Modeling Direct Owned Real Estate In A Securities Market Framework

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Risk Definition Concept I

- Statisticians would argue that risk is the uncertainty of return
  - Imagine you receive a gift of a lottery ticket for next week's Megabucks drawing. There is a condition on the gift that you cannot give away or sell the ticket. You must experience the outcome of the lottery. Would you accept the gift? Most people would say "yes".
- According to statisticians, you just did something very risky. The uncertainty of the economic outcome of a lottery drawing is very high, even though you had nothing to lose.

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Risk Definition Concept II

- You go to the observation deck of the Empire State Building, get by the anti-jumper fences, and jump off.
  - In this case the “potential for loss” is total....your life
  - However, the uncertainty of the outcome is very low. We’re all pretty confident of what the outcome is going to be.

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Risk Definitions Unified

- These two concepts of risk are mutually consistent when the likely distribution of returns is symmetric around the expected value.
- The return on an investment portfolio is the sum of the returns on the individual assets
  - Returns on diverse portfolios will approach normality (i.e. symmetric) as the number of assets increase even if the individual assets have skewed return patterns (e.g. an individual simple mortgage doesn't have much upside to the investor. You either get what you expect, or a default)
  - This is a function of the Central Limit Theorem of Statistics
  - Hlawitscka, Walter and Mitch Stern. "Selecting Portfolios of Highly Skewed Assets Using Means, Variances and Higher Moments", Fairfield University Working Paper, 1995
  - Because of the symmetry property, we don't need to do Monte Carlo style numerical simulations. There are direct formulas for what we need to calculate

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Portfolio Theory

- Harry Markowitz wins Nobel Prize in Economics for 1952 paper on portfolio risk. It shows that the volatility (uncertainty of return) of a portfolio can be estimated from the volatility of the individual assets and the correlations among the assets. This approach is called Modern Portfolio Theory.

$$S_p = (\Sigma_{i=1 \text{ to } n} \Sigma_{j=1 \text{ to } n} S_i S_j P_{ij})^{.5}$$

Markowitz, Harry. “Portfolio Selection”, Journal of Finance, 1952

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Risk Estimation for Real Estate

- Volatility and correlation are hard to estimate for real estate
- Real observations of total returns are very few. You need more data than you have assets for stable correlations
- Not even the broad market can be reliably measured by real estate indices because of appraisal smoothing
- Appraisal smoothing also induces serial correlation in the returns

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Real Estate Return Measurement Research

- Lots of research on the measurement problems
  - Fisher, Jeffrey D., “A Repeat Sales Index for Commercial Real Estate Using Sold Properties in the NCREIF Database”, Real Estate Finance 2000
  - Fisher, Jeffrey D. and David Geltner. “De-Lagging the NCREIF Index: Transaction Prices and Reverse Engineering”, Real Estate Finance 2000
  - Graff, Richard and Michael Young, “Real Estate Return Correlations: Real-World Limitations on Relationships Inferred from NCREIF Data”, Journal of Real Estate Finance and Economics”, 1996.
  - Geltner, David, “How Accurate is the NCREIF Index as a Benchmark and Who Cares?”, Real Estate Finance, 1998

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One Possible Approach: Hedged REITS

- Estimate real estate volatility and correlations by looking at REIT returns and trying to hedge away the stock market influence, leaving just the real estate effect to be measured
  - Chatrath, Arjun, “Can We Hedge REIT Returns?”, Real Estate Finance, 1999
  - Clayton, Jim and Greg MacKinnon, “The Time-Varying Nature of the Link Between REIT, Real Estate and Financial Asset Returns”, Journal of Real Estate Portfolio Management, 2001
  - Liang, Youguo and James Webb, “The Hedged Real Estate Index and Mixed Asset Portfolios”, Journal of Real Estate Portfolio Management, 1996.
  - Possibly a useful approach for generic asset allocation purposes but does not provide detailed analysis of the specific properties that we hold as investors.

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Factor Models to Infer Correlations

- One way around our problems is to use a factor model. Rather than relate returns to different assets to each other, we relate the returns to each asset to a set of underlying economic drivers and then infer the cross-asset relationships from the magnitude of common influences.
- Justified in economic theory by the Law of One Price
  - Changes in prices of similar things must move similarly
- Allows us estimate correlations for a large number of assets from a small number of common economic drivers for better statistical stability
- Each asset's risks are expressed as a series of exposures to the common drives, plus an amount of idiosyncratic asset specific risk

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The Problem in Estimating Firm-wide Risk

- Multiple asset types
  - Stocks, bonds, private equity, real estate
  - Some liquid assets, some illiquid
- Many countries around the world
- Northfield's "Everything Everywhere" is designed for this sort of problem
  - All investment assets are related to nineteen economic factors, plus 38 currency exchange rates. We call the numerical estimates of these relationships *factor exposures*. Only a subset of these may be relevant for any particular asset. Each asset also has idiosyncratic asset specific risk

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EE Model Factors

- Monthly returns on global stock market indices representing six different economic sectors are forward looking measures of economic activity and demand for real estate in areas where each particular sector dominates the local economy
- Monthly returns on stock market indices by geographic region as forward looking measures of regional economic activity
- Three different measures of investor outlook
  - Relative returns of large cap stocks and small cap stocks
  - Relative returns of developed country stocks and emerging market stocks (also picks up some trade effects)
  - Relative returns of conservative stocks with high dividends and growth-oriented stocks that pay no dividends

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EE Model Factors

- Monthly percent change in oil prices to measure energy costs
- Monthly bond market returns to measure overall pressure on financial markets
- Monthly changes in three measures of the interest rate yield curve:
  - the average level of interest rates
  - spread between long term rates and short term rates
  - Curvature of the yield curve
  - EE incorporates a very detailed binomial model of the range of possible future interest rate conditions. This is important for working out possible mortgage pre-payment scenarios

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Credit Risk in EE

- We track credit related yield spreads for each economic sector and rating agency rating level
  - Fluctuations in credit yield spreads are related as exposures to the appropriate factors in the EE model (i.e. you can think of exposure to a firm's credit as a partial exposure to the firm's equity)
  - Every level of credit yield spread has an implied default rate associated with it. You must get the same present value of an uncertain cash flow, whether you discount the nominal cash flow by a discount rate including a credit spread, or discount default-rate adjusted cash flows by the risk-free discount rate
  - Firm specific credit problems can be addressed by adjusting the idiosyncratic asset specific risk of the affected financial instruments

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Composite Assets

- Complicated investment securities can be defined in the EE framework as a package of simpler security risks. Consider a Japanese corporate convertible bond (or a participating mortgage)
  - Risks associated with the payment of bond interest and principal (time value of money and prepayment options)
  - Credit risks
  - Risks from the warrant to convert the bond to equity in the firm (option delta-neutral equivalent equity risk)
  - Exchange rate risk between the Yen and the investor's base currency
- We'll use this "package" capability to model individual real estate properties

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Proposed Framework for Including Direct Owned Real Estate in EE

- A “bottom up” property-by-property approach
- Each property is treated as “composite asset”, a package of risk exposures to the EE common factors plus idiosyncratic risks
- The risk exposures of each property are of three basic types
  - Risks based on “steady-state” cash flow assumptions for existing and expected leases
  - Risks of future fluctuations in rents and occupancy
  - Risks related to mortgage financing

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Steady State Cash Flow

- Assume a useful life for a property (e.g. 50 years)
- For each major individual tenant and for other tenants collectively
  - Within the current lease period, consider operating expenses and expected losses from defaults given the credit of the tenant
- At lease renewal date, project the next lease period of rental revenue considering
  - Likelihood of lease renewal. Non-renewed leases are assumed to be taken over by a “generic tenant”
  - New rent level given long-term inflation expectations (can be adjusted for expectations of local market conditions)
  - Expected vacant period for lease non-renewals
  - Adjust default rate losses for the probability of generic tenant in second lease

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Steady State Cash Flow

- Repeat this projection yearly out to the expected useful life of the building to form expected cash flow stream
  - A different discount rate may apply to each year's cash flow according to the shape of the yield curve
  - All cash flow streams will have exposure to the three factors that describe changes in yield curve conditions (time value of money)
  - Each cash flow stream can be assigned a lesser or greater value for idiosyncratic risks (e.g. specific location, property condition, ability to sub-divide, etc.) and best/case worst/case scenarios for vacant time between leases
- Idiosyncratic risks diversify so an apartment complex of 1000 tenants may have less property specific risk than an office building with three investment grade tenants even though the individual office tenants have much better credit

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Steady State Cash Flow

- Each projected cash flow stream will have its own exposures to the relevant subset of EE factors
  - An industrial firm will have exposure to the industrial sector equity return volatility, while a tech firm will have exposure to the tech sector equity return volatility
  - A BBB rated retail tenant will have the credit risk exposures of the BBB rated consumer sector for the credit spread volatility
  - A shopping mall next to Miami airport might have exposure to conditions in emerging markets and Latin American stock markets
  - The creditworthiness and risk exposures of the “generic” tenant are estimated for each metropolitan area based on “share of employment statistics” for that area. The generic New York office tenant has more exposure to finance, while San Jose has more high tech, and Houston more energy exposure

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Steady State Cash Flow

- To carry out the cash flow projections we need property by property information on
  - Average lease length
  - Operating expenses as % of rents
  - Expected Vacancy rates
  - Expected renewal rate of existing tenants
- For major tenants some lease by lease data is required such as remaining lease period, renewal options, and escalation clauses.

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Rent and Occupancy Volatility

- Over time, changes in the level of rents and occupancy are driven by both supply and demand.
- Each property "package" will include a set of risk exposures to represent rent and occupancy volatility
  - Since the supply of commercial space changes very slowly, it doesn't show much reaction to the broad economic factors of the EE model. It is largely a function of local market conditions.
- Demand for commercial space is much more elastic and can be effectively captured in our framework by relating percentage changes in rents to the broad economic factors of the EE model
  - We need historical rent statistics by property type and metropolitan area. These statistics are available for many major regions.

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Rent and Occupancy Volatility

- The volatility of demand is modeled as a function of employment shares in the local economy compared to regional averages
  - In Tokyo or New York, financial businesses are a large part of the economy so demand is high after periods of good stock market performance by the financial sector.
  - In Houston, the economy is dominated by the oil sector so demand is related to returns to the oil sector
  - In San Jose, the economy is dominated by high tech firms so demand would be a function of tech sector returns
  - All the risk exposures related to rent/occupancy risks will be scaled to reflect the nature of a property. A property that is triple net leased for 100 years will have zero exposure, while an apartment complex with short term leases would have its exposures scaled accordingly. This scalar is roughly the annual percentage of lease turnover.

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Mortgage Financing

- Financing of properties will be included as a set of factor exposures to outgoing cash flows, just as “steady state” Net Operating Income was represented as incoming cash flows
- The binomial interest rate model incorporated in EE will be used to adjust the yield curve factor exposures of the financing for fixed/variable rates and prepayment options
- Multiple mortgages on one property may be represented including cross-collateralization across properties.

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Summary

- Looking at real estate risk from a portfolio perspective allows us to assume normality of returns, hence Modern Portfolio Theory is applicable
- We use the EE factor model to relate behavior of each asset to a set of common economic drivers
  - Infer relationships between investment assets
  - Integrated risk measurement across asset classes is now possible
- We represent each real estate property as a package of relationships to the EE factors plus some amount of idiosyncratic risk
  - Each property will be analyzed from three perspectives: cash flow, rent/occupancy volatility, and financing
  - Detailed information about each property and its major tenants is incorporated

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