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# Managing Sector and Issuer Risk and Alpha in Credit Portfolios Using DTS

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# Managing Alpha Expectations

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- How much alpha is expected from an actively managed credit portfolio?
- How much alpha is expected to be generated by active exposures to:
  - Duration?
  - Overall portfolio credit exposure?
  - Industries?
  - Issuers?
  - Out-of-benchmark asset classes?
- Is the amount of alpha expected in line with portfolio risk constraints along each of these dimensions?
- Is there a formal process to review this periodically given changes in the market environment?
- A structured process for managing the active risk and expected alpha of a credit portfolio could be useful in several different contexts:
  - Internal discussions of portfolio strategy within a management firm
  - Mandate design by a plan sponsor
  - As a basis for continued dialog between manager and investor about the relationship between risk controls and active alpha opportunities

# Goals

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- Design a structured process for managing the active risk and expected alpha of a credit portfolio, given:
  - The current spread environment
  - Manager skill
  - Risk constraints imposed by investment policy
- Use DTS exposures to measure and manage risk at all levels:
- Bottom-up – estimate portfolio risk when portfolio contents are known in detail
- Top-down – build a more abstracted model to help establish management style to target risk and return at each level
- Issues to address:
  - How to tie out between top-down and bottom-up approaches
  - Interactions among different levels
  - Estimation of model parameters

# Targeting Portfolio Risk and Return

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- Ideal: plan portfolio targets for risk and return from different types of active return
- For example:

|                          | Overall<br>Credit<br>Exposure | Credit<br>Sector<br>Rotation | Issuer<br>Selection | Total |
|--------------------------|-------------------------------|------------------------------|---------------------|-------|
| Expected Alpha (bp/year) | 6.0                           | 6.9                          | 9.8                 | 22.7  |
| TEV (bp/year)            | 17.3                          | 17.3                         | 21.9                | 32.9  |
| Annualized IR            | 0.35                          | 0.40                         | 0.45                | 0.69  |

- How can we arrive at such an estimate that:
  - Is based on the DTS framework
  - Uses a simple set of inputs
  - Ties out with typical portfolio practice
  - Is realistic about achievable outperformance and not just wishful thinking?

Source: Barclays Research

# Building Blocks

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- Fundamental Law of Active Management
- DTS
- Multi-Factor Risk Models

# The Fundamental Law of Active Management

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- In *Active Portfolio Management* (McGraw Hill, 2000) Grinold and Kahn show that the information ratio (IR) achievable from active returns can be expressed as

where

$$IR \approx IC \times \sqrt{Breadth}$$

IC (information coefficient) = correlation of predicted and realized returns

Breadth = the number of independent active decisions per year

- But since IR is simply the active return  $\alpha$  per unit of tracking error volatility (TEV),

$$\alpha \approx TEV \times IC \times \sqrt{Breadth}$$

- In our research on risk budgeting, we have defined skill based on directional views: 0% skill gives a 50% chance of a correct forecast, 100% skill would be always correct, and thus 10% skill would result in a hit ratio of 55%.
- When using this definition of skill (excess hit ratio) rather than IC, we have shown that the IR approximation becomes

$$IR \approx \sqrt{\frac{2}{\pi}} \times Skill \times \sqrt{Breadth}$$

- In this presentation, we will overlook this distinction, and ignore the scaling constant (which is about 0.8) to keep the numerical example more intuitive

# DTS Paradigm Shift: From Absolute to Relative Spread Change

- Return due to spread change

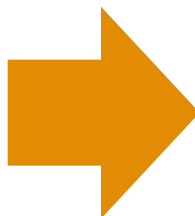
$$R = -D \cdot \Delta S$$

- Volatility of return

$$\sigma_{return} \cong D \cdot \sigma_{spread}^{absolute}$$

- Measure of exposure to absolute change in spread is contribution to duration

$$w_i \cdot D_i$$



- Return due to spread change

$$R = -D \cdot S \cdot \frac{\Delta S}{S}$$

- Volatility of return

$$\sigma_{return} \cong D \cdot S \cdot \sigma_{spread}^{relative}$$

- Measure of exposure to relative change in spread is contribution to duration times spread (DTS)

$$w_i \cdot D_i \cdot S_i$$

Source: Barclays Research

# A Simple Numeric Example

## Using DTS to estimate risk for some typical credit exposures

| Characteristics                          | Inputs | Exposures and Estimated Risks |           |        |
|--|--------|-------------------------------|-----------|--------|
|  |        | Portfolio                     | Benchmark | Active |
| Duration (years):                        | 5.0    |                               |           |        |
| Spread (bp):                             | 100    |                               |           |        |
| Individual Issuer Exposure               |        |                               |           |        |
| MV Weight (%):                           |        | 2.0%                          | 1.0%      | 1.0%   |
| DTS Contribution ( $w * D * S$ ):        |        | 10.0                          | 5.0       | 5.0    |
| Vol. of Rel. Spread Change (%/month):    | 10%    |                               |           |        |
| Contrib. to Exc. Return Vol. (bp/month): |        | 1.0                           | 0.5       | 0.5    |
| Sector Exposure                          |        |                               |           |        |
| MV Weight (%):                           |        | 30.0%                         | 25.0%     | 5.0%   |
| DTS Contribution ( $w * D * S$ ):        |        | 150.0                         | 125.0     | 25.0   |
| Vol. of Rel. Spread Change (%/month):    | 5%     |                               |           |        |
| Contrib. to Exc. Return Vol. (bp/month): |        | 7.5                           | 6.25      | 1.25   |

Source: Barclays Research



# Dimensions of Portfolio Breadth

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- How many independent strategies are at play in the portfolio?
  - We use three: Overall credit exposure; Sector rotation; Issuer selection
- At each level, how many independent decisions are being made?
- How frequently are these decisions revisited? (What is the horizon of the view?)

| Quantity                                    | Symbol             | Overall | Sector | Issuer |
|---|--------------------|---------|--------|--------|
| Typical number of active positions          | N                  | 1       | 4      | 250    |
| Typical Size of Active Positions (%MW)      | w                  | 10.0%   | 10.0%  | 1.0%   |
| Average Holding Period (months)             | T                  | 1       | 3      | 6      |
| Breadth (num. independent decisions / year) | $B=N*12/T$         | 12      | 16     | 500    |
| Assumed Skill (Excess Hit Ratio)            | Skill              | 10%     | 10%    | 2%     |
| Annualized Information Ratio (IR)           | $Skill * \sqrt{B}$ | 0.35    | 0.40   | 0.45   |

Source: Barclays Research

# Projecting Portfolio Active Risk and Return

- At each level, assume that we have N independent exposures of the specified size, rebalanced at the specified horizon, to achieve a certain breadth
- Risk (TEV) of each exposure is approximated using DTS (assuming D=5, S=100)
- The expected alpha is projected based on the Fundamental Law, from assumed skill
- Alphas sum to total of 22.7 bp/year, TEVs combine (sum of squares law) to 32.9 bp/y, so total portfolio IR is 0.69

| Quantity                                    | Formula                      | Overall | Sector | Issuer |
|---|------------------------------|---------|--------|--------|
| Typical Size of active position (%MW)       | w                            | 10.0%   | 10.0%  | 1.0%   |
| Typical size of active position (CntDTS)    | $w * D * S$                  | 50      | 50     | 5      |
| Relative spread volatility (monthly)        | $\sigma$                     | 10%     | 5%     | 8%     |
| Contrib TEV per exposure (CntTEV, bp/month) | $\text{CntDTS} * \sigma$     | 5       | 2.5    | 0.4    |
| Assumed Skill (Excess Hit ratio)            | Skill                        | 10%     | 10%    | 2%     |
| Breadth (num. independent decisions / year) | $N * 12/T$                   | 12      | 16     | 500    |
| Annualized IR                               | $\text{Skill} * \sqrt{B}$    | 0.35    | 0.40   | 0.45   |
| Annualized TEV (bp/year)                    | $\text{CntTEV} * \sqrt{12N}$ | 17.3    | 17.3   | 21.9   |
| Expected Alpha (bp/year)                    | $\text{IR} * \text{TEV}$     | 6.0     | 6.9    | 9.8    |

Source: Barclays Research

# Setting Model Parameters: Practical Considerations

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- Are the three levels of active exposures (overall, sector, issuer) truly independent? How can we make sure we are not double-counting risk (and alpha)?
  - Views at each level must be expressed relative to higher levels
  - Sector active weights are views on relative spread change vs. the market
  - Issuer active weights are views on relative spread changes vs. the sector
  - Volatilities of sector-specific and issuer-specific relative spread changes will depend on the details of the sector partition
    - Finer partitions => more sector risk, less issuer risk
- In reality, our active positions do not fit the neat model of N exposures of equal DTS contribution. How do we set model parameters to reflect this?

# Breaking Down Excess Return Volatility

## How much is systematic? How much is issuer-specific?

- Cross-sectional regression analysis helps attribute monthly excess returns of index issuers to systematic factors and idiosyncratic returns
- Various regression specifications can be used, with only one market factor, or multiple industry factors. Issuers are weighted according to their index market value contribution.
- Regression betas can be interpreted as the systematic monthly relative spread changes of the market as a whole or of different sub-sectors of the index

### Single Market Factor:

$$ER_i = F_{market} \cdot DTS_i + \varepsilon_i$$

### $n$ Industry Factors:

$$ER_i = \sum_j F_{industry(i)=j} \cdot DTS_i + \varepsilon_i$$

- One can compare the explanatory power of a single factor model (overall market) with multiple factor models (industry-specific) to assess the attractiveness of granular sector allocation vs. timing entire market performance

# Separating Sector Risk from Overall Credit Market Risk

- We carry out regressions of excess return vs. DTS each month using either a 1-factor model (entire market), or a sector model using 3 or 9 industry cells
- This gives us monthly estimates of systematic relative spread change (by industry)
- To measure the extent of sector spread change **not** linked to market spread change, we subtract the market estimate from each sector-specific one
- The below example illustrates how this technique augments the 3-factor model into a 4-factor model that includes a market effect together with industry-specific ones
- We can then calculate volatilities and correlations for each model (and similarly, for our 9-factor model which can be augmented to a 10-factor one)

| 1-Factor Model |        |      | 3-Factor Model |       |       |      | 4-Factor Model (3 plus market) |       |       |      |
|----------------|--------|------|----------------|-------|-------|------|--------------------------------|-------|-------|------|
| Date           | Market | R-Sq | Ind            | Util  | Fin   | R-Sq | Market                         | Ind   | Util  | Fin  |
| Jun-17         | 4.7%   | 0.70 | 4.4%           | 4.4%  | 5.5%  | 0.71 | 4.7%                           | -0.3% | -0.3% | 0.7% |
| Jul-17         | 3.4%   | 0.37 | 2.1%           | 7.3%  | 6.1%  | 0.49 | 3.4%                           | -1.3% | 3.9%  | 2.7% |
| Aug-17         | -7.3%  | 0.74 | -7.6%          | -5.0% | -6.7% | 0.74 | -7.3%                          | -0.3% | 2.2%  | 0.6% |
| Sep-17         | 9.2%   | 0.89 | 9.4%           | 4.2%  | 9.4%  | 0.90 | 9.2%                           | 0.2%  | -5.0% | 0.2% |
| Oct-17         | 2.4%   | 0.20 | 1.4%           | 6.0%  | 4.9%  | 0.30 | 2.4%                           | -1.0% | 3.6%  | 2.5% |
| Nov-17         | 0.0%   | 0.00 | -0.4%          | -0.2% | 1.4%  | 0.04 | 0.0%                           | -0.4% | -0.1% | 1.4% |

Source: Barclays Research

# Separating Sector Risk from Overall Credit Market Risk

- We show the volatilities and correlations for the 3-factor and 4-factor models
- For the 3-factor model, the average relative spread volatility is 11.2%, and the average correlation between sectors is 71%
- In the 4-factor model, with the common market factor taken out:
  - Average sector-specific volatility is 5.7%
  - Average correlation between sectors is -14%
  - Average correlation of sector-specific risk with market is -21%

## 3-Factor Model, Jan 1994 – Nov 2017 (Relative Spread Changes by Industry)

| Factor Volatilities |                  | Correlation Matrix |      |      |      |
|---------------------|------------------|--------------------|------|------|------|
|                     | Volat.<br>(%/mo) |                    | Ind  | Util | Fin  |
| Industrials         | 10.4%            | Industrials        | 100% | 71%  | 75%  |
| Utilities           | 11.2%            | Utilities          | 71%  | 100% | 66%  |
| Financials          | 11.9%            | Financials         | 75%  | 66%  | 100% |

## 4-Factor Model, Jan 1994 – Nov 2017 (Relative Spread Changes by Industry Relative to Market)

| Factor Volatilities |                  | Correlation Matrix |        |      |      |      |
|---------------------|------------------|--------------------|--------|------|------|------|
|                     | Volat.<br>(%/mo) |                    | Market | Ind  | Util | Fin  |
| Market              | 10.9%            | Market             | 100%   | -31% | -34% | 3%   |
| Industrials         | 4.3%             | Industrials        | -31%   | 100% | 27%  | -65% |
| Utilities           | 8.2%             | Utilities          | -34%   | 27%  | 100% | -4%  |
| Financials          | 4.5%             | Financials         | 3%     | -65% | -4%  | 100% |

Source: Barclays Research

# Volatilities and Correlations Using a Finer Industry Partition

## 10-Factor Model, Jan 1994 – Nov 2017 (Relative Spread Changes by Industry Relative to Market)

| Factor Volatilities |                  | Correlation Matrix |        |        |        |      |         |        |        |           |         |         |
|---------------------|------------------|--------------------|--------|--------|--------|------|---------|--------|--------|-----------|---------|---------|
|                     | Volat.<br>(%/mo) |                    | Market | BasInd | CapGds | Cycl | NonCycl | ComTec | Energy | Utilities | Banking | Finance |
| Market              | 10.9%            | Market             | 100%   | -37%   | -55%   | -26% | -57%    | -26%   | -47%   | -34%      | -4%     | 0%      |
| Basic Ind           | 7.8%             | Basic Ind          | -37%   | 100%   | 50%    | 46%  | 57%     | 23%    | 68%    | 31%       | -5%     | 6%      |
| Cap Goods           | 5.6%             | Cap Goods          | -55%   | 50%    | 100%   | 39%  | 63%     | 50%    | 55%    | 27%       | -5%     | -2%     |
| Cyclical            | 5.3%             | Cyclical           | -26%   | 46%    | 39%    | 100% | 43%     | 32%    | 45%    | 43%       | -31%    | -6%     |
| Non-Cycl            | 6.8%             | Non-Cycl           | -57%   | 57%    | 63%    | 43%  | 100%    | 27%    | 65%    | 37%       | -2%     | 10%     |
| ComTech             | 5.8%             | ComTech            | -26%   | 23%    | 50%    | 32%  | 27%     | 100%   | 18%    | 21%       | -30%    | -36%    |
| Energy              | 6.3%             | Energy             | -47%   | 68%    | 55%    | 45%  | 65%     | 18%    | 100%   | 40%       | 10%     | 24%     |
| Utilities           | 8.2%             | Utilities          | -34%   | 31%    | 27%    | 43%  | 37%     | 21%    | 40%    | 100%      | -12%    | 11%     |
| Banking             | 4.9%             | Banking            | -4%    | -5%    | -5%    | -31% | -2%     | -30%   | 10%    | -12%      | 100%    | 39%     |
| Finance             | 5.2%             | Finance            | 0%     | 6%     | -2%    | -6%  | 10%     | -36%   | 24%    | 11%       | 39%     | 100%    |

Source: Barclays Research

# Effect of Using a Finer/Coarser Sector Partition

- Using a finer industry partition to define market sectors results in:
  - More risk explained by sector factors
  - Less risk defined as idiosyncratic (issuer-specific)
- But – this effect is relatively small
- In recent periods, a single market factor has captured a large portion of risk

## Avg. Relative Spread Vol. by Level, Using different models, Jan 1994 – Nov 2017

|               | 1 Market<br>Factor | Market plus<br>3 Sectors | Market plus<br>9 Sectors |
|---------------|--------------------|--------------------------|--------------------------|
| Market        | 10.9%              | 10.9%                    | 10.9%                    |
| Sectors       |                    | 5.7%                     | 6.2%                     |
| Idiosyncratic | 7.8%               | 7.3%                     | 6.9%                     |
| Total         | 13.4%              | 14.3%                    | 14.3%                    |
| R-Sq          | 0.54               | 0.62                     | 0.66                     |

## Avg. Relative Spread Vol. by Level, Using different models, Calibrated to different time periods

|               | Pre-Crisis: Jan94 - Apr07 |                          |                          | Crisis & Recovery: May 07 - Dec09 |                          |                          | Post-Crisis: Jan10 - Nov 17 |                          |                          |
|---------------|---------------------------|--------------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|-----------------------------|--------------------------|--------------------------|
|               | 1 Market<br>Factor        | Market plus<br>3 Sectors | Market plus<br>9 Sectors | 1 Market<br>Factor                | Market plus<br>3 Sectors | Market plus<br>9 Sectors | 1 Market<br>Factor          | Market plus<br>3 Sectors | Market plus<br>9 Sectors |
| Market        | 9.5%                      | 9.5%                     | 9.5%                     | 18.8%                             | 18.8%                    | 18.8%                    | 9.3%                        | 9.3%                     | 9.3%                     |
| Sectors       |                           | 5.7%                     | 6.0%                     |                                   | 8.9%                     | 10.4%                    |                             | 3.0%                     | 3.9%                     |
| Idiosyncratic | 8.0%                      | 7.8%                     | 7.3%                     | 11.5%                             | 9.9%                     | 9.5%                     | 6.1%                        | 5.7%                     | 5.5%                     |
| Total         | 12.5%                     | 13.6%                    | 13.4%                    | 22.0%                             | 23.0%                    | 23.5%                    | 11.1%                       | 11.3%                    | 11.5%                    |
| R-Sq          | 0.48                      | 0.60                     | 0.68                     | 0.51                              | 0.59                     | 0.61                     | 0.77                        | 0.81                     | 0.85                     |

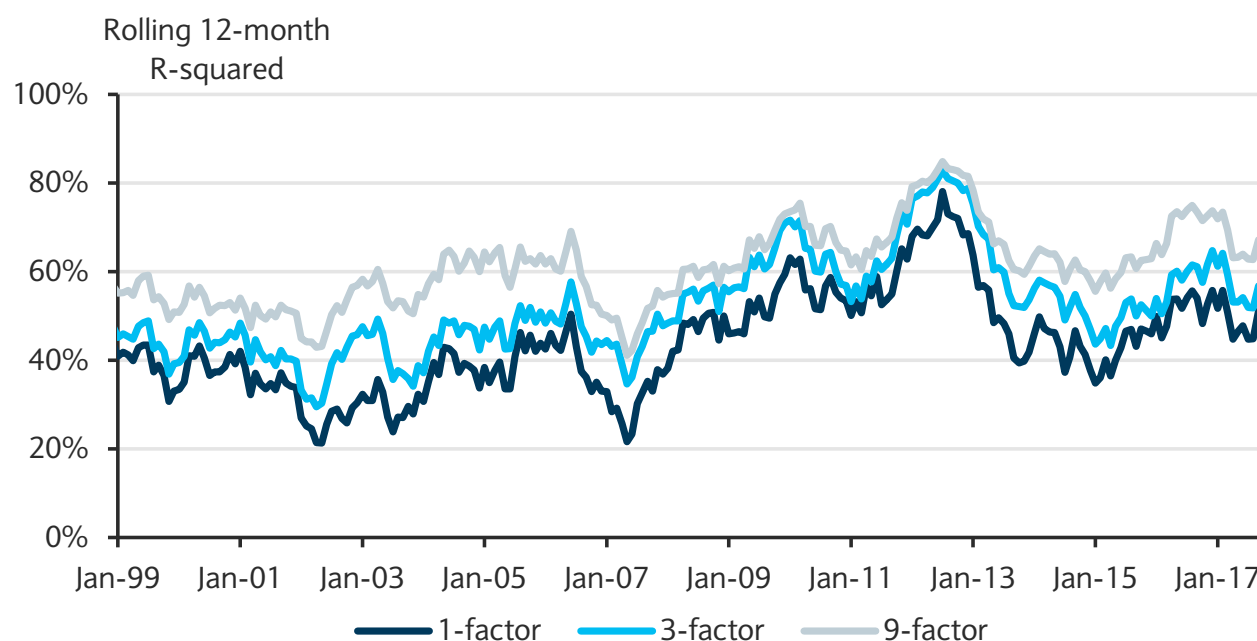
Source: Barclays Research



# Effect of a Finer Partition Varies Over Time

- The importance of a finer industry partition depends on the market environment
- In some periods (risk-on / risk-off) a single factor has captured almost all market risk
- Since 2014, the finer 9-sector partition has helped add explanatory power

## Rolling 12-month average R-squared for one-, three- and nine-industry factor models



Source: Barclays Research

Reference: [Time Dynamics of Credit Active Returns](#), Barclays Research, 27 May 2014

# Finding the Effective Number of Issuers

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- The effective number of active issuer positions (breadth) will depend on:
  - How many issuers are there in the universe?
  - How different are the sizes of the active exposures? More unequal => lower breadth
- We can estimate the breadth of the active issuer exposures by comparing its exposures to an idealized portfolio with a given breadth B
- Assume we have B active exposures, each having an active DTS contribution with the same magnitude z

- The sum of the absolute values of the DTS exposures will be simply Bz

- The root-mean-square total DTS exposure will be

$$\sqrt{\sum_{i=1}^B z^2} = \sqrt{Bz^2} = \sqrt{B}z$$

- The ratio of these two quantities will thus be simply  $\frac{\text{Sum\_Abs\_DTS\_Exp}}{\text{RMS\_DTS\_Exp}} = \sqrt{B}$

- For any actual portfolio, we can calculate these two statistics of active weights, and estimate breadth as

$$\hat{B} = \left( \frac{\text{Sum\_Abs\_DTS\_Exp}}{\text{RMS\_DTS\_Exp}} \right)^2$$

# Finding the Effective Number of Issuers - Example

- We illustrate this procedure on a sample portfolio, which we create as follows:
  - Benchmark: Bloomberg Barclays US IG Corporate Index (728 tickers total)
  - Portfolio: EW portfolio of top 100 tickers from this universe by MV
  - We measure the active weights (as contributions to DTS) to all 728 tickers
  - We calculate the two statistics of the active DTS exposures as of 30 Nov 2017:
    - SumExp = Sum of absolute values of active DTS contributions
    - RMS\_Exp = Root mean square net exposure
  - This portfolio has 100 issuer positions with weights of 1% each (mostly overweights) plus another 628 small underweights to benchmark names not in the portfolio; below we find that approximate breadth is 178.

| Quantity   | Symbol / Formula     | Value |
|--|----------------------|-------|
| Total size of active exposures (sum(abs(DTS Contrib.)) | SumExp               | 846.2 |
| Net DTS exposure of active positions (sqrt(sumsq))     | RMS_Exp              | 63.5  |
| Ratio  | SumExp / RMS_Exp     | 13.3  |
| Implied Breadth if positions were equal-DTS            | $B = \text{Ratio}^2$ | 177.6 |
| Implied avg position size (active DTS exp) per issuer  | SumExp / B           | 4.76  |

Source: Barclays Research

# Pulling it All Together

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- To come up with a top-down model of portfolio risk and alpha-generation, we thus need to pull in information from different sources:
  - A bottom-up analysis of our portfolio – can be used to establish an estimate of the breadth of active issuer (or industry) positions
  - A risk-modeling exercise – can be used to estimate relative spread volatilities at different levels (market, industry, issuer)
  - Historical analysis of manager track record – via portfolio performance attribution or direct analysis of prior forecasts (hit ratio, information coefficient) – to measure skill in different dimensions
  - Knowledge of the portfolio management process – what is the typical holding period for active weights at different levels (overall, industry, issuer)?
  - Current market spread levels
    - All else equal, a lower spread environment will bring lower risk and lower potential for alpha
    - This framework offers a way to form a top-down estimate of how potential changes in the management process (size and number of active exposures) can impact the expected alpha within a given spread environment

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