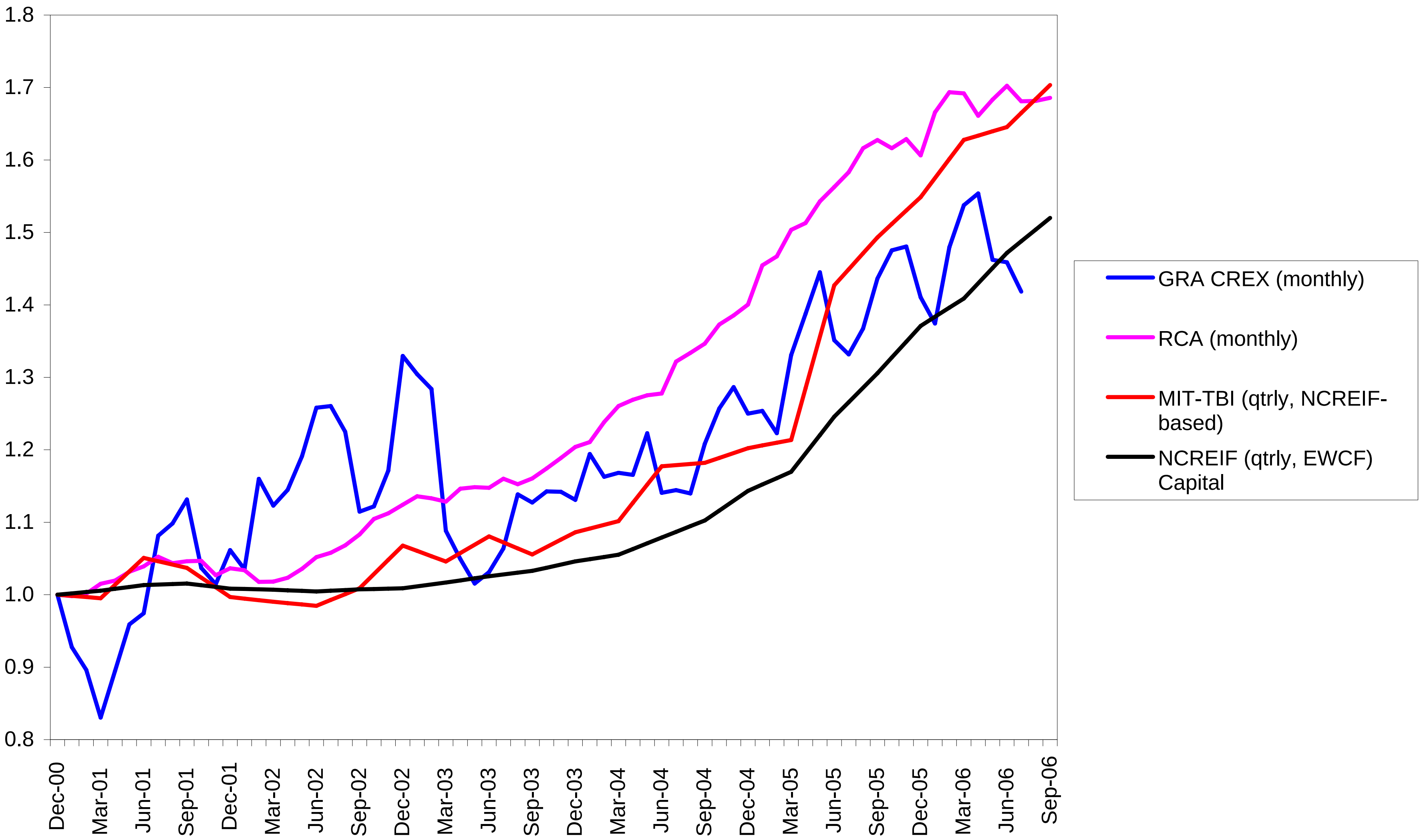
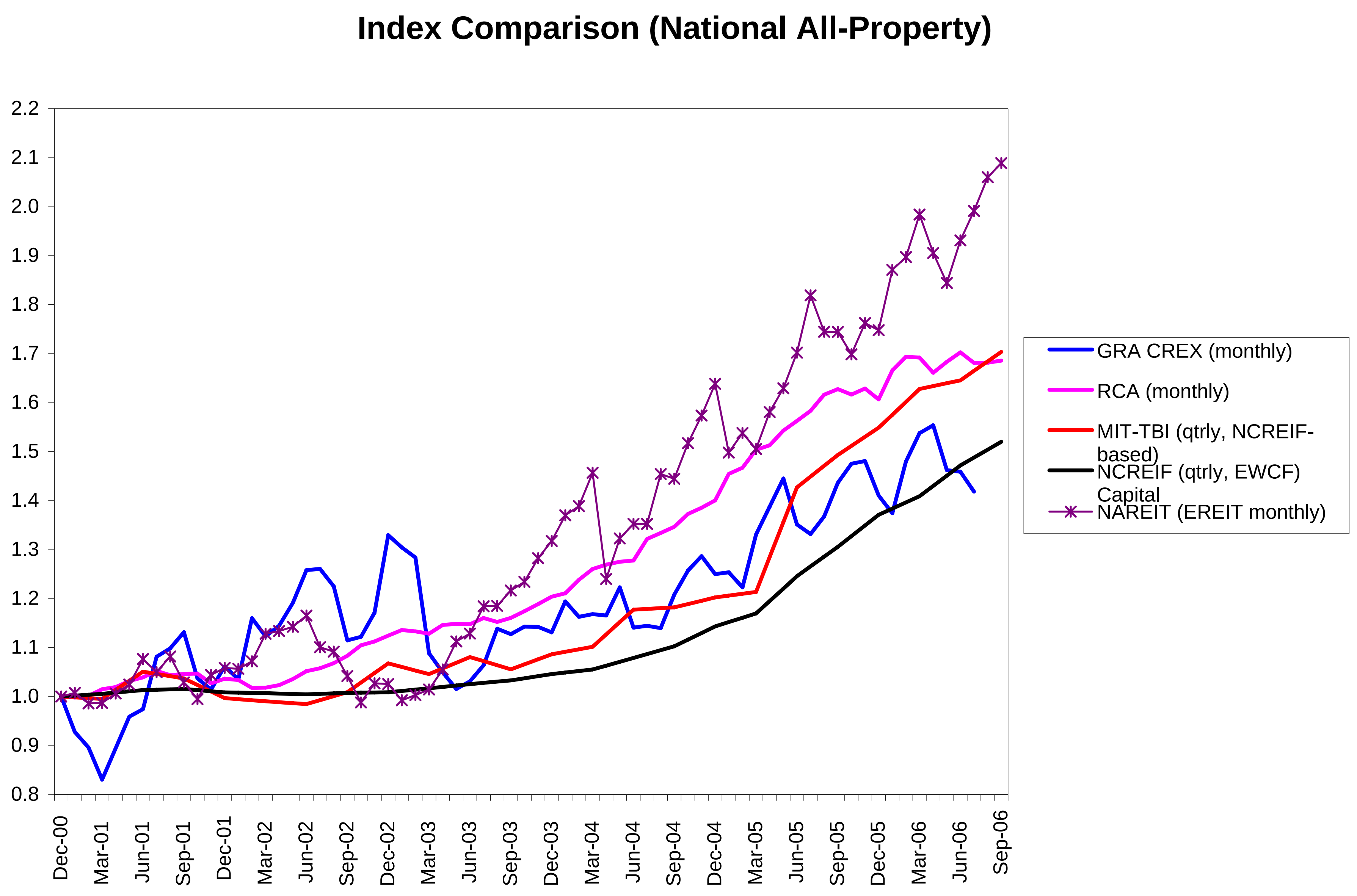


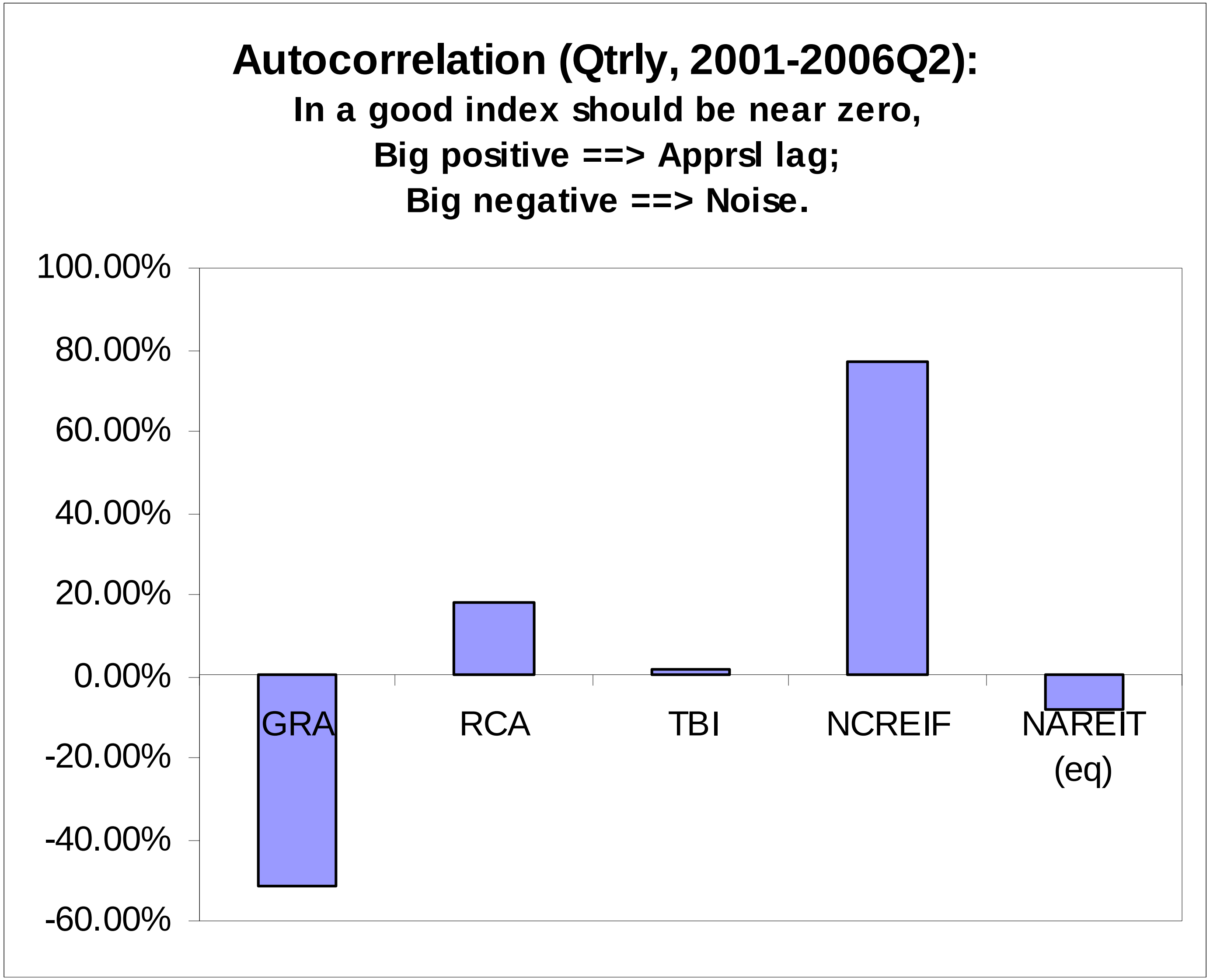
Figure by MIT OCW.

Index Comparison (National All-Property)

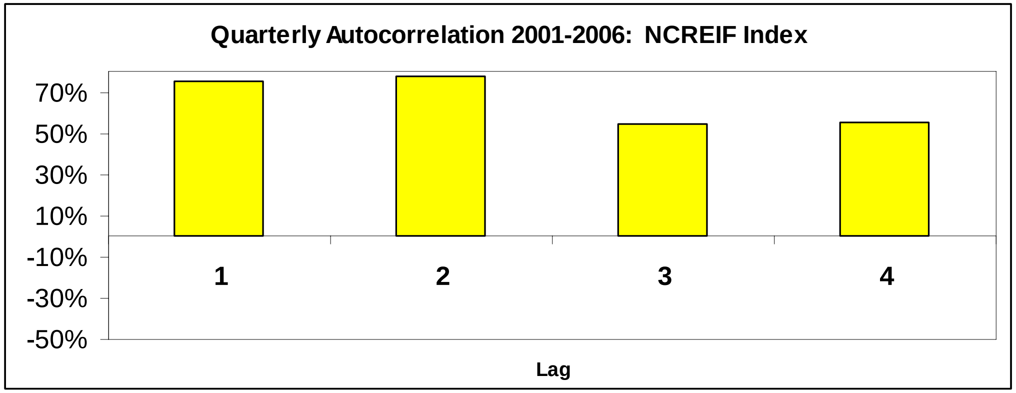


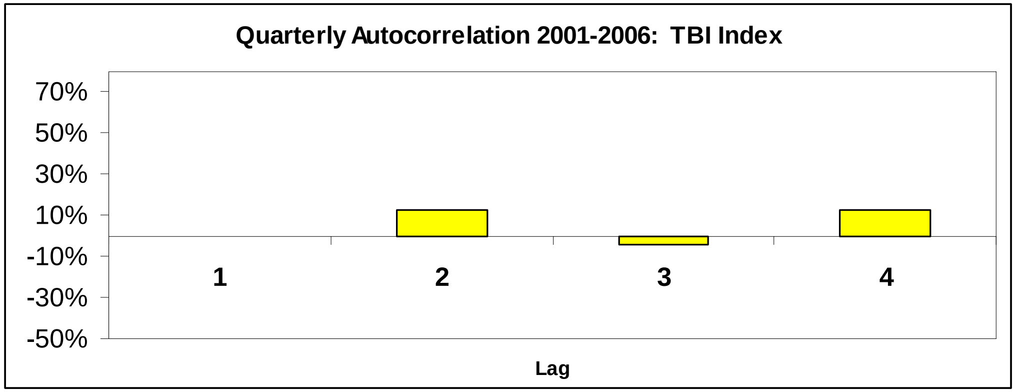

Index Comparison (National All-Property)
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Mar-05
Jun-05
Sep-05
Dec-05
Mar-06
Jun-06
Sep-06
GRA CREX (monthly)
RCA (monthly)
MIT-TBI (qtrly, NCREIF-based)
NCREIF (qtrly, EWCF) Capital
NAREIT (EREIT monthly)

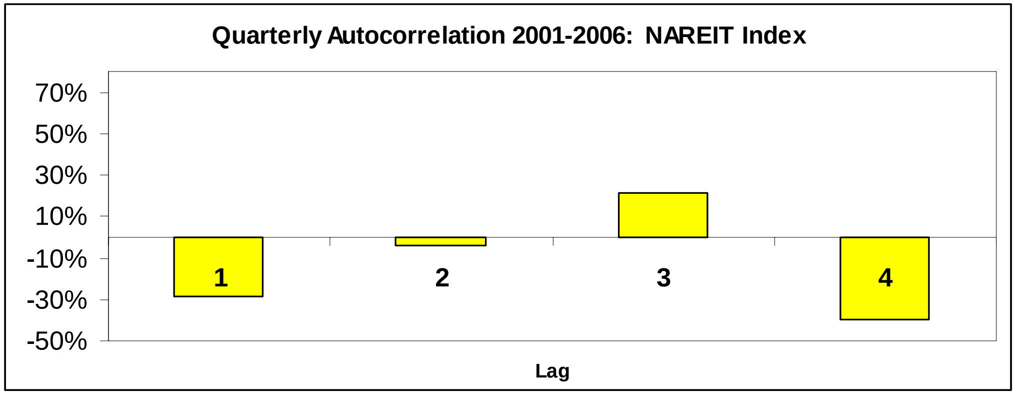
Index Comparison: National All-Property



Autocorrelation in Various R.E. Indexes







Autocorrelation in Various R.E. Indexes