

**Real Estate
And Diversification
Episode II:
Rise of the Clones**

Emilian Belev, CFA and Richard Gold
Northfield Information Services, Inc.
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Introduction

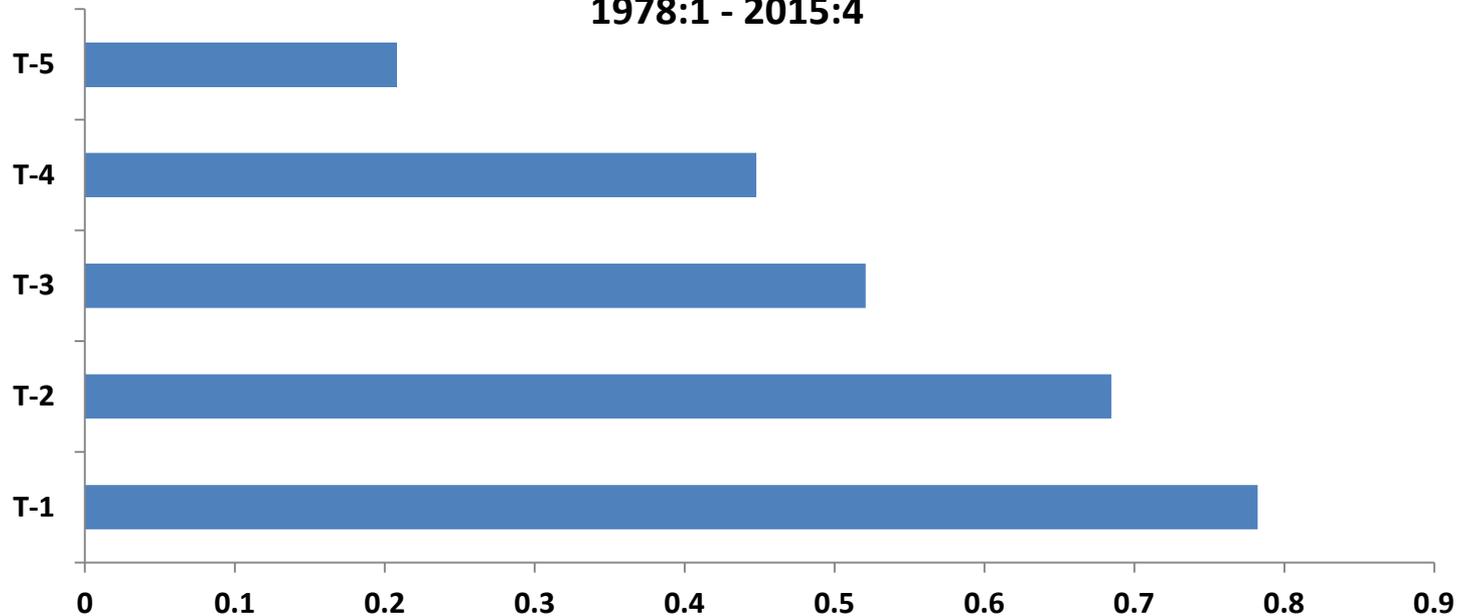
- Taken at face value indices such as NCREIF and IPD seem to suggest that real estate is a good diversifier
 - Low or negative correlation with other asset classes
 - Low volatility and high absolute returns relative to equities and bonds
- Appraisal smoothing impacts risk and return metrics
- Correlations between real estate and bonds estimated in previous studies are counterintuitive.
- Real estate should be positively correlated with treasury securities due to their inverse relationship with interest rates. Also improving credit spreads diminish the discount rate on both property cash flows and bond coupons making higher positive correlation between real estate and corporate bonds the most plausible outcome.
- Equity returns should also be positively correlated with real estate
 - Improving economy leads to better cash flows and lower risk

Introduction (cont.)

- By economic intuition as well as mathematically, real estate and bonds returns are not independent.
 - They are driven by the same factors (interest rates, economy), co-varied movements in a one period setting can only be captured using techniques such as factor risk models
 - However, this does not mean that a linear relationship of appraisal-based real estate and bond returns is the one that holds over multiple periods; hence using regression/correlation than the changes in appraised values vs. changes in interest rates or the stock market should be done with great caution.
- Bottom line: real estate can't have it both ways:
 - Either it has bond-like and equity-like characteristics
 - Or the math of cap rates and cash flows is wrong
 - We choose the former

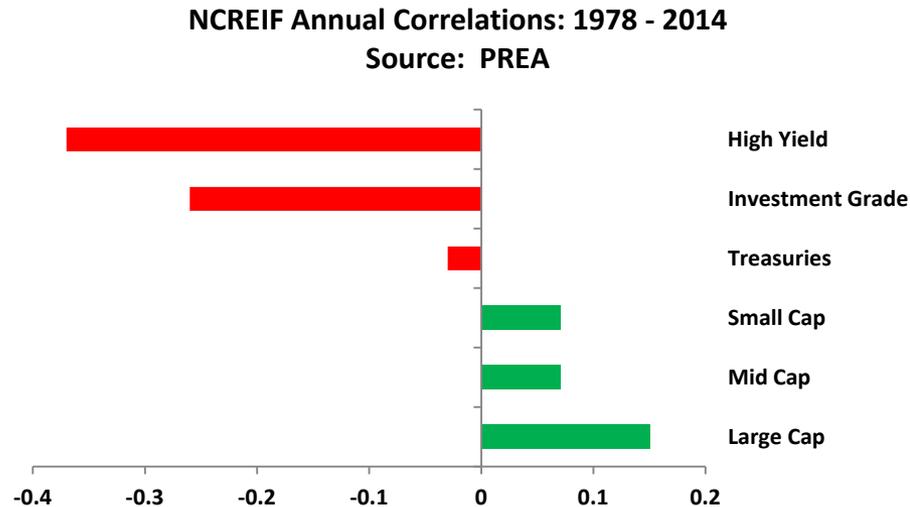
NCREIF: Return Persistence/Serial Correlation

The Culprit – Serial Correlation
NCREIF Total Returns Lagged Correlations
1978:1 - 2015:4

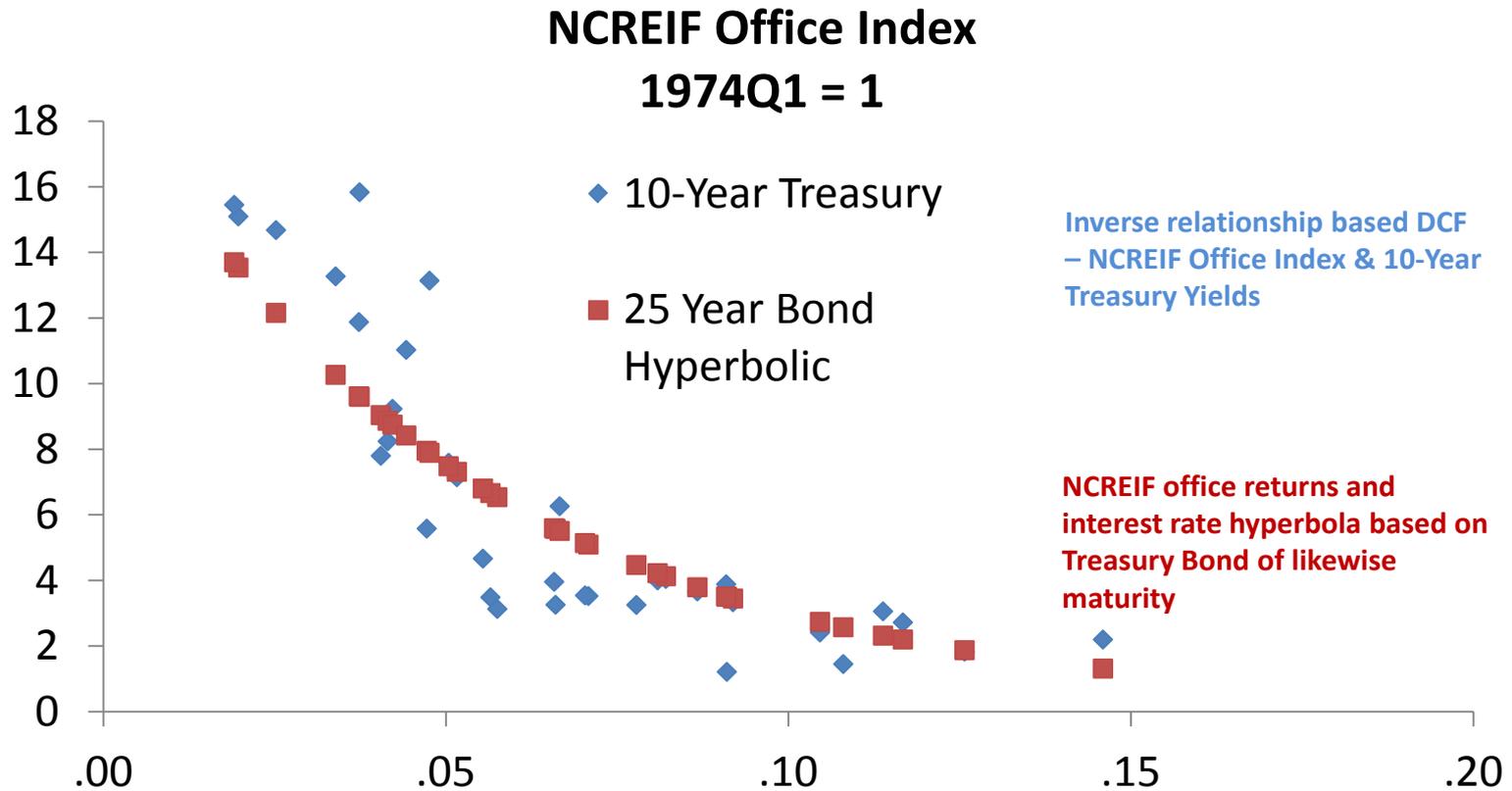


Examples of previous correlation findings

- Real estate's purported low/negative correlation of real estate with other asset classes has been the impetus for adding property to investment portfolios
- A publication by Merrill Lynch in 2012 indicated that using quarterly returns, the correlation between direct real estate was $-.14$ with the Barclays Agg Bond Index and $.19$ with the S&P between 2002 and 2011.
- Same conclusions by Clarion Partners in 2011 and Pepperdine University in 2009.
- The Pension Real Estate Association's own study using annual data:

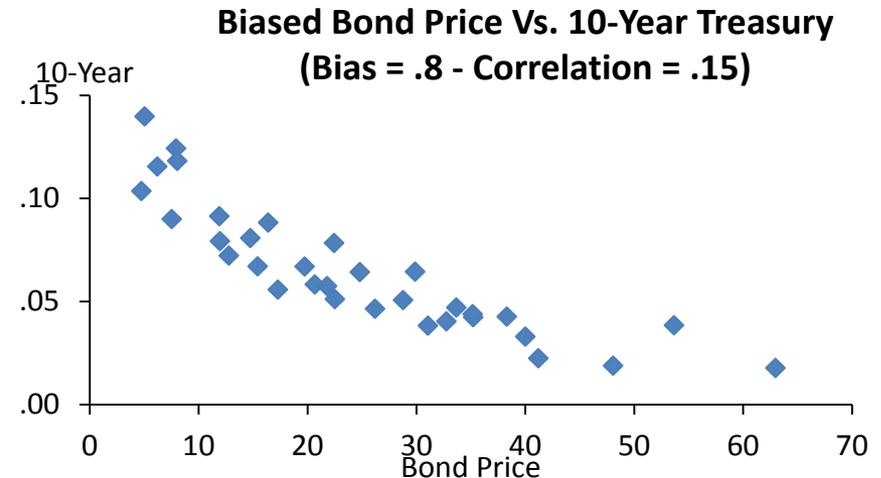


NCREIF Office Index and 10 Year Treasury Rates



Serial Correlation – Another View

- Take a transparent instrument like Treasuries
- Progressively smooth it by introducing bias in Period t from Period $t-1$
 - .2
 - .5
 - .8
- Introduces serial correlation and it begins to mimic NCREIF
 - NCREIF AR1 term $\approx .8$
- Bonds are similar to Real Estate
 - Biased bond series behaves like RE in relation to Treasuries
 - Similar correlation to other studies



Next Step: Hyperbolic Curve Transformation

- Transform the hyperbolic curve relationship into a linear one.
- Restate the DCF of \$1 to the present moment into an independent variable.
- Estimate a linear regression. Slope coefficient is secondary to a significant statistical relationship between the dependent and independent variables.
- Critical: Find a power of the discount cash flow model resulting in a zero intercept. Ensures relationship conforms to an actual DCF model.

$$\text{NCREIF Index Value}_{it} = \beta * (1/(1+r_t)^k)$$

Where:

NCREIF Index Value_{it} = Index value in period t where 1974Q1 = 1

r_t = Long-Term Treasury Rate

k = Input parameter which minimizes absolute value of intercept (i.e. makes it zero). Equal to the useful life of the property cash flows implied by the index. Can be solved iteratively or heuristically.

Bonds, Real Estate, and Interest Rates - Derivation

$$P_1^* = w \cdot P_1 + \sum_{i=1}^n k_{-i} * P_{1-i}^*$$

$$P_1^* - P_0^* = w (P_1 - P_0) + (k_{-1} * P_0^* - k_{-n} * P_{-n}^*)$$

$$P_1 = P_0 + \text{DUR}_{\text{RE}} * \Delta \text{INT} + (\text{CONVEX}_{\text{RE}}/2) \Delta^2 \text{INT}$$

$$P_1^* - P_0^* = w (\text{DUR}_{\text{RE}} * \Delta \text{INT} + (\text{CONVEX}_{\text{RE}}/2) \Delta^2 \text{INT}) + (k_{-1} * P_0^* - k_{-n} * P_{-n}^*)$$

k_{-n} and $(\text{CONVEX}_{\text{RE}}/2) \Delta^2 \text{INT}$ are small

Linear

$$\Delta P_{\text{RE}}^* = k_{-1} P_0^* + w \text{DUR}_{\text{RE}} \Delta \text{INT} + \epsilon$$

$$\Delta P_{\text{RE}}^* = k_{-1} P_0^* + w \frac{\text{DUR}_{\text{RE}}}{\text{DUR}_{\text{B}}} \Delta P_{\text{B}} + \epsilon$$

Non-Linear

$$\text{Return}_{\text{RE}} = k_{-1} + w \frac{P_{\text{B0}}}{P_0^*} \frac{\text{DUR}_{\text{RE}}}{\text{DUR}_{\text{B}}} \text{Return}_{\text{Bond}} + \frac{\epsilon}{P_0^*}$$

Inferred Useful Lives Per Sector

These are the inferred from the hyperbolic regressions that provide the best fit:

Property Types	R-squared	Implied Useful Life
Industrial	85 %	30 years
Retail	85 %	35 years
Office	82 %	25 years
Apartment	83 %	28 years
Hotel	76 %	30 years

This R-Squareds are good news not only as magnitudes but also as a ranking !

Correlation with Equities (cont'd)

- Previous studies known to us only considered contemporaneous correlations between equities and commercial real estate indexes
- The reasoning that there might be a lag can be one or combination of:
 - Appraisal professionals incorporating information regarding the economic environment into valuations
 - The stock market is a lead signal for the real economy. As the real economy picks up, so does pricing for commercial real estate but not simultaneously. Also given the nature of a building's cash flow, it takes time for changes in demand to manifest themselves as changes in rent and occupancy.
- Leading or not the correlation between equities and real estate is just as important to a long-term investor, where those effects will be fully reflected in returns over their investment horizon.
- Correlated annual returns for NCREIF and the S&P500 Index lagging the S&P by one year.

What About Correlation with Equities ?

NCREIF Lags S&P500 - 1 year Correlations

NCREIF	.46
Office	.48
Hotel	.51
Apartment	.50
Industrial	.46

Geometric Return Correlation and Dependency

$$R_B = \prod_{i=1}^N (1 + c * A_{i-1} + B_i^*) - 1$$

$R_B =$

“Sum of Sums Products of B_i^* Combinations of Order Increasing up to N”

+ (λ * “Sum of Products of A_{i-1} Combinations of Order Increasing up to 1”)

+ (λ^2 * “Sums of Products of A_{i-1} Combinations of Order Increasing up to 2”)

+ (λ^3 * “Sums of Products of A_{i-1} Combinations of Order Increasing up to 3”)

+

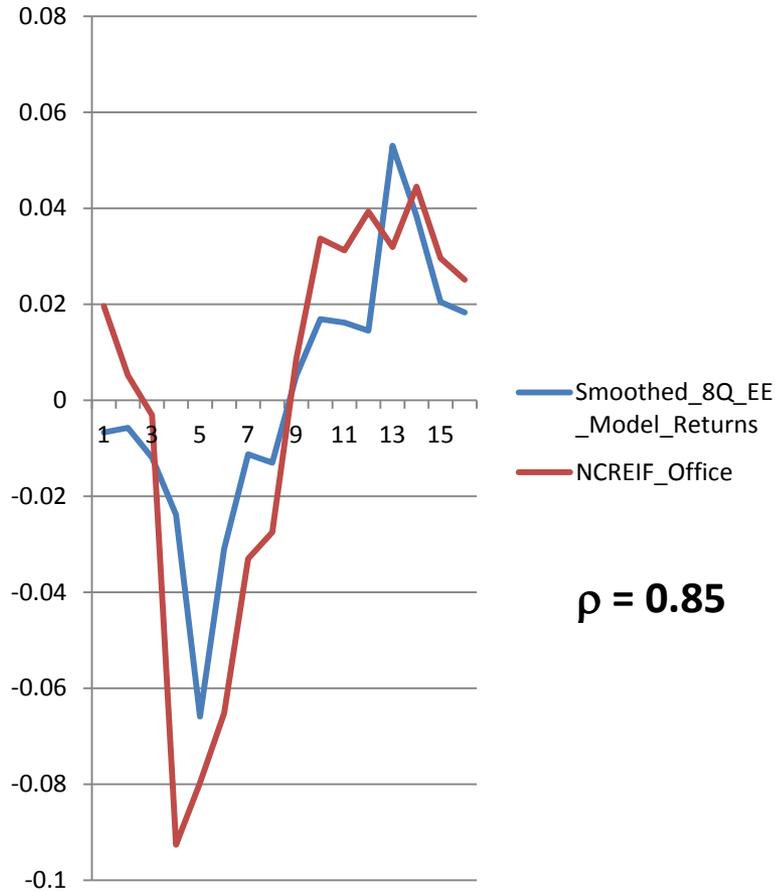
+ Sum of Sums of Products of Mixed combinations of B_i^* and A_{i-1} of Increasing Order and λ of Increasing Power

Linear
Correlation

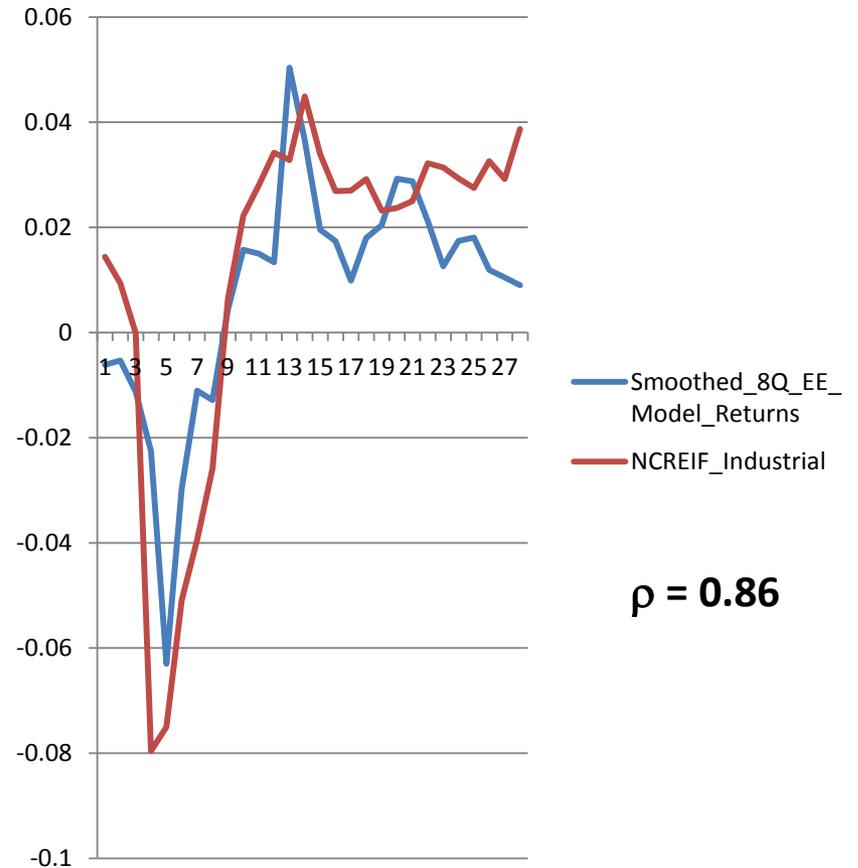
Non-Linear Correlation

The Northfield Direct RE Model and NCREIF

Quarterly 2006 - 2012

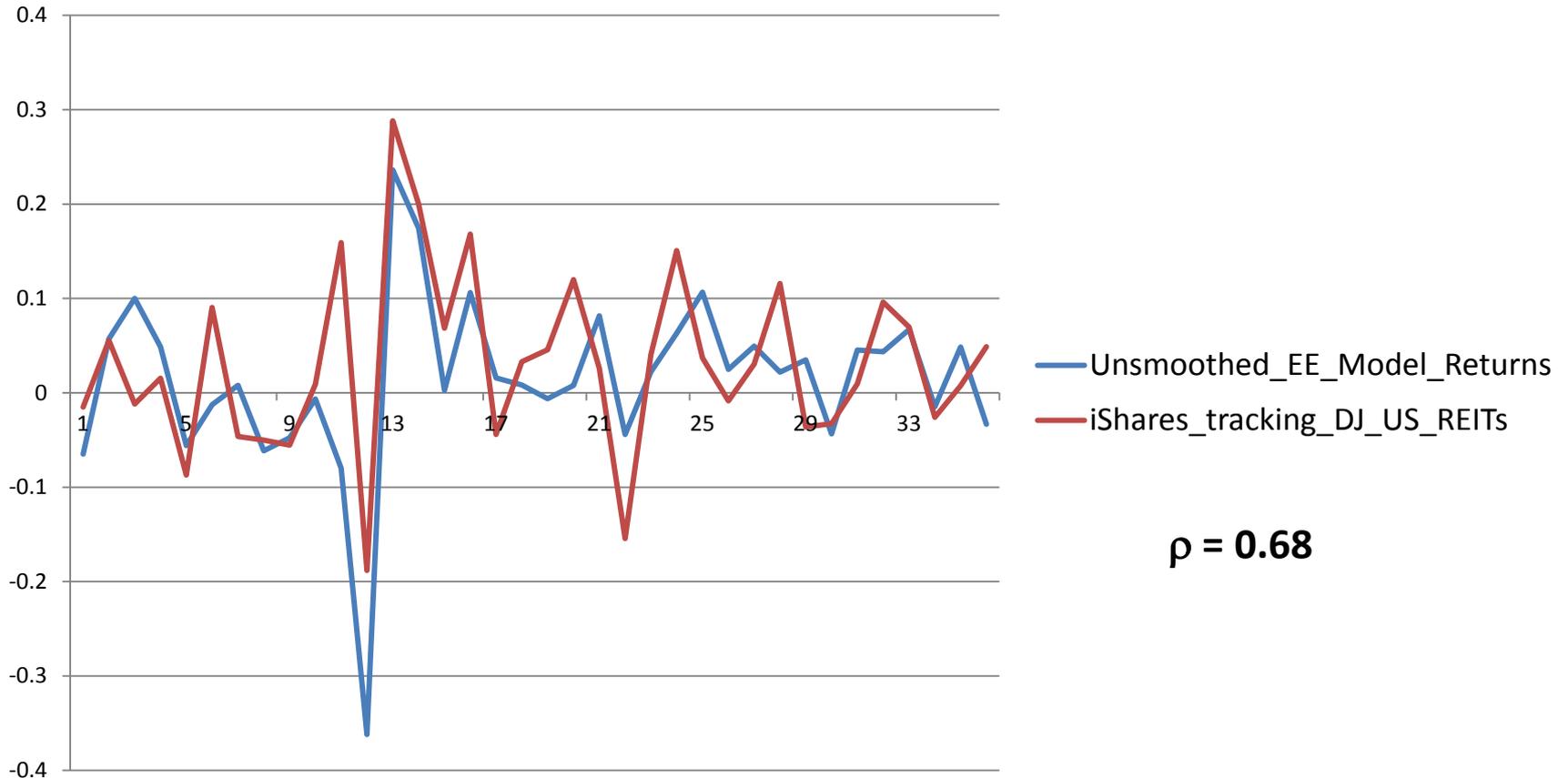


Quarterly 2006 - 2014



The Northfield Direct RE Model and REITs

Quarterly 2006 - 2014



$\rho = 0.68$

Northfield Model Observations:

- Northfield's Direct Real Estate Model:
 - Highly correlated with both direct and indirect real estate indices, results not found in any prior industry or academic factor model work
 - Provides a bridge and reconciles the performance discrepancy between publicly- and privately-owned real estate, which has not been done in any prior study, or at least not to this degree
 - Achieves these high correlations without relying on any private and/ or public real estate indices. Instead, the model works through explicit and observable economic payoff drivers that build the investment in a bottom-up granular fashion
- **The coincidence of these facts is unprecedented**

Hedge of a Direct Real Estate Investment

From prior analysis and additional work Northfield has done, it can be shown that REIT returns can be expressed as a function of:

- A. The Northfield Risk Model Factors explaining Direct Real Estate
- B. A select Small Cap stock portfolio (with which unexplained returns Step A have some correlation)
- C. REIT specific factors captured as residuals form the previous two stages

Therefore, to back into the Direct Real Estate component, we start with a broad REIT portfolio, short Small Cap portfolio, and optimize by trading specific REITS in and out of the mix to mimic the Direct Real Estate benchmark.

The resulting “Long REIT /Short Stock” portfolio is a tradable basket of securities that correlates with a particular Direct Real Estate portfolio or investment

Can We Hedge the NCREIF Benchmark?

- Most institutional real estate investor's and advisor's performances are measured against this benchmark, or another index that is based, partially or fully, on appraisal data
- All such indexes exhibit a high degree of smoothing, which can be expressed, as we have seen, in either Auto-Regressive or Moving-Average (MA) form.
- The Moving-Average formulation is appealing as it is unambiguous
- It also is embedded daily in a familiar investment form: derivatives.
- *Can we use derivatives to engineer the "smoothed" benchmark performance ?
Yes.*

Mimic Real Estate with Stocks and Bonds

- We take a portfolio consisting of property types and geographies that approximate NCREIF content (any portfolio can be subjected to this process)
- Run Northfield Real Estate Model to generate a set of synthetic real estate securities (lease streams, rent stocks, mortgages)
- Use an optimization algorithm which uses the Real Estate portfolio as a benchmark, and the manipulated portfolio is a set of US Treasury Bonds and Large Cap stocks. The goal is for the stock/bond portfolio to replicate the risk characteristics of the Real Estate portfolio
- Make the analysis account for different lease structures of the leases; in our example we take the two ends of the spectrum – leases adjust at renewals, and leases adjust every year

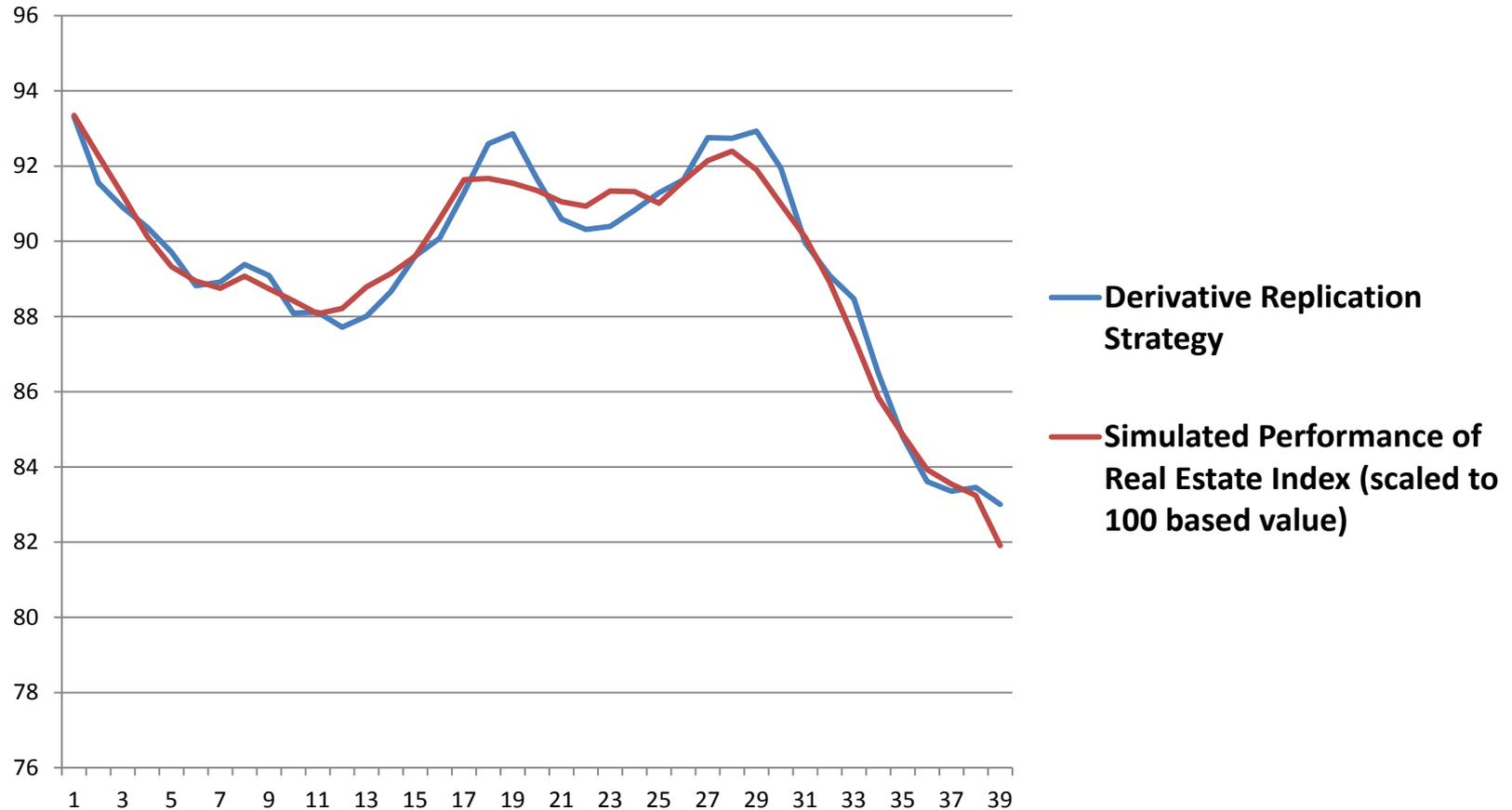
Synthetic Liquid Real Estate Results

- The optimal portfolio does end up containing some cash, some Treasuries, and some Large Cap Stocks, as our intuition and experience has been suggesting from many years of direct real estate portfolio analysis.
- For the case of lease-end renewal lease rate resets, we are able to achieve a *Beta of .99* of the synthetic real estate portfolio consisting of stocks and bonds to the actual real estate portfolio, which is the benchmark.
- For the case of annual renewal lease rate resets, we are able to achieve a *Beta of .96*
- In both cases portfolios are similar in the sense of having equities to bonds in the ratio approximately of 1 to 3, with the more frequent lease reset portfolio having bonds with shorter duration, and stocks with higher “equity market” exposures

Derivatives Usage for Index-like Performance

- Many real estate managers are measured against appraisal based indexes like NCREIF; short- and mid-term investors in real estate funds are often subject to payoffs based on appraisals; what can this “Synthetic Real Estate” method offer them ?
- We can achieve the index-like smoothed pattern of payoffs using the previously shown synthetic real estate portfolio and liquid derivatives which the marketplace has known well for a long time
- This procedure can be applied to any real estate index or real estate portfolio

Index-like Smoothing with Derivatives



Summary of Real Estate Diversification Points

- Real Estate, unlike what a number of previous studies suggests a positive correlation with the performance of both stocks and bonds.
 - Both the math of DCF/Cap Rate models and the underlying economics of valuation theory support this conclusion
 - Hurdle is to recognize the limitations of appraisal-based return series
 - De-smoothing appraisal-based series is not sufficient
- The key feature of commercial real estate is that it is hybrid between bonds and an equities.
 - Real estate investors tout the bond-like qualities of its cash flows and researchers spend their time analyzing market risk.
- Solution: Use bespoke risk model to find what proportion of RE belongs to each.

Summary of Application to Hedging / Investing

- Very strong empirical validation of the Risk Model vis-à-vis both private and public real estate benchmarks
- This in turn provides the mechanism for replicating private real estate payoffs using publicly traded investments
 - Allows investors to put capital to work immediately rather than “parking” it in cash for extended periods.
- The resulting basket of securities could be a convenient beacon for any ETF provider who wanting to offer synthetic exposure to real estate markets, an investor looking for low cost hedge of real estate exposure, real estate managers looking to use modern quantitative techniques, and market makers in derivatives looking to broach the illiquid investor and asset owner space.
- We would be happy to discuss any aspect of the model analysis. Please contact us with questions during the Q and A session, or after this presentation !

Question and Answer Session



**For follow up questions please contact
Northfield's Illiquid asset modeling team at:**

Emilian Belev, CFA, Head, Enterprise Risk Analytics – Emilian@northinfo.com

Rick Gold, Senior Risk Analyst Illiquid Assets – rgold@northinfo.com

Nick Cutler, Business Manager, Real Estate, Infrastructure, & Private Equity -
cutler@northinfo.com