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Introduction to corporate bond portfolio management

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Beatenberg, 1 September 2003

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Summary of presentation

- Corporate bonds as an asset class
- The case for diversifying into corporate bonds
- Differences between managing corporate and government bonds
- Quantifying market risk in a corporate bond portfolio

Corporate bonds as an asset class

- Corporate bonds are debt obligations issued by corporations to finance their business activities
- Corporate bonds are broadly classified into investment and non-investment grade
- Some corporate bonds have collateral attached to them
- Bonds with collateral are called secured bonds
- Most corporate bonds issued by corporations are debentures
- A debenture is an unsecured debt obligation backed by the issuer's general credit and capacity of its cash flow to repay debt

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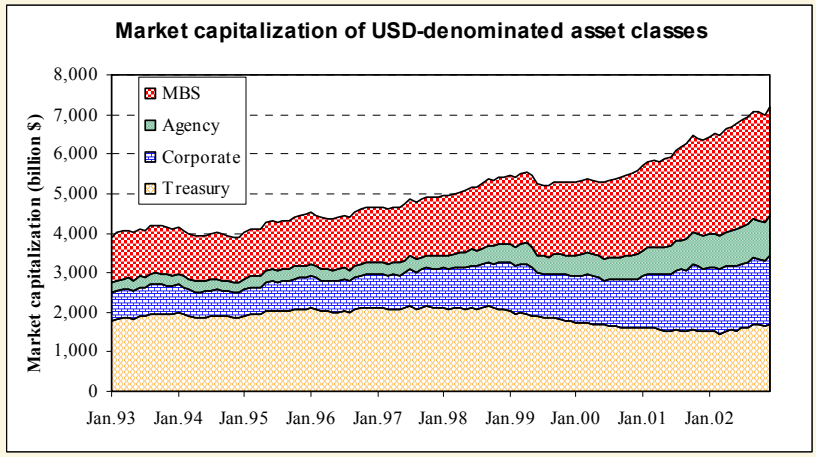
Market capitalization of asset classes (February 2003)

Description	Number of issues	Market cap (USD billion)
Multiverse	11,360	**17,907**
Government	2,212	**9,868**
Treasuries	804	8,088
Agencies	1,408	1,780
Corporate	5,645	**3,410**
Industrial	3,704	1,645
Utility	755	385
Financial Institutions	1,816	1,379
Non-corporate	937	**996**
Sovereign	423	419
Supranational	234	301
Others	280	275
Securitized	2,567	**3,632**
Mortgages	2,401	3,531
Asset Backed	166	101

Source: Lehman Brothers global family of indices



Source: Lehman Brothers global family of indices

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Historical performance (Jan 1973 – Jan 2003)

Description	UST	COR
Annualized return	8.91%	9.01%
Annualized volatility	5.51%	7.58%
Sharpe ratio	0.214	0.169
Probability that annual return is positive	94.50%	85.90%
Conditional expected return if positive	9.83%	11.75%
Probability that annual return in negative	5.50%	14.10%
Conditional expected return if negative	-2.24%	-4.56%

Historical performance (Jan 1975 – Jan 2000)

Description	UST	COR
Annualized return	9.02%	9.83%
Annualized volatility	5.69%	7.77%
Sharpe ratio	0.098	0.176
Probability that annual return is positive	93.75%	87.50%
Conditional expected return if positive	10.27%	12.41%
Probability that annual return is negative	6.25 %	12.50%
Conditional expected return if negative	-2.21%	-4.31%

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The case for corporate bonds

- Changing objectives for reserves management
- Desire to hold larger reserves increases cost
- Return on reserves given greater emphasis to reduce this cost
- This leads to choice of instruments that have higher yields
- Among fixed income asset classes, corporate bonds offer scope for yield enhancement over government bonds
- In USD, investment grade corporate bonds have greater market capitalisation than US Treasuries (1,900 bn versus 1,770 bn)
- Provides some diversification benefit (correlation of total returns versus Treasuries is 0.90)
- Cash flows are more standard (unlike the case for MBS)

The case for corporate bonds

- Performance comparison of single-A or better rated corporates versus Treasuries on a duration-neutral basis

Performance of 1-5 year sector duration-neutral portfolios (Jan 1999 to Jan 2003)			
Description	**Annual return**	**Annualized volatility**	**Market capitalization**
Corporates A-minus or better	7.77%	2.45%	$ 410 bn [a)]
US Treasuries	6.86%	2.83%	$ 840 bn [a)]

a) Market capitalization as of January 2003

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The case for corporate bonds

- Benchmark characteristics of different credit sub-indices (as of June 2003)

Index	# issues	Duration	Spread	Market cap
USD corporates	3,644	6.09	134 bp	$ 1,903 bn
1-3 year sector	777	1.97	77 bp	$ 465 bn
1-5 year sector	1,541	2.74	89 bp	$ 910 bn
A-rated corporates	1,537	5.92	121 bp	$ 833 bn
JACI	**103**	**5.20**	**170 bp**	**$ 76 bn**

Instrument composition of US dollar reserves at end-March 2000

In billions of US dollars

	Short-term	Long-term	Total
Treasury securities	165	492	657 (58%)
Other assets	262	211	565 (42%)
Deposits in the US	32		
Money market paper in the US	104		
Offshore deposits	126	12	
Agency securities		91	
Corporate bonds		12	
Equity		96	
Total	**427**	**703**	**1130 (100%)**
Memorandum items: Share of Treasury securities in assets of the given maturity	*39%*	*70%*	
Total estimated US dollar reserves at end-1999			*1359*

Source: Robert McCauley and Ben Fung, "Choosing instruments in managing dollar foreign exchange reserves", *BIS Quarterly Review*, Table 1, p. 41, March 2003.

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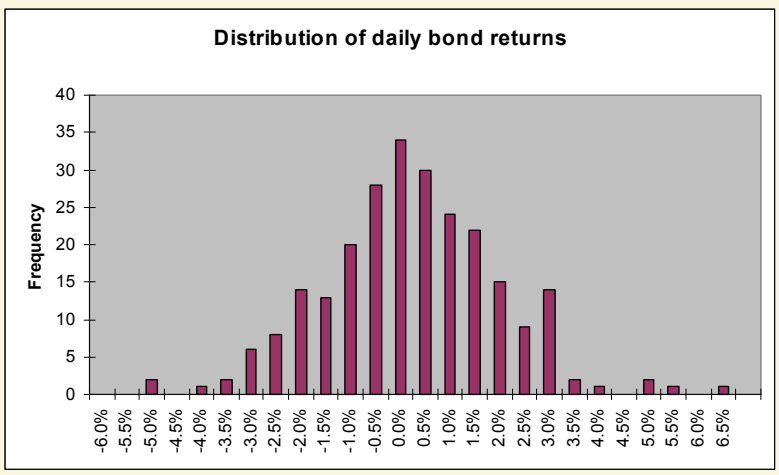

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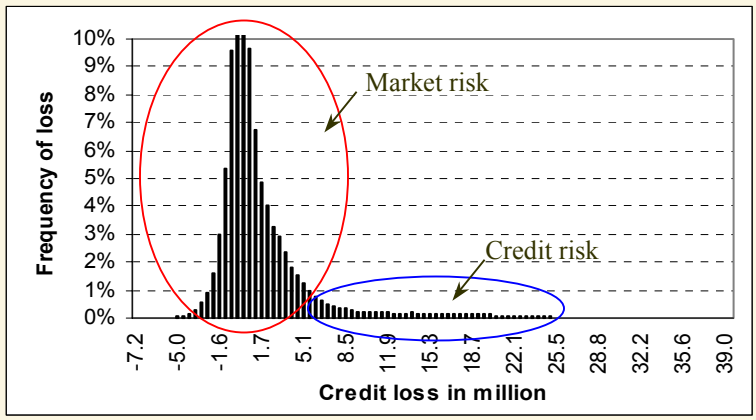
Typical loss distribution for corporate bonds



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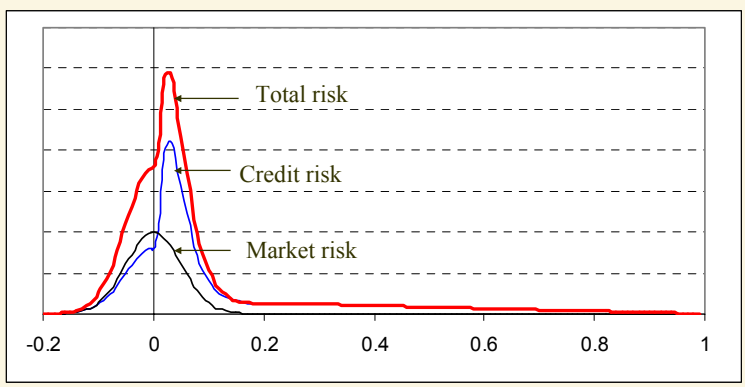
Decomposing returns into market and credit risk



Approach taken for risk measurement

- To measure the market risk and credit risk components for a corporate bond separately
- This allows us to keep the complexity of risk measurement manageable, and further, improves our ability to identify the sources of risk
- As a consequence, it also facilitates the development of quantitative tools for portfolio management
- Finally, it allows us to focus on the major source of risk in a corporate bond portfolio, which is credit risk, and to manage it prudently

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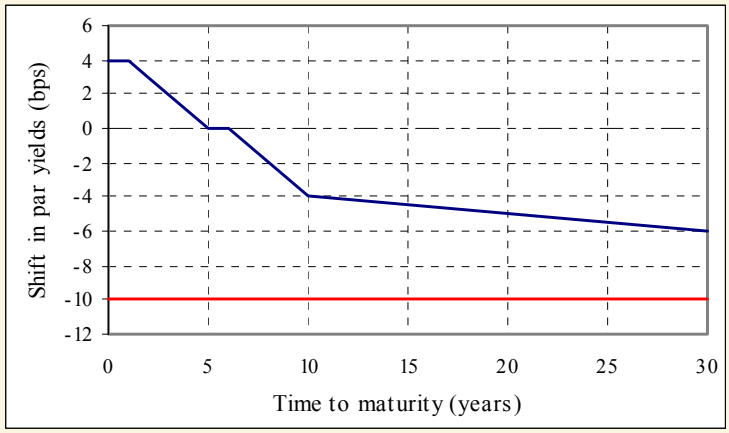
Quantifying market risk

- Dealers quote corporate bond yields at a spread to swap curve
- Changes to the interest rate swap curve can be regarded as one component of market risk that corporate bonds are exposed to
- Other components of market risk in a corporate bond portfolio include exchange rate risk and risk from changes to the implied yield volatility that affects prices of callable/puttable bonds
- Changes to swap curve can be modelled using 2 or 3 risk factors
- Important factors are level shift, twist and curvature
- Principal component analysis can provide optimal direction vectors for shape changes of the swap (or yield) curve
- Any other direction vector can be also used

Yield curve risk factors



Modelling yield curve risk factors

- Denote swap rates at time *t* as $y_i(t)$ where *i* refers to maturity of the swap rate
- Changes to swap rates (equivalently, yield changes) can be represented as

$$\Delta y_i(t) = y_i(t) - y_i(t-1),\ i = 1, 2, \cdots, n$$

- In terms of the shift and twist risk factors used to model yield curve shape changes, the yield changes can be represented as

$$\Delta y_i(t) = a_i \Delta s + b_i \Delta t_i + e_i(t),\ i = 1, 2, \cdots, n$$

- The shift and twist risk factors can be estimated by minimising the sum of squared residuals $e_i(t)$

Market risk model

- Foreign exchange risk is modelled as the factor sensitivity to a 1% appreciation of the foreign currency
- The coefficient associated with this risk factor is

$$c_t^k = 100 \times \frac{x_t^k - x_{t-1}^k}{x_{t-1}^k}$$

- One can construct a vector series of risk factor coefficients using weekly data and denote it $\left\{\vec{\phi}(t)\right\} = \left\{\left[a_t^{us} \quad b_t^{us} \quad a_t^{eu} \quad b_t^{eu} \quad c_t \quad v_t\right]\right\}$
- The risk model for measuring exposures to market risk factors is the covariance matrix $\Sigma = \left[\sigma_{ij}\right]$ where σ_{ij} denotes covariance between *i*th and *j*th time series components

Computing tracking error

- Knowing the sensitivity to different risk factors will allow us to compute the tracking error resulting from market risk factors
- The basis points sensitivity of the portfolio to the *k*th risk factor modelled is given by

$$S_P^k = 10000 \times \frac{M_P^k - M_P}{M_P}$$

- Tracking error of the portfolio versus the benchmark is given by

$$Tracking\ error = \sqrt{52(\vec{S}_P - \vec{S}_B)^T \Sigma (\vec{S}_P - \vec{S}_B)}$$