PRIVATE EQUITY REAL ESTATE
Equity Risk Model

IDENTIFY
ANALYZE
QUANTIFY
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Northfield’s risk methodology spans the divide between real estate assessment methods, and those used in securities markets. Using this approach, it is possible to assess the risk of specific properties and simultaneously measure the expected contribution of such properties to the enterprise-wide risk of typical institutional portfolios. The model is economical in its structure; however, instead of forecasting the level of expected returns for future periods, it directly forecasts the variance or risk of returns at both the property and portfolio levels. Users can also measure the incremental risk contribution of a particular asset and the components of risk at the property level.

Although it is generally accepted that private equity real estate is a known diversifier, the true extent to which it increases a portfolio’s risk adjusted return is difficult to quantify. The dearth of observable prices due to the use of appraisals makes the answer to this question fuzzy. Published private real estate returns are not only notoriously smooth, but also suffer from return persistence as well as sample size issues (See Exhibits I and II). In addition, real estate is a notoriously local asset, and published index returns provide little insight into the impact of ownership of specific properties on a broad investment portfolio that is often dominated by stocks and bonds. Long time horizons have encouraged property investors to concentrate their research on forecasting absolute returns, while institutional security analysts often focus on risk or uncertainty of returns, as this is the dominant influence on performance over shorter horizons. This dichotomy arises as the cumulative return on an investment rises roughly linearly with time (ignoring compounding), while the volatility (standard deviation of returns) grows at the square root of time (assuming a random walk process).

**Exhibit I**

NCREIF vs. NAREIT Quarterly Returns (94Q1 - 11Q3)

- **NAREIT**: 20.6%
- **NCREIF**: 4.9%
Using Northfield’s approach, it is possible to assess the risk of specific properties and simultaneously measure the expected contribution of such properties to the enterprise-wide risk of typical institutional portfolios. The model is economical in its structure; however, instead of forecasting the level of expected returns for future periods, it directly forecasts the variance or risk of returns at both the property and portfolio levels. The expected level of correlation among properties in the portfolio and to other asset classes is also a direct output. With risk and correlation estimated, the investor can then provide expected returns and form an efficient frontier, as well as measure the incremental risk contribution of a particular asset and the components of risk at the property level.

For example, the model allows an investor to consider whether buying a shopping mall in either San Jose or Seattle would be more diversifying, given that their stock portfolio is typically concentrated in high tech companies. Similarly it can consider the decision to use fixed rate or variable rate financing, given the nature of prepayment options in the investor’s bond holdings. By assessing risk directly, it sidesteps the most critical problems associated with traditional property appraisals.

Exhibit II

Return Persistence
Lagged NCREIF Correlations

<table>
<thead>
<tr>
<th>LAG 5</th>
<th>LAG 4</th>
<th>LAG 3</th>
<th>LAG 2</th>
<th>LAG 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NCREIF: 00Q1 TO 11Q3
NCREIF: 78Q1 - 11Q3

2000Q1-2011Q3 1Q Lagged Correlations
NCREIF = .85
Modern methods of portfolio risk analysis typically rely on a linear factor model of assets returns.

\[ R_{it} = \sum_{j=1}^{n} B_{ijt} F_{jt} + e_t \]

Where:
- \( R_{it} \) = the return on security i during period t
- \( B_{ijt} \) = the exposure of security i to factor j during period t
- \( F_{jt} \) = the return to factor j during period t
- \( e_t \) = the residual return of security i during period t

By the usual algebra we can extend the linear model for the return of a single asset to describe the variance of return to an entire portfolio of assets.

\[ V_p = E[\sum_{i=1}^{n} \sum_{j=1}^{n} B_{it} B_{jt} \sigma_i \sigma_j p_{ij} + \sum_{k=1}^{m} \epsilon_k^2] \]

Where:
- \( V_p \) = expected return variance of the portfolio
- \( m \) = the number of securities in the portfolio
- \( n \) = number of factors in the model
- \( B_{it} \) = the exposure of the portfolio to factor i at time t
- \( p_{ij} \) = the correlation of returns between factor i and factor j
- \( \sigma_i \) = the standard deviation of returns to factor i
- \( \epsilon_k \) = standard deviation of asset specific returns to security k
- \( E \) = the expectations operator

Finally, we should note that the factor exposures of a portfolio are simply the weighted average of the factor exposures of the individual assets.

\[ B_{pj} = \sum_{i=1}^{z} (W_i \times B_{ij}) \]

Where:
- \( W_i \) = the weight of asset i in the portfolio
- \( B_{ij} \) = the exposure of asset i to factor j

In applying this sort of linear model to the financial assets, two types of specifications are popular. In economic models, the factors are defined to be exogenous variables such as interest rates or oil prices, such that the factor returns (the F values) can be observed in the real world. A separate time series regression is generally then used to estimate the factor exposures (the B values) of each asset. In such regressions, the independent variable is the periodic returns to the particular asset, and the independent variables are the observable returns to the factors.
Alternatively, we could use a fundamental model, where endogenous characteristics of the assets (e.g. market cap of a stock) are used to specify observable values of the factor exposures (the B values) and the factor returns (the F values) are estimated for each period in a separate cross-sectional regression for each time period. In these cross-sectional regressions, the independent variable is the vector of asset returns for the period, and the independent variables are the factor exposures for all the assets at the beginning of the period. Normally, we distinguish between the two types of models via notation. In fundamental models, the factor exposures can be time varying, so the factor exposures (the B values) would also carry a time subscript.

One particular model of the economic type that is widely used by institutional investors to evaluate the risk of their marketable securities portfolios is Northfield’s “Everything, Everywhere” (EE) model. The EE risk model database includes over 59,000 equities, over 470,000 fixed income securities, 1.3 million municipal bonds, 1 million mortgage back pools and approximately 300,000 CMOs and asset backed securities from 68 developed and emerging market countries, involving 57 currencies. There are 93 factors in total including currencies. Each security, however, is only exposed to thirteen factors: region, sector, interest rates, oil prices, currency, value / growth, market development, company size and 5 “statistical factors.” There are also factors meant to measure investor confidence (e.g. the spreads in yields for different qualities of bonds), and macroeconomic conditions (interest rates, energy costs, exchange rates). It breaks discount rate risk into two components; the risk of treasury curve movements and the risk of changes in credit related yield spreads. Bond risk is estimated by measuring a bond’s price sensitivity to both the credit factors and the treasury factors using a binomial model that incorporates prepayment options.

In that the EE model is of the economic type, the estimation of factor exposures is normally carried out by time series regressions. However, since real estate investments do not typically have observable periodic returns, we have no information to use as the independent variable in our regressions. Instead we take advantage of various techniques available to estimate the exposure of a financial asset’s returns to the factors in closed form. For example, one might compute the sensitivity of a bond’s return to changes in the level of interest rates by estimating a time series regression. Fortunately, there are well known closed form methods for calculating the duration of a bond, (the sensitivity measure that would have arisen as the result of a regression), thereby allowing us to include real estate within the EE framework.

Traditional real estate appraisals utilize one of three basic methods to value a property: (a) replacement cost, (b) comparable sales and (c) capitalizing the expected income. One way that real estate investors have tried to evaluate risk of individual properties in the past is to do Monte Carlo simulations of
their valuation models. By varying the valuation inputs across their expected range, one can obtain an expectation of the range of property values at any future moment in time. This allows us to estimate the uncertainty of return on that property over a known time horizon. However, such procedures are not tractable over large portfolios, nor do the “bottom up” estimates of real estate specific variables such as rents or operating expense allow for any insight into the interrelationships between real estate properties and other asset classes. Northfield’s use of factor model’s that estimate specific factor exposures for real estate are closely related to the third method.

From the perspective of typical real estate analysis, we are using financial market data external to real estate to forecast the possible range of inputs to such a valuation process across time, and thereby derive a direct assessment of risk. For example, we can employ observed volatility of bond interest rates to frame the range of potential capitalization rates for a property. Further, we can do things like assess potential demand for office space in lower Manhattan based on the recent strength of the stock market performance of the financial services sector of the economy. The more volatile the expected stock market performance of the financial services sector, the greater the uncertainty of demand for such office space. By direct use of information from the stock and bond markets, the model automatically provides the institutional investor with consistency of assumptions across all asset classes.

Northfield’s model first takes a complicated problem and breaks it down into its parts. We do this by disaggregating a portfolio into buildings, and buildings into their constituent sources of risk including the cash flow from tenants, tenant credit risk, rent volatility and the property’s financing structure. Each of these sources of risk is represented by a hypothetical proxy portfolio of marketable securities that we believe will have the same economic payoff properties as the concerned aspect of the real estate property. Once we have done this, we can apply our existing model used for traded securities to value and estimate the risk of each piece. Having done that, we can reassemble the components and examine risk at any level we choose.

Given the model’s framework, we can examine the sensitivity of each contributor to changes in property value to the common set of underlying factors. Armed with estimates of the potential range for factors (e.g. how volatile do we expect oil prices to be?) the mathematics of a risk assessment for a single property or entire portfolio is simple algebra. The risk estimate contains the future range of interest rates, existing cash flows streams, rent volatility, and financing structure risk.

It should be noted that the estimated property values are not used as part of the individual property analyses, but rather are used to compute portfolio weights for portfolio level calculations. In addition to the information on individual properties, we also collect data on local real estate market conditions for each area in which a property is located. Our real estate data
Private Equity Real Estate Risk Model

set is completed from commercially available databases of real estate statistical data, and regional economic data. The EE model encompasses a wide range of information on both individual securities and financial market conditions.

In order to make the model useful, we must define a parsimonious set of input data that can be practically collected for actual real estate portfolios in order to compute the various aspects of the model. Below is a listing of the inputs the model uses for each property. For even large property portfolios, this information can be maintained in a single spreadsheet:

1. Dominant Property Use (Apartment, Hotel, Industrial, Office, or Retail)
2. Location (Metro Area)
3. Current Occupancy
4. Anchor Tenants (Anchor is define as dominant use tenants)
   a. Lease Renewal Date
   b. Credit Rating of Anchor Tenants
5. Debt
   a. Property Only or Cross Collateralized
   b. Debt Duration
   c. Fixed or Variable
   d. Coupon Rate
   e. Prepayment Options/Penalties
6. Expected Capital Expenditures
7. Property Value
   a. Purchase Price
   b. Closing Costs
   c. Capital Expenditures
   d. Current Estimated Property Value

Mixed-use properties are first split into their component parts, treated as individual properties, and then reassembled if desired. Most, if not all, of the data can be downloaded directly into Excel from real estate management systems such as Argus or Yardi with only minimal manipulation.

At the property level, the Northfield private equity real estate model decomposes a property’s cash flow into three basic components:

I. A deterministic/steady-state cash flow module for existing and expected leases over the next 50 years of the building’s useful life based on the properties physical characteristics (number of leasable units), the quality of its tenants and other lease characteristics (downtime between leases, etc.). Rents in the steady-state model are assumed to grow at the rate of inflation.

II. A rent change module which directly correlates changes in rents to changes in factors returns adjusted by the structural profile of the local economy as well lagged rent change and other global factors from the EE model. Since each market has its own unique
employment profile, its exposure to each global risk factor will be shaped by its employment signature.

III. If leverage/gearing is present, a financing module is built as a short on the building’s cash flows. It is also subject to prepayment options and can be cross-collateralized with other buildings.

Our first step is to estimate the interest rate risk of incoming cash flows. This is done by forecasting the time series of a property’s cash flow in a deterministic fashion, without considering rent volatility. There are two components to the cash flow: 1) the inward cash flows provided by net operating income, and 2) the outgoing cash flows required by the mortgage financing (if any). Using the framework of fixed income securities markets, we consider tenant leases like long positions in bonds. These pseudo-bonds are subject to credit risk, and have other bond like characteristics such as fixed expiration dates, and embedded options (e.g tenant renewal options).

Incoming cash flows are based on projected net operating income (NOI) which changes with projected income taking into consideration expected vacancy levels. Our approach to forecasting cash flows is similar to that found in real estate software packages such as Argus and Yardi, but with less detail and precision only to the extent that not every lease is inputted.¹ In addition to rental growth, operating margins also depend on occupancy levels since vacant space is generally costly to the landlord. A building’s long-term vacancy is assumed to move from its current level to a long-term equilibrium structural vacancy over time unless there are convincing idiosyncratic factors to do otherwise. Lease renewal rates for existing tenants are also modeled in a manner that makes them inversely related to vacancy. Therefore, in order to calculate a property’s cash flow the following user-provided inputs are also needed:

- Current rent and expenses (NOI)
- Current occupancy/vacancy
- Market-level structural vacancy and reversion
- Down-time between leases
- Rent and expense growth over time
- Useful life of the building (assumed to be 50 years in examples)

With that data, we use current NOI and projected NOI forward based solely on an assumed rental inflation rate and expenses, lease renewal schedules, probability of renewal, credit risk, downtime, as well as changes due to whether the building’s occupancy level is above or below the market average. For buildings whose current vacancy is below the market’s long-term average there will be a downward trend in NOI as current vacancy reverts to the market’s structural vacancy estimates.

¹ Instead of analyzing the default risk of every tenant, the model restricts its analysis to “major” anchor tenants. All other tenants are considered generic tenants and received the average credit rating of the market in which they are located adjusted by its employment profile.
Given the projected pattern, a building’s cash flow can be valued and its exposure to the treasury curve risk factors can be measured in a fashion that is consistent with common bond market practice. The exhibit below shows a building whose current vacancy rate is well below the market vacancy. As the building trends towards the market equilibrium, cash flows decline to reflect the loss of tenants to other buildings. Once it approaches market occupancy, it is assumed to trend with the market thereafter.

Lease renewal rates for existing tenants are also inversely related to market vacancy levels. Tenants have more options in a market where the rate of vacancy is high, so the probability of renewal is presumed lower. Downtime between leases is also incorporated and like lease renewals are a function of the vacancy at the time of renewal. Finally, rents are assumed to move with inflation in the long run and we also assume the useful life of a building is 50 years from the start of the analysis.

The credit risk of tenants is incorporated into the model in two ways. First, expected levels of lease defaults are incorporated into projections of

Exhibit III

Northfield Private Equity Real Estate Risk Model Structure

- MORTGAGE FINANCING (SHORT)
- STEADY STATE CASH FLOW (LONG)
- RENT VOLATILITY
- TIME VALUE OF MONEY
- CREDIT RISK
- % CHANGE RENT
- EE FACTORS
- EE FACTORS
- EE FACTORS
- EE MODEL
- PROPERTY/ PORTFOLIO RISK
incoming cash flow in terms of vacancy level, and down time between leases. We will incorporate the impact of credit risk on discount rates in a later step. For anchor tenants with published credit ratings (e.g. Moody’s or S&P), the default rates associated with these ratings are taken into account in forecasting cash flows.

Exhibit IV

Expected Property Cashflows for a 100% Occupied Building

Properties with low starting vacancy rates will exhibit weak initial cash flow growth as vacancy mean reverts: therefore 100% leased buildings with multiple tenants are risky.

For each property we also estimate the creditworthiness of a non-credit rated, “generic,” tenant. Noncredit tenants are thought to be “typical” inhabitants of their local economy and their credit risk is determined by weighting the credit risk parameters of a low rated, high yield bond by the employment-based sector share of their metropolitan area. This generates different a different credit rating for generic tenants in Houston (i.e. local economy concentrated in the energy sector) than those in San Jose (i.e. concentrated in the high tech sector). It should be noted that corporate credit ratings provide a conservative measure of tenant risk since “salvage values” in bond defaults are lower than can be recovered from situations of tenants defaulting on leases. For properties with a large number of small tenants such as apartment buildings, some of this risk will diversify away (the tenant specific portion), while the credit risk arising from the potential for a general economic downturn will not.

It should be noted that the migration of credit risk across time is also taken into account. It is assumed that when a credit rated tenant’s lease expires, that tenant may renew their lease (with some assumed probability) or be replaced by a generic tenant. As such, cash flow expectations of a property (frictional vacancy rates, downtime, NOI) slowly migrate toward greater influence of generic tenants, as leases turn over. The credit migration
process is modeled as a binomial tree with expected renewal rates of leases used to define the probabilities at each decision node. For most properties, the projected NOI stream associated with each individual lease are then analyzed within the EE model’s term structure process, in the same fashion as we would consider each separate bond in a fixed income securities portfolio. Factor exposures to the three factors that define potential variation in the term structure (shift, twist, and butterfly) are then calculated using EE’s binomial type OAS model. The factor exposure to the “shift” potential of the term structure is comparable to duration.

Our next step is to consider the impact of credit risk on discount rates used to compute the present value of future cash incoming cash flows. The rate of discount applied to incoming cash flows can be thought of as having two components, the term structure portion having purely to do with the time value of money, and a credit spread. Time series changes in the credit spread are like a parallel shift in the yield curve, so the sensitivity of a cash flow stream to a change in the spread is given by its duration. The expected volatility and correlations of the credit spreads are modeled separately as a function of the EE model factors, for each credit rating level and economic sector.

So far, our detailed projections of future operating cash flows have assumed future rents will be the current rent level adjusted for inflation. We will now explicitly incorporate the future uncertainty of rental growth into a property’s cash flow stream. This is accomplished by linking the change in rents directly to the factors in Northfield’s EE model using a bridge equation. Over time, changes in the level of rents and occupancy are driven by both demand and supply. The supply of commercial space changes very slowly having little correlation with the EE model’s broad economic factors and is largely a function of local market conditions. In contrast, demand for commercial space is elastic and can be effectively captured in our framework by relating percentage changes in rents to the economic factors in the EE model.

For each property type and each metropolitan area we run a time series regression which estimates the quarterly annualized percentage change in rents. In addition to a four quarter lag in the dependent variable, it is also a function of U.S. sector return factors from Northfield’s EE model. The factors are entered using a four quarter moving average and entered in the form of a “Sum” variable which weights the individual returns of each sector by their share of U.S. employment over the past four quarters. Such that:

Economic Sector Returns:

A. Industrial
B. Consumer
C. Technology
D. Interest Rate Sensitive
E. Non Energy
F. Energy
Private Equity Real Estate Risk Model

\[ \text{SUM}_{it} = \text{Four quarter employment-weighted sum of economic sector returns (A through F) in a Metro area} \]

In addition to the weighted “SUM” and lagged rents, some of the following global factors (four quarter moving average) were also found to be significant in individual market/property type combinations:

G. \( \text{Bond}_t \) = the return on the Salomon Brothers World Government Bond Index (a proxy for global interest rates) in period \( t \)

H. \( \text{Oil}_t \) = the % change in oil prices in USD terms in period \( t \)

I. \( \text{Value to Growth}_t \) = A two part factor. 1) Dividend yield in period \( t \) (The difference between the return of an index consisting of the top decile by dividend yield of our universe of stocks and the return of an index of all stocks paying no dividend) 2) a response coefficient to the cross sectional dispersion of stock returns within a market. A complete explanation can be found in the documentation for the Northfield EE model at [www.northinfo.com](http://www.northinfo.com)

J. \( \text{Developed}_t \) = Market development in period \( t \) (The difference between an index of returns of companies in developed countries and an index of returns of companies in emerging countries)

K. \( \text{Size}_t \) = Company size in period \( t \) (The difference between a return index of the 10% of the companies with the largest capitalization and a return index of the 10% of the companies with the smallest capitalization)

Making the final percentage rent change specification as follows:

\[
\%\text{Ch}(\text{Rent}_{it}) = \alpha + \beta_1 \%\text{Ch}(\text{Rent}_{it}) + 4 + \beta_2 \text{SUM}_{it} + \beta_3 \text{Bond}_t + \beta_4 \text{Oil}_t + \ldots + \varepsilon_{it}
\]

Where the percentage change in rent is the quarterly change annualized.

While there is no explicit initial conditions variable (e.g. vacancy rate or deviation from the market’s equilibrium long-term structural vacancy rate), the regressions do continue a four quarter lagged dependent variable which is thought to be an initial conditions proxy. Negative rental growth in the prior year would indicate a market in negative disequilibrium and is thought to have the same effect as a vacancy rate which is above the market’s long-term structural rate. Of course, the opposite is true when lagged rental growth is positive and large.
The impact of rent volatility is incorporated into risk assessment in a novel fashion. Our cash flow analysis assumed future rents are known with certainty.

We incorporate the uncertainty in rents by assuming property owners have entered into a forward contract with tenants to keep future rents constant in real terms. The coefficients arising from the regression equation above represent the EE factor exposures of this contract. The portion of a building’s rents subject to the forward contract at any one moment in time is presumed to be a combination of the expected percentage of vacant space plus the expected percentage of leases turning over in the current year. As this expected value varies from year to year, this value is projected out over the expected life of the building and a present value weighted average is taken as the final coefficient. The residuals from the rent volatility estimation equation are also scaled by this rent volatility exposure coefficient and used as an estimate of the idiosyncratic risk of a particular building.

For example the following table shows the rent growth equation for New York City apartments. It is clear that both the sum variable and the lagged dependent variable are both significant as well as two factor return variables from Northfields EE model. The regression explains nearly 50% of the quarterly variation in the change in rents which given the volatile nature of the dependent variable is a respectable result. Similar results are typically found in most metro/property type regressions with the residual accounting for idiosyncratic risk.

### Exhibit V

**NEW YORK CITY APARTMENT: PERCENT CHANGE IN RENT REGRESSION 1992Q4 – 2011Q1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std Error</th>
<th>t-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>.0166</td>
<td>.0055</td>
<td>3.05</td>
</tr>
<tr>
<td>%Ch in Rent Lagged 4</td>
<td>.3348</td>
<td>.0940</td>
<td>3.56</td>
</tr>
<tr>
<td>Sum@NYC</td>
<td>.0009</td>
<td>.0002</td>
<td>4.35</td>
</tr>
<tr>
<td>Value to Growth Factor Returns</td>
<td>.0020</td>
<td>.0004</td>
<td>4.76</td>
</tr>
<tr>
<td>Bond Factor Returns</td>
<td>-.0014</td>
<td>.0005</td>
<td>-2.92</td>
</tr>
<tr>
<td>RSquare</td>
<td>.4890</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSquare Adj</td>
<td>.4575</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root Mean Square Error</td>
<td>.0273</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Having measured a property’s underlying cash flow structure, the model still needs to analyze and quantify the risk associated with its financing structure. Mortgages are modeled using the EE term structure model. This process is
comparable to analyzing a short position in mortgaged backed securities. Financing options may include fixed or variable rate mortgages.

Prepayment options are taken into account and are similar to having embedded calls, where the exercise price is the prepayment penalty plus the outstanding loan amount at the particular point in time. If a property is part of a cross-collateralized pool of assets we build a synthetic security which is the sum of all the properties under the same financing umbrella. We also take a conservative approach by assuming that intentional default is not an option.

Exhibit VI

The simple truth is that there is no published private equity real estate index or property returns series that uses observable prices and therefore can reliably produce unbiased estimates of risk and return. Except when a property is bought and sold, values are determined by appraisal and therefore subject to the inherent bias associated with heuristic price discovery. While commercial property repeat sales indices do exist, they suffer from small sample sizes and other statistical problems which severely limit their application. As a result, it is this very absence of unbiased estimators that has restricted the asset class’ maturation. Since appraisal-based indices tend to significantly dampen volatility, standard mean variance optimization models over-allocate, forcing investors to make artificial and significant post-
allocation adjustments to their real estate allocations. The bottom line is that private equity real estate tends to treated as a second tier asset class in the pantheon of investments despite its significant share of the U.S. and global investible universe.

Exhibit VII

In order to demonstrate how the model’s structure and dynamics produce unbiased and robust risk metrics, we tested it on a portfolio of fourteen properties located in ten metropolitan areas across the U.S.\(^2\) The portfolio includes office, retail, apartment, and industrial buildings. Leverage was relatively modest with an average loan to value ratio of less than 15%. The fund started investing after the financial meltdown in 2007-2008 and consists of “core” high quality properties.

A profile of the fourteen properties can be seen in the following table. While it is know that distance is not synonymous with diversification, the portfolio is spread across the country and is evenly divided across the four major commercial property types, although it does have a coastal bias.

With the exception of sale lease back funds, core funds are assumed to be the most stable of all private real estate vehicles since they are largely comprised of the highest quality assets with properties located in top tier markets. Typically their properties have a disproportionate percentage of

\(^2\) The model is not restricted to U.S. properties and can accommodate properties in any geography providing that the required data is available. That would include both local economic and property market data as well as property-level data on tenants and lease characteristics. In the absence of property-specific data, a generic building can be used which represents the typical building in a market for a particular land use for a particular quality class.
credit tenants compared to the average property and the properties themselves tend to have locational and design advantages over other properties.

Exhibit VIII

<table>
<thead>
<tr>
<th>PORTFOLIO PROFILE</th>
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<tbody>
<tr>
<td>Metro</td>
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<tr>
<td>Apartment</td>
</tr>
<tr>
<td>Boston</td>
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<tr>
<td>DC</td>
</tr>
<tr>
<td>Inland Empire</td>
</tr>
<tr>
<td>Miami</td>
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<tr>
<td>New York</td>
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<tr>
<td>Phoenix</td>
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<td>Sacramento</td>
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<td>San Diego</td>
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<tr>
<td>Seattle</td>
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<tr>
<td>San Jose</td>
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</table>

Before the model can be run, it is necessary to weight the EE model’s sector returns to reflect local employment variations. Markets that are more finance intensive should garner a higher share of finance-related sector returns than markets with smaller employment concentrations. Disaggregated local and national employment data is aggregated to match Northfield’s six economic sectors. Each sector’s share of national employment is used to weight the factor return series to give them a more local flavor. The result is that markets whose employment profile deviate significantly from the U.S. will have employment-weighted return factors that vary from the national pattern not only in absolute terms but also over time as their employment shares shift. For example, San Jose will be more impacted by technology factor returns than Washington, D.C. and Sacramento whose concentration of public sector jobs will overweight interest rate sensitive factor returns.\(^3\) In addition, over time as the share of employment in any sector trends up or down depending on the relative success of firms, a sector’s influence will also wax or wane.

Knowing that appraisal-based valuations significantly dampen volatility, it is expected that the model’s risk estimate will be higher than those produced by published indices. In addition, given the long-term nature of real estate’s cash flow stream, interest rate risk should be the dominate source of risk for the asset class in general. However, this should not lead investors to believe that credit and rent risk do not matter since interest rate risk can not only be hedged away but credit and rent risk can be significant as well. Given the

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\(^3\) Public sector employment is included in Interest Rate Sensitive employment.
differences in lease structures and tenant profiles, apartment buildings should generally exhibit the lowest volatility while sample size and other asset-specific variables will determine the rank risk order of the remaining three land uses.

Exhibit IX

<table>
<thead>
<tr>
<th>Contribution of Local Economy Variance by Sector (Percent of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving the Same Property Across Metros: Different Metro - Different Profile</td>
</tr>
<tr>
<td>Metropolitan Area</td>
</tr>
<tr>
<td>Sector</td>
</tr>
<tr>
<td>Industrial</td>
</tr>
<tr>
<td>Consumer</td>
</tr>
<tr>
<td>Technology &amp; Health</td>
</tr>
<tr>
<td>Interest Rate Sensitive</td>
</tr>
<tr>
<td>Non-Energy Minerals</td>
</tr>
<tr>
<td>Energy Minerals</td>
</tr>
</tbody>
</table>

A metro area’s employment profile was also found to impact a property and portfolio’s risk profile since generic tenants are assumed to have the same credit rating as the market’s employment-weighted average credit rating. This is important because it is assumed that generic tenants occupy all the non-anchor space in a building. Furthermore, it is also assumed that a generic tenant will replace a credit tenant when a lease turns or a credit event vacancy takes place. To the extent that market employment profiles across geographies differ, it will create variances in credit quality some of which can be significant depending on a market’s employment topology.

To give a sense of the differences between markets, we took an office property, delevered it, and moved it across the four metro areas for which there were other office properties, holding everything else equal. We then ran the model to measure how the individual employment sector in each local economy’s contributed to variance. As expected, Boston’s technology and medical industries variance contribution share was more than twice that of Washington D.C.’s. Not surprisingly, the same property moved to New York City, with its concentration of financial employment, shows the greatest sensitivity to the EE model’s interest rate factor relative to the other metro areas in the portfolio. Washington, D.C.’s interest rate sensitivity was also significant and arises from Northfield’s inclusion of government employment in the interest sensitive employment sector.
The results also support the belief that apartment would be the least risky land use. Multifamily buildings with their diversified tenant base and shorter leases tend to have less volatile cash flows than other land uses. In nonresidential buildings where vacancies cause greater voids in cash flow, owners are more subject to both higher cash flow volatility and the added impact of duration as their cash flows are pushed out into the future. For this specific portfolio, industrial properties had the greatest risk. With only a handful of tenants per property, these buildings were more exposed to credit events and duration effects than any other property type.

<table>
<thead>
<tr>
<th>Metro Area</th>
<th>Std Dev</th>
<th># Props</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego</td>
<td>2.12</td>
<td>1</td>
<td>Apartment</td>
</tr>
<tr>
<td>Phoenix</td>
<td>2.14</td>
<td>1</td>
<td>Apartment</td>
</tr>
<tr>
<td>NYC</td>
<td>2.44</td>
<td>3</td>
<td>Apartment, Office, Retail</td>
</tr>
<tr>
<td>DC</td>
<td>2.55</td>
<td>2</td>
<td>Office</td>
</tr>
<tr>
<td>Miami</td>
<td>2.58</td>
<td>2</td>
<td>Industrial, Office</td>
</tr>
<tr>
<td>Sacramento</td>
<td>2.60</td>
<td>1</td>
<td>Retail</td>
</tr>
<tr>
<td>San Jose</td>
<td>2.65</td>
<td>1</td>
<td>Retail</td>
</tr>
<tr>
<td>Seattle</td>
<td>2.65</td>
<td>1</td>
<td>Industrial</td>
</tr>
<tr>
<td>Inland Empire</td>
<td>2.65</td>
<td>1</td>
<td>Industrial</td>
</tr>
<tr>
<td>Boston</td>
<td>2.85</td>
<td>1</td>
<td>Office</td>
</tr>
</tbody>
</table>
By dropping metro areas and looking at the incremental change in portfolio risk, we can also see several geospatial and portfolio effects. For example, both San Diego and Phoenix exhibit the lowest incremental change which is not surprising since they each have only one apartment property. Even if additional apartment investments were added, given an apartment’s well diversified rent roll, it is highly likely that these markets would continue to register the lowest incremental volatility.

Exhibit XII

Risk Attribution for New York City Office Building

- Interest Rate Risk: 16.1%
- Rent Risk: 5.1%
- Credit Risk: 3.9%
- Total Risk: 17.3%

In contrast, Boston with a single office property shows the highest incremental risk; exceeding that of Seattle and the Inland Empire with their single industrial properties. This result may seem inconsistent since the three industrial properties in the portfolio exhibited the greatest incremental risk. However, unlike apartments, volatility in office, industrial, and retail properties are more property idiosyncratic; subject to the timing of lease rollover, credit risk, rent volatility, etc. Therefore as sample size grows, diversification begins to reduce risk. For example, New York with three properties shows the benefits of diversification as the lower volatility apartment building helps countermand the risk in the office and retail properties.
Results from the 14 property test portfolio show that as expected, private equity risk significantly exceeds that of the NCREIF Index. At the property level interest rate risk does indeed dominate and can be attributed to the longevity of a building’s cash flow. However, rent and credit risk is also important and represent over a third of the total risk associated with the New York City office building shown in Exhibit VII.

Exhibit XIII

<table>
<thead>
<tr>
<th>Risk Attribution for New York City Office Building by Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent Risk</td>
</tr>
<tr>
<td>Factor: 1.06%</td>
</tr>
</tbody>
</table>

A more detailed analysis of risk shows that most of the building’s rent risk is idiosyncratic (e.g. specific) and therefore diversifiable. In the case of credit risk the opposite is true; factor, not specific, risk dominates. The high level of specific risk associated with rental risk is easily understood when put into context. Unexpected new supply or major vacancies in competitive properties within a property’s submarket or simply a building’s age and condition can easily affect the relationship between market rental trends and those actually achieved by the property over time thereby leading to significant idiosyncratic risk. Fortunately at the portfolio level, idiosyncratic risk rapidly disappears for well diversified property portfolio.

Exhibits XIV and XV show exactly what happens to specific risk as the number of properties in the sample portfolio grows over time. When the first property was purchased (New York City Apartment) specific risk for both the portfolio and at the property level was 16.9%. As a standalone investments, the second property (Inland Empire Industrial) had specific risk of 4.6% but when added to the portfolio, it reduced overall idiosyncratic risk to 6.2%. The pattern generally repeats itself as the number of properties grows such that after the fourteenth property idiosyncratic risk is almost diversified away.
### Exhibit XIV

**Portfolio Acquisition Schedule and Impact on Risk (Standard Deviation)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Property Type</th>
<th>Individual Property Total Risk</th>
<th>Individual Property Specific Risk</th>
<th>Portfolio Total Risk</th>
<th>Portfolio Specific Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York City</td>
<td>Multifamily</td>
<td>13.1</td>
<td>16.9</td>
<td>13.1</td>
<td>16.9</td>
</tr>
<tr>
<td>Inland Empire</td>
<td>Industrial</td>
<td>18.9</td>
<td>4.6</td>
<td>15.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Seattle</td>
<td>Industrial</td>
<td>18.9</td>
<td>4.5</td>
<td>16.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Miami</td>
<td>Office</td>
<td>18.3</td>
<td>1.8</td>
<td>17.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Miami</td>
<td>Industrial</td>
<td>19.0</td>
<td>9.8</td>
<td>17.1</td>
<td>1.4</td>
</tr>
<tr>
<td>New York City</td>
<td>Office</td>
<td>32.1</td>
<td>10.3</td>
<td>19.3</td>
<td>1.3</td>
</tr>
<tr>
<td>New York City</td>
<td>Retail</td>
<td>19.7</td>
<td>2.9</td>
<td>19.4</td>
<td>1.0</td>
</tr>
<tr>
<td>San Jose</td>
<td>Retail</td>
<td>18.9</td>
<td>1.6</td>
<td>19.3</td>
<td>0.7</td>
</tr>
<tr>
<td>San Diego</td>
<td>Multifamily</td>
<td>17.3</td>
<td>24.9</td>
<td>18.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Boston</td>
<td>Office</td>
<td>22.5</td>
<td>4.7</td>
<td>19.3</td>
<td>0.8</td>
</tr>
<tr>
<td>D.C.</td>
<td>Office</td>
<td>18.5</td>
<td>3.1</td>
<td>19.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Sacramento</td>
<td>Retail</td>
<td>18.6</td>
<td>0.7</td>
<td>19.1</td>
<td>0.5</td>
</tr>
<tr>
<td>D.C.</td>
<td>Office</td>
<td>30.3</td>
<td>3.7</td>
<td>19.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Phoenix</td>
<td>Multifamily</td>
<td>12.8</td>
<td>8.1</td>
<td>19.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Exhibit XV

**Incremental Idiosyncratic Risk (Subject Portfolio)**

- **Risk - Std Dev**
- **Number of Properties & Standard Deviation**
However, systematic risk cannot be diversified away and therefore as the number of properties grows, total risk settles within a narrow range since the incremental impact of the next property purchased becomes smaller. In the case of the test portfolio, systematic risk is relatively stable after the sixth property is purchased. In fact, much of the movement in total risk after that can be attributed to changes in idiosyncratic risk.

For the test portfolio, expected one year total risk (standard deviation) is estimated to be 19.5% as of July 2011 or more than double that of the NCREIF Index over the past five years. This is only basis points less than the expected risk for the S&P500 but nearly 4.5% lower than the NAREIT Index. At first glance, the results may be disturbing to investors who are accustomed to thinking that real estate’s true volatility would be well below that of equities. In fact, since the test portfolio was a low leverage core portfolio, it does not take much imagination to see how risk would be greater for a collection of properties with lower quality tenants and more typical leverage levels of 40% or more.

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4 The NCREIF Index is a total return index published quarterly by the National Council of Real Estate Investors and is considered the benchmark for private equity real estate returns. The NAREIT Index is NCREIF’s public equity counterpart and is published by the National Association of Real Estate Investment Trusts. For purposes of comparison, the NAREIT Equity Index was selected. For bonds, the Barclay’s Aggregate Bond Index was used and for equities the S&P500 was chosen as the appropriate benchmark.
In fact it is possible to get a sense at the true underlying volatility of appraisal-based indices by correcting for positive serial correlation. The simplest methodology to get the approximation of true returns is to create an annual return from the product of a series’ quarterly returns and use those annual numbers to create the annual standard deviation. The other is to use a partial adjustment model to eliminate the inter-quarter dependencies.\(^5\) For the five years ending in July, 2011, the partial adjustment model approach generated standard deviation estimates for the total NCREIF Index of 14.69% and for the NCREIF Open-End Fund Index of 21.8% both of which confirm the model’s results of 19.5% before adjusted for the differences in leverage.

The Northfield private equity real estate model calculates risk without the use of appraisal-based benchmark indices. The model decomposes property-level risk into four components: rent risk, interest rate risk, credit risk, and idiosyncratic risk. Each of these risks is then expressed as functions of factors that are observable in financial markets or in the general economy. Our approach is congruent with methodologies used for risk management of securities market portfolios allowing for seamless integration of risk assessment in multi-asset class portfolios. Most important, the model provides a framework for determining how much of the risk of investing in a

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\(^5\) For this purpose we employed a technique outlined by Anish Shaw in an unpublished presentation, “Short-Term Risks for Long-Term Models”, presented at Northfield’s 2007 client conference in Key Largo, Florida. The presentation can be found on Northfield’s website, www.northinfo.com. Also see Getmansky, M., Andrew Lo, and Igor Makarov, 2004. “An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns,” Journal of Financial Economics, v74(3,Dec), 529-609. For purposes of comparison, the simple product approach produced standard deviation estimates of 15.4% and 20.9% for the NCREIF property index and the Open-End Fund Index respectively. On a quarterly basis, the differences are even smaller.
property arises from characteristics of the specific property, and how much of the risk arises from common influences across all properties such as interest rates and levels of economic activity. We believe this new level of transparency with respect to real estate risk will encourage investors to be confident in their understanding of real estate and consequently be more willing to allocate more of their resources to property investments.

In addition, armed with this new approach, investors can now for the first time truly understand intra-asset risk as well as the inter-relationship between their real estate holdings and their larger portfolio. For example, imagine an investor who is interested in buying a portfolio of shopping centers across the U.S. While it may be economically diversified across metro areas, the model might show that there is a significant correlation between the portfolio’s rent roll and the investors’ equity and bond portfolios resulting in further concentration of their risk exposure in a manner that is not consistent with their investment objectives. Until now, this holistic form of analysis was not possible with traditional real estate risk models.

Regardless of its use, the model eliminates the bias associated with risk models that use appraisal-based pricing data all of which suffer from return persistence and rely on unobservable prices to determine value. Because of this bias, private equity real estate has been afforded larger allocations simply on the brute strength of both its relative and absolute performance, rather than as a result of any theoretical justification arising out of new methodology or data. This model hopefully puts an end to that practice, and allows the asset class to return to the table as an equal partner with full voting rights.