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Optimal Deal Flow For Illiquid Assets

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Why this is important

- Illiquid asset investment process has been siloed away from most widely accepted quant practices

- Two schools of thought bring unique core competencies to the table:
  - Quant: Rigor of estimation and aggregation to overall risk
  - Fundamental: On-the-ground experience with the fundamentals of illiquid asset investing

- Combining the two will produce compound benefits to the quality of the illiquid asset investment decisions

The Illiquid Asset Investment Process

- Investment process varies from investor to investor:
  - Single purpose investor focused by land use, geography, and/or strategy
  - Larger investor needs more flexible and may require possibly some formal “queuing” system for allocating deals across funds
- Regardless of size, all investors face the same problem:
  - The investable universe at any given time is unknown. Investors receive investment deals based on their size, previous activity, reputation - even the largest and most active do not see every deal
  - Capital market and economic conditions affect deal flow: during downturns because deals are withheld; during booms bidding wars decrease decision time
  - Makes it difficult to rebalance portfolio in a timely and efficient manner

Illiquids Investment Process: Bidding

- Asymmetric bidding between buyers and sellers over a differentiated product (the illiquid asset) creates incentives to overpay:
  - Little time for buyer to contemplate the impact of a revised upward bid
  - Behavioral biases – win the bid rather than invest well
  - Reputation – managers have limited time to invest on behalf of sponsors
  - REITs – legal implications to stay invested

Illiquids Investment Process: Bidding (cont'd)

- A winning bidder that has overpaid has:
  - Reduced potential return
  - Simultaneously increased the uncertainty of the size of loss
  - Potential increased correlation with other assets:
    - due to pervasive bias from pressure to win and stay invested as a matter of investment practice

- Losers are forced to move down "food chain", with more pressure to add "lesser" assets at "higher" prices taking on more risk for less reward

- **STRIKING THE BALANCE:** Setting the correct risk-adjusted upper limit is paramount for the illiquid asset investment process

ODFI - The Tools

- **(1) Fundamental:** Knowledge, or reasonable expectation, of the fundamental of individual deals in the deal flow, to estimate NPV
- **(2) Quant:** Basic Portfolio Theory to capture the incremental impact of proposed investment deals to existing portfolio volatility
- **(3) Quant:** Real option analysis to estimate the expected downside impact of the new asset to portfolio performance
- **(4) Fundamental:** Capital budgeting, using expected marginal benefit of the particular deals

Step 1: Calculating baseline NPV of new deals

- Estimating operating income is the bread-and-butter of brick-and-mortar experts
- When discounting, we use the risk-free rate
- The reason: we will be subtracting explicitly the expected impact of downside performance from baseline NPV to get to “risk-adjusted” NPV.
- **Fundamental Theorem of Asset Pricing:** This will have identical effect to NPV as calculating a cap rate and using it instead of the risk-free rate

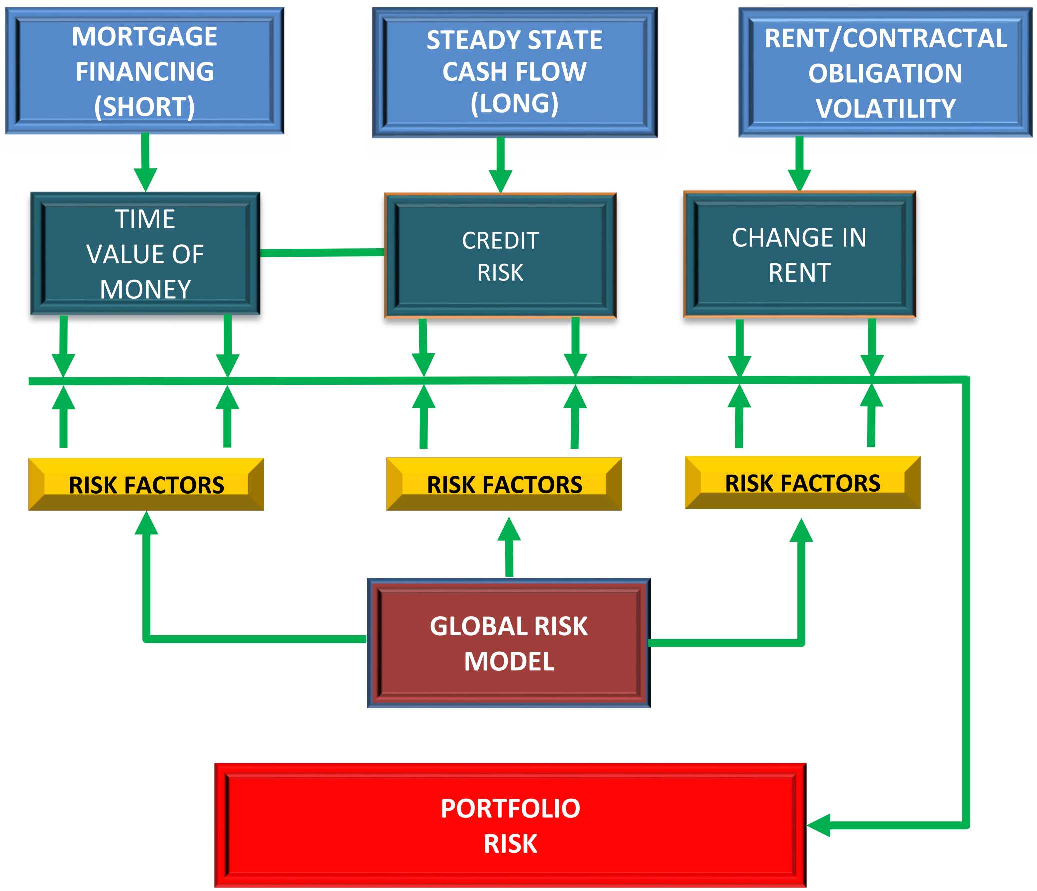
Step 2: Estimating Incremental Volatility

- A tenet of Portfolio Theory is that an asset should always to be analyzed in light of its impact on the portfolio, and not in isolation
- Therefore we are concerned not with the standalone volatility of the new asset, but with its impact to the existing portfolio
- Given a *risk model that transcends liquid and illiquid asset classes*, calculation of the incremental impact of a new asset, or combination of new assets, is a simple algebraic exercise:
  - The difference of portfolio volatility with and without the new assets
- The risk model has to be global and across-asset class because the existing portfolio is global and across-asset class, so incremental impact is captured appropriately.

Modeling Illiquids

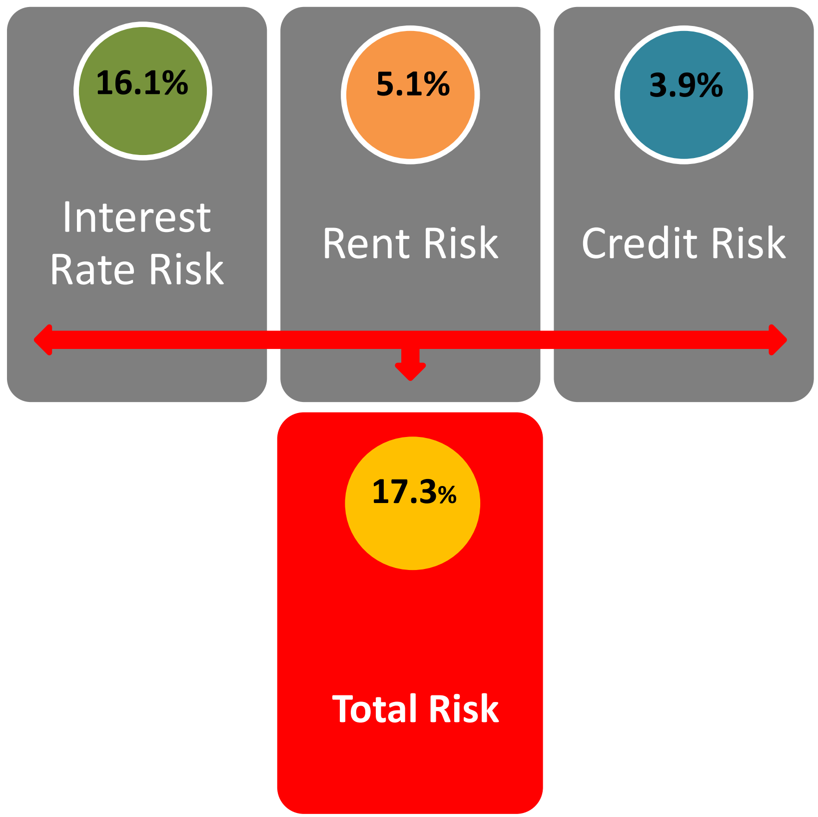
- Northfield models illiquids using a “bottom-up” asset-by-asset approach that is not appraisal-based
- Each investment is viewed as a composite asset with:
  - Risks based on “steady-state” cash flow assumptions for existing and expected leases/sources of cash flows
    - Uses lease structure, renewal, credit quality of tenants, vacancy dynamics, revenue and expense schedules
  - Risks related to mortgage financing (if any)
    - Takes into consideration floating rate, fixed rate, interest-only, balloon clauses, prepayment behavior, etc.
  - Risks of future fluctuations in market rents/contractual obligations
    - Takes into consideration the combined impact of lease rollover, vacancy, renewal, and market volatility of rents
- Each component has risk exposures to common risk factors plus idiosyncratic risks

Northfield's Private Equity Model (con't)



Example: Real Estate Model Results

Risk Profile: A Sample US Apartment Building
Risk by Source



Step 3: Estimating Downside Impact

- Merton real option analysis has been in existence for while and with a wide range of applications – from analysis of firms to credit. The key idea:

    Debt – level to which we measure loss – a strike price

    Underlying – the collateral with its volatility and value

    Estimation – done with an option pricing model

- In the same spirit, but different setting, we can use

    Offer Price – *level to which we measure loss – a strike price*

    Underlying – *the illiquid assets future cash flows with their volatility and present value*

    Estimation – *done with an option pricing model*

Step 3: Estimating Downside Impact (cont'd)

- A buyer in an investment is short a put on the asset underperformance, which the seller of the investor is long.

- Treat the incremental volatility as the effective volatility of the asset underlying the put. The strike price of the put is the offer price for the new asset

- $\boldsymbol{\sigma_{Imputed}} =$

$$\frac{\sqrt{\omega^2_{New\ Investment} * \sigma^2_{New\ Investment} + 2\omega_{Current\ Port.}\omega_{New\ Investment} * COV_{New\ Investment, Current\ Port.}}}{\omega_{New\ Investment}}$$

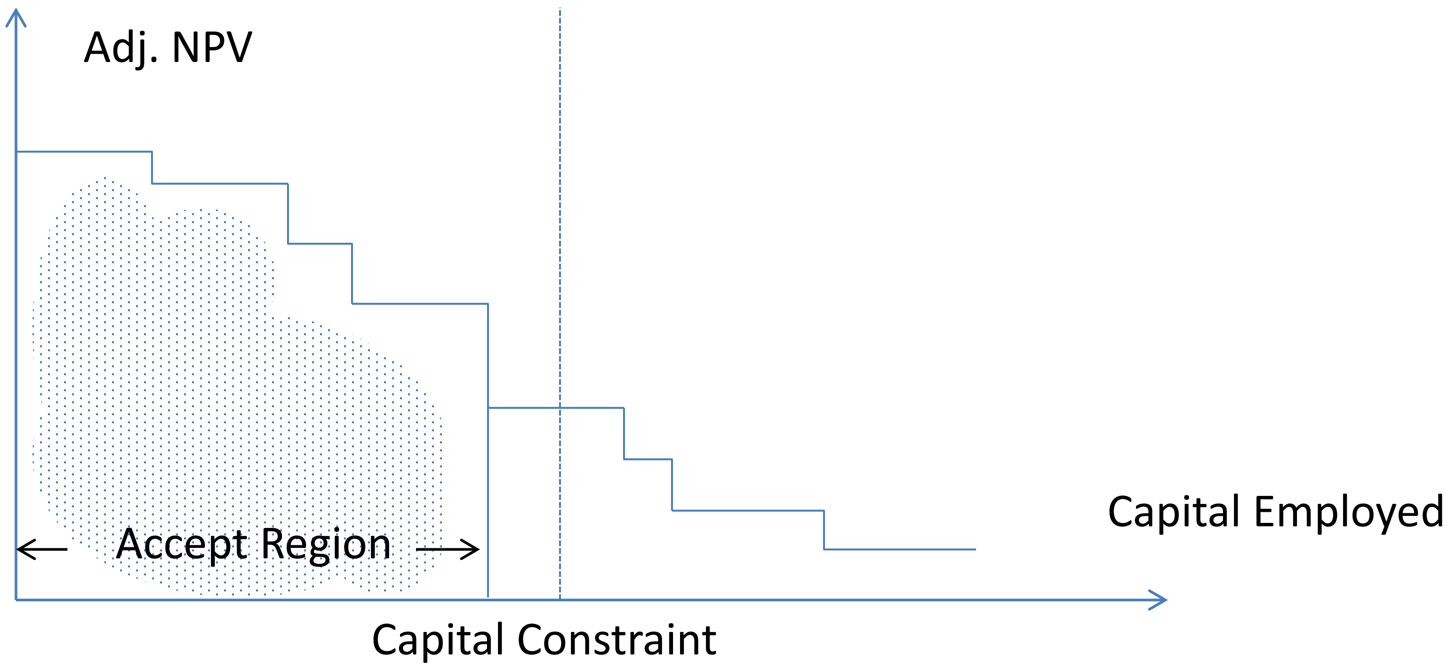
- The result is the dollar value an investor assigns to the estimate downside impact. Option theory agrees with intuition – the higher the offer price (put strike) – the higher the downside potential and risk. Also, the higher the (incremental) volatility the higher the downside risk.

Step 4: Calculating Risk-Adjusted NPV

- Subtract the value of the loss-related put from the baseline NPV
- We perform steps 1-4 for all assets and combination of assets that sum to or less than the budget constraint. Combinations should potentially include some cash, and should not have an overlap of assets included in them
- The sum of all asset and combinations in any decision making cycle (usually a week to a month) and within constraint of investable cash per investment portfolio is usually in the vicinity of 10-20
- Modern technology makes the turnaround of all calculations involved in this process completely tractable

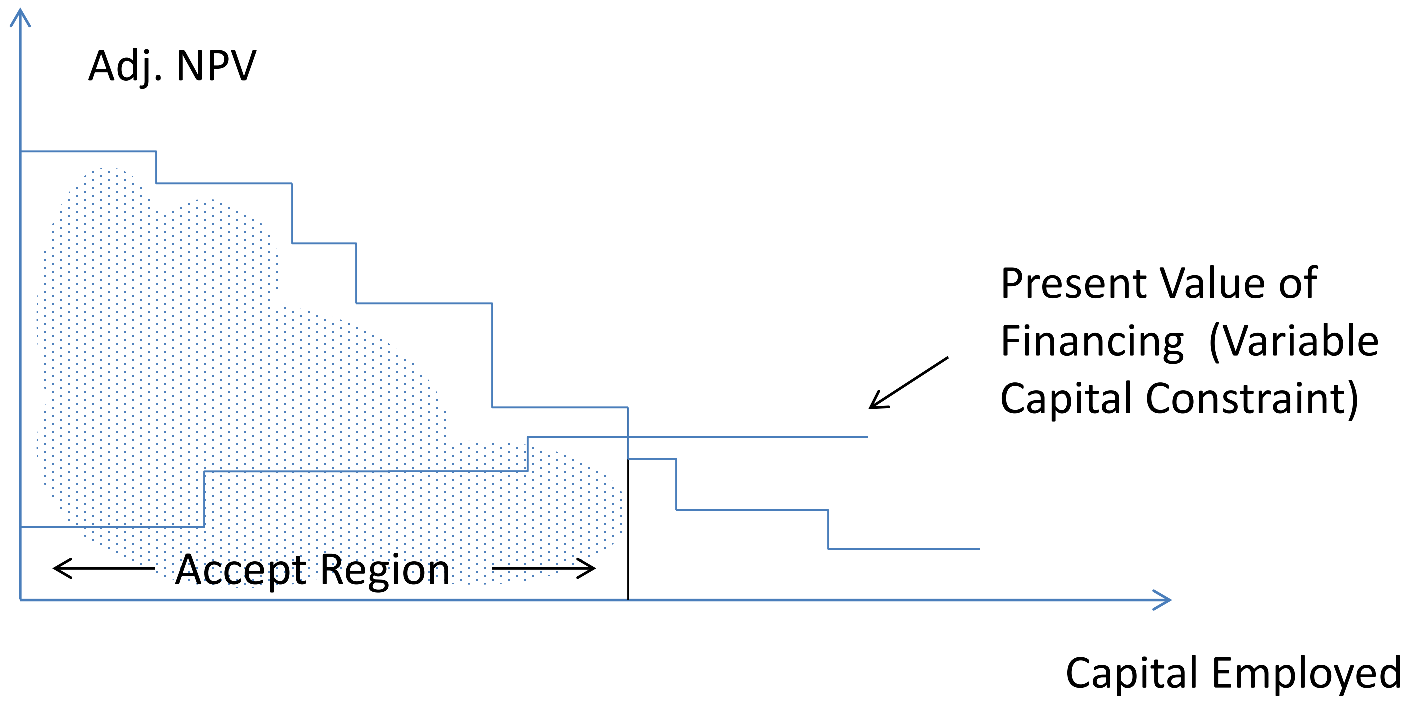
Step 5: Capital Budgeting

- We sort all investment possibilities by Risk-Adjusted NPV in descending order
- The cutoff point will be the acceptance threshold for possibilities



Step 5: Capital Budgeting (cont'd)

Increasing cost of capital due to borrowing will contribute to increasing present value of financing cash flows (discounted at the risk-free rate), presenting a dynamic capital constraint



ODFI in Practice

Investment	PV Cash Inflows (mill dollars)	Offer Price (mill dollars)	PV (per dollar Invested)	NPV (per dollar Invested)	Time Horizon	Imputed Volatility	CCA Drawdown Value per dollar invested	Adjusted NPV (per dollar invested)	Cumulative Investment (mill dollars)	Cumulative Budget Constraint (mill dollars)
Investment 3 (***Office prop.***)	36.8	23.6	1.6	0.56	15	23.5	0.07	0.49	23.6	50
Investment 6 (***Retail prop.***)	17.6	12.1	1.5	0.45	15	16.3	0.04	0.42	35.7	50
Investment 5 (***Electric Distr.***)	14.8	9.9	1.5	0.50	15	29.3	0.11	0.39	45.6	50
Investment 3 (***Timberland***)	25.3	17.0	1.5	0.48	15	30.0	0.12	0.36	62.6	50
Investment 1 (***Farmland***)	14.8	11.0	1.4	0.35	15	18.3	0.05	0.30	73.6	50
Investment 7 (***Private Debt***)	28.6	22.0	1.3	0.30	15	20.0	0.07	0.23	95.6	50
Investment 8 (***Office prop.***)	11.0	8.8	1.3	0.25	15	15.8	0.05	0.20	95.6	50
Investment 2 (***Warehouse***)	23.6	20.9	1.1	0.13	15	15.0	0.05	0.08	95.6	50

Optimal Objective: MVO vs. ODFI

- MVO Objective $= \mu_r - {\sigma_r}^2$

  (ignoring the impact of a risk aversion coefficient)

- ODFI Objective $= \mu_r + \ p(\mu_r) - \frac{\sigma_r}{\sqrt{2\pi}} + \frac{{\mu_r}^2}{2\sigma_r\sqrt{2\pi}}$

  P is a p value under normal distribution corresponding to the cutoff region.

  This expression is more involved than MVO, as it recognizes the investment downside potential, in specific, and the interaction of the mean and volatility with the offer price.

Extensions to the ODFI Model

- The option-based ODFI model is particularly well suited to incorporate, the "option to wait" for the investor to invest. Every time an investor enters an illiquid investment, they also give up the option to wait for a better deal to come along. This relates to:
  - The potential that frequency of offered deals changes in slower economies than booming economies
    - Only cash-strapped owners will sell at depressed prices
  - However the deals that would appear in a distressed market might offer better entry point for an investor and hence better payoff
  - A liquidity probability distribution of outcomes can then be constructed conditional on the state of the economy and incorporated in the ODFI option pricing. Assuming a Poisson distribution is a very simple starting point.

Summary

- For too illiquid asset deal selection has been tied up like Gulliver in regards to optimal investing:
  - Agency problems and competitive bid situations have lead to no-win situations where winners and losers make suboptimal decisions due to lack of hard criteria

- Using a quant risk model and fundamental inputs, ODFI allows users to quickly rank in rigorous fashion all available investment deals by their risk-adjusted NPV in descending order, and find the cut-off point that matches their capital budgeting constraints; ODFI implicitly confirms the "liquidity drag" concept in asset allocation, usually attributed to Bill Sharpe.

- The ODFI methodology (which unlike MVO is multi-period) is very well suited for the investment horizons of illiquid asset investors. It also offers the more intuitive measure of risk – expected loss, and process – capital budgeting, both of which are a good fit to the investment culture an practice in the field and thus improve the acceptance level.