MERCER

Consulting. Outsourcing. Investments.

MARSH MERCER KROLL
GUY CARPENTER OLIVER WYMAN

25th May, 2010

Bond Markets and Yield Curves
Presentation to the Irish Society of Actuaries

John O'Brien

Bond Markets and Yield Curves

Agenda

1. What is a yield curve?
2. What drives yield curves?
3. Composition of bond markets today
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. What's all the fuss in today's markets? Plausible implications
6. Conclusions

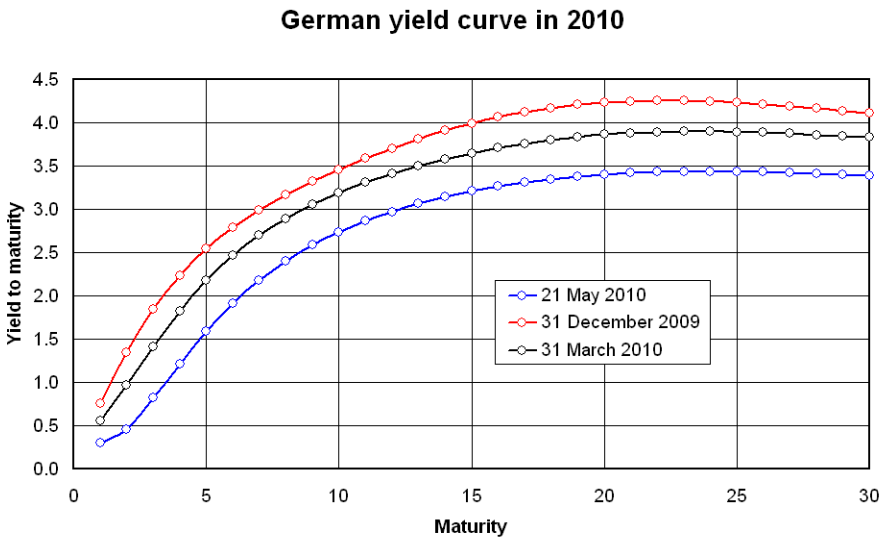
Bond Markets and Yield Curves

Agenda

1. **What is a yield curve?**
2. What drives yield curves?
3. Composition of bond markets today
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. What's all the fuss in today's markets? Plausible implications
6. Conclusions

What is a yield curve?
Yield to maturity

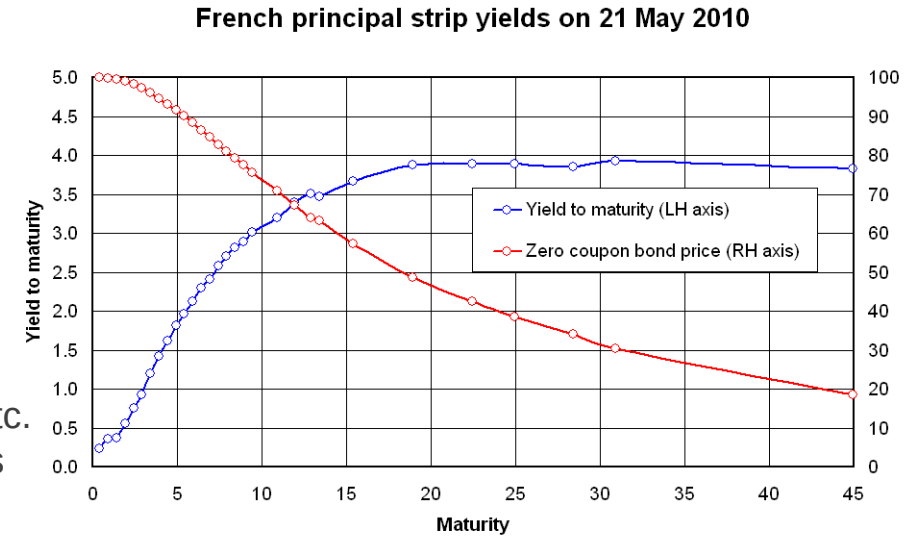
- A bond's yield is directly derived by its market price, being the single rate at which all contractual cash flow is discounted to arrive at this price
- A yield curve is a graph or table displaying the yield of the debt instruments of a given issuer for a given maturity date
- The "yield to maturity" on a coupon-bearing bond is itself a theoretical concept and just that since
  - it is an IRR rather than a point-to-point return
  - assumes coupon is reinvested at that rate
  - weighted average of spot discount rates



- Yield is further complicated/distorted by
  - compounding frequency, day-count conventions, settlement versus valuation date
  - off-market coupon
  - potential lack of term granularity in a given issuer's outstanding debt
  - uncertain maturity dates with certain debt instruments introduces the concept of "yield to worst"
  - options or warrants attached to the debt instrument

What is a yield curve?
The spot curve

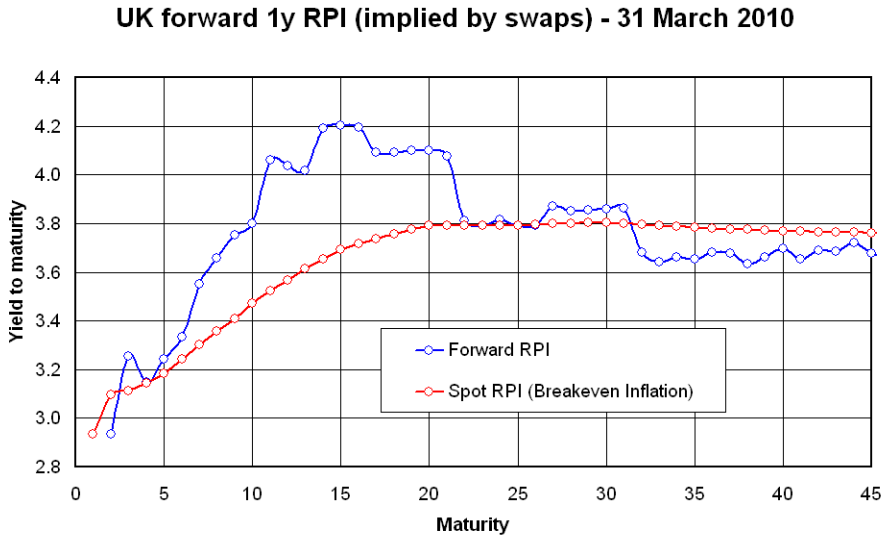
- A better way of measuring the present value of a contractual payment owed by a given borrower at a future date is by using the spot curve
- Can be easily
  - calculated, from the coupon (or par) yield curve through "bootstrapping", i.e. given the 1y spot rate, calculating the implied 2y rate, given these calculating the implied 3y rate etc. - this is the approach of many data providers in calculating spot curves
  - or observed, through prices on zero-coupon obligations of the issuer



- When many government bonds are first issued, a substantial portion is retained by the investment banks and "stripped" into its constituent cash-flows which go on to trade as assets in their own right
  - US, UK (both very liquid)
  - France (very liquid and it was for example possible to buy a 45 year strip on 21st May for €18)
  - Germany, Italy, Netherlands, Spain, Belgium (but not Ireland)
  - While some inflation-linked bonds legally can be stripped, there has been little or no market activity

What is a yield curve?
The forward curve

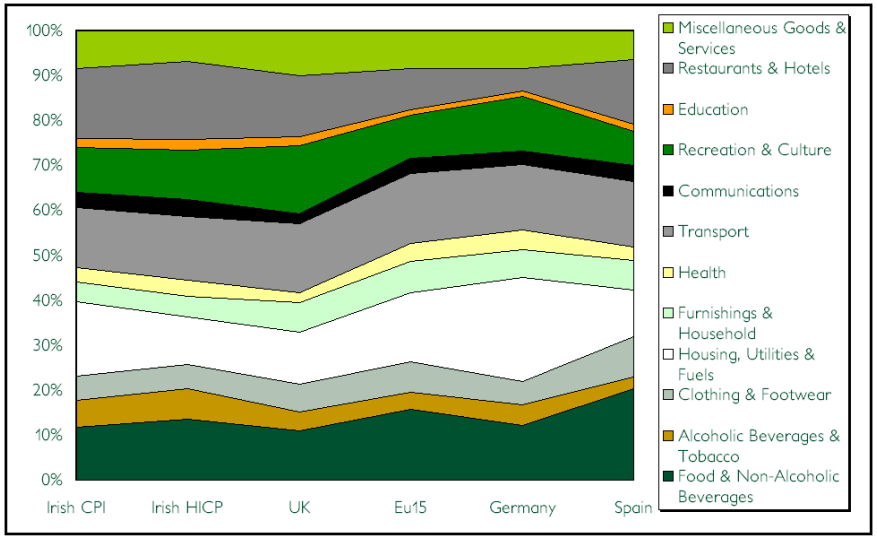
- From the spot curve, we can readily derive the forward curve (and vice versa)
- This tells us what the market-consistent discount rate would be in getting from two future points A and B, and further tells us what the expected path of short term rates (& indeed medium term rates) might be
- The forward curve depends crucially on no-arbitrage principles in its derivation
- If the yield curve reflects factors other than short-term rate expectations, then the implied forward rates might be curious



- When (par) yield curves are upward sloping, both spot curves and forward curves tend to be higher than the yield curve
- Forward curves take pride of place in Solvency II for example, since in order to determine a risk free spot rate where no deep, liquid and transparent market exists, it is necessary that an arbitrage free and sensible ultimate forward rate (UFR) is chosen

What is a Yield Curve?
Inflation linked cashflows

- A growing number of governments are issuing inflation linked bonds to
  - diversify the funding profile
  - achieve greater correlation with income tax and VAT receipts
  - avoid paying the premium for inflation uncertainty in nominal yield
- Inflation linked bonds pay a real coupon; both principal & coupon roll up over time indexed to an index of consumer prices, generally with a 3m lag and a deflation floor



- There are no natural payers of Eurozone inflation but France, Italy, Germany and Greece issue bonds linked to Eurozone HICP ex tobacco (HICPx)
- For the purposes of hedging Irish inflation linked liabilities
  - one Housing Finance Agency bond maturing in 2015 and a handful of private placements
  - difficulty lining up supply & demand even when a payer (e.g. infrastructure project) emerges
  - basis between Irish CPI and Eurozone HICP ex Tobacco needs to be considered if Eurozone inflation linked bonds or derivatives are used as a proxy hedge
- Zero coupon swaps are very popular where a fixed amount is exchanged for €HICPx

Bond Markets and Yield Curves

Agenda

1. What is a yield curve?
2. **What drives yield curves?**
3. Composition of bond markets today
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. What's all the fuss in today's markets? Plausible implications
6. Conclusions

What drives yield curves?

Granular understanding of interaction of assets & liabilities and the possibility to trade determinants in their own right draws attention to yield curve drivers

- Textbook
  - Expected path of short-term interest rates
  - Segmented markets: clearance of supply and demand among agents
  - Preferred habitat: investors pay a premium for assets that hedge a liability
  - Liquidity premium: investors require a premium for lending further out the curve
  - Convexity premium: impact of a parallel shift in rates on prices per unit duration increases
- Piece by piece
  - Compensation for expected inflation
  - Compensation for inflation uncertainty
  - Real risk-free rate of return

  } Determinants of the nominal risk free rate
  - Compensation for expected default
  - Compensation for default uncertainty
  - Premium for that bond cannot be sold for its worth

  } Determinants of the credit spread
- Key issues
  - What is the risk free rate and can it be measured?
  - Nominal yields can be decomposed into real yields and inflation expectations by observing the real yields on bonds of the same issuer. Given a risk free yield for a particular maturity, can the remainder of the yield on a particular instrument be decomposed into credit risk, liquidity risk and other risk?
  - How is the aftermath of the financial crisis going to effect the interplay of supply and demand

Bond Markets and Yield Curves

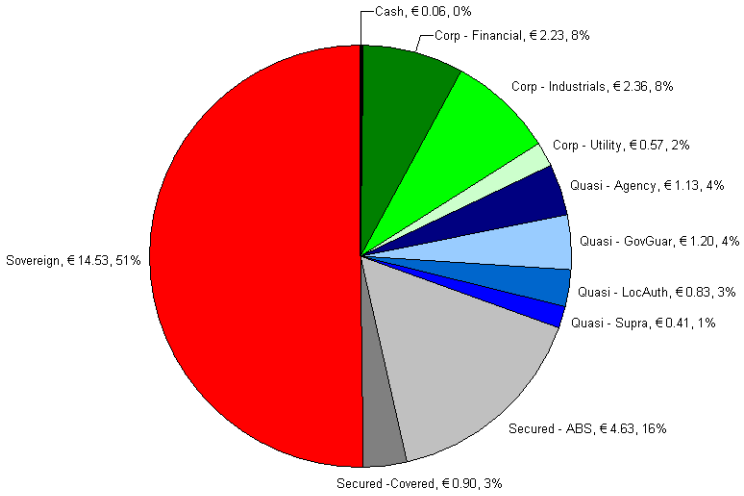
Agenda

1. What is a yield curve?
2. What drives yield curves?
3. **Composition of bond markets today**
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. What's all the fuss in today's markets? Plausible implications
6. Conclusions

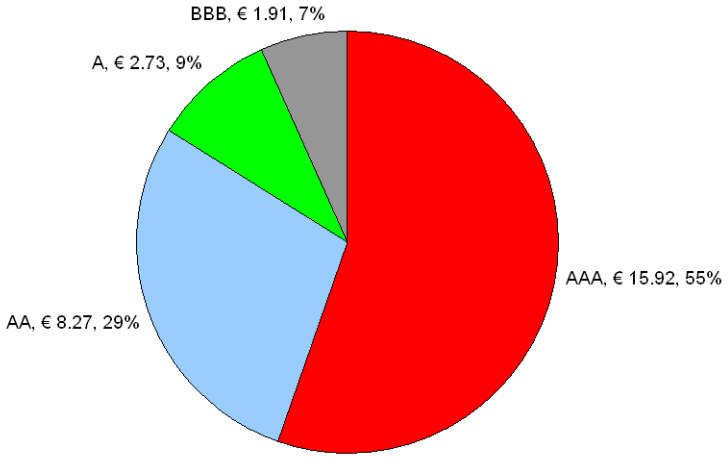
Composition of bond markets today

Composition of global bond market - fixed income only

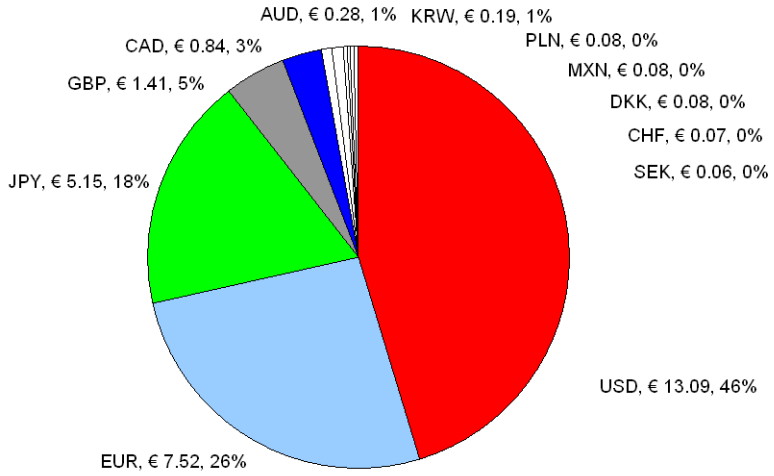
Global IG fixed income universe May 2010 (€tr)



Global IG fixed income universe May 2010 (€tr)



Global IG fixed income universe May 2010 (€tr)

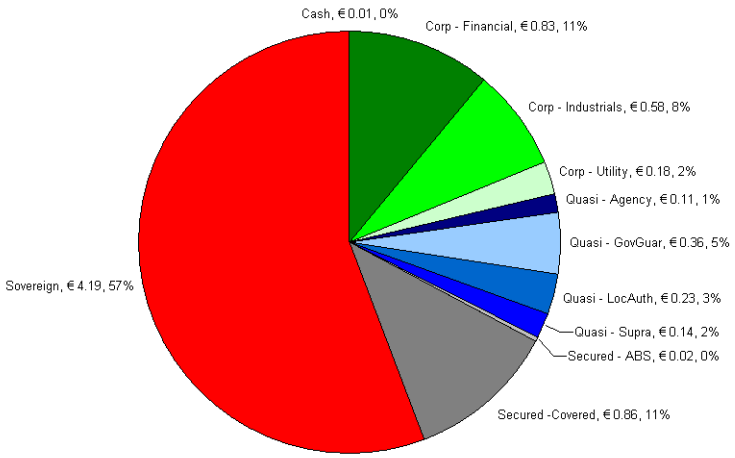


- In addition to all the above
  - Floating rate notes, bank loans, treasury bills, commercial paper, certificates of deposits and bank deposits
  - Non-investment grade debt and emerging market debt
  - Inflation linked bonds. Sovereign issuance
    - Eurozone: €310bn Vs €4.2tr nominal (7%)
    - USA: $580bn Vs $5.1tr nominal (10%)
    - UK: £230bn Vs £750bn nominal (23%)
  - Derivatives: futures, options and swaps

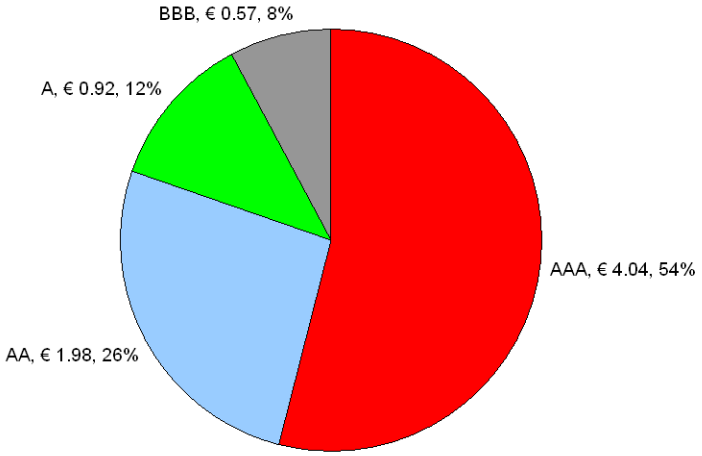
Composition of bond markets today

Composition of Eurozone bond market - fixed income only

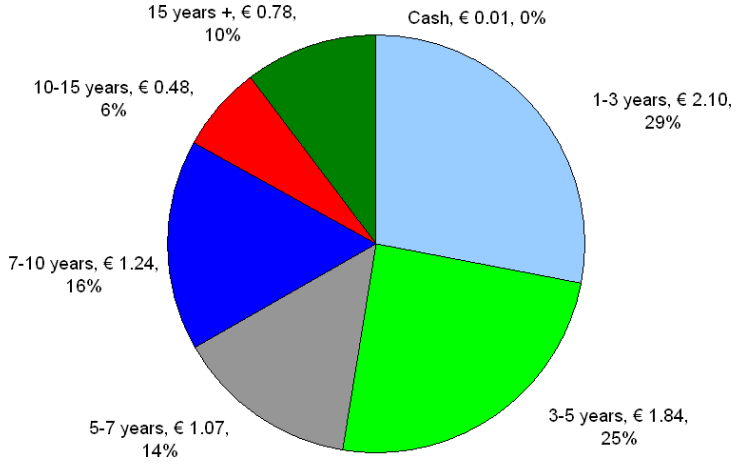
Eurozone IG fixed income universe May 2010 (€tr)



Eurozone IG fixed income universe May 2010 (€tr)



Eurozone IG fixed income universe May 2010 (€tr)



- A major difference between the European and US bond markets arises through the financing of residential mortgages
- In addition, the weighting of financials including subordinated financial debt is higher in Euro corporate issuance than elsewhere
- The sectoral composition of the market varies by maturity. Most covered bonds and corporates have <10 years to maturity while the >10 area is dominated by sovereigns

Bond Markets and Yield Curves

Agenda

1. What is a yield curve?
2. What drives yield curves?
3. Composition of bond markets today
4. **Some topical issues**
   a) **Investment and bond benchmarks**
   b) **The importance of curve (versus single point) discounting**
   c) **Discounting for the purposes of IAS 19**
   d) **Solvency II: The liquidity premium and other matters**
5. What's all the fuss in today's markets? Plausible implications
6. Conclusions

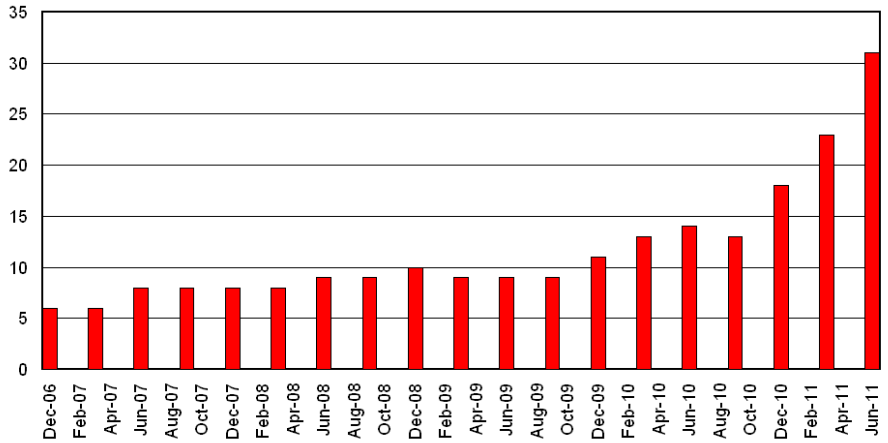
Topical issues
Investment and bond benchmarks

- Fiduciaries and corporate managers like to judge the performance of those investing on their behalf against benchmark indices
- Typical benchmarks used in Ireland by savers and pension funds are the Merrill Lynch >5 and >10 year indices for Eurozone nominal bonds and indices such as the iBoxx Lynch 1-3 year Corporate bond index or similar are used in Non-Life insurance
- Fixed income benchmarks are almost all issue-size weighted
- Managing money against fixed income benchmarks come with warnings attached however and is increasingly being challenged in the wake of the recent crisis
  - Debt is a less stable means of financing than equity as it comes with refinancing risk, leverage and higher interest cost. When an corporate entity gets into trouble, it can choose to borrow its way out. Alternatively a government can choose to finance an unsustainable spending program with debt. Either way, the entity's weighting in a benchmark index will *increase* rather than decrease as a result of increased borrowing.
  - Most bond benchmarks rebalance at the end of a month when coupon income is reinvested pro-rata in the constituents, new issues are added, constituents that no longer meet eligibility criteria are dropped (generally on grounds of being shorter than the minimum maturity date but often because of a ratings downgrade). On average index duration extends by 0.1 of a year. Some of these features encourage herd behaviour while some are pro-cyclical.
  - Passive investors generally go through two transaction costs per bond, one since new issuance is generally sourced in the secondary rather than primary market and two because fixed income indices do not hold bonds to maturity. Is this clever?

Topical issues
Investment and bond benchmarks

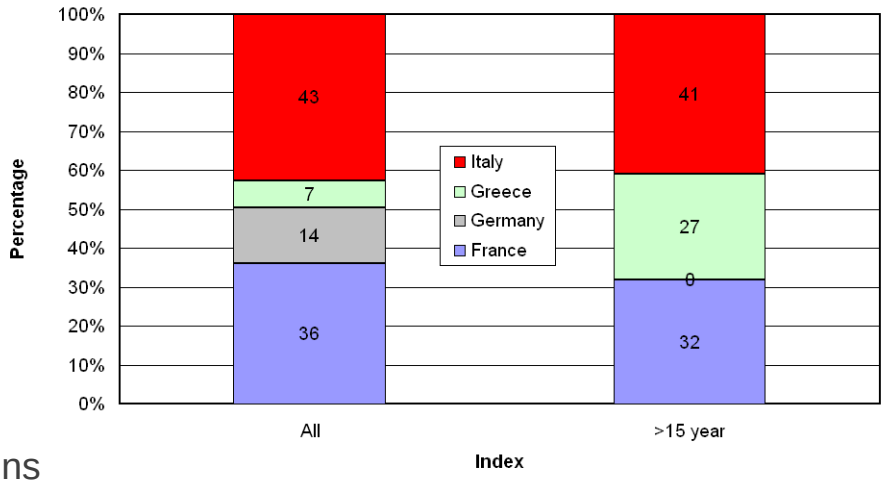
Italy's weight in the Merrill Lynch Eurozone bond indices

Expected composition of government guaranteed debt in bespoke 0-1 year liquidity index



- As a result of some of the factors discussed on the previous slide, investors can find themselves in an entirely different product as time elapses; particularly relevant for passive investors
- What are the alternatives?
  - Absolute return or unconstrained investing
  - GDP-weighted benchmarks
  - Liquidity or equally weighted benchmarks
  - Regular appraisal of asset allocation decisions

Country weightings in Govt EMU HICP indices Dec 09



Topical issues

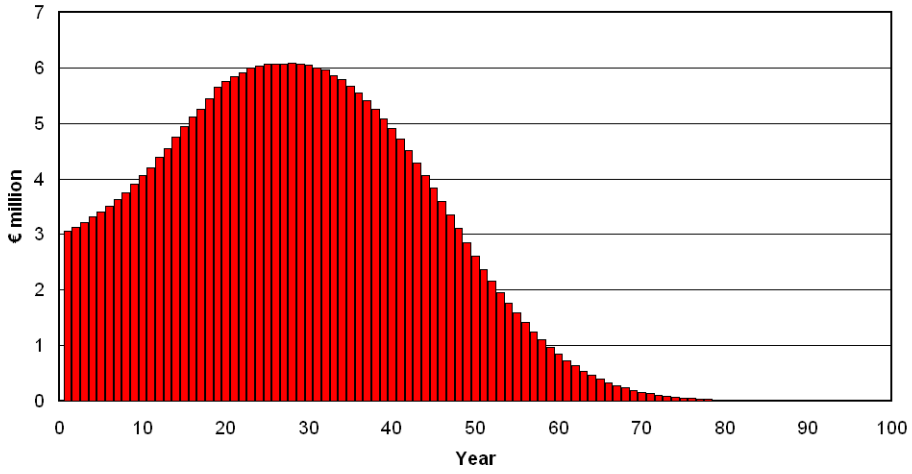
Single point versus curve discounting in pensions

- Yield curves are not always flat
- There are many yield curve shapes that can result in a bond of certain maturity (e.g. 20 years) having a given yield (e.g. 4%)
- The PV of a liability schedule whose cash-flow profile differs to that of a reference bond with the same duration will be incorrectly evaluated using the bond's yield
- The insurance industry has long moved toward full yield curve discounting
  - Driven by gradual alignment of solvency capital regulation and accounting standards toward the economic reality that is consistent with market data
- The pensions industry has lagged this trend somewhat
  - In the UK, the Technical Provisions held in respect of a defined benefit liability is typically calculated by reference to a UK government bond of similar duration to that of the liability, plus a small risk premium
  - In Ireland, the Minimum Funding Standard references an irregularly updated bond yield while a triennial valuation typically also references a single yield
  - Since valuations carried out on schemes often result in real economic decisions, it is important to appreciate that single discount rates are at best a rough proxy
  - Overleaf a worked example of a typical defined benefit cash-flow profile is analysed
- When multiple measures of a DB liability are in play, e.g. MFS, IAS 19, ongoing, buyout, self-sufficiency and economic, hedging decisions become difficult

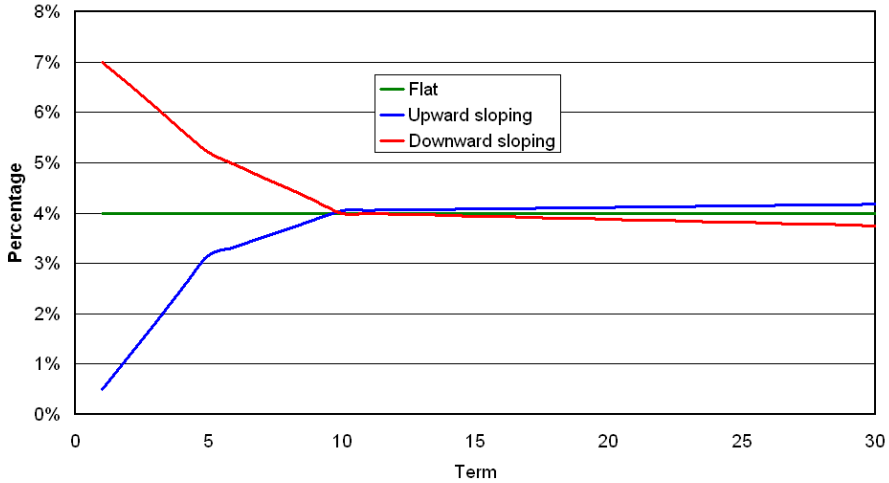
Topical issues

Single point versus curve discounting in pensions

Cashflows of a hypothetical €100m DB pension liability



3 spot yield curves consistent with a 20 bond yield of 4%



- As a hypothetical example, these three spot yield curves all result in a 20y bond paying a 4% coupon yielding 4%
- None are without precedent in recent market conditions

Scenario	True PV of liability
Flat yield curve	€100m
Upward sloping curve	€97.9m
Downward sloping curve	€103.8m

Topical issues

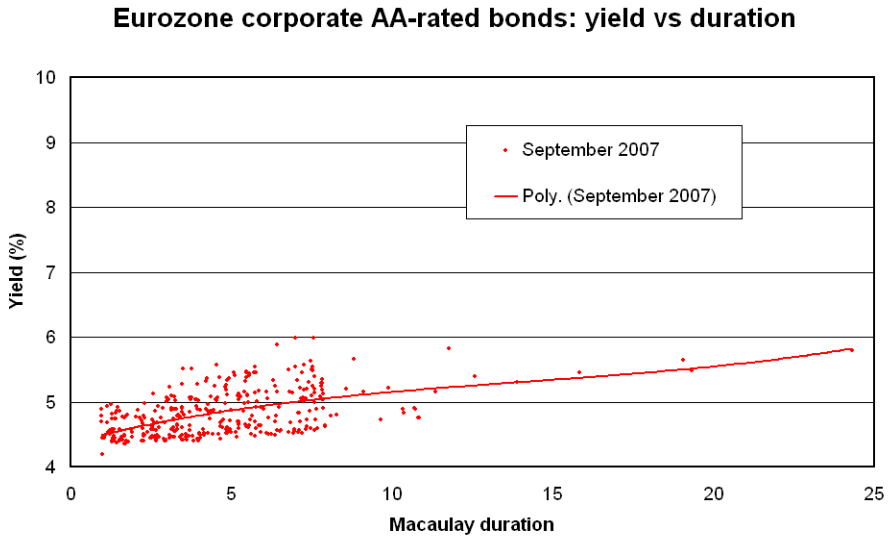
IAS 19 for defined benefit pensions

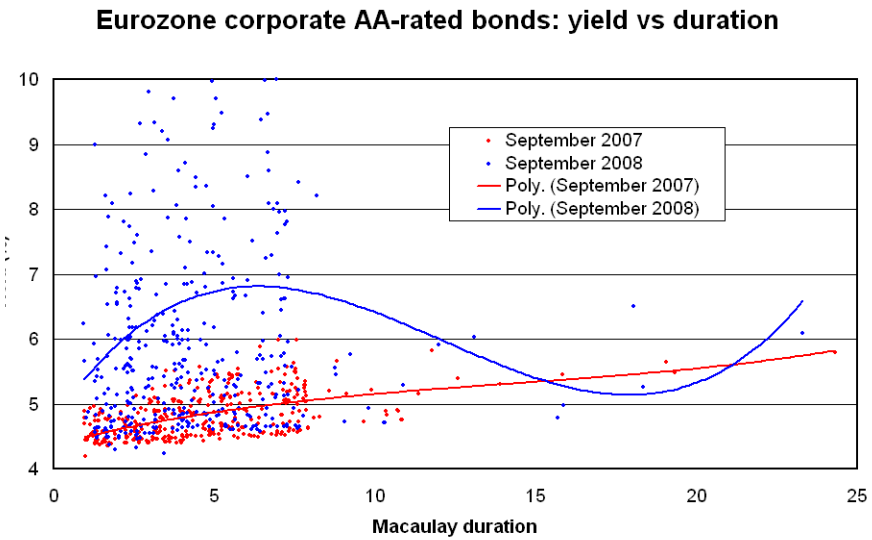
- Discount rates are based on the yield of "high quality" corporate bonds (interpreted normally as AA-rated) that are consistent with the currency and estimated term of the benefit obligations
- In the past, setting discount rates under US GAAP / IFRS was relatively easy
  - whether iBoxx yields or bootstrapped yield curve was used as the basis, similar conclusions were reached
- The financial crisis has changed this
  - more discussions and different views regarding the discount rate than ever before

	31/12/07	31/12/08	31/12/09
Actuarial Firm 1	5.5%	5.7%	5.5-6.2%
Actuarial Firm 2	5.5-5.7%	6.2-6.3%	5.2-5.6%
Actuarial Firm 3	5.6-5.8%	5.8-6.0%	5.3-6.0%
iBoxx 10+ AA bonds	5.5%	6.2%	5.1%

Topical issues

IAS 19 for defined benefit pensions





- Within a rating band such as AA, there can be substantial differences between the highest yielding and the lowest yielding bonds; in addition, issuer composition typically changes by duration
- Several issues make the use of AA yields complicated at the best of times
  - AA typically dominated by financial institutions. Subordinated bank debt
    - rating agencies have typically rated lower tier 2 debt one notch lower than senior and tier 1 debt 2 notches below senior
    - market understanding prior to early 2008/2009 was that issuers would call sub debt
  - Electricite de France dominates the long end
  - Credit spreads also have a term structure, often downward sloping in crisis times

Topical issues

IAS 19 for defined benefit pensions

- Ultimately the key issue is the lack of a deep and liquid market at the end of the curve relevant for defined benefit pension schemes
- Remedial actions considered by the industry
  - Index providers producing ex-Sub and ex-T1 indices
  - Use of a government curve plus a spread determined
- Such actions are all arbitrary but lead to significantly different outcomes
- Harmonisation of approach necessary
- Solvency II envisages bringing own-defined benefit schemes of insurers into full-blown economic capital treatment
  - 2009 consultation suggests that the IAS 19 deficit excluding corridor effects is deducted from available capital while surplus is generally excluded
  - AA-spreads are likely therefore to impact insurer's solvency position
- May all be moot if IASB switch to valuation of liabilities off a swaps basis

Topical issues
Solvency II

- Three key areas where yield curves are important in Solvency II are
  - Calculating the risk free curve and the role of extrapolation toward an ultimate forward rate (UFR)
  - Further allowing for an illiquidity premium in establishing Life reserves
  - The stresses in the Solvency II standard formulae and their impact on capital requirements
- Key recent documents include
  - The QIS5 calibration paper published by CEIOPS in Apr10
  - Task force report on the liquidity premium, CEIOPS Mar10
  - Draft L2 advice on valuation of assets and other liabities, CEIOPS Dec09

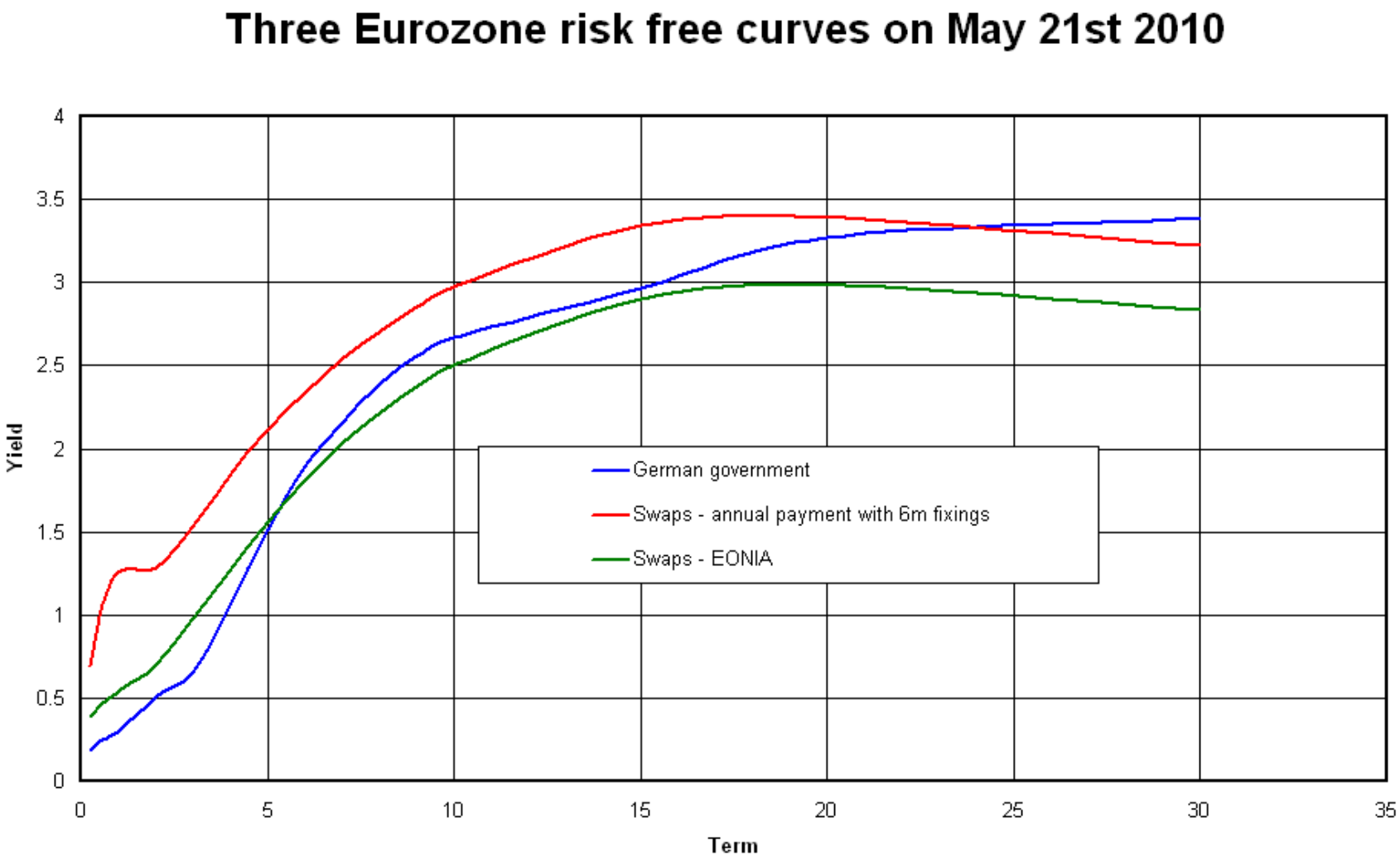
Topical issues

Solvency II: establishing the risk free curve

- Choice of basic risk free rate term structure is still in discussion
- Swap curve taken as starting point
  - Acknowledgement that swap rates are not free of credit risk
  - Long dated swaps are generally collateralised so counterparty risk is low
  - However the investor will have credit exposure to the bank(s)
  - In fact ignoring credit risk, it would be a miracle in practice to earn the swap rate on a hold to maturity basis since it would depend on earning the exact Euribor fixing every time a deposit is rolled
- CRO/CFO proposal
  - risk free rates to reference swap curve appropriately adjusted for credit risk
  - adjustment for credit risk should refer to overnight swap rates where appropriate
  - Credit adjustment could be determined by looking at EONIA or overnight swaps
- Market conditions are constantly changing. See the Bank of England's quarterly bulletins for good discussion of risk free rate
- Where no market data is available, forward rates converge to an ultimate forward rate (UFR) which must be arbitrage-free

Topical issues

Solvency II: establishing the risk free curve



Topical issues

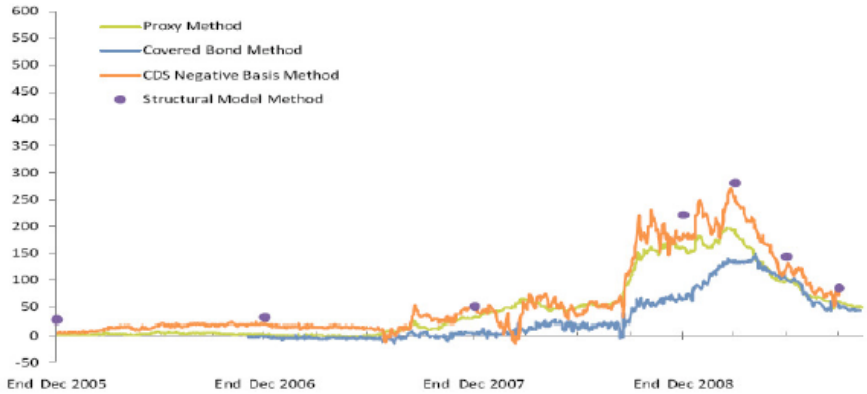
Solvency II: the liquidity premium

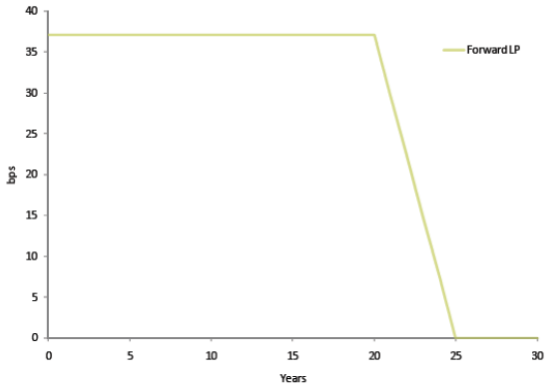
- "The illiquidity of an insurance liability measures the extent up to which its cash flows are certain in amount and in timing, due consideration being given to the resilience to forced sales"
- "Most life insurance liabilities can be considered to be at least partially illiquid"
- "In normal circumstances the liquidity premium on assets is small and has thus no significant influence on the valuation of insurance liabilities" ... but is anti-cyclical in distressed conditions
- "During periods of stressed liquidity the liquidity premium on assets has a positive value, but its application to insurance liabilities aims only to eliminate an valuation mismatch between the valuation of assets and liabilities"
- "The risk free reference rate applicable to the valuation of a liability should be the sum of a basic risk free reference rate and a liquidity premium depending on the nature of the liability"
  - independent of the investment strategy
  - should not exceed the extra return which can be earned by the insurer by holding illiquid assets free of credit risk, available in the financial markets and matching the cash flows of the liability

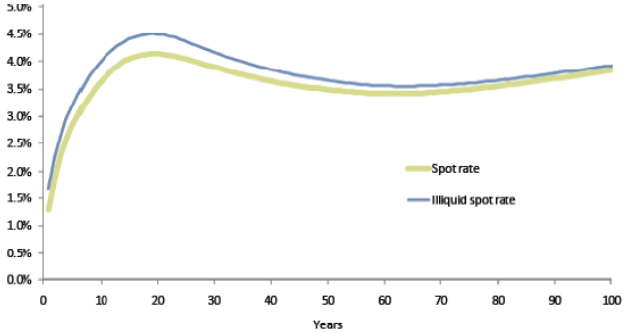
Topical issues

Solvency II: estimating the liquidity premium

- **CDS Negative-Basis Method** which compares the spread on a corporate bond with the spread of a Credit Default Swap for the same issuing entity, same maturity, same seniority and same currency
- **Covered Bond Method** which involves choosing a pair of assets which, besides liquidity, are assumed to offer equivalent cash flows and equivalent credit risk. The primary example is an index of covered bonds versus swaps
- **Structural Model Method** which involves the use of option pricing techniques (esp. the Merton Model) to calculate a theoretical credit spread which compensates only for credit (default and spread) risk. The difference between the theoretical spread and the actual market spread is typically taken to be liquidity premium
- Each method has pros and cons
- All methods will require a greater degree of understanding in terms of what drives the yield curve, especially credit spreads







Topical issues

Solvency II: the proposed stresses under QIS5

- Interest rates
  - Multiplicative approach with downward stress overridden if necessary with a parallel shift of 1%

	QIS 4		Proposed stresses	
Maturity in Years	**Up**	**Dn**	**Up**	**Dn**
0.25			70%	-75%
0.5			70%	-75%
1	94%	-51%	70%	-75%
2	77%	-47%	70%	-65%
3	69%	-44%	64%	-56%
4	62%	-42%	59%	-50%
5	56%	-40%	55%	-46%
6	52%	-38%	52%	-42%
7	49%	-37%	49%	-39%
8	46%	-35%	47%	-36%
9	44%	-34%	44%	-33%
10	42%	-34%	42%	-31%
11	42%	-34%	39%	-30%
12	42%	-34%	37%	-29%
13	42%	-34%	35%	-28%
14	42%	-34%	34%	-28%
15	42%	-34%	33%	-27%
16	41%	-33%	31%	-28%
17	40%	-33%	30%	-28%
18	39%	-32%	29%	-28%
19	38%	-31%	27%	-29%
20	37%	-31%	26%	-29%
21			26%	-29%
22			26%	-30%
23			26%	-30%
24			26%	-30%
25			26%	-30%
30			25%	-30%

  - Stresses to rate volatility surface

- Credit spreads
  - to incorporate impact of changes in liquidity premium
  - distinction made between for bonds (including bank deposits), loans, structured credit and CDS
  - capital charge for spread risk for bonds determined by multiplying the market value of the bond by its modified duration and a function F of the rating class of the bond
  - Stresses for bonds below

	$F^{up}(Rating_i)$	$F^{down}(Rating_i)$	Duration floor	Duration cap
AAA	1.0%	-0.4%	1	-
AA	1.5%	-1.0%	1	-
A	2.6%	-1.7%	1	-
BBB	4.5%	-3.0%	1	7
BB	8.4%	-6.3%	1	5
B or lower	16.2%	-8.6%	1	3.5
Unrated	5.0%	-3.3%	1	7

Bond Markets and Yield Curves

Agenda

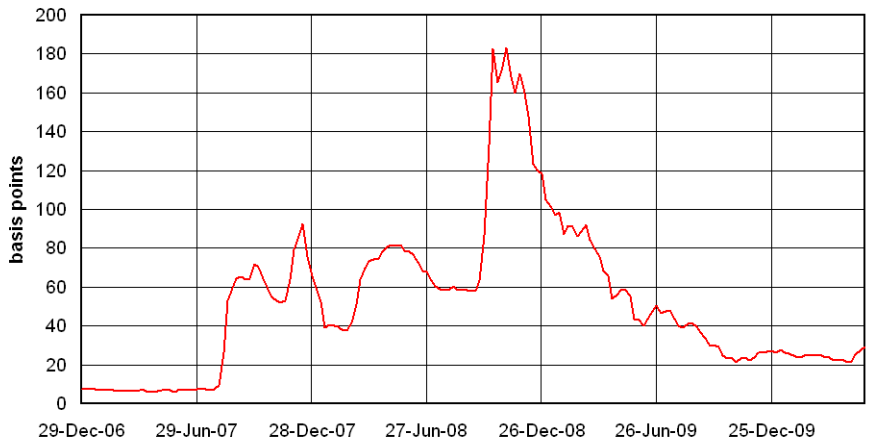
1. What is a yield curve?
2. What drives yield curves?
3. Composition of bond markets today
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. **What's all the fuss in today's markets? Plausible implications**
6. Conclusions

What's all the fuss about today? Possible Implications

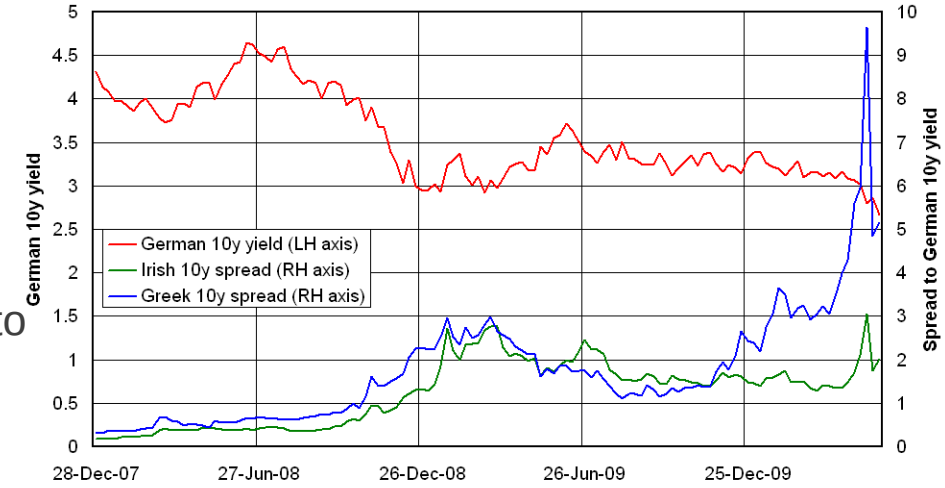
Recent global developments

- Initially manifested itself through increase in US sub-prime delinquencies
- Rapidly escalated into a bank confidence and liquidity crisis
- Governments were forced into rescuing banking systems
- Measures have largely been plauded as having prevented a global depression but consequences are finally catching up
- Global recession and financial strain on governments has led to major budget deficits and increased dependence on the bond markets
- In some cases, markets simply do not believe that the government can continue to service its debt without support
- Fears of contagion risk if Greece defaulted

Euro unsecured (3m Libor) versus unsecured (3m Repo) rates



European bond yields since 2007

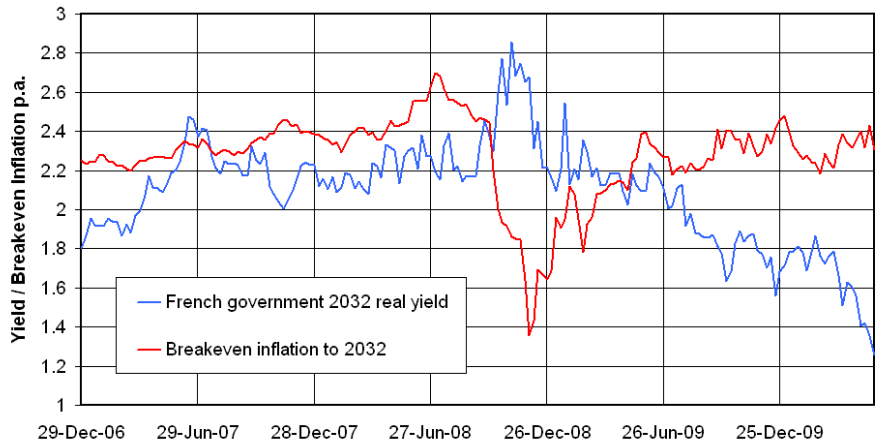


What's all the fuss about today? Possible Implications

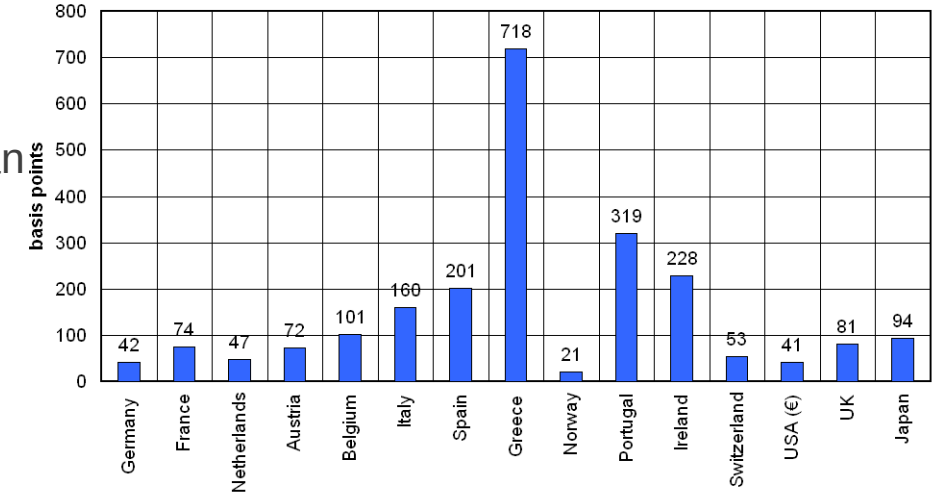
Recent Eurozone developments

- The EU, in conjunction with the ECB and the IMF were forced to announce an enormous €750bn financial support package for countries in severe financial difficulty over a few weeks ago
  - to protect the currency
  - to avoid sovereign default
  - understanding of future prudence
- Problems of individual European countries has been passed on to the EU as a whole
- Credit spreads on periphery European government bonds remain elevated
- As yet no upward pressure on core German nominal bond yields or breakeven inflation
- ECB have indicated that the measures will be paid for *without* printing money
- Positive for unhedged foreign currency investments if Euro pressure continues

Eurozone long-dated inflation expectations and real yields since 2006



Major government CDS spreads



Bond Markets and Yield Curves

Agenda

1. What is a yield curve?
2. What drives yield curves?
3. Composition of bond markets today
4. Some topical issues
   a) Investment and bond benchmarks
   b) The importance of curve (versus single point) discounting
   c) Discounting for the purposes of IAS 19
   d) Solvency II: The liquidity premium and other matters
5. What's all the fuss in today's markets? Plausible implications
6. **Conclusions**

Conclusions

Key areas highlighted

- There are many different kinds of yield curves; the textbook remains as relevant as ever in understanding the drivers of yield curves in today's volatile markets
- The use of benchmarks for fixed income investing needs reappraisal
- Single yield discounting is at best a rough proxy for valuing a liability and can arguably disincentivise sensible hedging/derisking decisions
- The lack of a deep market for long dated corporate bonds makes current IAS 19 accounting challenging and in need of harmonisation
- Solvency II ups the ante for insurers in understanding yield curves
  - what constitutes the risk free rate
  - determining a liquidity premium
- Fixed income markets are currently stressed and have been since 2007
  - credit spreads and liquidity premia to remain elevated compared to pre-2007 levels
  - whether core € yields rise or fall in response depends critically on whether rescue measures prove inflationary. Critical to understand inflation sensitivity of liabilities
  - elevated rate volatility likely to make products such as GMIB unattractive

MERCER

MARSH MERCER KROLL
GUY CARPENTER OLIVER WYMAN