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Quantitative Portfolio Strategy
Research

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Defining a Credit Mandate Without a Benchmark

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Motivation

- Market-weighted benchmarks are inefficient
- QPS has proposed a number of ideas for outperforming a credit benchmark:
  - Avoiding prolific issuers (and sectors)
  - Downgrade tolerance – avoid forced selling of fallen angels
  - Credit selection – according to various signals (ESP, EMC, SPiDER)
- How can a plan sponsor specify an investment policy for such a portfolio mandate?
  - Active mandate – give manager discretion to deviate from MW benchmark
    - If performance is measured vs. benchmark, might still have bias to large issuers
    - Manager may have more freedom than desired
  - Passive mandate against customized benchmark
    - Difficult to formulate alternative benchmark by hard-and-fast rules
    - Even for alternative benchmark, rules may lead to inefficient behavior
  - Is there an alternative?
- QPS was engaged by an official sector institution with a large endowment to review a proposal for defining such a mandate and help evaluate the portfolio return dispersion that could be expected

Defining a passive mandate without a benchmark - Goals

- Performance
  - Enable manager to run a “more efficient” credit portfolio
- Passive
  - If several portfolios are run independently by different managers, we would like their returns to be similar – need to impose constraints
- Manager discretion
  - Constraints should allow managers room for sector allocation, issuer selection
  - Rules should not force excessive portfolio turnover
  - Managers should not be required to hold unreasonable allocations

- These goals contradict each other to some extent
- Need to find balance

Example Guidelines for a G3 Corporate Bond Mandate

Investment universe	• IG intermediate corporate bonds • Denominated in USD, EUR, or GBP
Interest rate exposure	• Overall duration target +/- tolerance • USD contribution: target +/- tolerance • EUR contribution: target +/- tolerance
Currency exposure	• No active FX risk – hedged back to base currency • Maximum drift tolerance allowed to any other currency
Sector limitations	• Maximum allocation to each corporate sector
Overall credit exposure	• Overall spread duration: target +/- tolerance • USD contribution: target +/- tolerance • EUR contribution: target +/- tolerance
Credit quality	• Average numeric rating target +/- tolerance
Issuer diversification	• Maximum exposure for issuers rated Aa and above • Maximum exposure to issuers rated A • Maximum exposure to issuers rated Baa and below
Downgrade tolerance	• Downgrades to HY allowed up to % of portfolio MV • Allowed grace period for liquidation of HY bonds over limit
Derivatives	• FX forwards allowed for currency hedging • Interest rate derivatives allowed to adjust duration • No other derivatives allowed

Challenges in Designing the Guidelines

- Target levels
  - Could specified target levels (for duration, quality, allocation to financials) become unrealistic as markets evolve?
  - How would choice of a given target level have affected performance?
- Permitted ranges around target levels:
  - If too tight:
    - More likely to have problems in evolving markets
    - Risk of forcing turnover to stay within target ranges
  - If too loose:
    - Increased manager discretion – more active than passive
- How can we measure how much active risk is allowed within a given set of constraints?

Estimating the Performance Dispersion Achievable

- Model the main sources of risk in the portfolio: rates, spreads, etc.
- What is the maximum deviation in any dimension?
- How much tracking error volatility might be expected as a result?
  - In terms of difference from (assumed) target?
  - Between any two compliant portfolios?
- We construct a simple risk model and use it to estimate tracking error volatility:

$$TEV^2 = \text{Active Risk Exposure} * \text{Covariance Matrix} * \text{Active Risk Exposure}$$

A One-dimensional Example:

- Duration target: 4 years +/- 0.25
- Assume portfolio A duration is 3.75 and portfolio B duration is 4.25
- For each portfolio, active risk exposure is (+/-) 0.25
- Rates vol is estimated at approximately 25 bp/month or 87 bp/year
- Estimated TEV (relative to the target duration) ≈ 0.25 * 87 ≈ 22 bp/year
- Estimated TEV (between portfolios A and B) ≈ 0.5 * 87 ≈ 44 bp/year

Example: Estimating TEV of a Long-Duration Tilt

- We model a long-duration tilt of 0.25
- Specific assumptions:
  - Implemented by overweight to long-duration bonds and underweight short duration
  - Duration tilt goes across all three currencies
  - Overweight to long credits brings a DTS overweight to credit as well

Factor Name	Exposure Unit	Factor	Target Exposure	Deviation	Final Exposure
USD 6M	KRD	**dYield, %**	0.05	0.00	0.04
USD 2Y	KRD	**dYield, %**	0.55	-0.05	0.50
USD 5Y	KRD	**dYield, %**	1.11	0.07	1.18
USD 10Y	KRD	**dYield, %**	0.66	0.14	0.80
EUR 6M	KRD	**dYield, %**	0.03	0.00	0.02
EUR 2Y	KRD	**dYield, %**	0.37	-0.03	0.34
EUR 5Y	KRD	**dYield, %**	0.74	0.05	0.79
EUR 10Y	KRD	**dYield, %**	0.30	0.07	0.37
GBP 6M	KRD	**dYield, %**	0.00	0.00	0.00
GBP 2Y	KRD	**dYield, %**	0.05	0.00	0.04
GBP 5Y	KRD	**dYield, %**	0.10	0.01	0.10
GBP 10Y	KRD	**dYield, %**	0.04	0.01	0.05
USD Fin	DTS	**ER/DTS**	0.62	0.05	0.67
USD NFin	DTS	**ER/DTS**	0.98	0.10	1.09
EUR Fin	DTS	**ER/DTS**	0.35	0.02	0.37
EUR NFin	DTS	**ER/DTS**	0.49	0.05	0.53
GBP Fin	DTS	**ER/DTS**	0.06	0.00	0.07
GBP NFin	DTS	**ER/DTS**	0.08	0.01	0.09
		Sum USD KRD	2.37	0.15	2.52
		Sum EUR KRD	1.43	0.09	1.52
		Sum GBP KRD	0.19	0.01	0.20
		Sum Fin DTS	1.03	0.08	1.11
		Sum Non-Fin DTS	1.55	0.16	1.71
		Sum KRD	3.99	0.25	4.24
		Sum DTS	2.59	0.24	2.83
		StDev(%/yr)	**2.33**	**0.20**	**2.51**

Source: Barclays Research

Example: Specifying Allowable Risk Exposures

Category	Target	Allowed Deviation
Overall Duration	4.00	0.25
USD Contrib. OAD	2.40	0.25
EUR Contrib. OAD	1.40	0.25
GBP Contrib. OAD	0.20	0.25
Overall OASD	4.00	0.50
USD Contrib. OASD	2.40	0.50
EUR Contrib. OASD	1.40	0.50
GBP Contrib. OASD	0.20	0.50
Allocation to Financials	0.30	0.10
Average Num. Quality	8.00	0.50
MW to Baa equivalent to AvgNumQual target:	*46%*	
Benchmark MW to Baa as of given date:	*48%*	
Issuer Limits By Quality:		
Aaa-Aa	2.5%	
A	1.5%	
Baa	1.0%	

Source: Barclays Research

Modeling Extreme Active Risks Along Multiple Dimensions

- Portfolios are assumed to take extreme positions along different dimensions
- To stress test just how different portfolios can be from each other, we assume that each portfolio pushes each risk dimension to one extreme or the other

Examples of Extreme Allowed Portfolio Tilts in Different Dimensions

Risk Dimension	Example
Duration (all currencies)	Duration +0.25
Duration (single currency)	EUR Duration +0.25
Market Tilt	USD corp + 20%
Industry Tilt	Financials - 20%
Credit Quality	Avg Quality Up 0.5 Notch

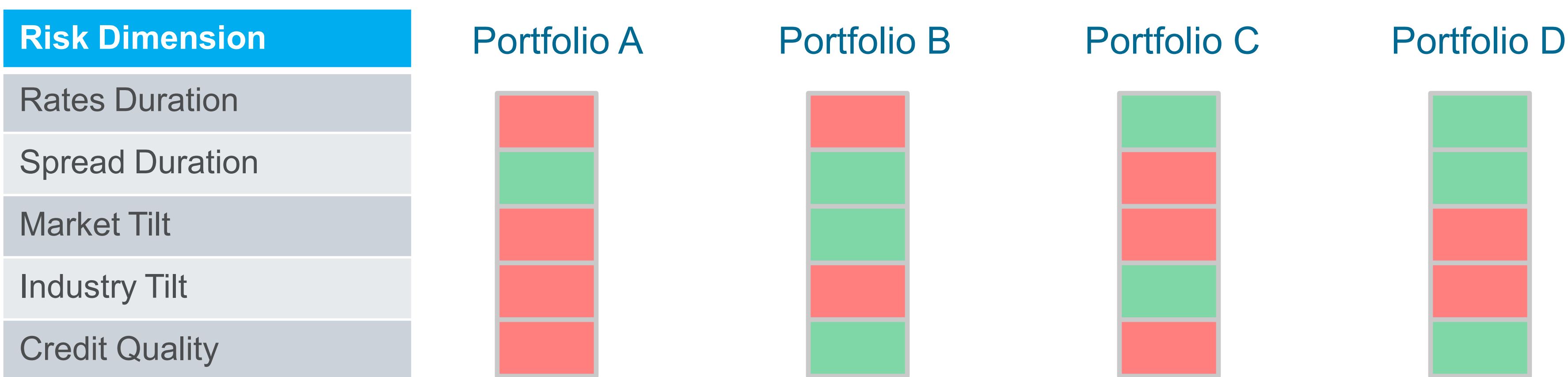
Source: Barclays Research

Modeling Multiple Dimensions of Active Risk

- We generate multiple portfolios that take extreme risks in several dimension
- In below illustration, green cells are overweights and red cells underweights (max allowed)
- We examine all different permutations of maximal risk exposures in different dimensions
- We estimate the overall risk for each portfolio, as well as the pairwise tracking error volatility (TEV) between any two portfolios
- We measure the distributions of these TEV numbers
- Median risk between 2 portfolios is 41 bp/year

Projected Distributions of TEV Across Extreme Portfolios (%/year)

Percentile	Single Tilt	Pairwise TEV
10%	0.15	0.22
25%	0.26	0.29
50%	**0.31**	**0.41**
75%	0.47	0.55
90%	0.59	0.80



Source: Barclays Research

Modeling Idiosyncratic Risk

- We estimate idiosyncratic risk based on a model of downgrade risk ("Sufficient Diversification in Credit Portfolios", Barclays Research, 14 December 2010)
- Key inputs:
  - Realized historical downgrade rates, by quality (e.g. from Moody's)
  - Realized historical excess returns of bonds prior to downgrade, by quality
  - "Natural" issuer-specific spread volatility
  - Specified issuer limits, by quality
- For a portfolio structured in this way, we estimate non-syst. risk is 61 bp/year
- Non-systematic risk between 2 such portfolios (with no overlap) is 86 bp/year ($\times \sqrt{2}$)

Modelling Non-Systematic Return Volatility for a Portfolio of N Issuers

Credit Quality Rating	AAA to AA	A	BAA	Total
Percent of Portfolio By Market Weight	8.3%	45.8%	45.9%	100.0%
Limit on any Single Position	2.50%	1.50%	1.00%	
Number of bonds to buy	4	31	46	81
Non-systematic Risk for one Portfolio	1.48%	0.81%	1.02%	0.61%

Source: Barclays Research

Estimating Overall Portfolio Risk (Dispersion)

- We combine systematic and idiosyncratic risk to form a total risk projection
- Systematic exposures used “worst case” assumptions for differences among portfolios; not so for idiosyncratic risk
- By this estimate, the dispersion of portfolio returns due to flexibility in allowed exposures to systematic risk exposures is less than idiosyncratic risk
- This is true even for the portfolio pairs that are most different
- Conclusion – portfolios compliant with such a mandate can be expected to earn similar returns – within about 1%/year of each other

Summary of Projected Portfolio Return Dispersion Subject to Mandate Constraints

Summary of Risk Measures as of January 2018

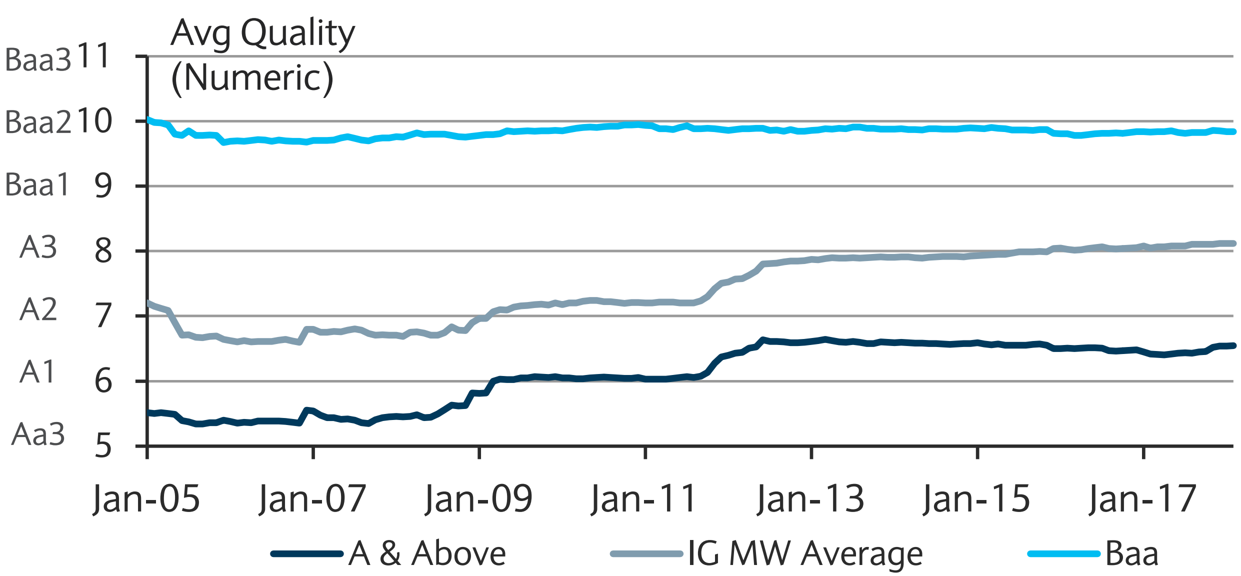
	Systematic	Non-Systematic	Total
Typical TEV of one portfolio (%/y)	0.31	0.61	0.68
Extreme TEV for one portfolio (%/y)	0.59	0.61	0.85
Typical pair-wise TEV (%/y)	0.41	0.86	0.95
Extreme pair-wise TEV (%/y)	0.80	0.86	1.18

Source: Barclays Research

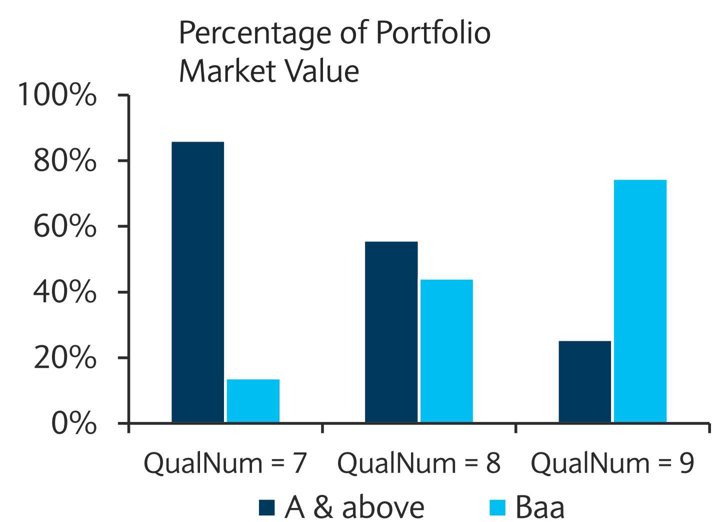
What are “Reasonable” Bounds on Average Credit Quality?

- Availability of bonds in different credit qualities changes over time
- We seek to set quality constraints that would be reasonable in different environments
- Average numeric quality has varied from <7 (better than A2) to >8 (worse than A3)
- To allow flexibility going forward, we might propose that credit quality be limited in the range 7-9 (A2 through Baa1) …
- However – this range reflects a huge difference in portfolio composition!

Evolution of Quality in MW Benchmark, 2005-18



Market weights needed to target Average Quality



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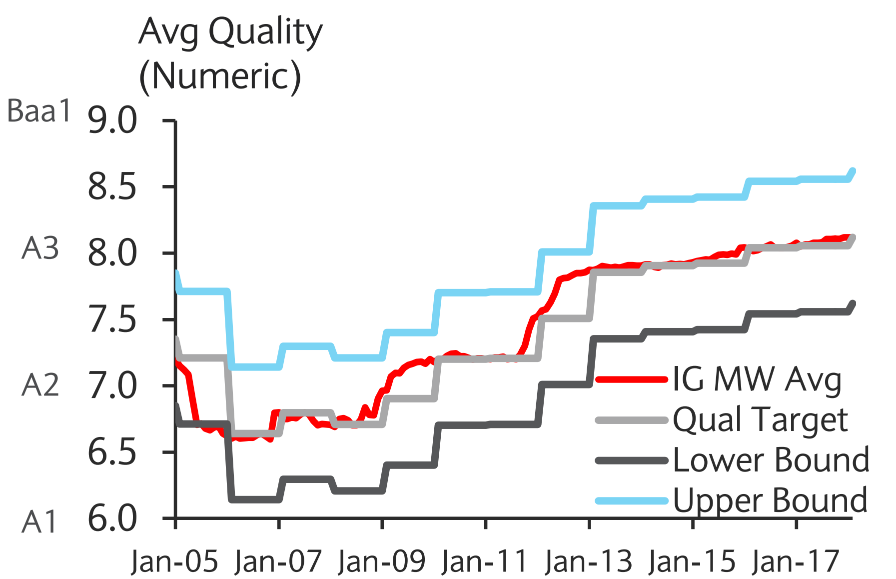
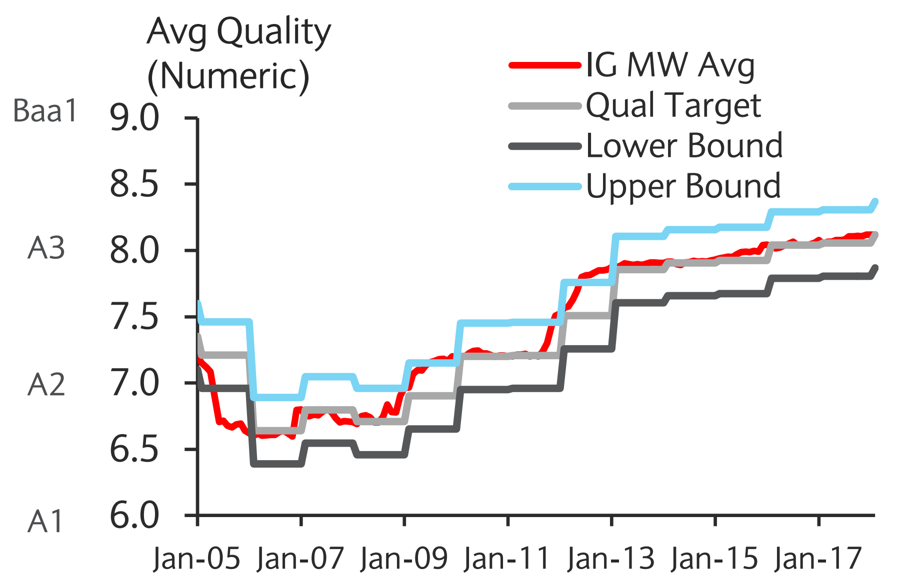
Alternative: Loose tie to index quality via annual reset

- Perhaps imposing a fixed quality target is too restrictive
- Instead of allowing a wide range around a fixed target, we can restrict quality to within a narrower band around a target quality to follow (with a lag) that of a MW index
- Below we illustrate this with a lag of 2 months – reset quality target as of end of February to average index quality as of end of December
- But – index quality can change quickly at times – we can still find that MW index violates the allowed range periodically (which could force portfolio turnover)
- Since 2005, violations occur in 7 months for ½-notch tolerance, 27 months for ¼-notch

Quality Constraint: Target +/- ½ Notch



Quality Constraint: Target +/- ¼ Notch

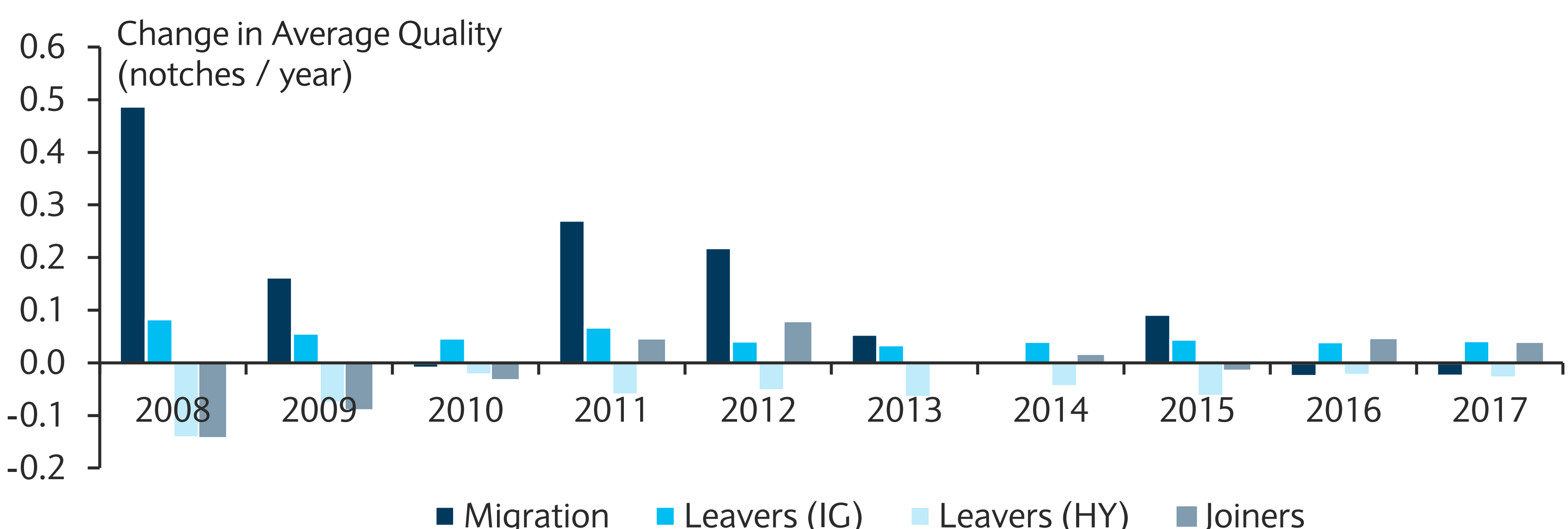


Source: Barclays Research

What Causes Average Index Quality to Change?

- We attribute the annual change in average quality of MW index to four effects:
  - Migration – changes in ratings within the index
  - Leavers (HY) – bonds leaving IG index due to downgrade to HY (Fallen Angels)
  - Leavers (IG) – bonds rated IG leaving index for other reasons (e.g. maturing)
  - Joiners – bonds entering index – mostly newly issued bonds
- We find that the biggest annual changes in index quality have been caused by waves of downgrades within the IG range of credit qualities

Change in Average Index Quality Attributed to Four Effects, 2008-2017



Source: Barclays Research

Setting Limits on Duration Exposure

- Arguments for a tight constraint on duration:
  - Duration exposure is a prime determinant of FI portfolio performance
  - Therefore, a passive mandate should have a clear duration target

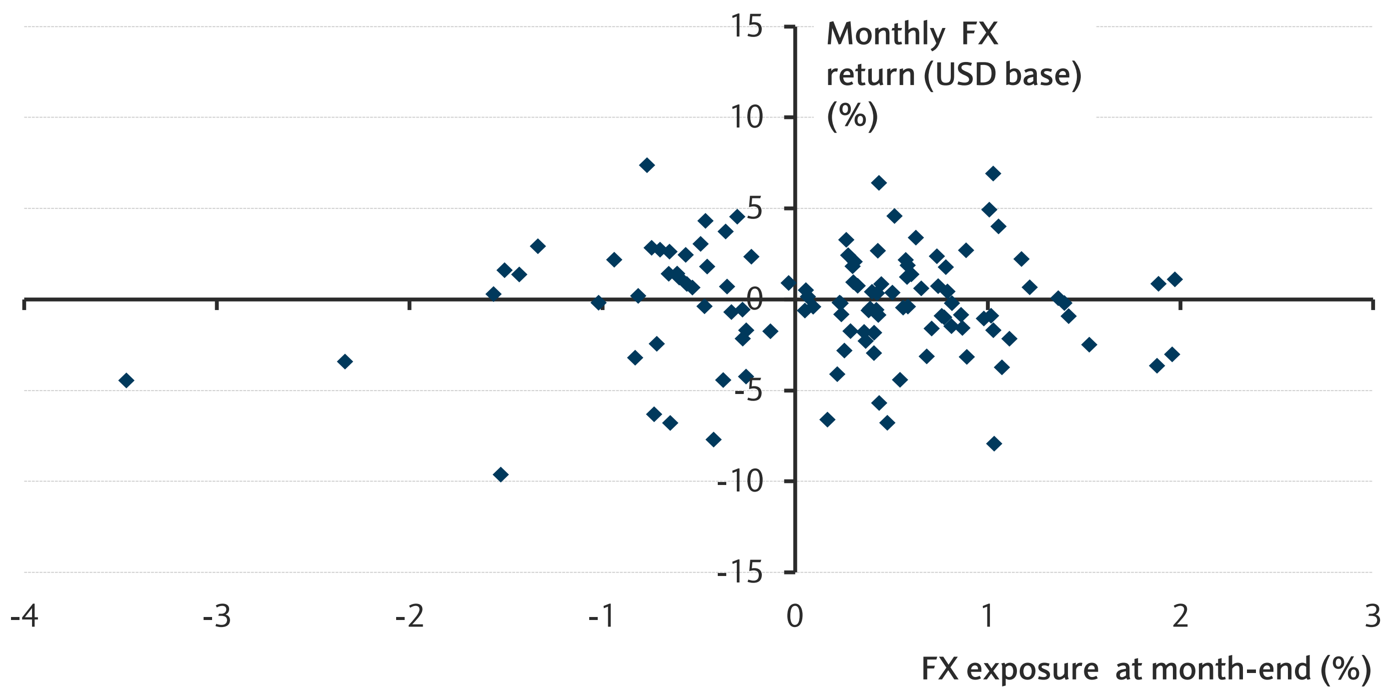
- Arguments for a looser constraint:
  - Portfolio duration is always a dynamic quantity – all bonds shorten as they age
  - Transactions are required to maintain duration at a certain level
  - Forcing duration into too tight a band could require excessive portfolio turnover
  - Especially in a credit portfolio, this can drive up transaction costs

- A possible solution:
  - Allow separate limits for rates duration and spread duration
  - OAD – tight bounds; can be hedged cheaply using futures or swaps
  - OASD – looser bounds; want to avoid forcing excessive credit transactions

Setting Limits on Residual FX Hedging

- FX hedging in global bond portfolios is often managed using 1-month forwards
- Hedging is not perfect: fluctuation in MV leads to residual FX positions
- Index convention of rebalancing FX hedges on a monthly basis can sometimes result in sizeable FX exposures

Residual Exposures and FX Returns for a EUR 1-10Yr Index Hedged to USD, March 2008 – January 2018



Source: Barclays Research

Effect of Constraints on Residual FX Hedging

- A hard constraint on residual FX exposures can reduce currency return risk
- But – it will sometimes require mid-month hedge transactions, increasing hedge cost
- We show how hard limits of 0.5% or 1.0% on currency exposure would affect:
  - The magnitude of currency returns
  - The frequency of required mid-month currency hedge rebalancing
- Note: this study examines one currency at a time, assuming a portfolio with base currency USD invested 100% in securities denominated in either EUR or GBP

Minimum and Maximum 12-month Cumulative Residual Currency Returns, March 2008 – January 2018

	Unconstrained		Cap at 1%		Cap at 0.5%	
	EUR	GBP	EUR	GBP	EUR	GBP
Min (bp)	-13	-28	-12	-20	-10	-11
Max (bp)	37	24	21	18	10	10
Range (bp)	51	52	33	38	20	21
Percentage of months when cap is active:			22%	35%	59%	62%

Source: Barclays Research

Summary: Studying Effects of Investment Policy on Performance

- We have demonstrated in principle how a credit mandate can be specified purely in terms of a set of constraints
- This approach frees managers from the need to “hug the benchmark”, and thus allows them to avoid index inefficiencies
- We have built a framework for measuring both:
  - The risk of making constraints too loose – by estimating maximal dispersion of return among compliant portfolios
  - The cost of making constraints too tight – in terms of frequency of required intervention, and hence increased transaction cost
- We have focused on the tradeoffs involved in constraining risk relating to:
  - Duration
  - Credit Quality
  - Issuer Exposures
  - FX Exposures

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