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

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Managing Alpha Expectations

- 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

- 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

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

	Overall Credit Exposure	Credit Sector Rotation	Issuer 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

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

The Fundamental Law of Active Management

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

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

where

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 α 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

- 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)	σ	10%	5%	8%
Contrib TEV per exposure (CntTEV, bp/month)	CntDTS * σ	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	Skill * $\sqrt{B}$	0.35	0.40	0.45
Annualized TEV (bp/year)	CntTEV * $\sqrt{12N}$	17.3	17.3	21.9
Expected Alpha (bp/year)	IR * TEV	6.0	6.9	9.8

Source: Barclays Research

Setting Model Parameters: Practical Considerations

- 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	
	Volat. (%/mo)
Industrials	10.4%
Utilities	11.2%
Financials	11.9%

Correlation Matrix			
	Ind	Util	Fin
Industrials	100%	71%	75%
Utilities	71%	100%	66%
Financials	75%	66%	100%

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

Factor Volatilities	
	Volat. (%/mo)
Market	10.9%
Industrials	4.3%
Utilities	8.2%
Financials	4.5%

Correlation Matrix				
	Market	Ind	Util	Fin
Market	100%	-31%	-34%	3%
Industrials	-31%	100%	27%	-65%
Utilities	-34%	27%	100%	-4%
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

	Volat. (%/mo)
Market	10.9%
Basic Ind	7.8%
Cap Goods	5.6%
Cyclical	5.3%
Non-Cycl	6.8%
ComTech	5.8%
Energy	6.3%
Utilities	8.2%
Banking	4.9%
Finance	5.2%

Correlation Matrix

	Market	BasInd	CapGds	Cycl	NonCycl	ComTec	Energy	Utilities	Banking	Finance
Market	100%	-37%	-55%	-26%	-57%	-26%	-47%	-34%	-4%	0%
Basic Ind	-37%	100%	50%	46%	57%	23%	68%	31%	-5%	6%
Cap Goods	-55%	50%	100%	39%	63%	50%	55%	27%	-5%	-2%
Cyclical	-26%	46%	39%	100%	43%	32%	45%	43%	-31%	-6%
Non-Cycl	-57%	57%	63%	43%	100%	27%	65%	37%	-2%	10%
ComTech	-26%	23%	50%	32%	27%	100%	18%	21%	-30%	-36%
Energy	-47%	68%	55%	45%	65%	18%	100%	40%	10%	24%
Utilities	-34%	31%	27%	43%	37%	21%	40%	100%	-12%	11%
Banking	-4%	-5%	-5%	-31%	-2%	-30%	10%	-12%	100%	39%
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 Factor	Market plus 3 Sectors	Market plus 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

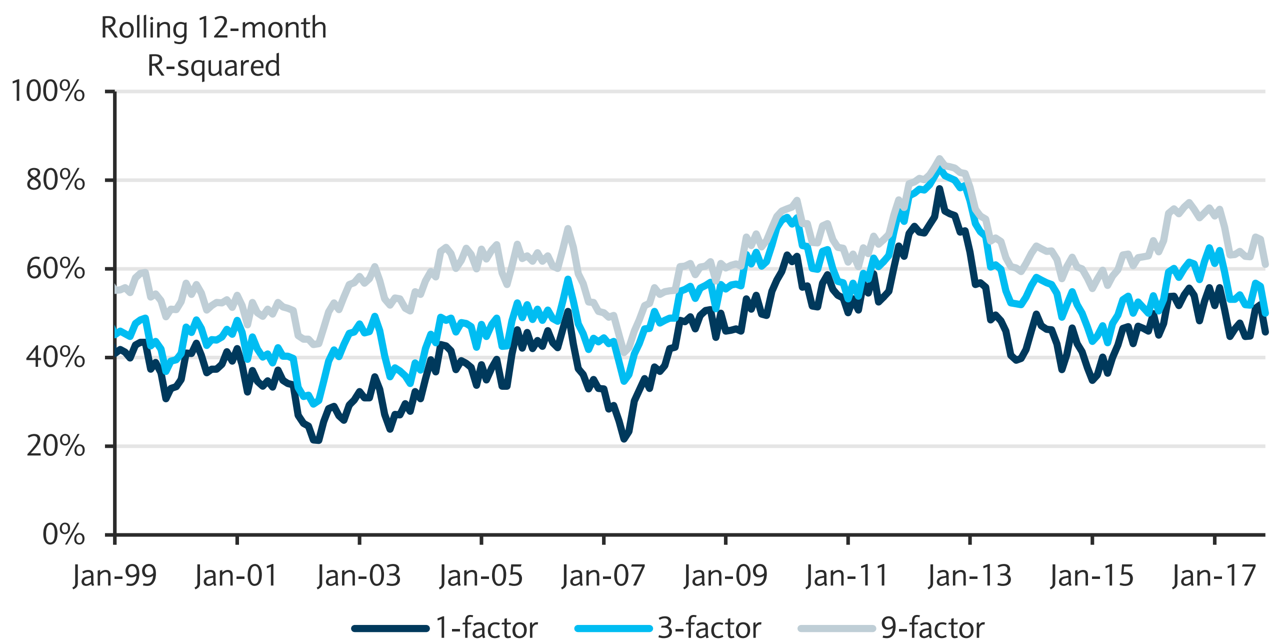
	Pre-Crisis: Jan94 - Apr07			Crisis & Recovery: May 07 - Dec09			Post-Crisis: Jan10 - Nov17		
	1 Market Factor	Market plus 3 Sectors	Market plus 9 Sectors	1 Market Factor	Market plus 3 Sectors	Market plus 9 Sectors	1 Market Factor	Market plus 3 Sectors	Market plus 9 Sectors
Market	9.5%	9.5%	9.5%	18.8%	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

- 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 $\frac{Sum\_Abs\_DTS\_Exp}{RMS\_DTS\_Exp} = \sqrt{B}$
- For any actual portfolio, we can calculate these two statistics of active weights, and estimate breadth as

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

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	$B=Ratio^2$	177.6
Implied avg position size (active DTS exp) per issuer	SumExp / B	4.76

Source: Barclays Research

Pulling it All Together

- 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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