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Asset allocation with concentration risk

Insights from Real Estate

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Asset allocation with concentration risk
Outline

The original challenge:

Create for real estate
a general risk analysis and
asset allocation framework

- within Markowitz's critical line framework
  but adapting it to handle
- the special features of real estate investments
- their data limitations
- the apparently sub-optimal behaviour of real estate investors

In this presentation, I'll cover:

1. The framework for risk analysis
2. Extending the framework for asset allocation
3. Results
4. The New Frontier
5. Conclusions and lessons

1. Risk analysis
The usual story

In asset allocation for equities and many other classes, it is often adequate to use

the risk of the industry index (country etc) σ_I

as a proxy for the risk of the sub-portfolio σ_i invested in that industry.

eg

$$\begin{aligned} \sigma^2_P &= w'\Sigma w \\ &= \Sigma w_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} \qquad (1) \end{aligned}$$

For portfolios of institutional size, the argument runs, the beta will be close to 1 and the specific risk will be diversified away.

Alternatively, the stock allocation may be seen as a separate step, someone else's problem

1. Risk analysis
Why real estate is different

But now look at the holdings in a typical direct UK real estate portfolio:

Sector	£m	Sector	£m	Sector	£m
Retail SE	37	Shopping Centre	314	Office - City	226
Retail SE	11	Shopping Centre	312	Office - City	140
Retail SE	10	Shopping Centre	129	Office - City	75
Retail SE	10	Financing	-210	Financing	-60
Retail SE	99				
Retail SE	59	Retail Warehouse	90	Office - WE	97
Retail SE	32	Retail Warehouse	78	Office - WE	45
Retail SE	18	Retail Warehouse	72	Office - WE	110
Retail SE	12	Retail Warehouse	55	Office - WE	53
Retail SE	6	Financing	-70		
Retail ROUK	25	Industrial SE	9	Office - SE	53
Retail ROUK	15	Industrial SE	6	Office - SE	18
Retail ROUK	10				
Retail ROUK	1	Industrial ROUK	23	Office - ROUK	35
Retail ROUK	22	Industrial ROUK	12		

1. Risk analysis
Why real estate is different

In direct real estate portfolios

- there is often significant gearing

- lot sizes for direct property are much larger overall than for other assets

- within property some sectors (eg retail shops) have lot sizes much smaller, and so are much more diversifiable, than others (eg shopping centres)

- properties are not fungible: no fund can have the same holdings as another fund, and no fund can hold the index

  ➢ *stock selection is part of the asset allocation problem*

1. Risk analysis
A simple fix for real estate

In principle, we can address this by modelling each sector as a single index model, so instead of

$$\sigma^2_i = \sigma^2_I$$

we write

$$\sigma^2_i = \beta^2_{i,I}\sigma^2_I + \xi^2_i$$

where ξ_i denotes the aggregate specific risk for the portfolio's holding in I

This we could expand to

$$\Sigma w^2_s(\beta^2_{s,I}\sigma^2_I + \xi^2_s)$$ where s is an individual stock

or $$\beta^2_{i,I}\sigma^2_I + \Sigma w^2_s \xi^2_s$$ if gearing at sector level only

1. Risk analysis
A simple fix for real estate

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BUT we have no way of observing for individual properties their β_s or ξ_s.
HOWEVER Callender et al (2007) did estimate data allowing us to calculate averages $\xi_{\mu I}$ for the 11 IPD PAS sectors. Using these or similar we can write

$$\beta^2_{i,I}\sigma^2_I + \xi^2_{\mu I}\Sigma w^2_s$$

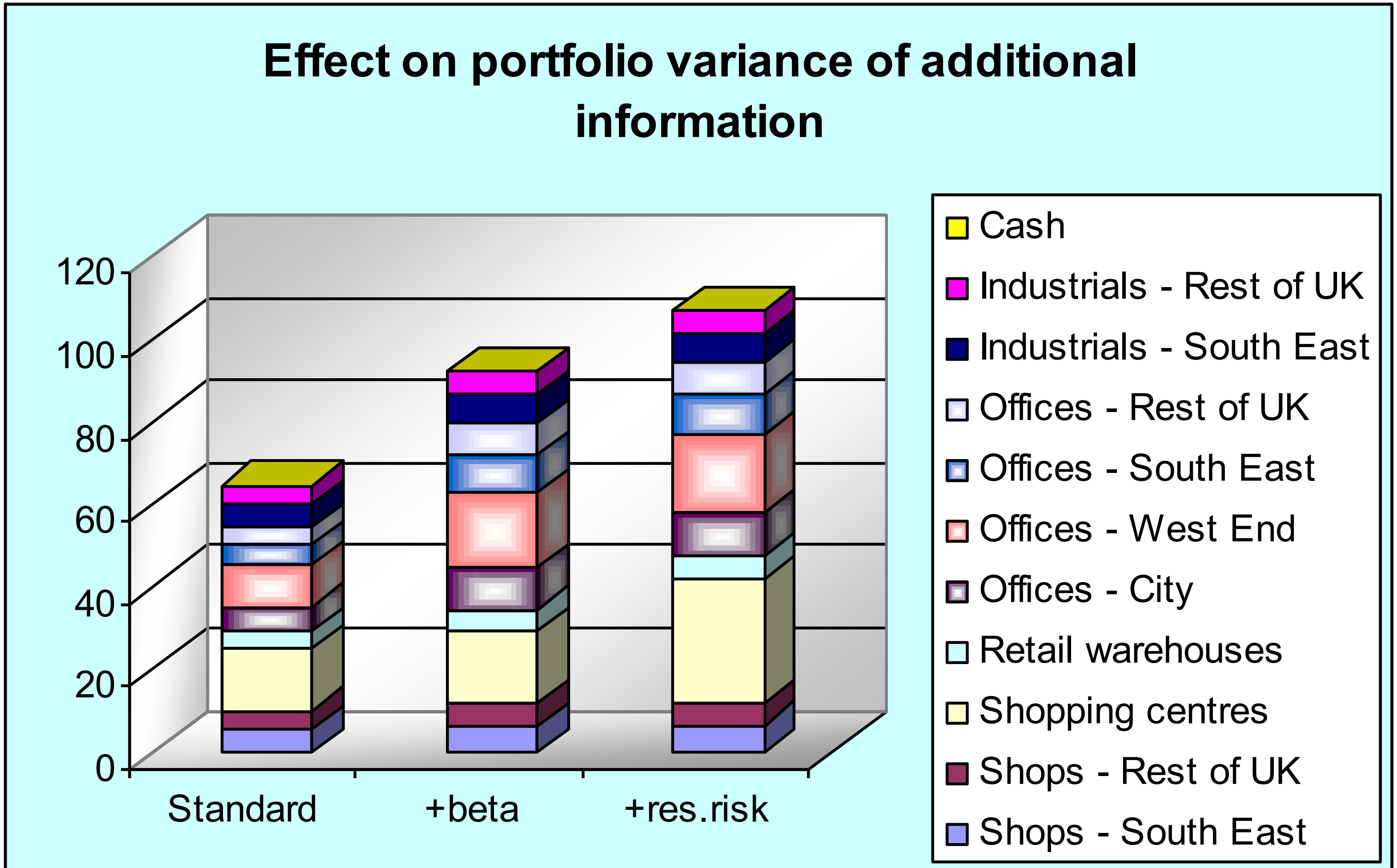
giving $$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I} \Sigma w^2_s \qquad (2)$$

Note that In tracking error space this becomes

$$TE^2_P = \Sigma d_i \beta_i \sigma_I \Sigma d_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I} \Sigma w^2_s \qquad (2b)$$

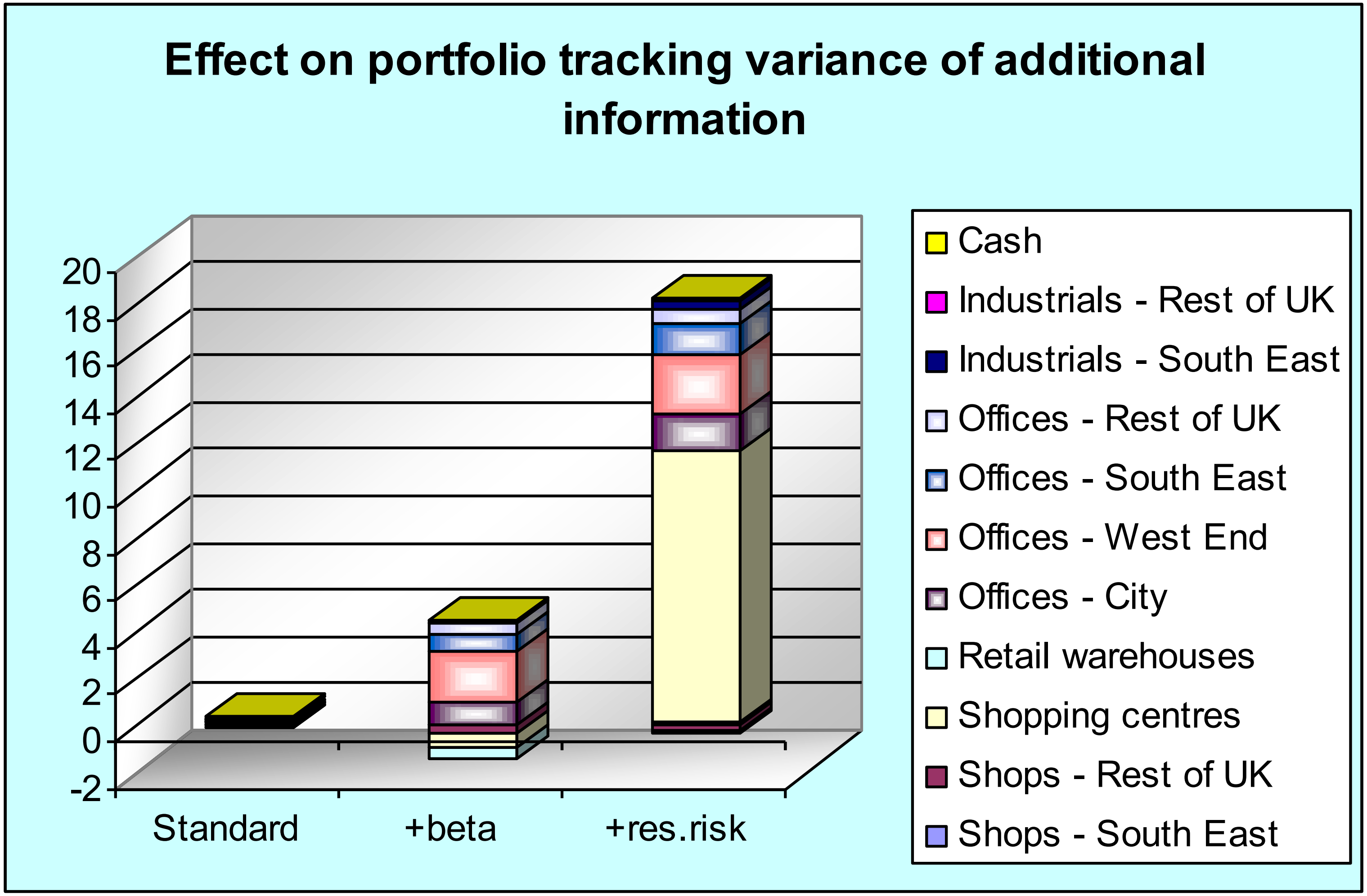
where d_i = weight of i in the portfolio relative to the benchmark

1. Risk analysis
What is the effect on Portfolio Risk ?



1. Risk analysis

What is the effect on Tracking Error ?



1. Risk analysis
When we don't know the full story

This works well enough for risk analysis if each w_s is known. But what if not?

As long as we know the number of holdings in each sector, we can follow Sharpe (1963) and Elton & Gruber (1995+) replacing Σw^2_s with

$$\Sigma(1/N^2_i) = 1/N_i$$

giving

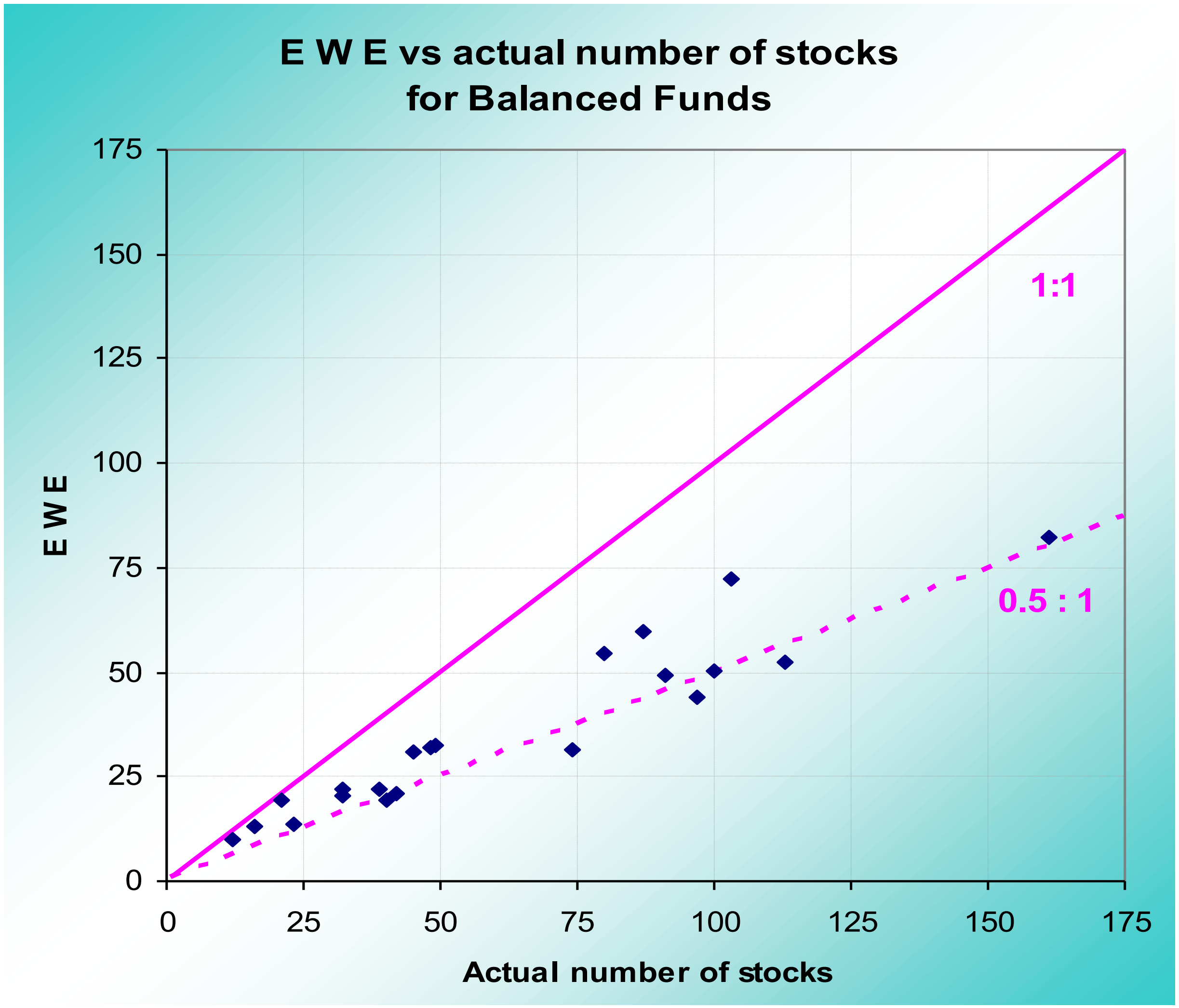
$$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I}/N_i \qquad (3)$$

But would be this be realistic ?

Imagine we have 3 assets, weighted 10%, 20% and 70%, this would give make $\Sigma w^2_s = 0.54$, only as good as 1/.54=1.85 equally weighted assets

Let us call $1/\Sigma w^2_s$ the Equal Weighted Equivalent (EWE), and calculate it for some AREF balanced funds. This is what we find:

1. Risk analysis
Typical fund EWEs



1. Risk analysis
Using the Concentration Ratio

So it looks as if we need to estimate a typical ratio of EWE** to N for each sector. We can do this easily enough by portfolio, manager or industry

We'll call this the Concentration Ratio* or c_i where

$$c_i = EWE_i/N_i$$

So we now have

$$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I}/(c_i N_i) \qquad (4)$$

`

And this will work fine for risk analysis of a given portfolio.

**Beware – this term is used in other ways in other literatures.*
*** See Morrell (1993) and Shuck (2003) for earlier attempts to capture EWE*

2. Asset allocation
Is it the same as risk analysis ?

But what about asset allocation ?

For allocating to a set of *indirect* funds, we'll usually know Σw^2_s for each fund, but we can use $c_i N_i$ when and if we don't

But for allocating to *direct* sub-portfolios, we don't have a hope of knowing each w_s until we've worked how much we are going to put into that sector.

So it looks as if we'll have to use N_i or $c_i N_i$

Let's try N_i for now.

How can we get that ?

2. Asset allocation
Using a linear risk term to solve for N_i

$$N_i = w_i V_P / h_{\mu i}$$

So it is a function of

- w_i = the proportion of the portfolio invested in sub-portfolio i
- V_p = the £ value of the portfolio as a whole
- $h_{\mu i}$ = the (mean) £ lot size of assets in i.

We know V_P and can get a fix on $h_{\mu i}$, but w_i is what we are solving for ! Somehow we need to allow for this. Let us define

$$u_i = h_{\mu i} / V_P$$

then $$N_i = w_i / u_i$$

and $$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I} / (w_i / u_i)$$

$$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w_i \xi^2_{\mu I} . u_i \qquad (5)$$

We can solve for N_i at the same time as w_i by including this linear term.

2. Asset allocation
The Concentration Ratio again

This is nice, because using N_i like this implies that all stocks are equally weighted within the sector, and theoretically this is optimal.

But sadly the real world steps in with two issues:

1. Even if we have real estate managers who are convinced quants, their hands are tied:

   not all shops and shopping centres are created equal

   so we need to bring back our concentration ratio, giving

$$\sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w_i \xi^2_{\mu I} . u_i / c_i \qquad (6)$$

2. Asset allocation
Value Creep

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2. Value Creep. As the £ value of a (sub-)portfolio goes up, so does the lot size h_i managers like to use – less work, so quite rational. We can model this

by $\quad h_i = a_i h_{\mu i} + b_i w_i V_P$

so $\quad 1/N_i = (a_i h_{\mu i} + b_i w_i V_P)/(w_i V_P)$

$\quad = a_i u_i/w_i + b_i$ or $(a_i u_i/w_i + b_i)/c_i$

giving $\quad \sigma^2_P = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w^2_i \xi^2_{\mu I}.(au_i/w_i + b_i)/c_i$

$\quad = \Sigma w_i \beta_i \sigma_I \Sigma w_j \sigma_J \rho_{I,J} + \Sigma w_i \xi^2_{\mu I} u_i.a_i/c_i + \Sigma w^2_i \xi^2_{\mu I}.b_i/c_i$

(7)

So we now have a further term, this time quadratic but at least diagonal.

If there is no value creep, $a_i = 1$ and $b_i = 0$, and the term drops out, bringing us back to (6); or, if equal weighted, back to (5).

3. Specimen results
The data and 2 hypotheses

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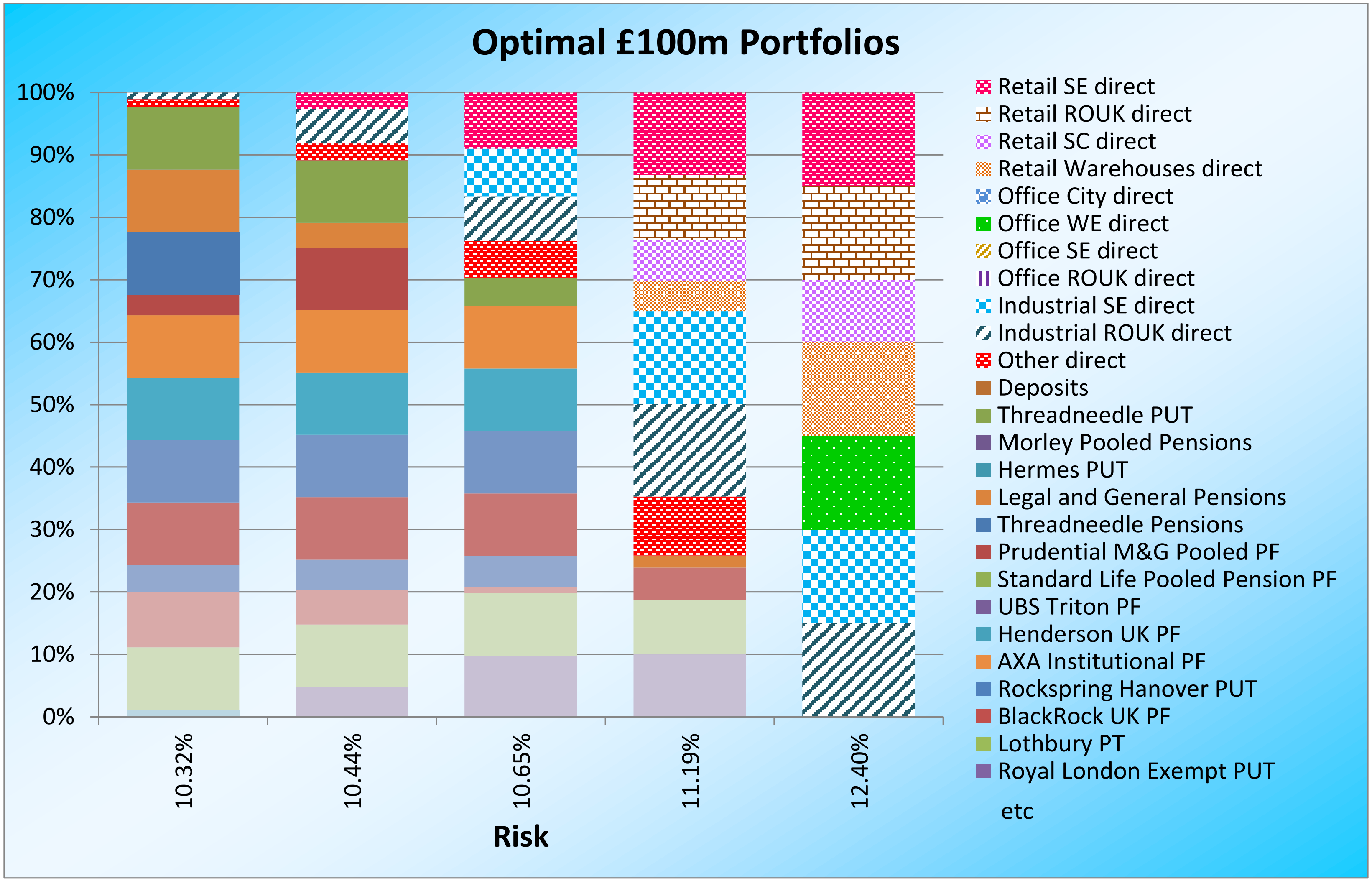
- The Data
  - The IPD monthly, quarterly and annual databases (1981-2010)
  - Individual IPD/IPF property risk data from Callender, Devaney and Sheahan 2007 (based on data 1995-2004)
  - The IPD AREF fund database
  - Assume 0.5% annual fee on managed funds, but no alpha or tracking error ie they perform in line with their sector weighting

- The Hypotheses
  1. LOW VALUE portfolios will tend to go for INDIRECT funds, which are themselves large and diversified, especially at the bottom of the frontier, even if the return net of fees is lower, while HIGH VALUE portfolios will go for DIRECT PROPERTY
  2. LOW VALUE portfolios will avoid HIGH LOT SIZE-size sectors like shopping centres, while HIGH VALUE portfolios will hold them according to their other merits

3. Specimen results

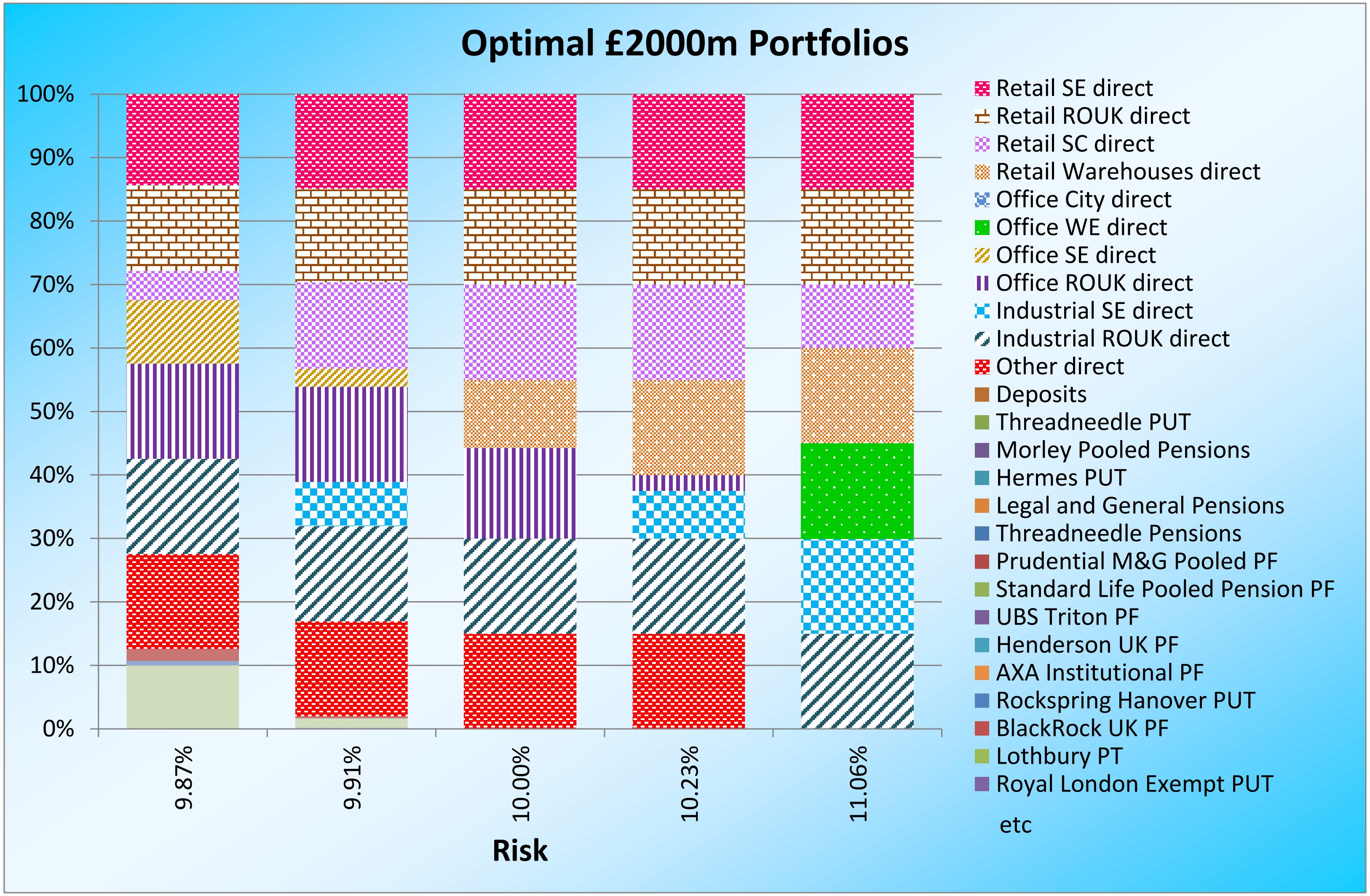
Case 1a: £100m portfolio, up to 15% in any sector

Indirect property is unhatched, direct hatched



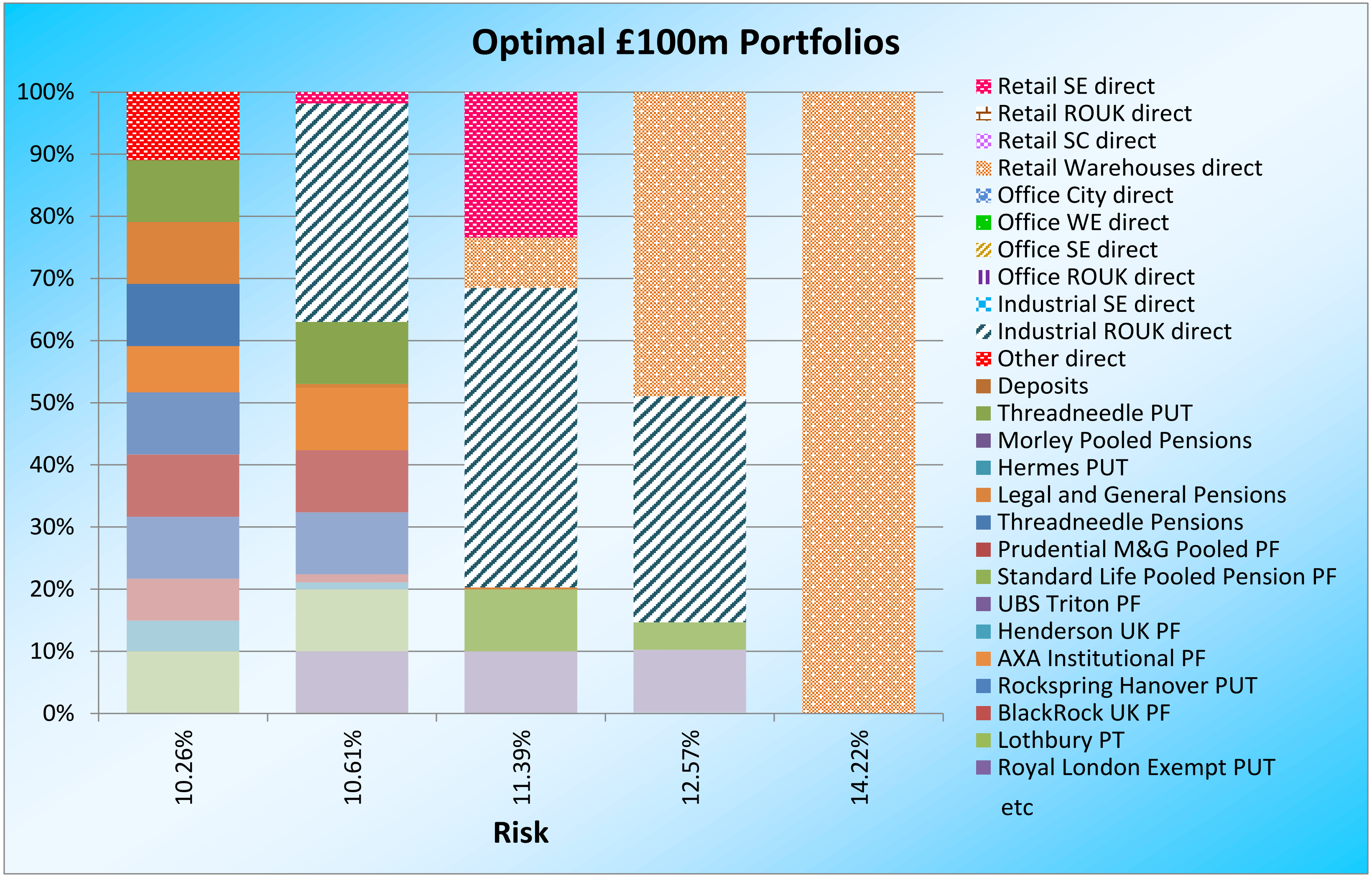
3. Specimen results

Case 1b: £2,000m portfolio, up to 15% in any sector



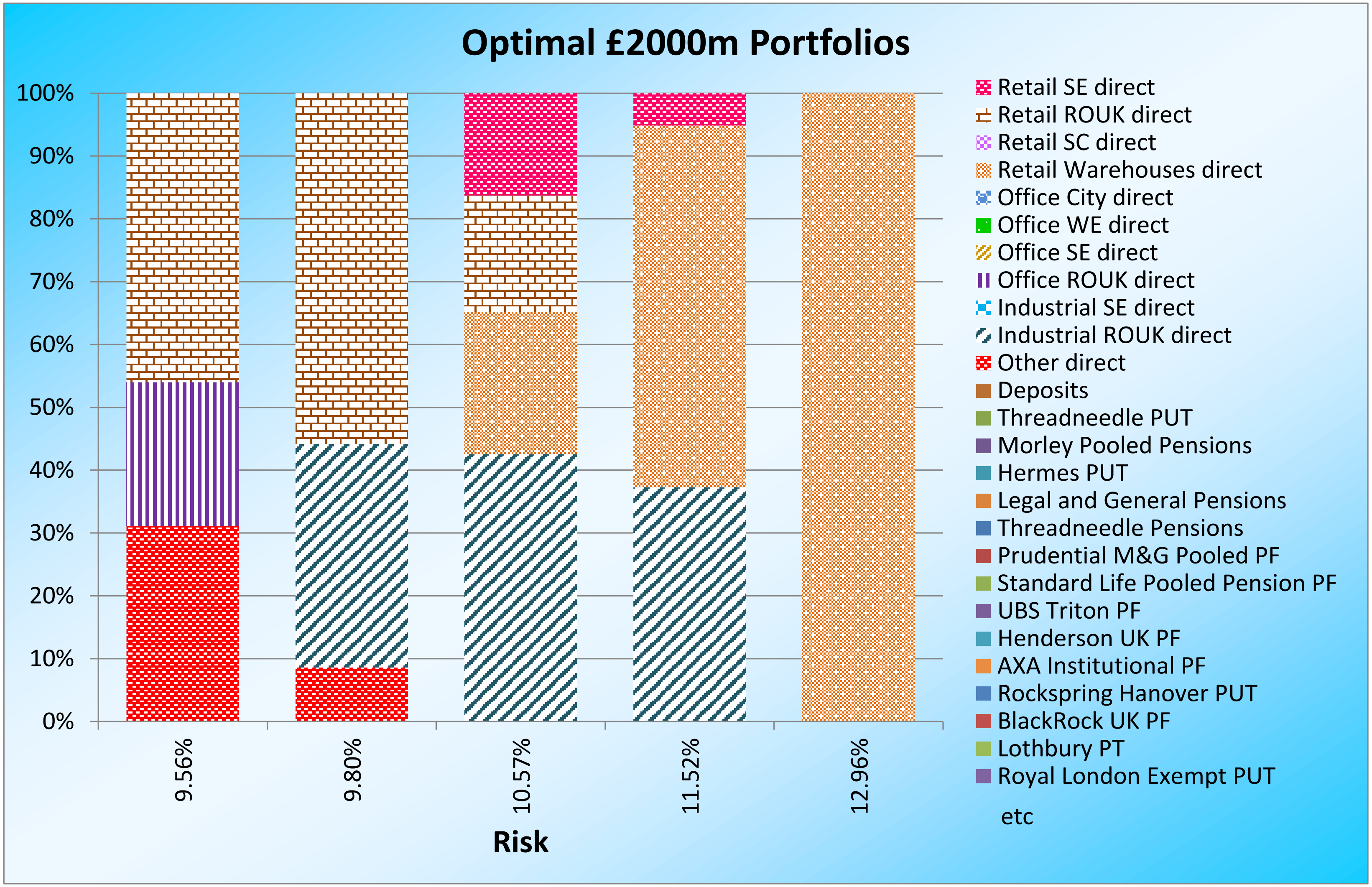
3. Specimen results

Case 2a: £100m portfolio, up to 100% in any sector

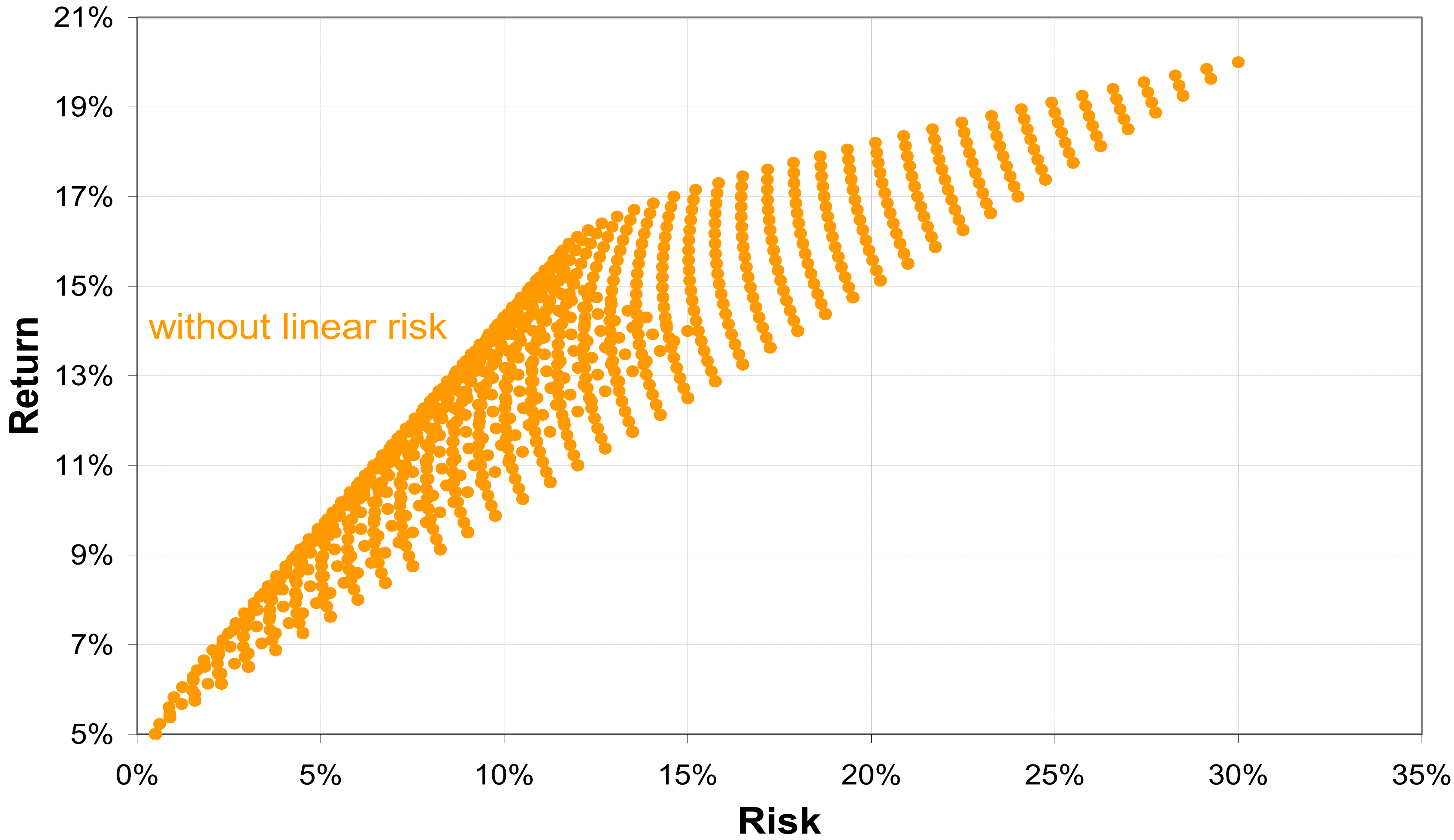


3. Specimen results

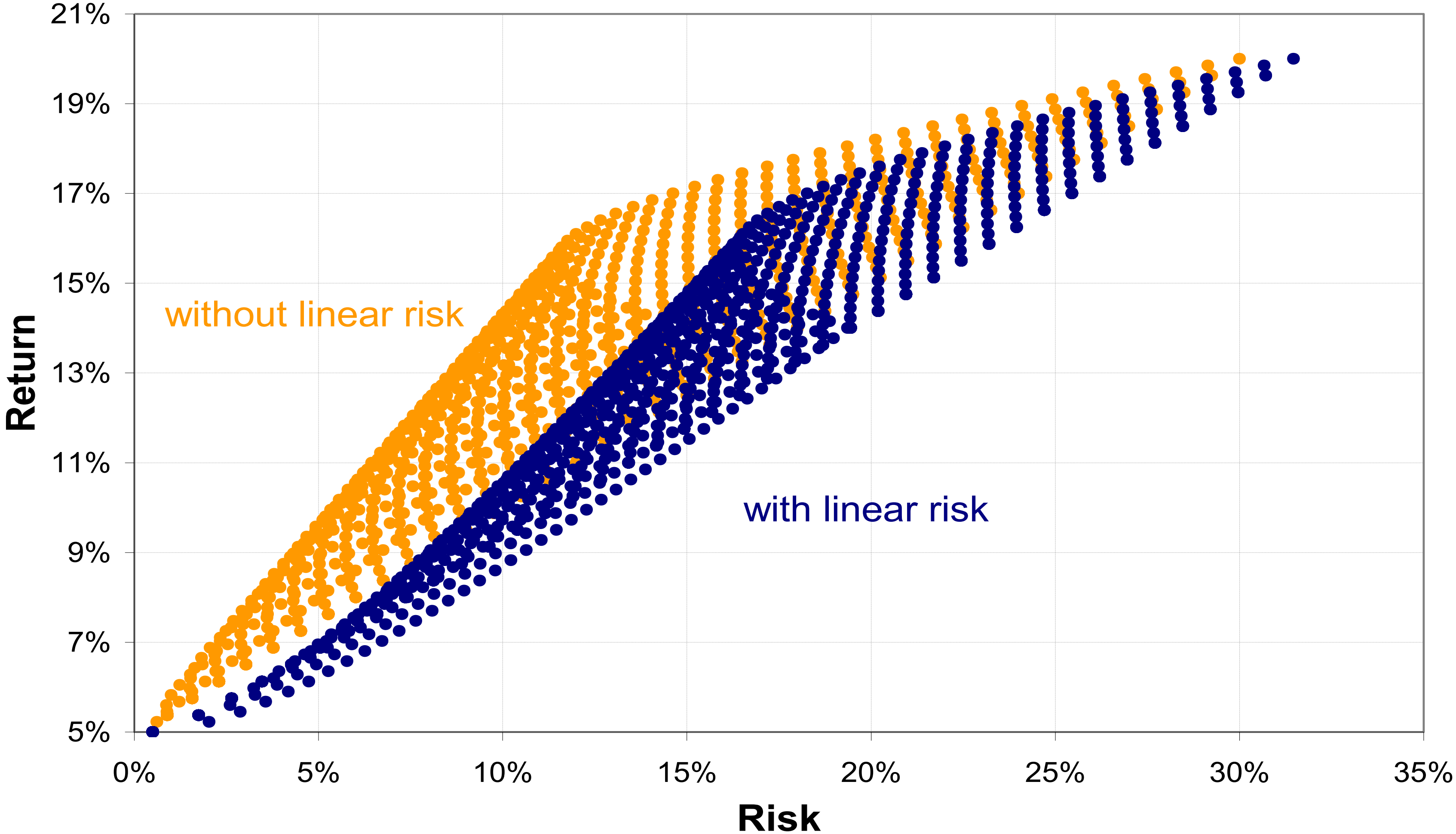
Case 2b: £2,000m portfolio, up to 100% in any sector



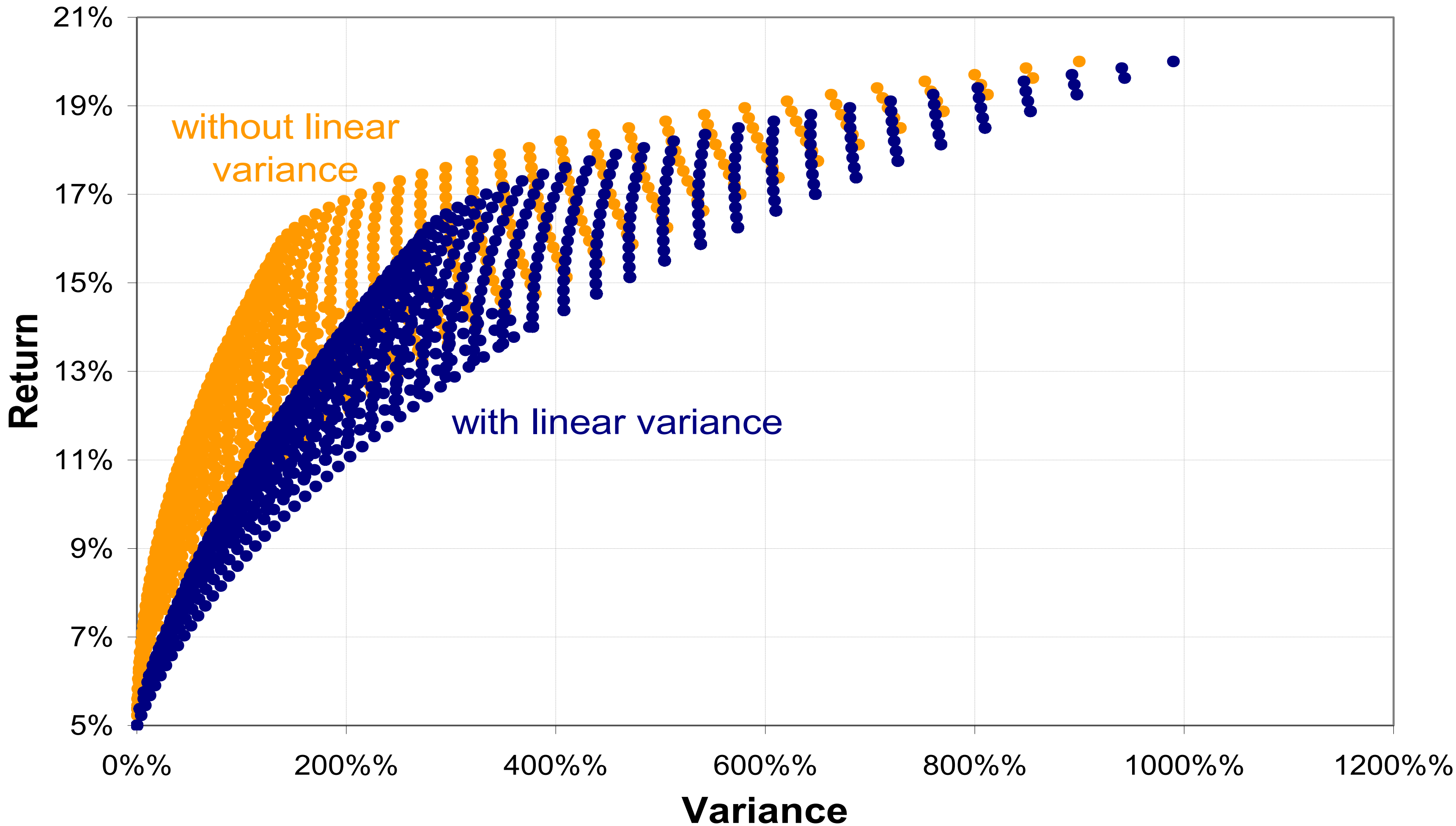
4. The New Frontier
Without linear risk



4. The New Frontier
...and with...



4. The New Frontier
No, its not impossible...



5. Conclusion and Lessons

- The Markowitz frontier is a special cases
  - maybe the additional terms have other applications

- Portfolio size increases diversification potential
  - Lot size reduces diversification potential

- Small portfolios require significant alpha to make Direct worthwhile
  - especially if they are over-concentrated

- Much better to hold an indirect stake in a fund
  - even if it has negative alpha
  - provided management fees are reasonable !

- What can Property teach us ?
  - The same applies to not-so-high-net-worth investors in equities etc

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