PROMS

NCREIF Phoenix Conference

March 2024

Modern Portfolio Theory and CRE:
Volatility, Correlation and Diversification

Radley Associates

Today's discussion

- **The focus will be on why volatility metrics provide unique insights but are different and complementary to 'scenario or research-based forecasts'**

- **The two main ideas I want to get across**
  - Firstly, measuring portfolio diversification can provide significant performance gains and better align fund performance with the risk/return objectives of investors
  - Secondly, why CRE needs to align with other asset classes by <u>measuring</u> risk

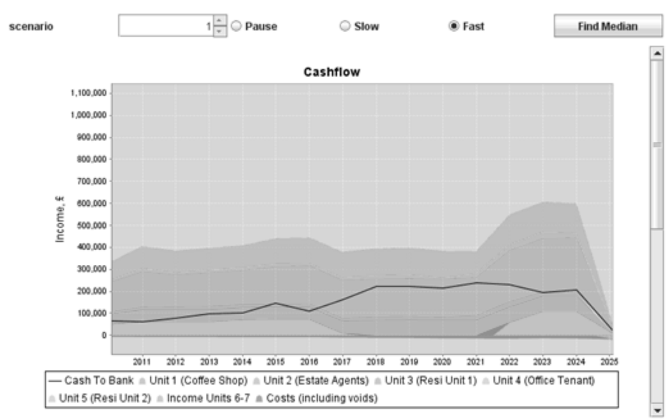
- **I want to keep discussion at a high level and not get into the weeds, with a focus on practical solutions, concepts and benefits not formulas, algorithms or 'greeks'**

CRE analysis typically starts with a detailed projection of future cashflows to arrive at a forecast

Property and loan data

IN

Discounted Cash Flow projections: Base Case, High Case, Low Case

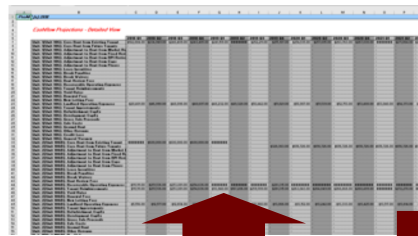


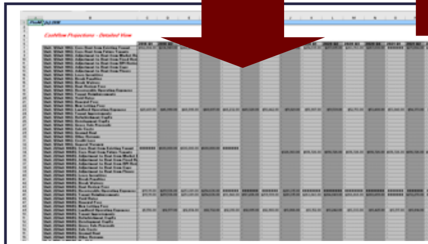
IN

Assumptions (Scenario) about future rents, tenant behaviour, vacancies, capital values, interest rates, inflation etc.

OUT

Valuation & cash-flow projection





Portfolio reporting, valuation & cash-flow projection

?

…but how *likely* is *this* projection? And how correlated or diversified is the portfolio?

Stochastic Modelling

The starting point for stochastic modelling is therefore a forecast

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Building stochastic models – simulating cashflows

We want to 'stress' assets or portfolios with both Market and Asset specific factors

Market volatility (historic data)

- **Changing Rental Rates**
  - Unemployment
  - GDP growth
  - Inflation
- **Changing Cap Rates**
  - Inflation
  - Money supply
  - FX movements
- **Changing interest rates**
- **Cost and CAPEX inflation**

Economic scenarios

Correlated Drivers. Based on 50 years of data

Idiosyncratic volatility (asset specific)

- **Tenant defaults**
- **Contractor defaults**
- **Lease breaks**
- **Break exercise**
- **Void period length**
- **Obsolescence**
- **Future lease terms**
- **Valuation error**

Cashflow simulation

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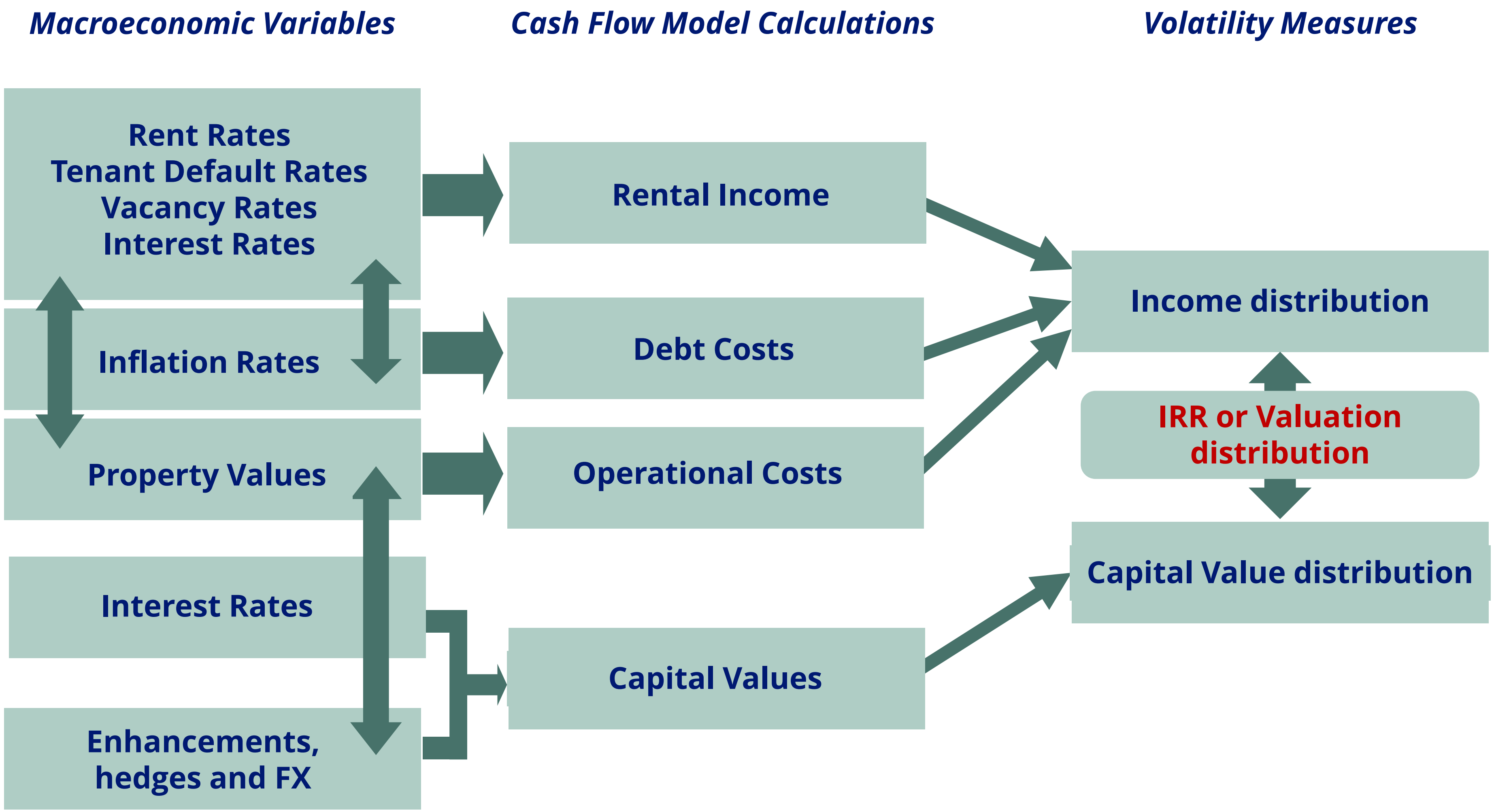
Where to start?

- **Build in-house**
  - Excel (and Crystal Ball) – more transparent but limited capacity
  - Matlab etc - suitable but less transparent and hard to create enterprise solution
  - Use open-source libraries – see Tim Savage NYU
- **External consultants:**
  - Oliver Wyman/McKinsey/Charles Rivers
- **Software**
  - MSCI high volatility fund model
  - CMM (Moody's) – debt focused
  - CoStar?
  - PROMS (Forgive the plug)

Simulation is the most suitable method to understand the relationship between cashflows and market factors



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The key elements of a cash flow that can be simulated with historical data

Rent from existing tenants

- Rents and rent review type/dates
- Breaks
- Lease ends
- Tenant defaults
- Vacancy periods

Rent from future tenants

- Future tenant leases
- Rent discounts for dilapidations

Operating and debt costs

- Inflation
- Interest Rates
- Expense allocation

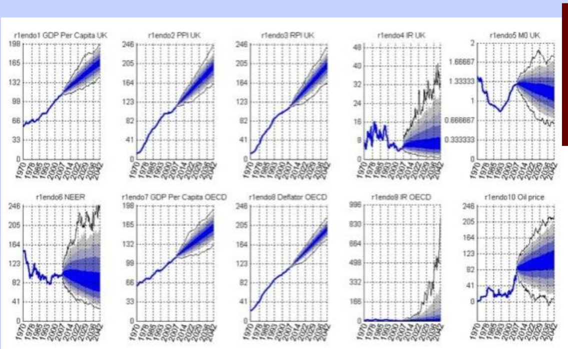
Changes in property values

- Future market changes by sector/unit
- Property vacant discount
- Property depreciation discount
- Lease event discounts
- Leasehold discount

The main components of a simulation platform

Use long run historic economic and property market data

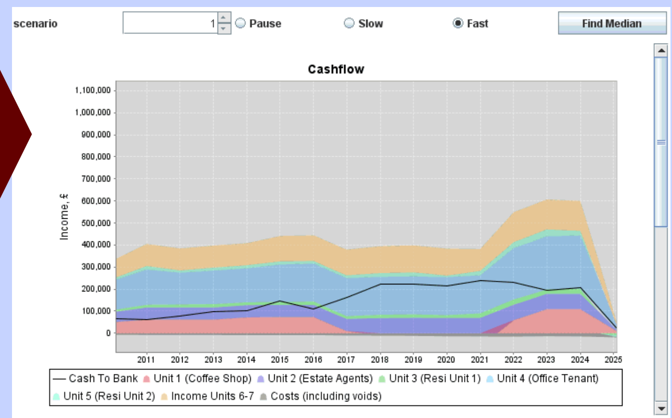
Stochastic scenarios model preserving economic and property market correlations



Allow users to override with their own forecasts

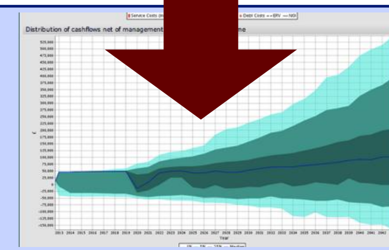
Validate property and leverage information

Cash-flow simulation models for each CRE type (construction/multifamily etc.)



Centralise and track assumptions and controls (use metadata)

Output risk metrics consistent across deals



Provide portfolio metrics of risk adjusted returns, concentration & diversification

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The cashflow logic (the devil is in the detail): for example, just to model vacancies we need to know:

- **The tenant's default probability (*Market Data*)**
- **This default and behavioural propensity rate needs to be varied with the economy in the simulations (*Market Data*)**
- **We need to ensure the number and severity of tenant defaults will occur in the right proportion of the scenarios**
- **Vacant period length from today's market and sector data. (*Market Data*)**
- **Vacant period average length varies with the economy (*Market Data*)**
- **The vacancy length is needs to be selected on a random basis according to the observed distribution of actual voids (*Market Data*)**
- **Expenses allocated to landlord if no tenant**
- **The inflation of expenses in each scenario *(Market data)***
- **The capital value adjusted for the discount during vacancy**
- **Rent set to new Market Rent at the time of finding a new tenant (*Market Data*)**
- **Replacement lease details based on market data average for sector (*Market Data*)**

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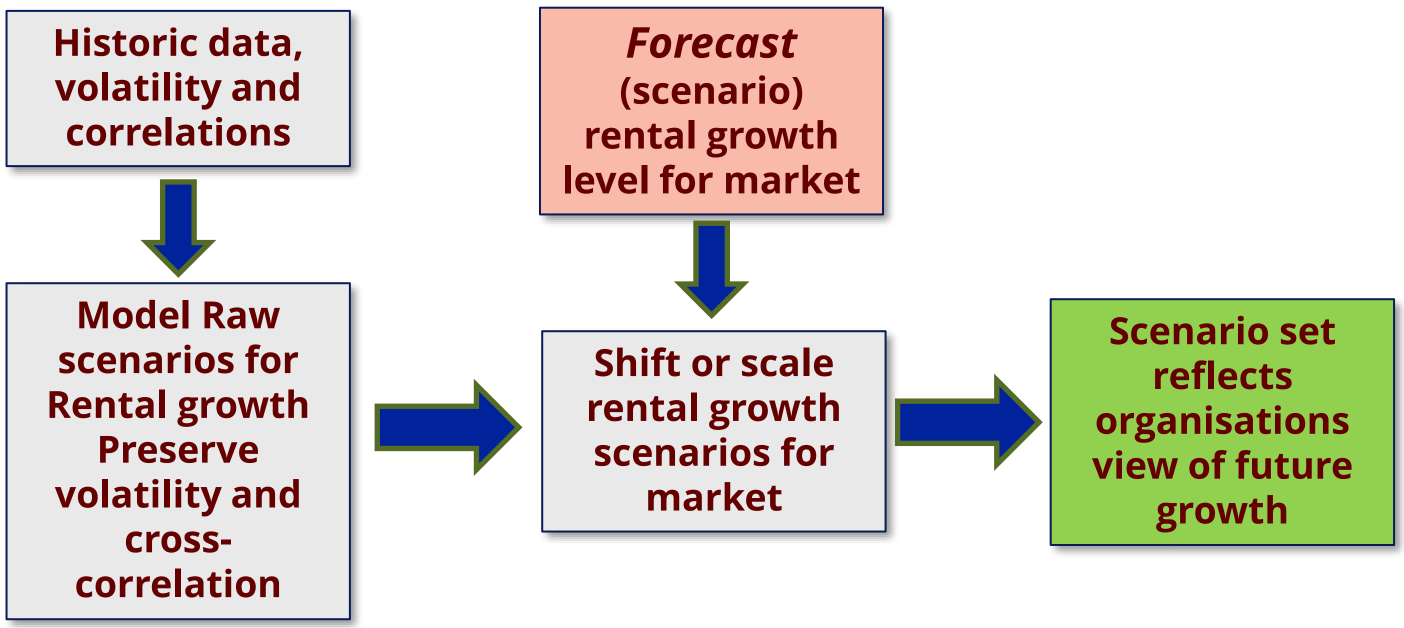
Simulation does not provide *specific* market forecasts: For example, rental growth scenarios



“Local or sector conditions indicate rents in this area will increase/decrease because….

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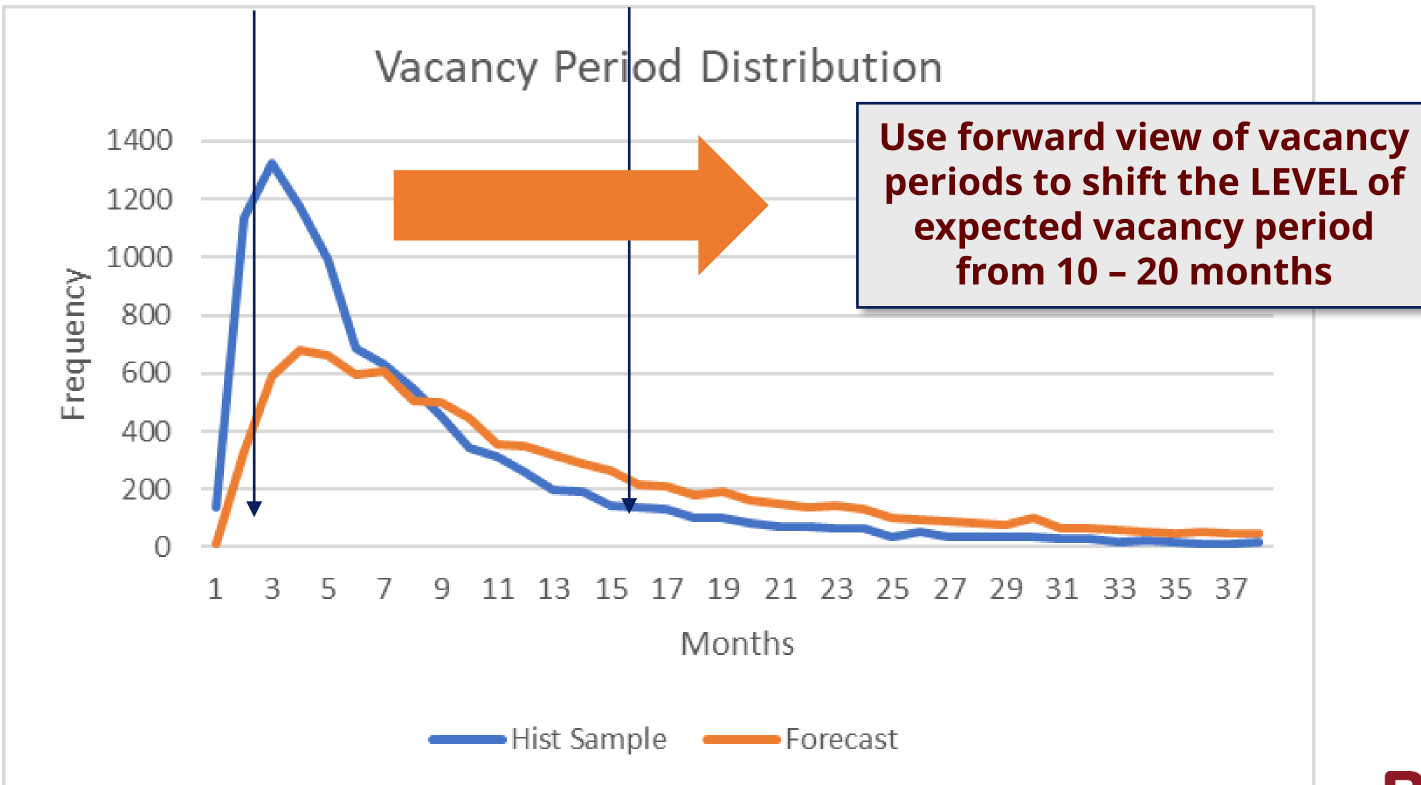
Combining the macro model with a research-based forecast
Example: Office vacancy period modelling

- **Use historic data to determine distribution *shape and correlation***
  - Lognormal distribution fits the historic data sample well
  - Vacancy period is -83% correlated with Rental value growth

- **Use forecast, eg Rents in this sector will do X because of Y, to set the expected average *level***



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Organisational challenges: The language of simulation

➢ How to de-mystify the risk concepts and terminology?

- Standard deviation:
  - "Range of outcomes"
  - "Volatility" (though not everyone knows what this looks like as a metric)
- VaR is often more easily understood:
  - E.g.: "A 1 in 20 chance IRR is below X%"

➢ How to combine expected IRR with Standard Deviation?

- "5.3% IRR with 8.2% volatility"
  - Users know what a good IRR looks like, but we need to set expectation of what a low volatility looks like
- Combined single number metrics:
  - "Risk adjusted IRR" or "Risk-free Equivalent Returns (REFR)"
  - Compare risk adjusted returns with 5-yr (or 10-yr) bond yields?

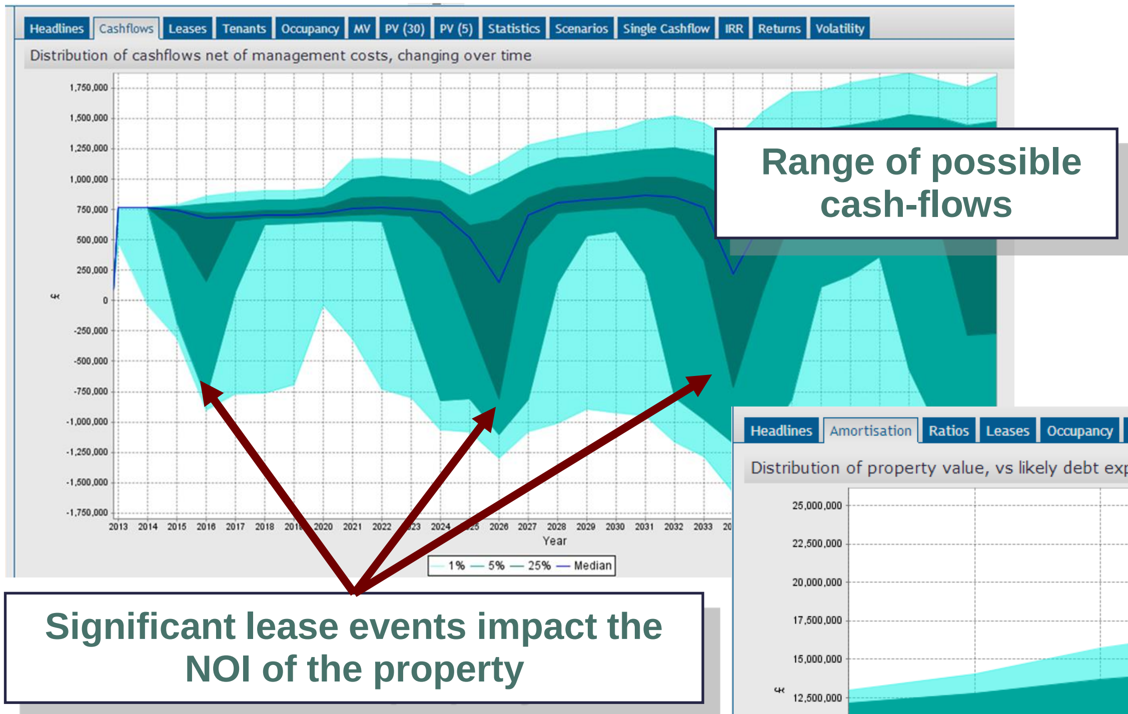
➢ How to describe diversification benefits?

- Demonstrating and measuring the portfolio impact of diversification

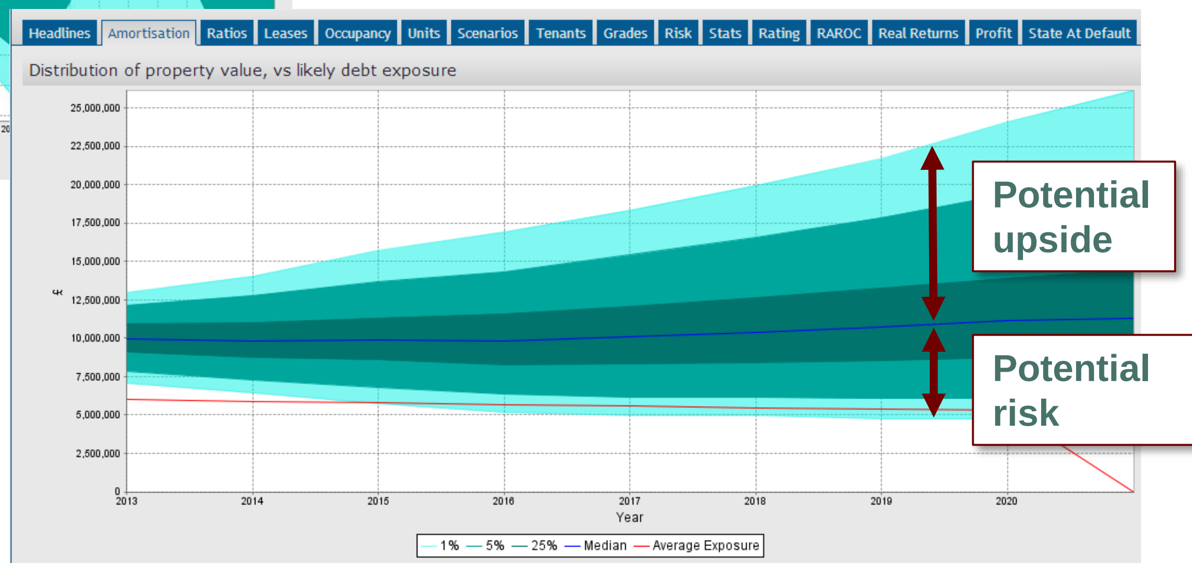
Stochastic modelling: some insights

Simulations measures the *uncertainty* of cash-flows and asset values

Probability distribution for NOI…



…and of the asset's value



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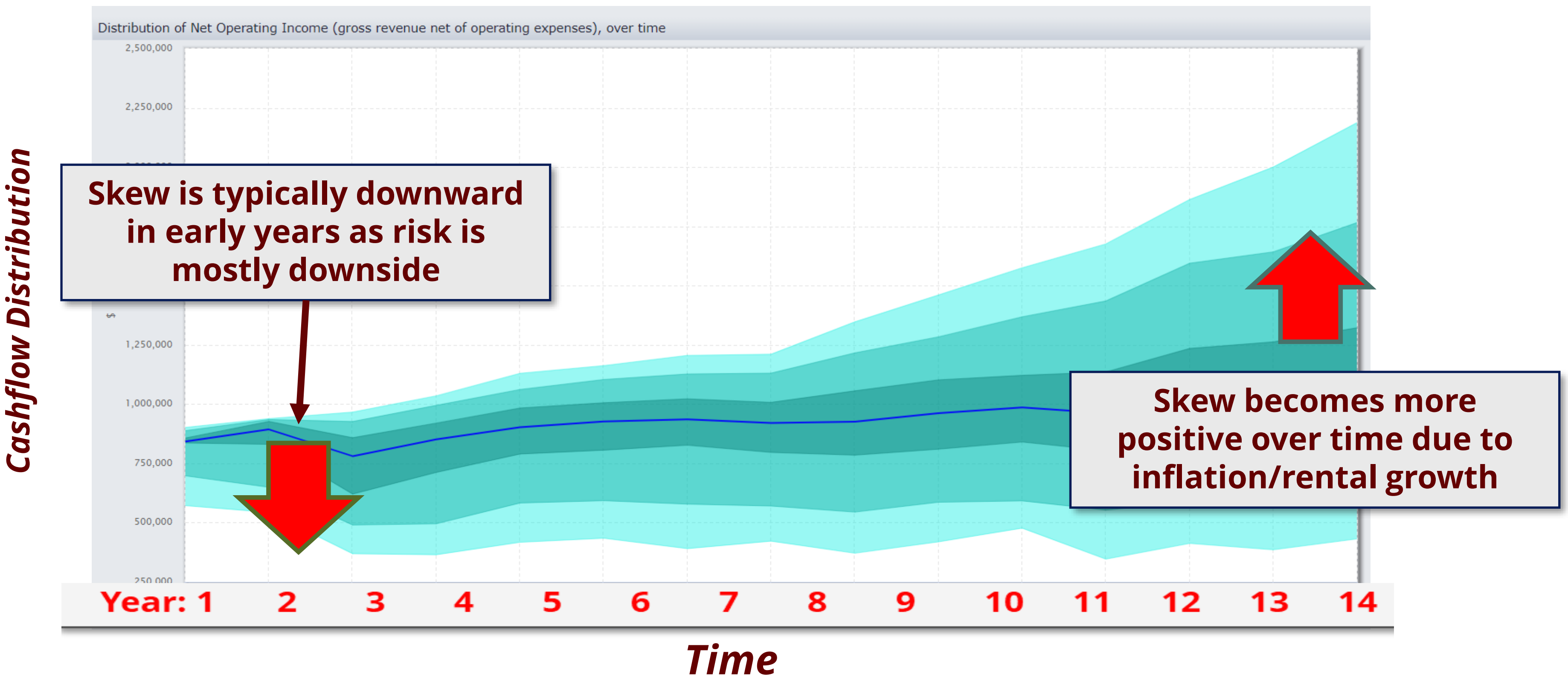
Bottom-up simulation from the unit level upwards is essential to reflect *skew* in the return distributions

Example Office Asset: cashflow distribution over time



- Market factors, such as rental growth, cost inflation, tenant default rates typically have normal distributions
- Whereas property specific events e.g. lease renewal, vacancy period length, TIs / LCs, are typically binary or non-normal

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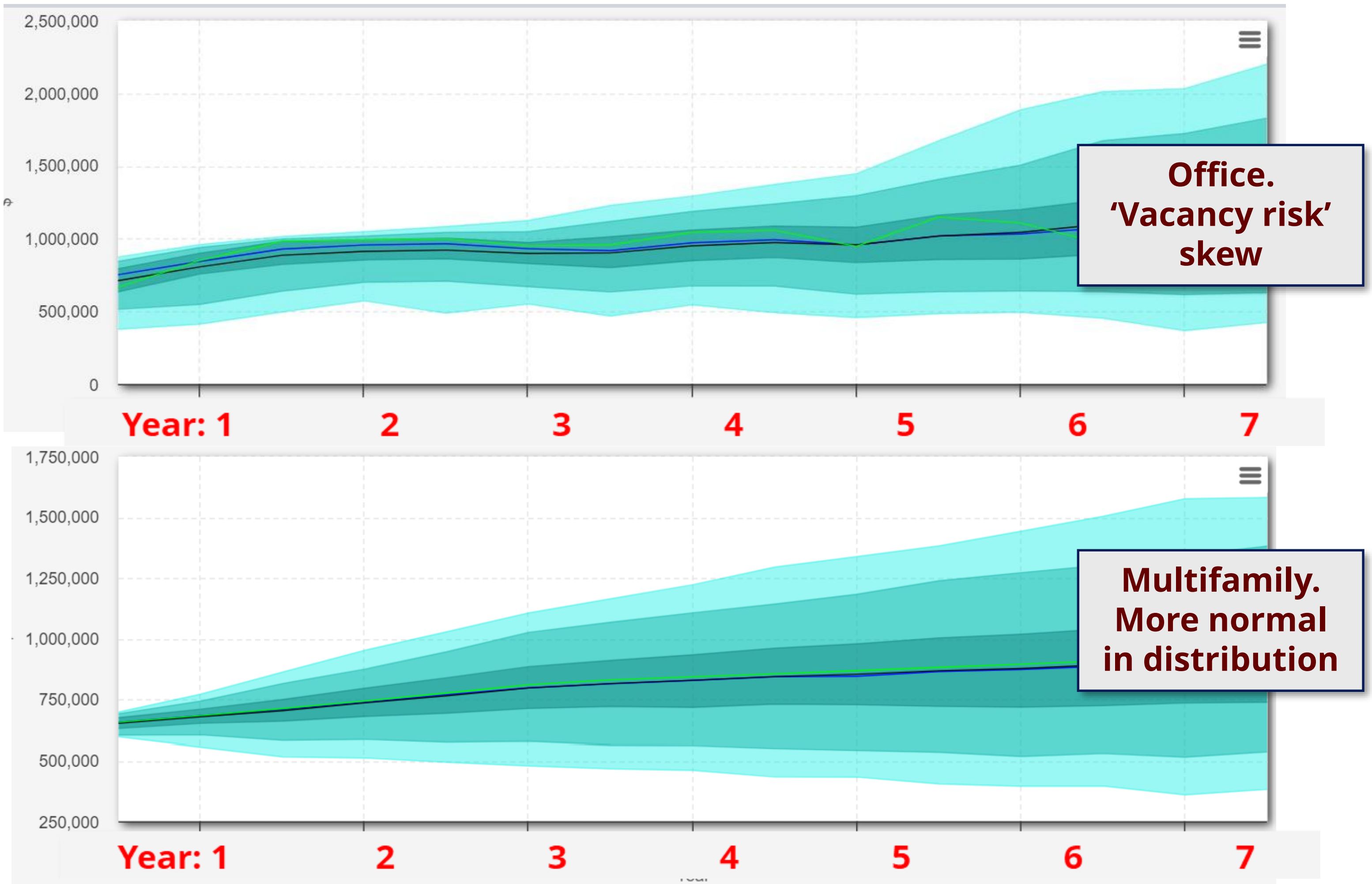
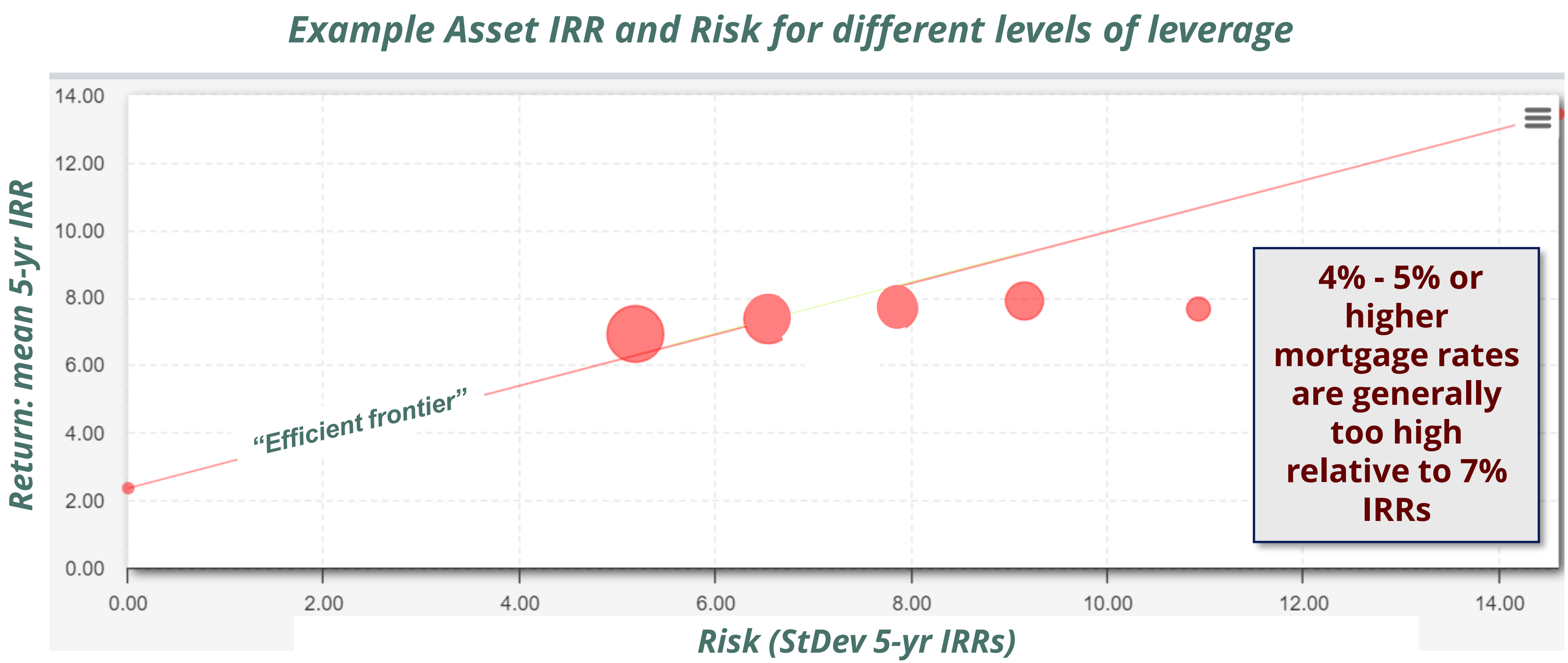
Examples: 4-unit office vs 120-unit Multifamily



2 Example Assets: NOI distribution over time

At current rates, leverage is rarely boosting risk-adjusted returns



	LTV	Fixed Rate	Sharpe 5yr	IRR 5yr - Mean	IRR 5yr - Std Dev	IRR 5yr - Risk Free Equivalent Return (RFER)
MF01 No lev			88%	6.9%	5.2%	1.4%
MF01 25 Lev	25.00%	4.50%	77%	7.4%	6.5%	0.4%
MF01 40 Lev	40.00%	4.50%	68%	7.7%	7.9%	-0.7%
MF01 50 Lev	50.00%	4.50%	61%	7.9%	9.2%	-1.9%
MF01 60 Lev	60.00%	5.00%	48%	7.7%	10.9%	-4.0%

BUT – portfolio diversification can correct this relationship

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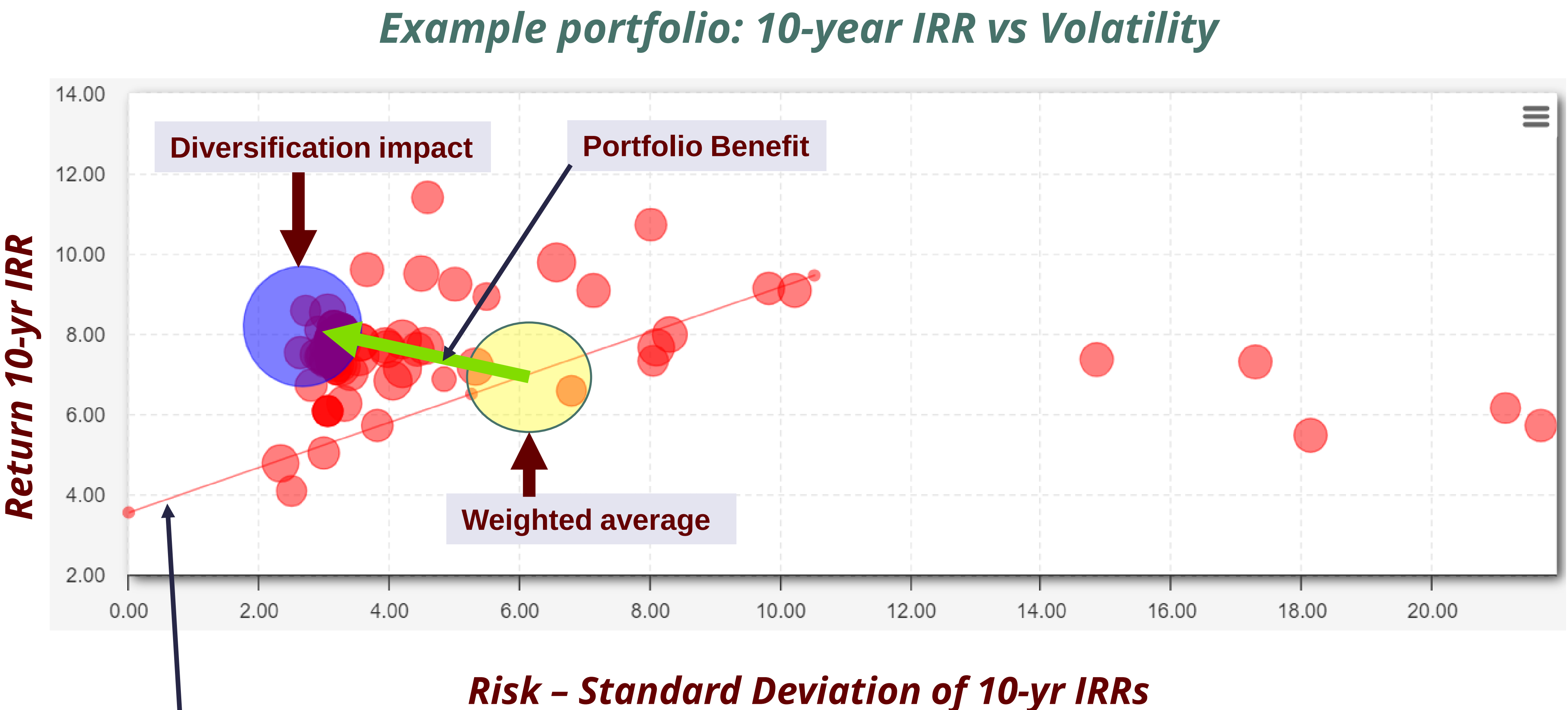
By simulating each asset with the same 'seed' we can measure the diversification benefits of the portfolio



Line represents the efficient frontier of 10-yr T-bond and historic S&P 500 Total Returns

Example quantification of the portfolio benefits of diversification on mean returns and standard deviation

Sample Portfolio

	Horizon	Mean	St Dev	Prob Making Target	Weighted Avg Mean	Weighted Avg St Dev	Diversification Benefit to Mean	Diversification Benefit to St Dev
IRR	10 years	8.19%	2.67%	79.90%	7.58%	4.67%	0.60%	2.01%

- Diversification reduces portfolio volatility by 2.01% (Weighted average 4.67% - portfolio 2.67%)
- Diversification also improves the mean IRR by 60 bps
- This effect is due to skew in the distributions and is normally positive except where leverage is high (or in CRE debt portfolios) where the effect is the opposite

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Calculate each asset’s contribution to marginal IRR and marginal volatility

Absolute Impact of each property to key measures of portfolio over 10 years

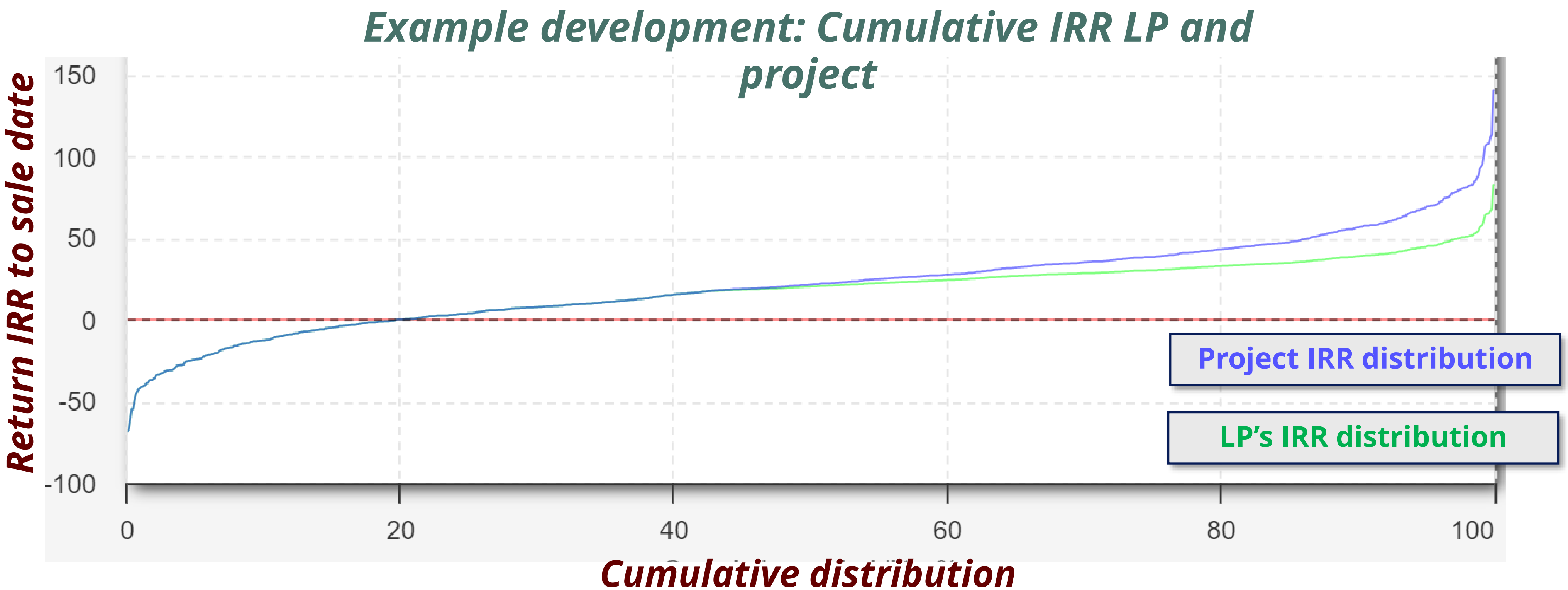
Property name	Current Value	Sharpe	IRR	IRR Vol	Impact RFER*	Leverage	Concentration	Sector
Example 42	$94,637,687.00	3.76%	0.11%	0.00%	0.116%	37%	7.8%	CA Office
Example 81	$38,476,436.00	2.17%	0.12%	0.03%	0.084%	45%	3.2%	CA Multifamily
Example 61	$21,829,942.00	2.47%	0.08%	0.00%	0.077%	50%	1.8%	CA Industrial
Example 9	$98,330,000.00	3.33%	-0.03%	-0.09%	0.065%			
Example 48	$57,080,793.00	2.73%	-0.02%	-0.07%	0.053%			
Example 8	$15,950,000.00	1.72%	0.03%	-0.02%	0.047%			
Example 11	$19,210,000.00	1.76%	0.02%	-0.02%	0.046%			
Example 28	$49,420,000.00	2.00%	-0.02%	-0.06%	0.037%			
Example 78	$41,900,000.00	1.84%	-0.03%	-0.06%	0.031%			
Example 58	$45,890,000.00	1.49%	-0.03%	-0.05%	0.022%			
Example 25	$19,100,000.00	0.93%	0.00%	-0.02%	0.021%		1.6%	CA Industrial
Example 99	$15,300,000.00	0.87%	0.01%	-0.01%	0.020%		1.3%	CA Industrial
Example 57	$28,368,615.00	0.42%	0.03%	0.01%	0.019%	30%	2.4%	CA Multifamily
Example 34	$26,164,389.00	0.18%	0.04%	0.02%	0.018%	46%	2.2%	CA Multifamily
Example 37	$23,981,340.00	0.10%	0.05%	0.03%	0.017%	48%	2.0%	CA Multifamily

This asset reduces the portfolio IRR by 3bps but is so well diversified it reduces the volatility by 9 bps – overall the 4th best on a risk adjusted basis

An asset may have a good IRR forecast but be poorly diversified from portfolio

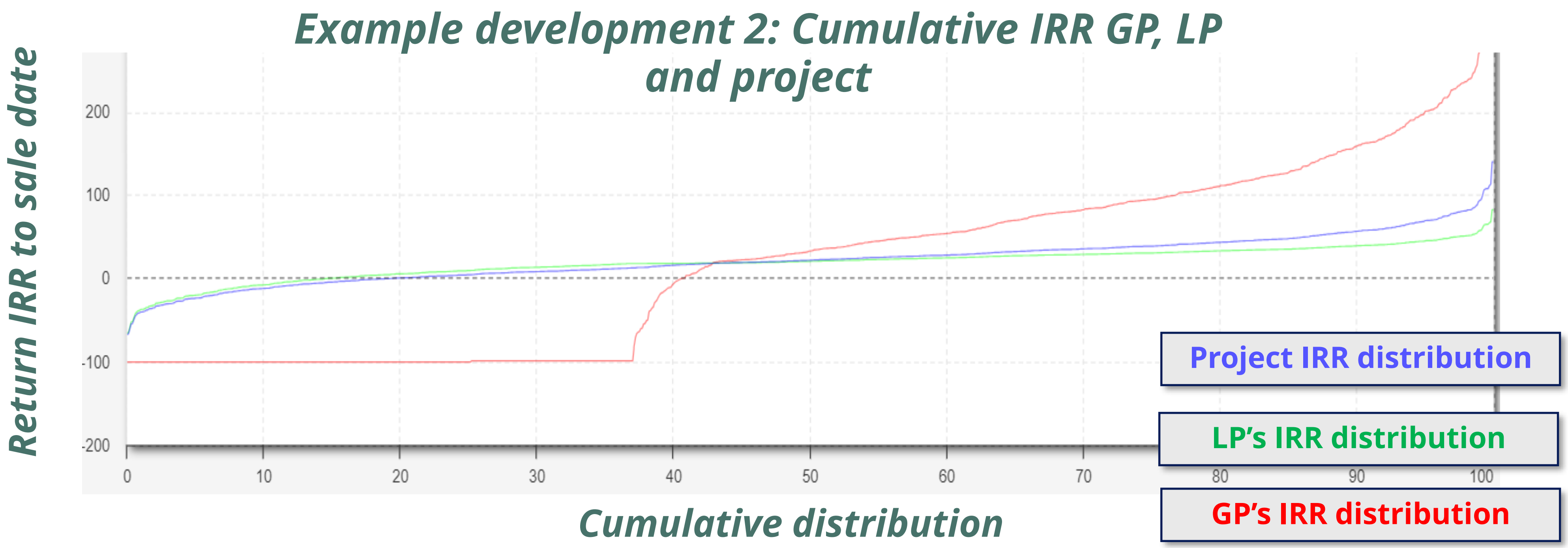
* REFR (Risk Free Equivalent Rate = Mean IRR – StDev(IRR) x (Avge. 10yr S&P500 Returns – 10yr Tbond yield)/StDev S&P500 10-yr returns)

Simulation analysis in an example waterfall arrangement



- The waterfall distribution can reduce LPs upside whilst keeping the downside resulting in much lower expected IRR
- However, the expected IRR of this project is still 22%

Catch up example between GP and LP



- In this project the GP is 36% likely to lose their initial investment – but 58% likely to exceed their initial hurdle.
- GP and LP expect similar returns – but GP has higher risk.
- Note that the LP's loss of upside gives a negative skew to the returns

	GP	LP	Project
1.0% Percentile	-100.0%	-38.1%	-41.1%
5.0% Percentile	-100.0%	-20.8%	-24.4%
25.0% Percentile	-100.0%	8.9%	3.9%
50.0% Percentile	32.5%	20.1%	21.4%
75.0% Percentile	94.6%	30.1%	38.3%
95.0% Percentile	200.9%	44.7%	69.3%
99.0% Percentile	273.2%	57.3%	93.5%
Mean IRR	18.7%	18.0%	21.7%
StDev IRR	106.5%	19.4%	27.7%
Skew IRR	0.34	-0.88	0.15

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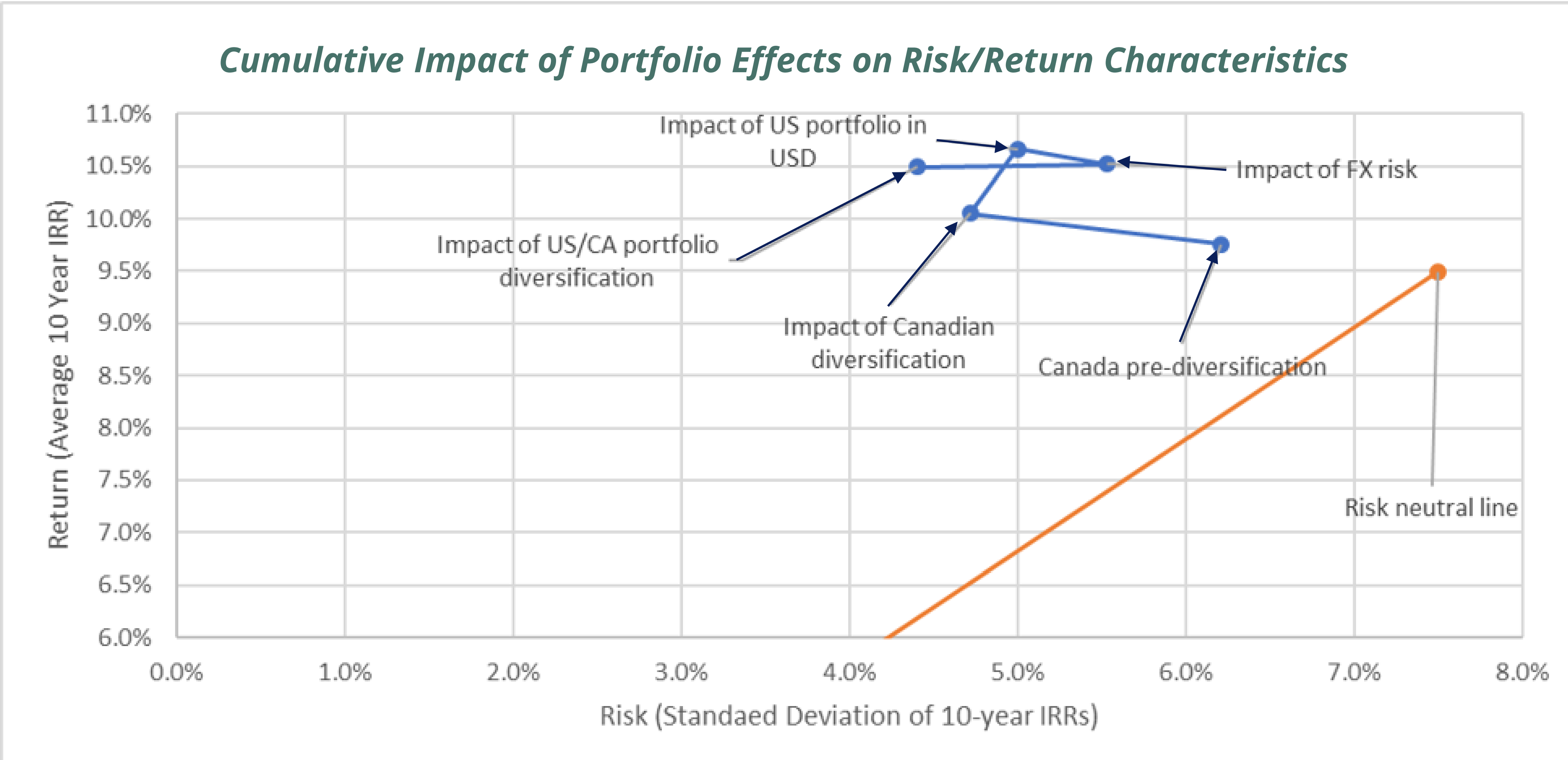
Quantifying the benefits and risks of cross-border CRE portfolios



Source: Investing in Cross-Border, Multi-Currency CRE assets: The impact on portfolio risk and return. Published article for PREA, Radley Associates using PROMS CRE Platform in association with Ontario Pension Trust.

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Summary

	Today	The Future
Objectives:	Selecting and structuring assets, to maximise return (at an unknown level of volatility)	Measuring and managing asset volatility, and optimising portfolio diversification to deliver higher returns with less volatility
Forward Metrics:	• Forecast cash-flows • Forecast IRR • Hi/low IRR	• Forecast cash-flows • Distribution of cash-flows • IRR and IRR volatility • Tail risk • Portfolio diversification measures • Marginal diversification by asset • Waterfall dynamics

Historic data to consider in building a simulation model

Area	Key examples	Sources	Granularity	Information
Macroeconomy	Inflation, GDP, long/short rates, FX	OECD, the FED etc.	Economy-wide	Volatility, cross-correlations
Property market	Rental value growth, Cap rates, Price indices, (occupancy rates)	NCREIF, Green St., BIS, CoSTAR, REIS etc.	Region/geography/sector/MSA – depending on sources	Cross-correlations, term-structure of volatility
Property behavioural	Lease lengths, renewal probabilities, TIs/ LCs	Augus files, specialist publications	Sectoral – depending on sources	Levels and distributions
Valuation error	Actual sale price vs. valuation	MSCI/RICs	National or universal	Distribution

Better a deep history rather than a short but granular history. At least 50 years

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Future view data options

Type	Key examples	Sources	Granularity	Use
Contracted (facts)	Rent (and escalators), lease terms, existing cost of leverage	Appraisals (Argus files), other internal systems of record	Unit, property, loan facility	Model actual or proposed contract information
Property market forecast	Future rental growth/ cap rates	Appraisers view – own research departments	MSA or building level	Can combine own forecasts with historic volatility and correlations
Asset level forecasts	Stabilization date, lease-up period. Tenant renewal	Underwriting models/ Argus	Unit, property	Stress using historic averages and own forecasts

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