

**The Actuarial Profession**   
making financial sense of the future

## Swaps and Other Banking Products

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Section 1

# The Role of Investment Banks

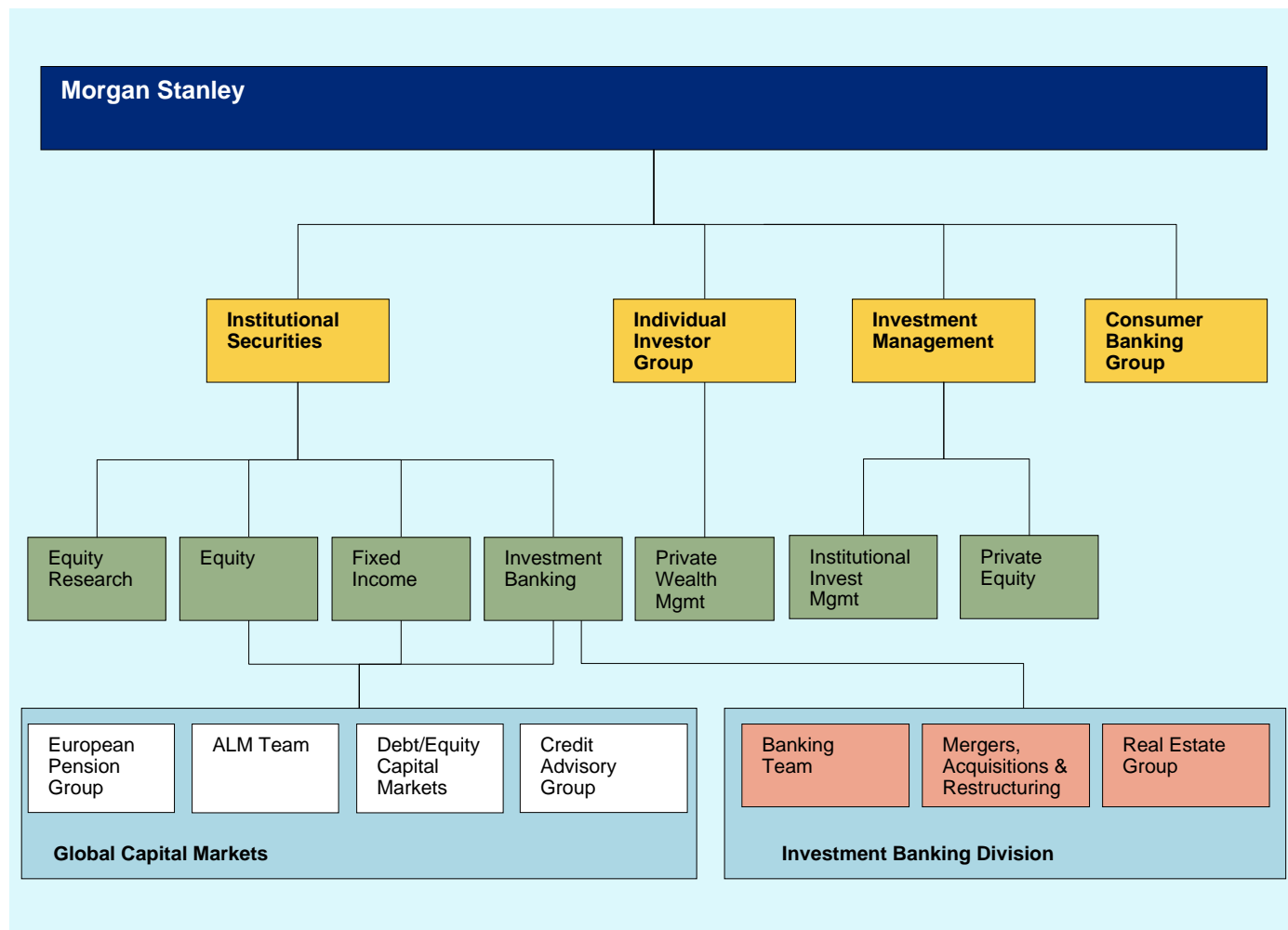
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# What do Investment Banks Look Like?

e.g. Morgan Stanley's Business Structure

Investment banks offer a wide range of financial products and services:

- Capital markets raising funds:
  - Debt instruments
  - Equity issuance
  - Hybrids (e.g. convertibles)
- Derivatives sales and structuring:
  - Interest rate derivatives
  - Inflation derivatives
  - Equity derivatives
  - Credit derivatives
  - Hybrid structures (e.g. outperformance options)
- Other products:
  - Investment management
  - Commodity investments
  - Transition management
  - Securities lending
  - Alternative investments

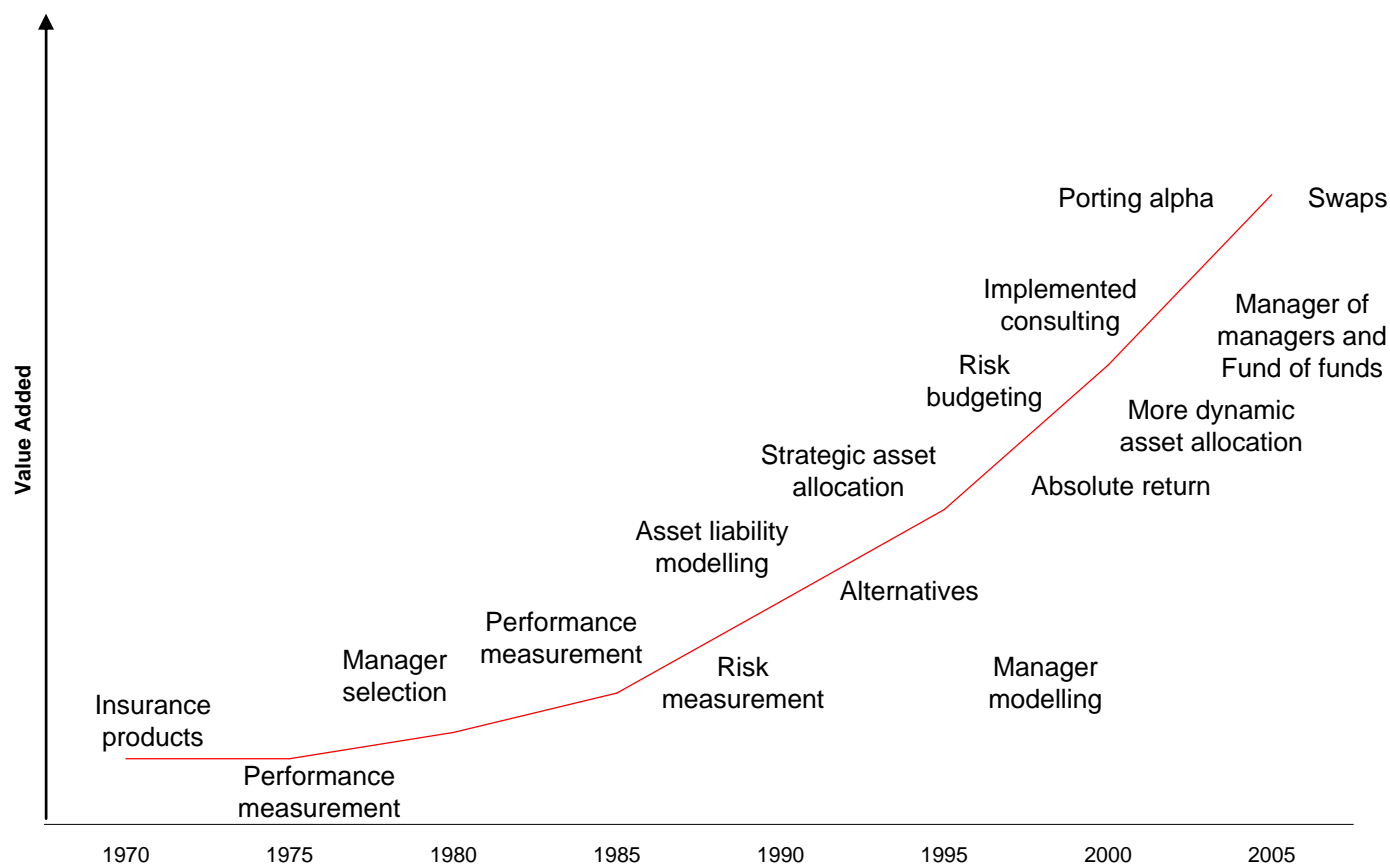


# Evolution of Investment for Pension Funds

Increasing Complexity

- Staggering growth in range and complexity of pension fund investment products
- Much heavier demands on Trustees to understand and use these:
  - From Government (Myers, Pensions Act 2004)
  - From sponsors
- Limited Trustee “Governance Budget”
  - Amount of time and expertise available to use these products
- Increasing realisation that sponsor has deep resource of relevant risk management skills
  - Need to work together
- Investment banks specialise in many of the risk management products
  - Experience and understanding of how to use them

## Range of Products



Source: NAPF – “Trustees’ relationships with their investment consultants and advisers – A guide to good practice – March 2005, Morgan Stanley

# Sponsors and Pension Risk

Pensions Feature Almost Everywhere

- Pensions Feature in almost every aspect of non-strategic risk
- Serious demands on management resource to monitor and manage these risks

## Sources of Risk



## Who Does What?

	Investment consultants	Investment banks	Investment managers
Governance consulting	✓		
Risk budgeting	✓	✓	✓
Asset liability modelling	✓	✓	✓
Investment strategy	✓	✓	✓
Mandate negotiation	✓		
Manager selection	✓		
Custodian selection	✓		
Myners reviews	✓		
SIP drafting	✓		
Performance monitoring	✓		✓
Risk monitoring	✓	✓	✓
Trustee training	✓	✓	✓
Execution		✓	✓
Funding solutions		✓	
Sponsor business risk modelling		✓	
Investment management			✓

Section 2

# Interest Rate and Inflation Sensitivity

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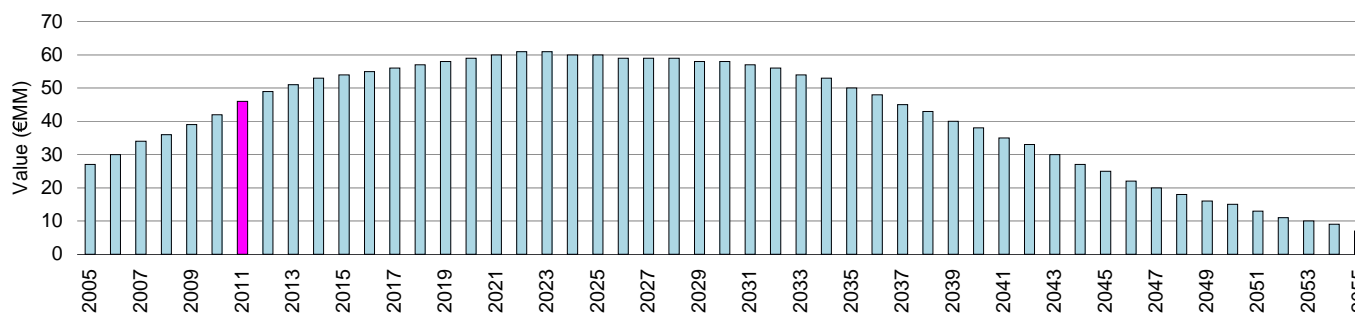
# Actuarial Valuation of Pension Liabilities

Discount Rates are the Main Influential Factor

- The actuary projects the expected cashflows from the scheme taking into account:
  - Expected inflation of benefits
  - Chance of payment (includes longevity)
- The value of your liabilities is the sum of the PV's each annual cashflow
- Discount rate depends on nature of valuation, but will typically depend on current market conditions:
  - Current level and shape of yield curve influences the discount rate chosen
  - FRS17/Economic valuations depend explicitly on the yield curve

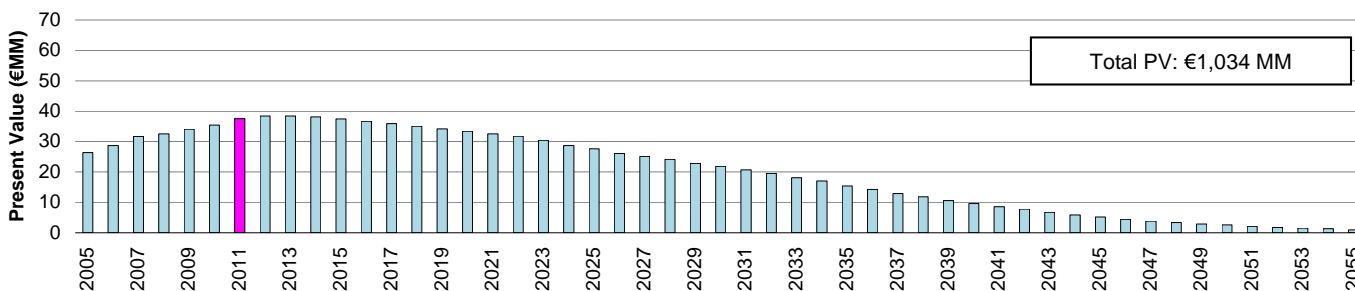
## Projected Pension Cashflows (Assuming 2% inflation)

Original Cashflows



Source Morgan Stanley – for illustrative purposes only

## Present Value of Each Cashflow



Source Morgan Stanley – for illustrative purposes only

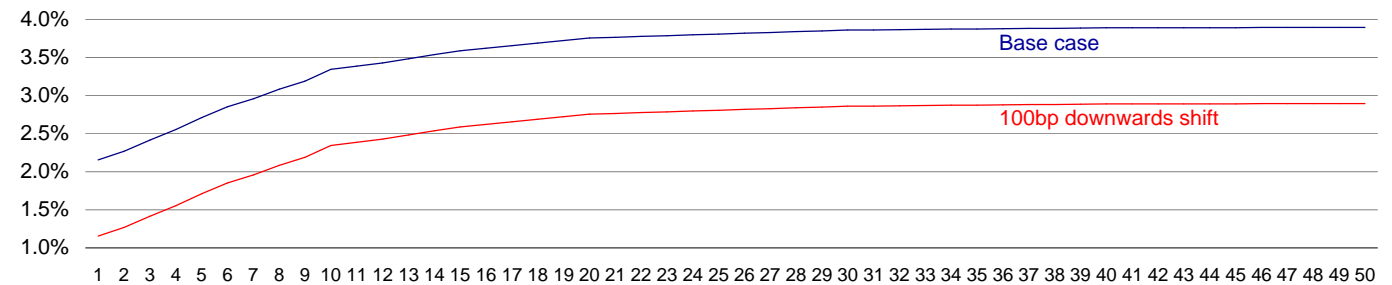
# Impact of a Change in Discount Rates

e.g. Following a Shift Down in the Yield Curve

- A shift down in interest rates will increase the PV of liabilities:
  - Discount rate reduced accordingly

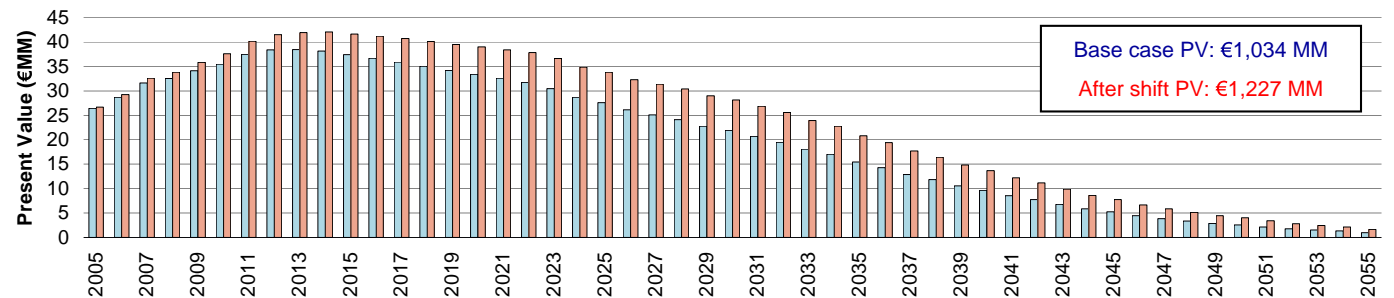
## Parallel Shift in the Yield Curve

Base case: European Swap Rate, 100bp downwards shift



Source Bloomberg – Closing yields 5 June 2005

## Present Value of Each Cashflow



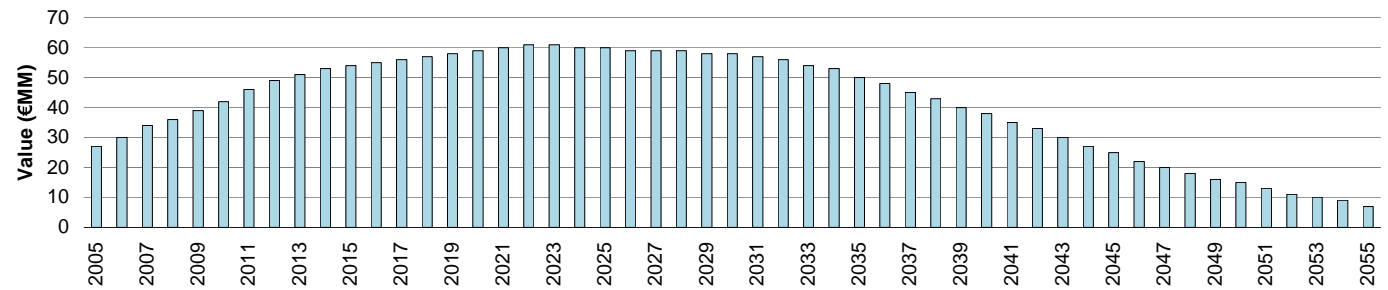
Source Morgan Stanley – for illustrative purposes only

# Understanding the Change

- Pension liability cashflows tend to have a “humped” shaped with a “hump” (or peak) in about 20 years and finally a “tail” of smaller cashflows after 50+ years
- The sensitivity of the PV of each year’s cashflow to discount rates depends on:
  - **Timing:** when the cashflow takes place
  - **Size:** the amount of the cashflow
- In general:
  - The further the cashflow is from the present, the more sensitive it is
  - The bigger the cashflow, the more sensitive it is
- The cashflows in the “hump” have the greatest sensitivity to a parallel shift in the yield curve

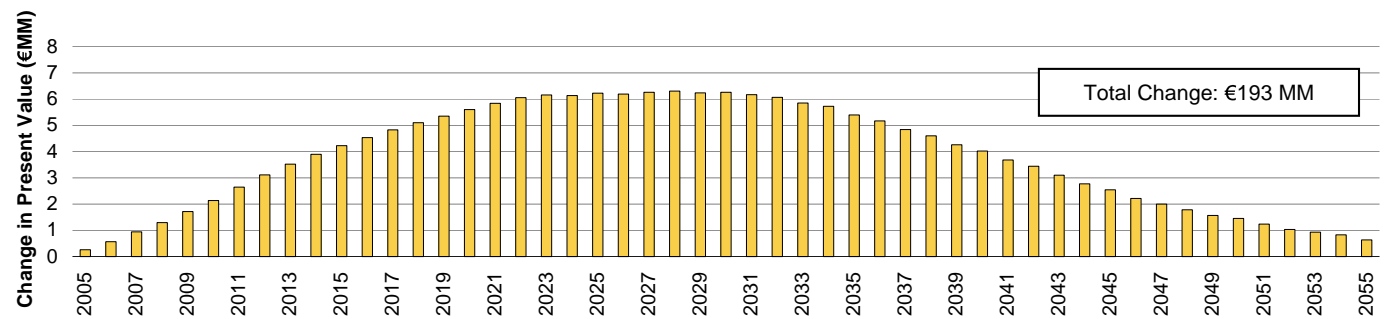
## Projected Pension Cashflows (Assuming 2% inflation)

### Original Cashflows



Source Morgan Stanley – for illustrative purposes only

## Change in Present Value of Each Cashflow



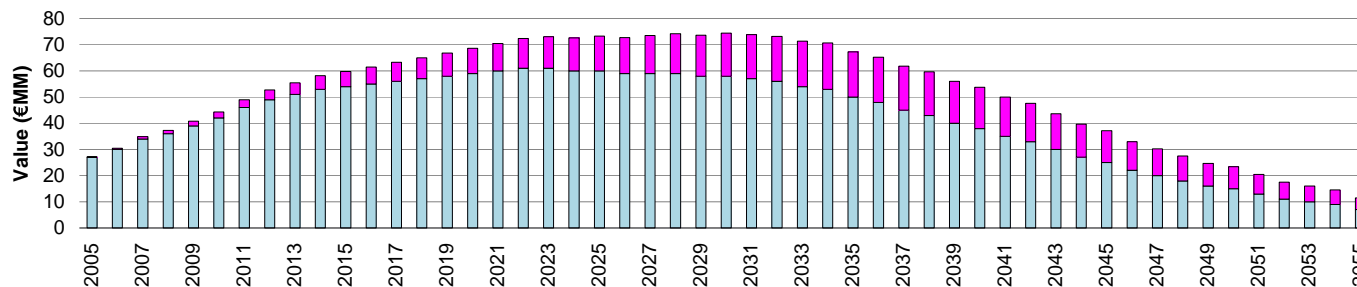
Source Morgan Stanley – for illustrative purposes only

# What if Inflation Expectations Rise?

- These projected pension cashflows assume a particular rate of inflation expected in the future (2% in this case)
- If this expected inflation level increases, that means a higher cashflow
  - ... and a higher PV of liabilities!
- A 1% rise in the inflation expectation increases the total PV of liabilities by €188 MM to €1,222 MM
- This needs to be factored into the interest rate sensitivity analysis ...
  - ... because larger cashflow amounts implies a greater sensitivity to interest rates

## Projected Pension Cashflows

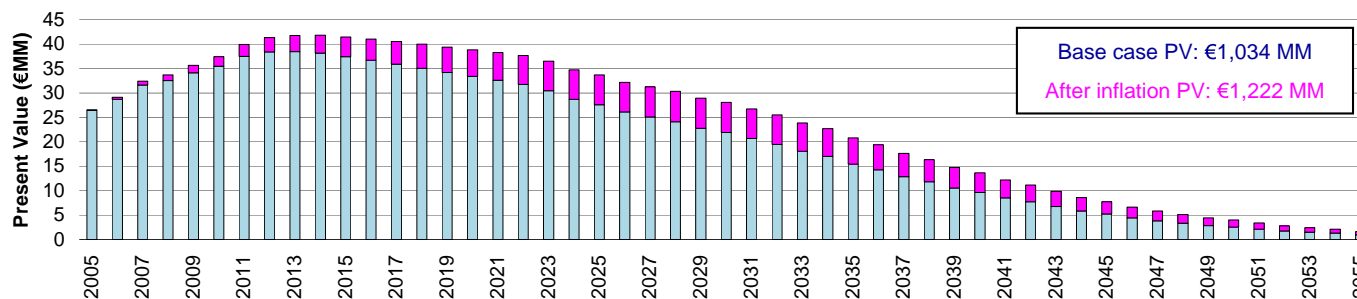
Blue Bars are Original Cashflows at 2% inflation, Incremental Purple Bars are due to Inflation increasing by 1%



Source Morgan Stanley – for illustrative purposes only

## Present Value of Each Cashflow

Blue Bars are Original Cashflows at 2% inflation, Incremental Purple Bars are due to Inflation increasing by 1%



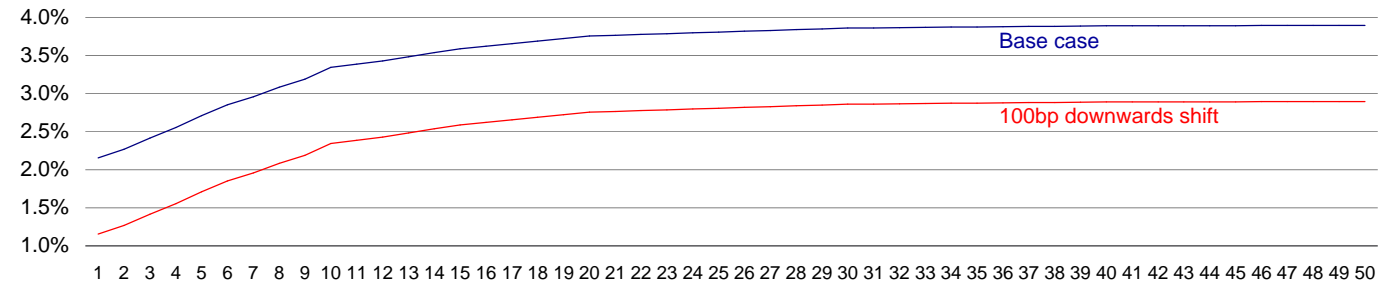
Source Morgan Stanley – for illustrative purposes only

# Increasing Inflation Magnifies Sensitivity

- Increasing the inflation assumption will result in higher projected cashflows and PV of cashflows
- The sensitivity of the PV of these cashflows to the yield curve will now also be increased
  - Sensitivity to a parallel shift is higher at every point (see green bars)
  - Total sensitivity to a parallel shift was €193 MM with the original inflation assumption
  - Total sensitivity goes up to €245 MM assuming 1% higher inflation
- Inflation is clearly something which needs to be factored into the equation when analysing pension liability risk

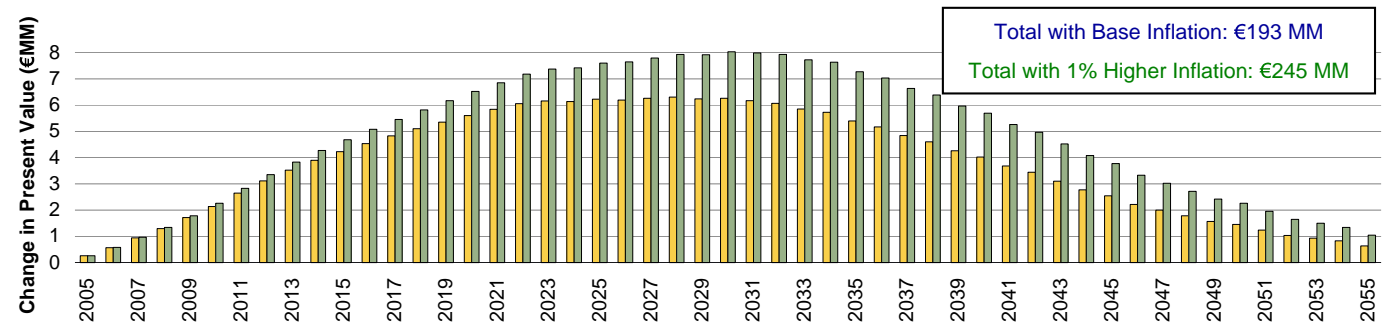
## Parallel Shift in the Yield Curve

Base case: European Swap Rate, 100bp downwards shift



Source Bloomberg – Closing yields 5 June 2005

## Change in Present Value of Each Cashflow (Original and with 1% Higher Expected Inflation)



Source Morgan Stanley – for illustrative purposes only

# What is Duration?

A Measure of Change in PV to a Parallel Shift in Yields

- PV of pension liabilities is €1,034 MM using the base case yield curve, it increases to €1,227 MM if yields shift down 100bps (parallel shift):

- €193 MM change
- 19% change in PV

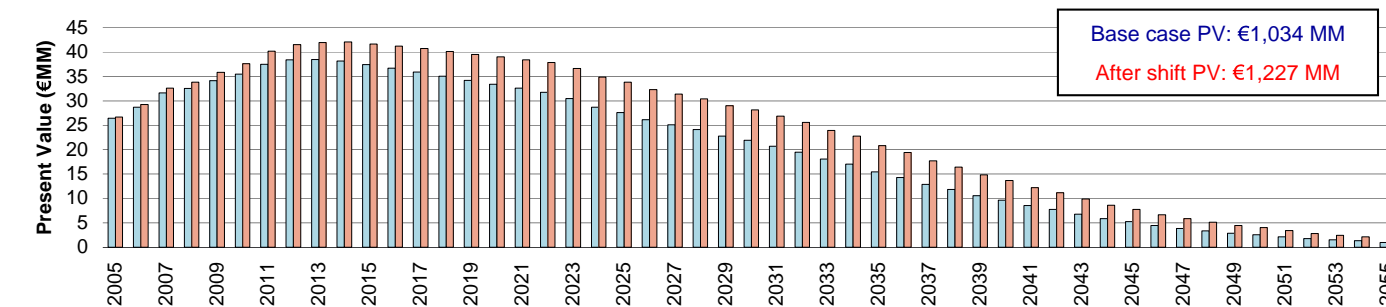
- Duration is the most common measure of sensitivity to changes in interest rates

- Duration = rate of change of PV when yields change
- Liabilities duration is about 19 (18.64) in this example
- i.e. Each 1bp change in interest rates results in a 19-fold change in PV
- e.g. 1% fall in rates implies a 19% increase in PV
- $193 = 18.64 \times 1,034 \times 1\%$

- Duration is also used as a measure of average time period to cashflow payment (weighted by the PV of each payment)

- Duration is 19 years

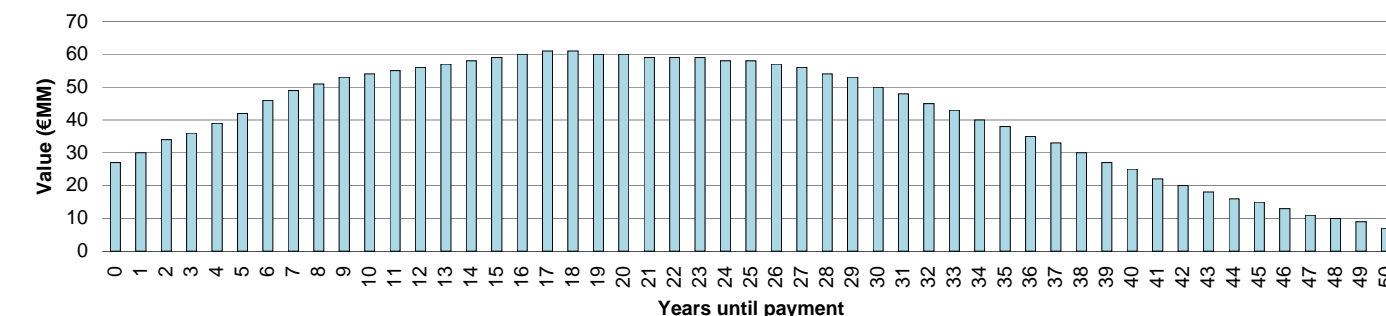
## Present Value of Each Cashflow (Base Case and Parallel Shift)



Source Morgan Stanley – for illustrative purposes only

## Projected Pension Cashflows (Assuming 2% inflation)

Original Cashflows



Source Morgan Stanley – for illustrative purposes only

Notes

1. Technically duration is only a good measure of small changes in interest rates

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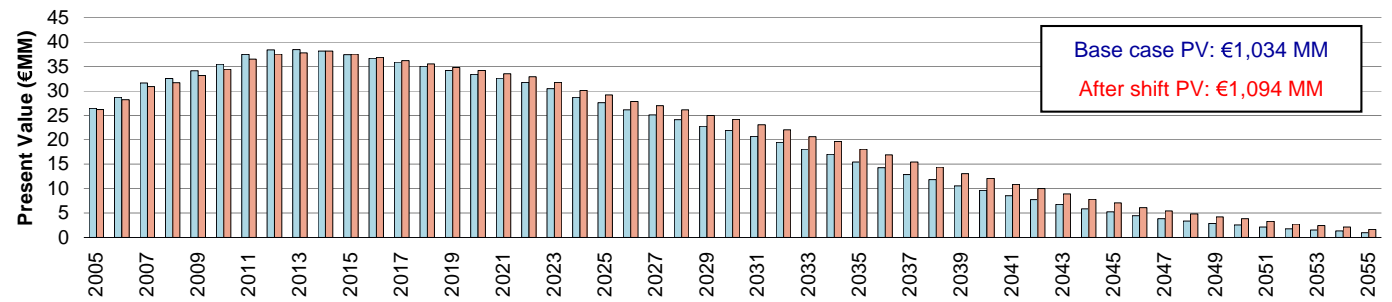
Interest Rate and Inflation Sensitivity

# What is Convexity?

A Measure of Change in PV to a Change in Shape of Yields

- Duration only captures the change in PV due to a parallel shift in yields
  - It may over or underestimate the change if the yield curve changes shape
- This is because the different changes in yields (i.e. the shape change) will affect cashflows at different points in time differently
  - due to the size and timing of these cashflows
- The higher the convexity of a series of cashflows, the more sensitive it is to changes in the shape of the yield curve
- Discounting at a single rate of interest may mask the impact of a change in shape of the yield curve
  - Liabilities may appear to be unaffected while assets are significantly impacted
- Important to consider the impact of shape changes on bond assets!

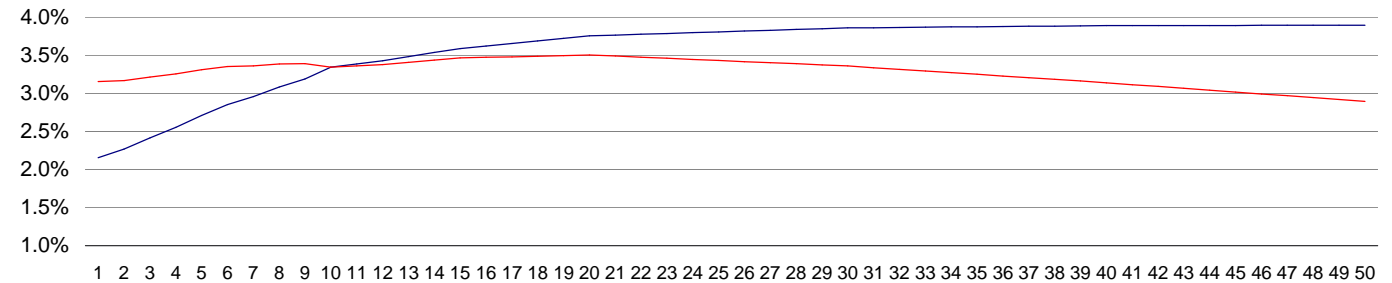
Present Value of Each Cashflow (Base Case and Inversion)  
Discounted at the Relevant Yield from the Yield Curve



Source Morgan Stanley – for illustrative purposes only

Inversion – Short End Moves Up and Long End Moves Down

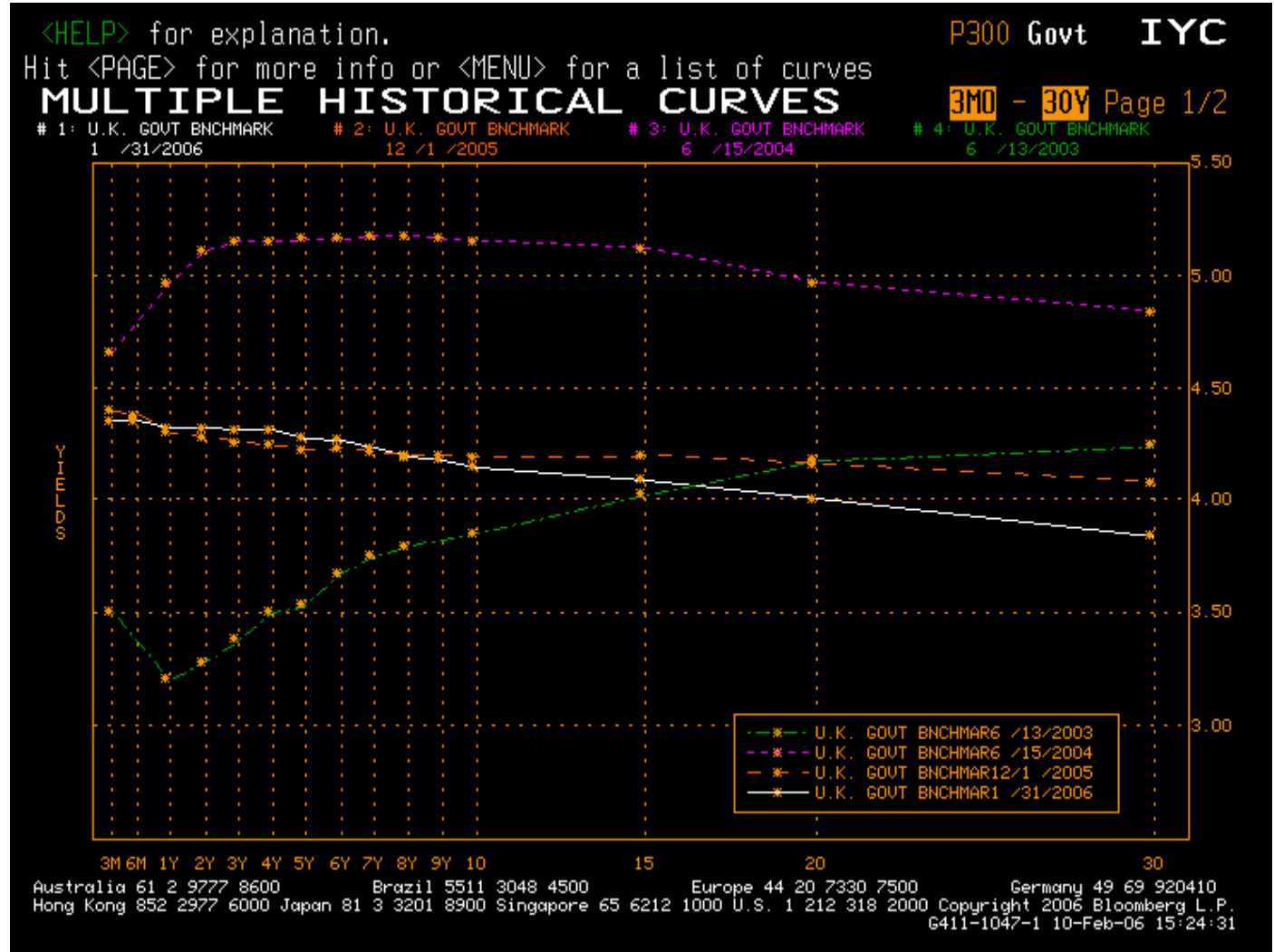
Base case: European Swap Rate, 100bp Shift Up on Short End and Down on the Long End (“Inversion”)



Source Morgan Stanley – for illustrative purposes only

# Shape Changes in Practice

Lessons from the Past





Section 3

Assets - Do They Offset This Sensitivity?

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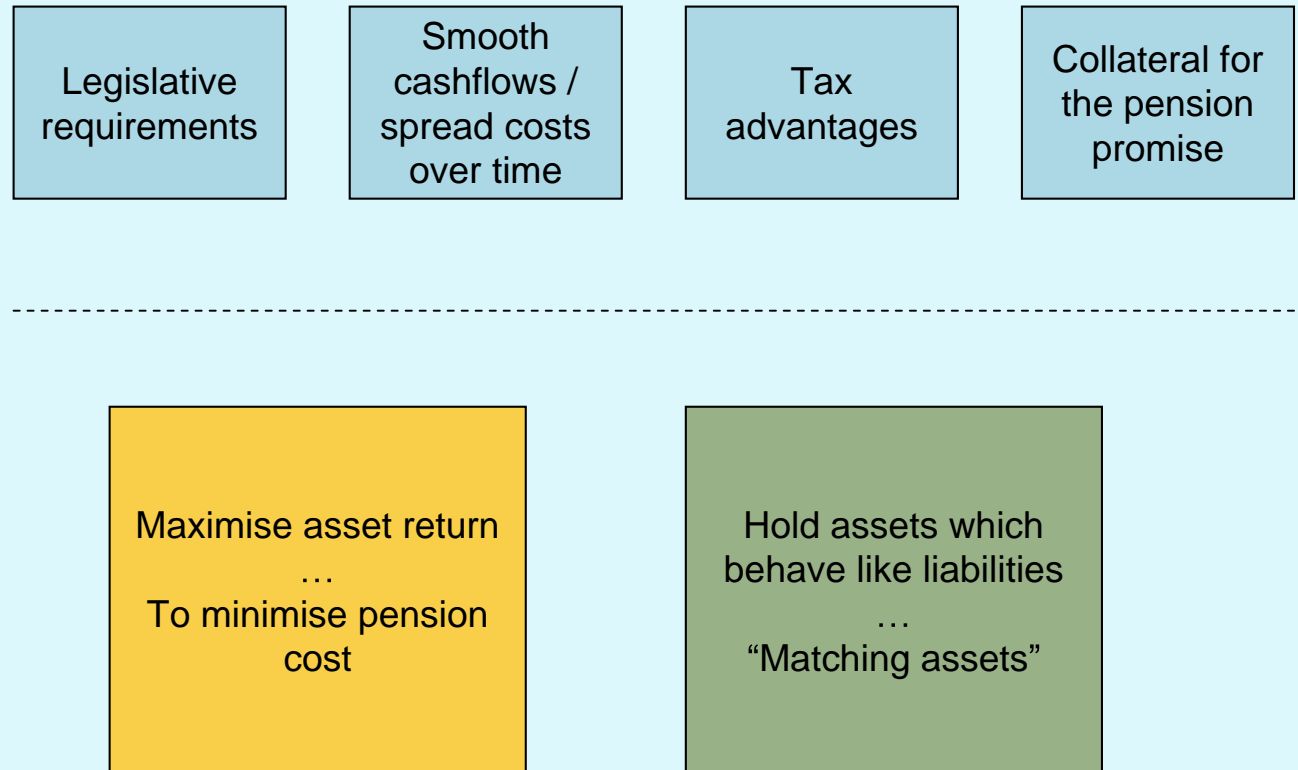
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## Assets - Do They Offset This Sensitivity?

# Why Do Pension Funds Hold Assets?

















## And How Are Assets Allocated?

- Pension funds hold assets for a number of reasons
- The asset allocation decision seeks to balance choosing assets which:
  - maximise expected returns (to minimise pension costs), and
  - behave like liabilities (to minimise the risk of not being able to pay pensions)
- These are conflicting desires because assets which behave like liabilities (e.g. bonds) tend to have comparatively lower expected returns
- Matching assets has become more important due to new legislative and regulatory requirements globally



# Asset Sensitivity to Interest and Inflation Rates?

- We have highlighted the significant impact of interest rates and inflation on the PV of liabilities
- Pension funds can offset this impact by holding assets which react in an equal, but opposite way
  - e.g. as PV of liabilities increases if yields fall, hold assets which grow in value when this happens (e.g. bonds)
- Pension funds need to analyse the short and long term sensitivity of their assets to interest rates and inflation rates

Sensitivity of Assets Short Term and Long Term		Govt. Fixed Income Bonds	Govt. Index-Linked Bonds	Corporate Bonds	Domestic Equities	Overseas Equities
Interest rate sensitivity (Short Term)						
Inflation rate sensitivity (Short Term)						
Interest rate sensitivity (Long Term)						
Inflation rate sensitivity (Long Term)						

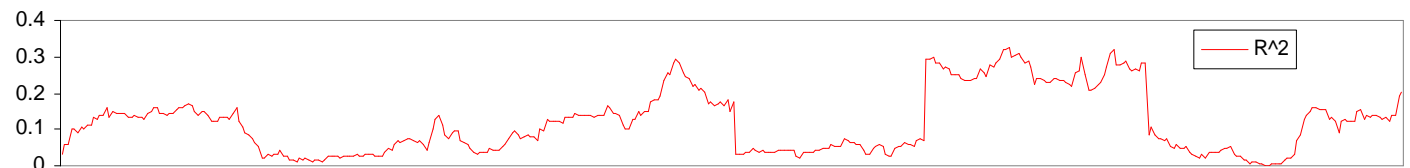
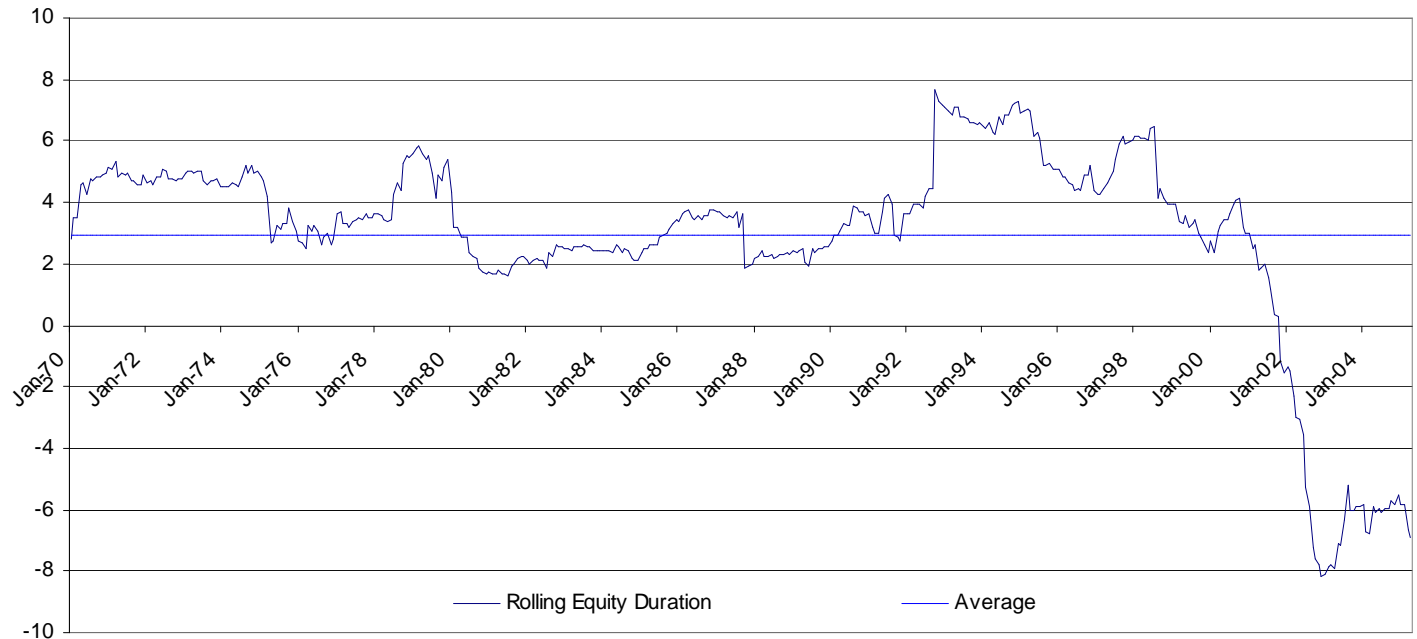
# Don't Count on Equities for Duration

Equities are a Poor Hedge for Interest Rate Exposure

- On average, equity has had a statistical duration of about 3 years.
- However, duration varies considerably and is “noisy” over time
- In recent periods, when pension plans needed duration, equity duration was negative.
- This analysis is based on US equity data, similar results can be seen in Europe

## 5-year Rolling Equity Duration

Jan 1970 – Apr 2005



**Notes**

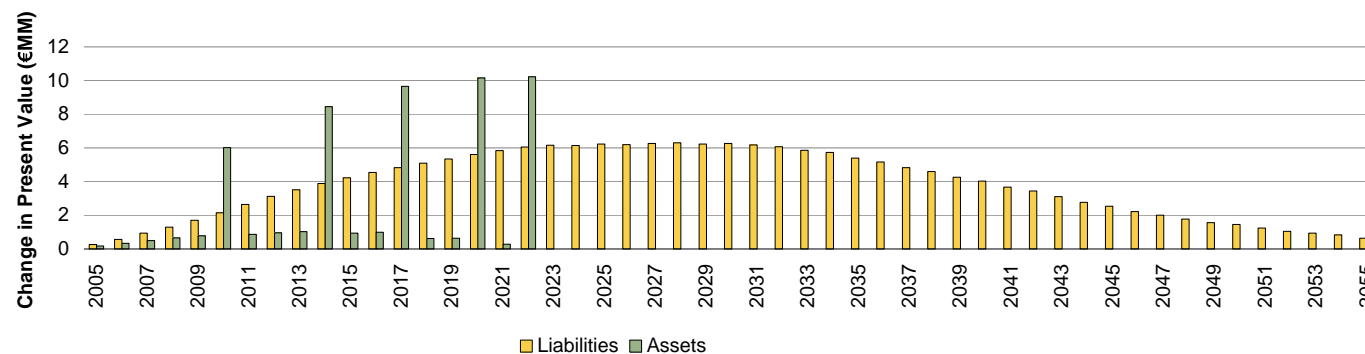
1. Monthly analysis based on S&P Total Return and 10-yr Treasury rates.

# Putting Assets and Liabilities Together

## Understanding the Offsetting Impact of Assets

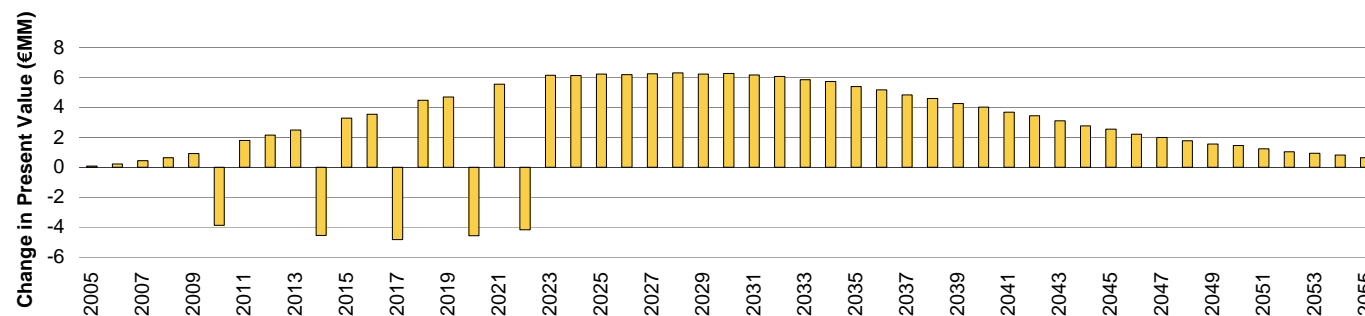
- We assume that about 50% of the fund's assets are invested in bonds
- These bond assets make payments earlier than the maturity of the liabilities
  - Duration of the bonds is much "shorter" than that of the liabilities
- Therefore the sensitivity to interest rates is concentrated at the short end
- The total asset sensitivity to interest rates is much smaller than total liability sensitivity
  - This is due to the shorter duration of the bond assets, and
  - ... only 50% of the fund's assets are in bonds
  - The remaining 50% is assumed to be in equities with duration zero
- Significant interest rate sensitivity still remains

### Change in Present Value of Liability and Asset Cashflow (Parallel Change in Yields)



Source Morgan Stanley – for illustrative purposes only

### Net Change in Present Value (Parallel Change in Yields)

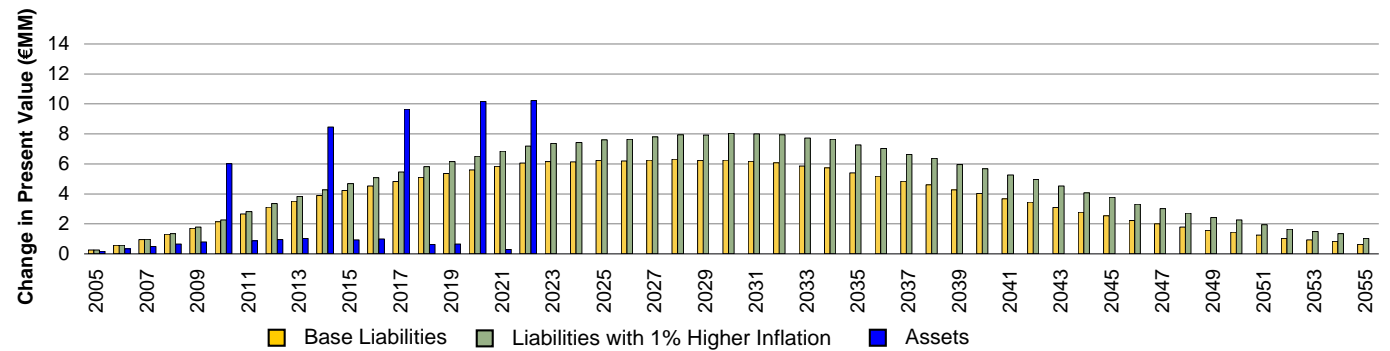


# Assets and the Impact of Inflation - I

## Non-inflation Linked Bond Assets

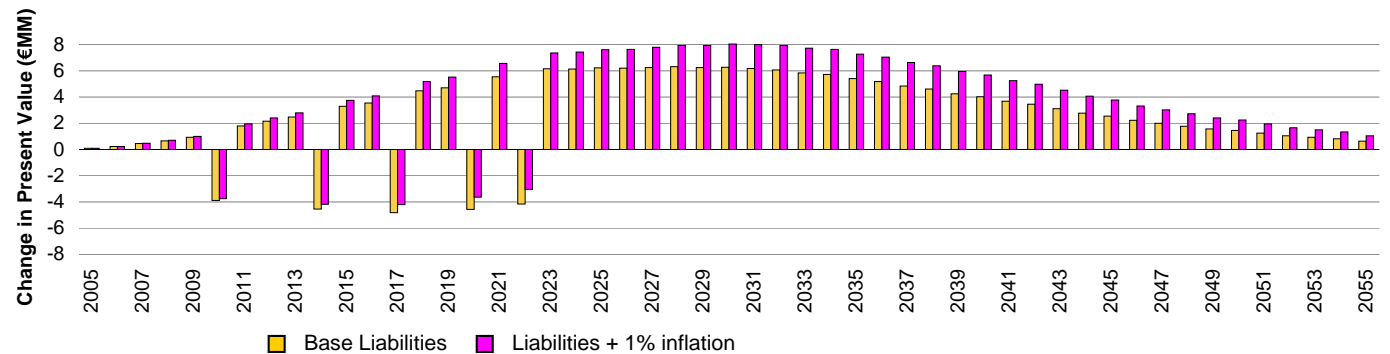
- Increasing the inflation assumption will result in higher projected cashflows and PV of cashflows
- The pension fund assets have some sensitivity to interest rates, but ...
  - ... if they are not also sensitive to inflation ...
  - ... the asset duration may magnify, rather than offset the interest rate sensitivity!

Change in Present Value of Each Cashflow (Original and + 1% Expected Inflation Liabilities and Assets)  
ALL BONDS NOT INFLATION LINKED



Source Morgan Stanley – for illustrative purposes only

Net Change in Present Value (Parallel Change in Yields)



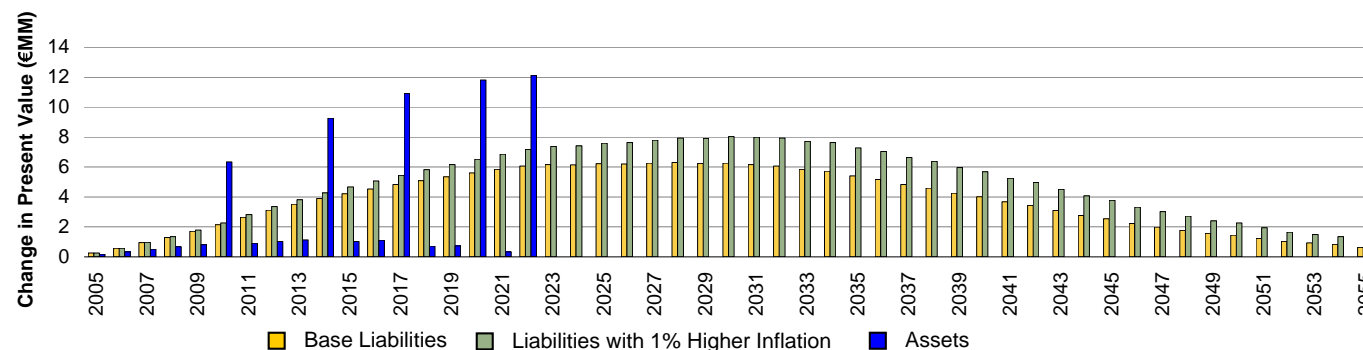
# Assets and the Impact of Inflation - II

## Fully Inflation Linked Bond Assets

- Even if the cashflows from the fund's bond assets were completely inflation linked (in the same way as the liabilities) ...
  - ... they would not offset the liabilities appropriately for two reasons:
    1. They are too early (the major impact of inflation is felt much later on in time)
    2. They are too large - the "lumpiness" of the principal repayments actually adds to interest rate risk (allowing for inflation) rather than offsetting it
- Even with inflation linked assets – there is still a significant gap!
- How can the pension fund bridge this gap?

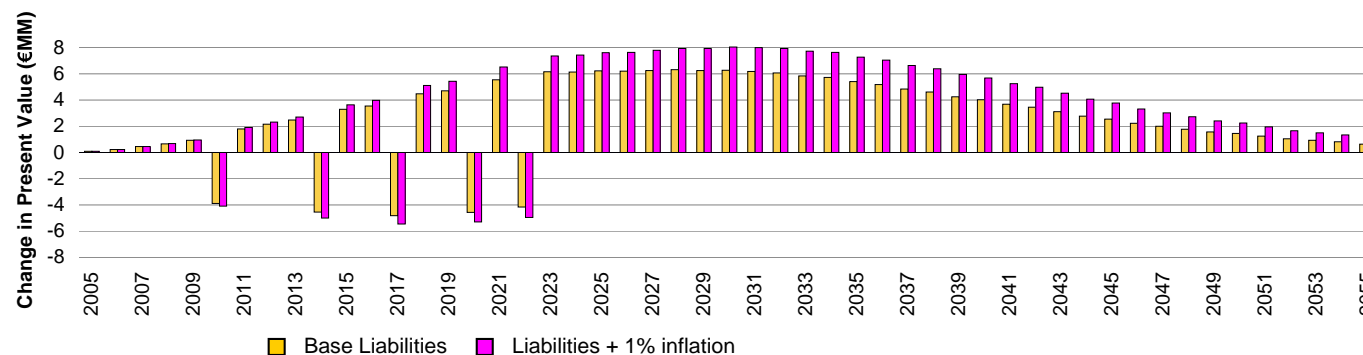
Change in Present Value of Each Cashflow (Original and + 1% Expected Inflation Liabilities and Assets)

ALL BONDS INFLATION LINKED



Source Morgan Stanley – for illustrative purposes only

Net Change in Present Value (Parallel Change in Yields)



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### Section 4

# Bridging The Gap Using Swaps

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# Swaps – the Concept



## Why Do Pension Funds Hold Mismatched Assets?

- **Most pension funds choose to have an asset/liability inflation mismatch**
- **Existing inflation linked assets are not ideal due to:**
  - scarce supply
  - low yields
  - concentration
  - lumpy cashflows
- **Pension funds are using swaps to manage risk**
- Ideally a pension fund would invest in assets which produced cashflows linked to inflation in the same way as these pension liabilities
- However, most pension funds have a significant inflation mismatch caused by investing in other assets
- This is usually a conscious decision due to the supply of inflation linked assets not being ideally suited to pension fund needs:
  - Relatively scarce supply of inflation linked assets
  - Low yields
  - Sector concentration
  - Lumpy cashflow profile (compared with relatively smooth pension cashflow)
- UK Pension Schemes are therefore now turning to interest rate and inflation derivatives, particularly swaps, as an efficient risk management tool to optimise risk and return (and eliminate unrewarded risks), e.g.:
  - Inflation swaps to manage the risk of higher inflation
  - Interest rate swaps to manage the risk of falling interest rates (re-investment risk)

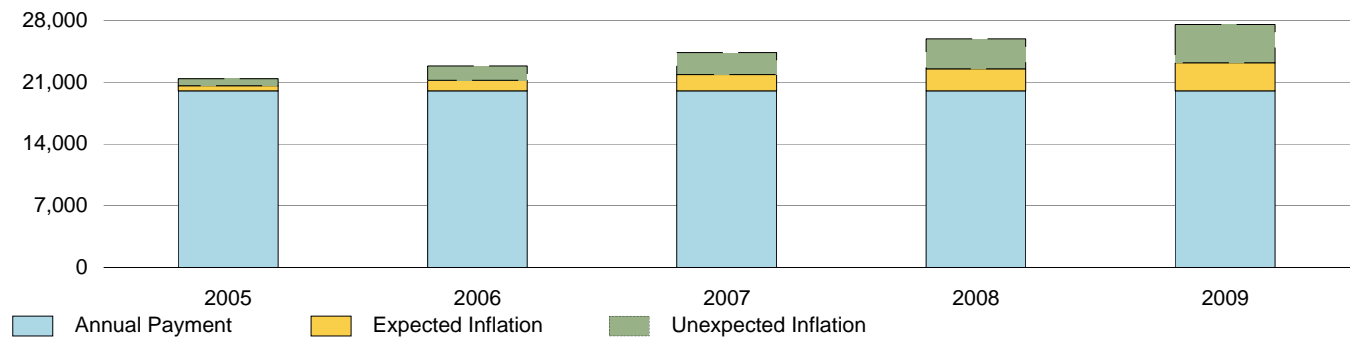
# Inflation Linked Pension Payments

## Pension Liabilities

- The pension fund needs to make inflation linked payments in the future
- While the actuary assumes a given level of expected inflation, in practice this could be higher (or lower)
- This inflation linkage is due to the benefits being linked to price and wage inflation
- The value of these pension liabilities will increase if inflation is higher than expected

### Projected Pension Cashflows over Next Five Years

Unknown Future Inflation Makes Cashflows Uncertain



### Inflation Linkage of Liability Cashflows

- The fund's liabilities are inflation linked due to:
  - Inflation linkage of pensions in deferment
  - Wage inflation linkage for expected pensions of active members
  - Inflation (LPI) linkage of pensions in payment

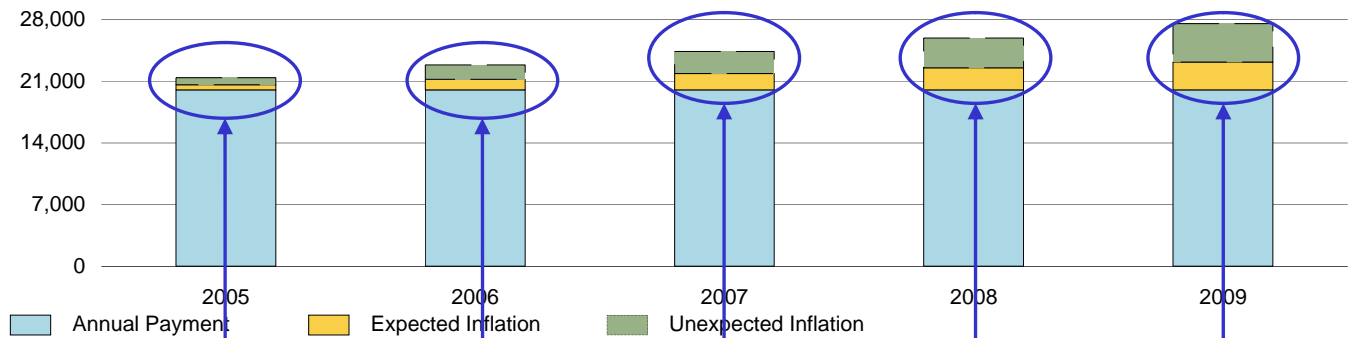
# Inflation Swaps

Transform Uncertain Inflation Payments into Certain Fixed Payments

- The pension fund can use inflation swaps to remove the inflation sensitivity of future pension payments
- Inflation swap involves:
  - Morgan Stanley pays pension fund actual inflation (expected + unexpected)
  - Pension fund pays a pre-agreed fixed payment
- This transforms the projected pension payments from being uncertain to being certain:
  - at least from the point view of inflation exposure
  - other sources of uncertainty still apply (longevity etc.)
- The pension fund is now free to invest in a wider range of assets instead of being forced to hold index-linked assets

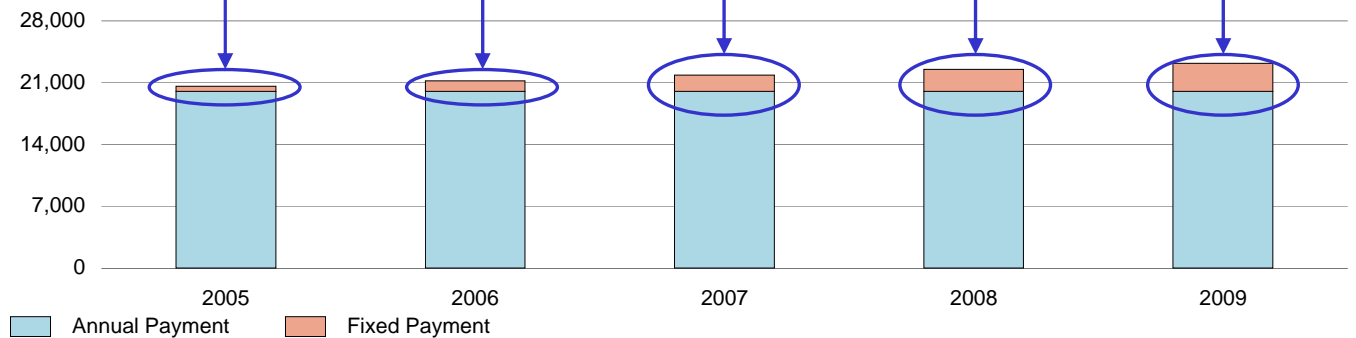
Projected Pension Cashflows over Next Five Years

Unknown Future Inflation Makes Cashflows Uncertain



Projected Pension Cashflows over Next Five Years

Cashflows Now Certain



Inflation Swap

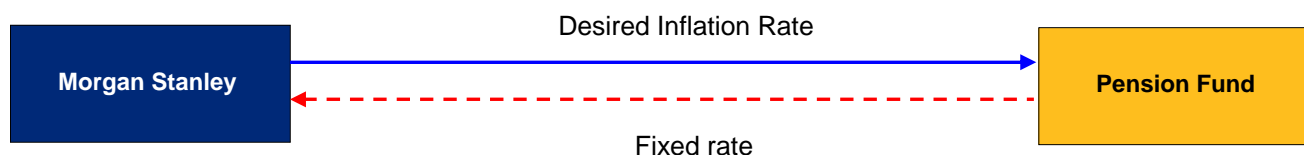
# Tailored Inflation to Pension Liabilities

Receive the Exact Inflation Promised on Pension Benefits

- The pension fund can receive inflation tailored to whatever has been promised on pension liabilities, e.g.
  - RPI inflation
  - RPI inflation with floor 0%
  - LPI (0,5%) inflation
  - LPI (0,3%) inflation, etc.
- In each case, the pension fund transforms this uncertain inflation component into a fixed, pre-agreed payment
- All cashflows are now effectively fixed and certain
  - Apart from uncertainty for “usual” projection factors such as mortality and other demographic changes

## Inflation Swap

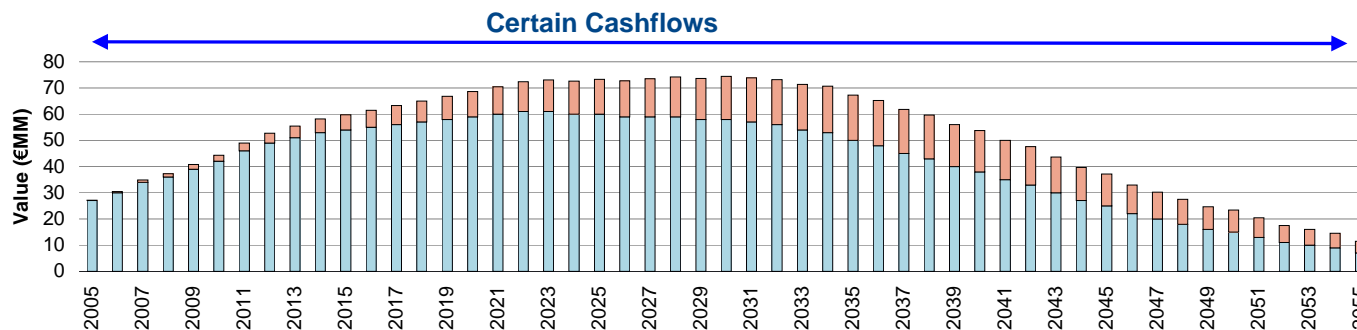
Pension Fund receives the exact inflation it needs to pay liabilities (and pays a fixed rate)



e.g. Pension Fund Receives **LPI (0,5)** each year from Morgan Stanley  
 Pension Fund Pays a fixed rate in exchange

## Projected Pension Cashflows

Cashflows Now Certain



Source Morgan Stanley – for illustrative purposes only

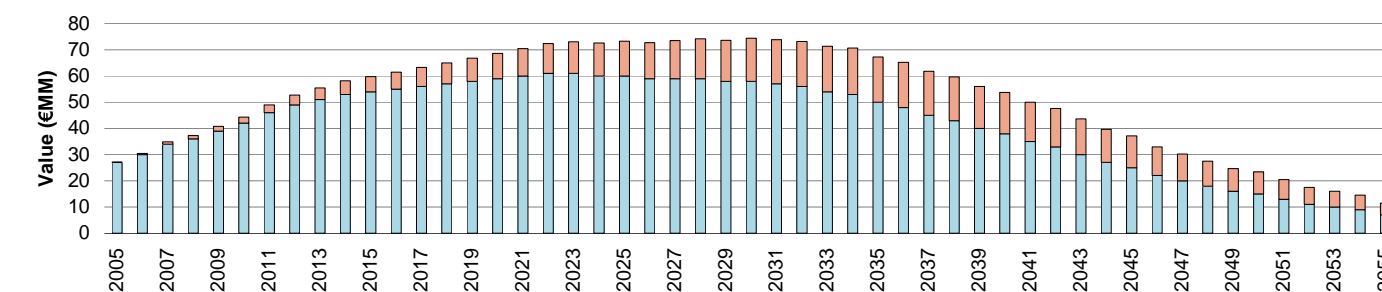
# Interest Rate Risk Remains

Pension Fund still faces interest rate risk after swapping away inflation risk

- Even if the pension fund invests in a bond portfolio which is broadly similar to these fixed liabilities, there will still be significant interest rate sensitivity
- A matched or immunised position is characterised by zero sensitivity (i.e. no change in present value for a change in yields)
- Interest rate swaps can be used to address the remaining interest rate mismatches at each point in time
- The pension fund enters into a swap which has an equal, but opposite, sensitivity to interest rates at each point
  - This protects the pension fund from duration mismatches (parallel shifts in the yield curve), and ...
  - ... also from changes in the shape of the curve (rotations, etc.)

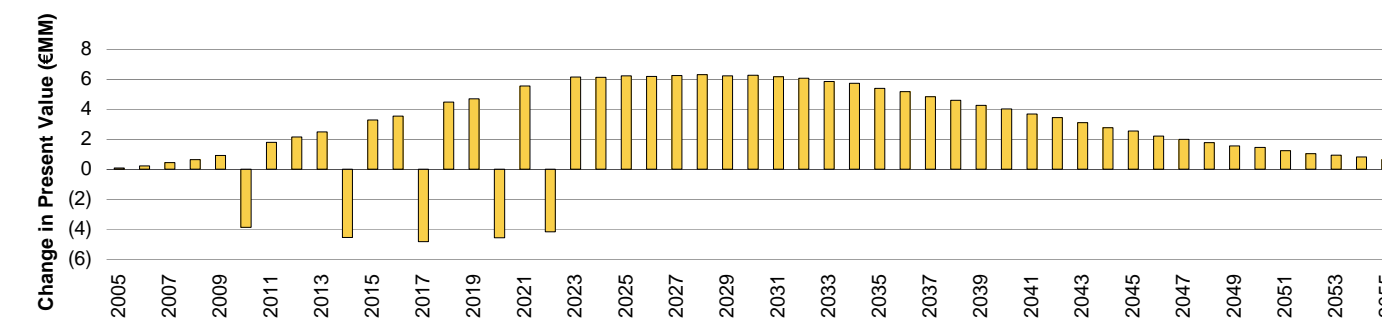
## Projected Pension Cashflows

Cashflows Now Certain



Source Morgan Stanley – for illustrative purposes only

## Net Change in Present Value (Parallel Change in Yields)



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Bridging The Gap Using Swaps

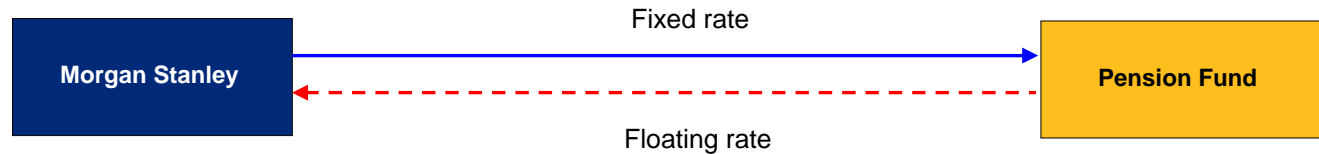
# Using Interest Rate Swaps

Offset liability risk with swaps with an equal, but opposite sensitivity to changes in yields

- In a swap, one counterparty pays a floating rate of interest in exchange for a fixed rate of interest
- This swap is worth more to them if interest rates fall:
  - i.e. they expect to pay less than they receive (as they receive a fixed amount)
- This swap is worth less to them if interest rates rise:
  - i.e. they expect to receive less than they pay (as they pay a greater amount)
- This swap is a natural hedge for pension fund liabilities which rise in value when interest rates fall (and vice versa)
- The pension fund can exactly offset liability risk by entering into a series of swaps with equal, but opposite, sensitivity to their liabilities

Interest Rate Swap

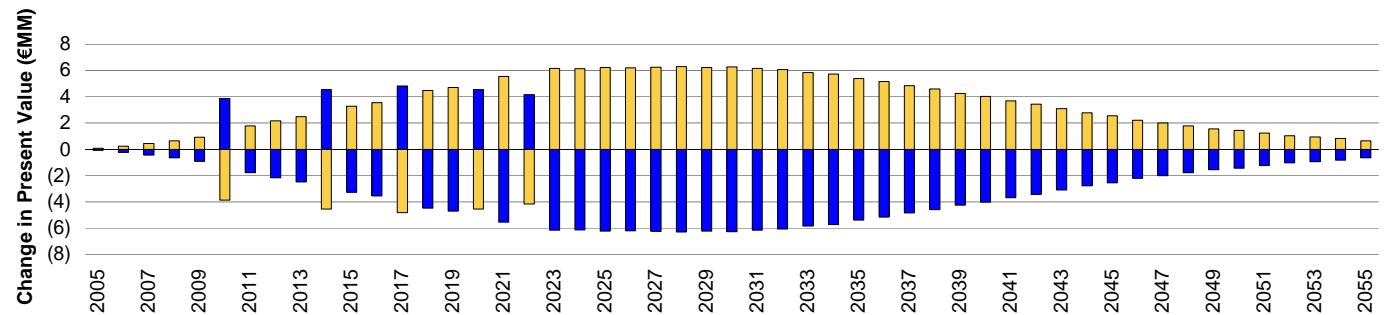
Pension Fund enters into a swap which has equal but opposite interest rate sensitivity to its liabilities at each point



e.g. Pension Fund Receives **4.5%** each year from Morgan Stanley  
 Pension Fund Pays **LIBOR** in exchange

Net Change in Present Value (Parallel Change in Yields)

Interest rate risk neutralised at each point in time

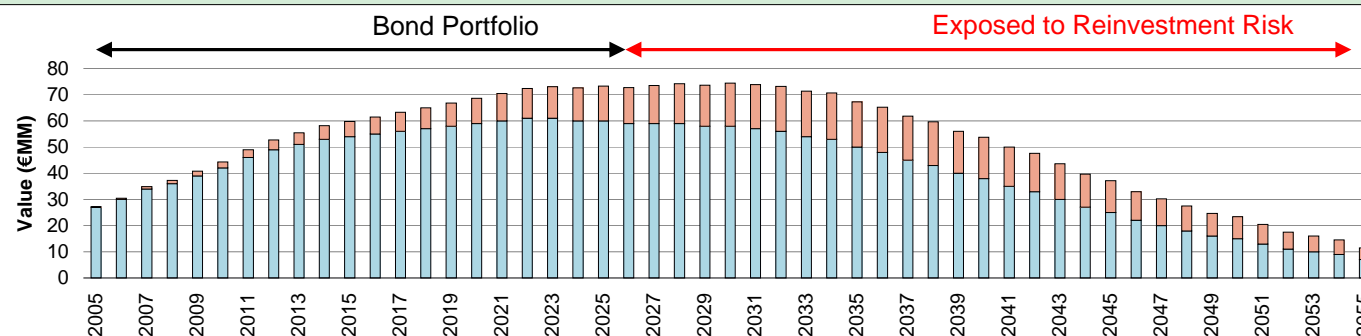


# Another Way of Thinking about it

## Dealing with Reinvestment Risk

- Projected pension liabilities stretch out longer than 60 years in most cases
- Most fixed income (bond) investments rarely extend out beyond 30 years
- Pension fund is unlikely to invest all assets in 30 year bonds, so:
  - serious reinvestment risk
  - i.e. danger of yields (interest rates) falling lower than current levels (i.e. bonds become more expensive)
- If bonds become more expensive in the future (when existing bonds mature) ...
  - ... then the scheme’s assets may be insufficient to buy more bonds to match future liabilities
- Pension fund needs some way to lock into a future yield (interest rate) today

### Projected Pension Cashflows



Source Morgan Stanley – for illustrative purposes only

### Reinvestment Risk

- Pension fund bond portfolio is likely to mature much earlier than pension fund liabilities
- If yields (interest rates) fall between now and maturity of existing bonds, then bonds will be relatively more expensive to buy in the future:
  - pension fund is exposed to “reinvestment risk”
  - increases the chance that scheme’s assets could be insufficient to purchase enough bonds in the future to provide for future liabilities

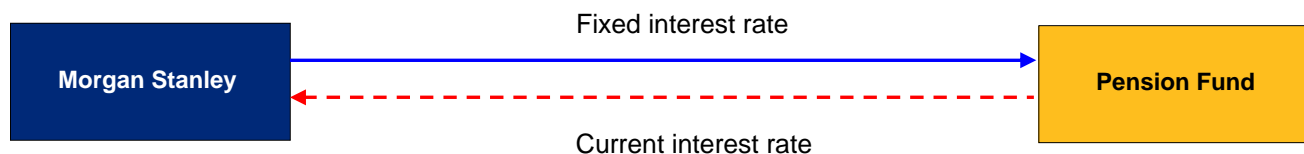


# Interest Rate Swaps to Lock in Future Rates

- Forward starting interest rate swap is an agreement which guarantees a fixed interest rate over a future period
- It involves:
  - Morgan Stanley pays pension fund a fixed rate for a future period
  - Pension fund pays the current interest rate at that time
- If interest rates fall, this agreement has a positive value to the pension fund:
  - this value offsets the higher cost of buying bonds
  - i.e. swap offsets reinvestment risk

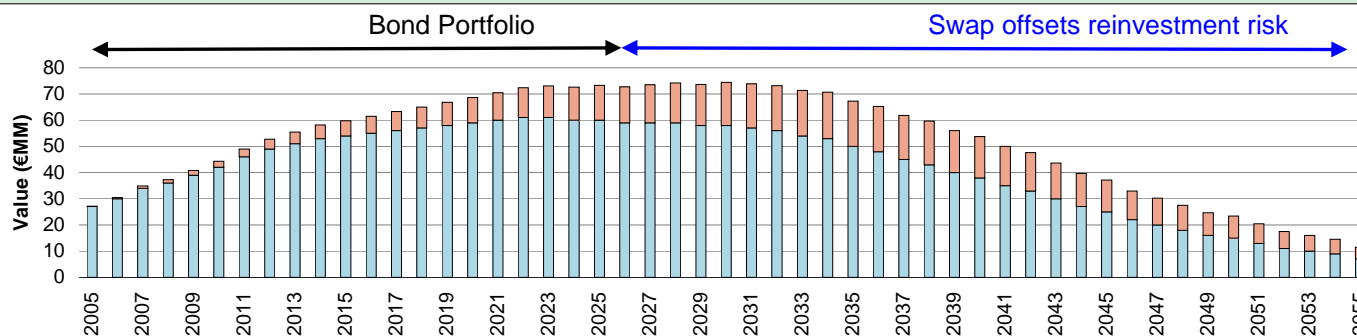
## Forward Starting Interest Rate Swap

AWG Pension Fund receives the market fixed rate (as determined today) and pays the floating



e.g. Pension Fund Receives 3.5% paid semi-annually each year from 2015 to 2025  
 Pension Fund Pays the current interest rate (LIBOR) each year in exchange

## Projected Pension Cashflows



Source Morgan Stanley – for illustrative purposes only

## Possible Levels of Matching

### Swap based solutions

- **Different levels of matching solutions can be used**
- **Solutions include:**
  - Duration matching
  - Cash flow matching
  - Inflation matching
- **Typically a solution may include elements of all three e.g.:**
  - Cashflow match early payments
  - Duration and inflation match later payments

Swaps can be used to partially reduce risk (duration matching) or completely eliminate risk (cash flow matching).

#### **Duration matching (either overall or using “buckets”)**

- Most pension schemes’ assets are less sensitive to interest rates than their liabilities (i.e. the assets have lower duration)
- Interest rate swaps and swaptions can be used to extend the duration of the assets so that the scheme’s assets and liabilities have the same duration
- This will protect the scheme from a parallel shift in the yield curve

#### **Cash flow matching**

- The cashflows generated by the most schemes’ assets differ in size and timing from those required to pay liabilities
- Interest rate swaps, swaptions and inflation swaps can be used to match up these cashflows
- This will protect the scheme from parallel shifts and changes in the shape of the yield curve.

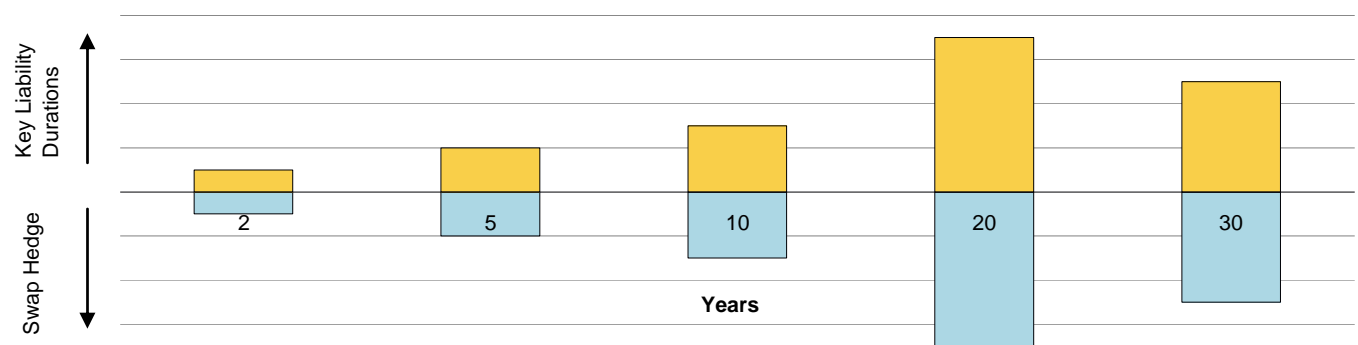
#### **Inflation matching**

- Most pension scheme liabilities tend to increase with inflation increases (due to inflation linked pensions or other benefits)
- The cashflows generated by the most schemes’ assets may have little if any explicit linkage or correlation with inflation
- Inflation swaps can be used to match the inflation element of these liabilities
- This will protect the scheme from changes in future inflation (relative to expectations) and asset growth failing to keep pace with inflation.

# Key Duration Buckets

- Pension funds may not want (or need) the precision of neutralising the interest rate sensitivity in each and every liability cashflow
- A very similar effect can be achieved by matching the duration of the liabilities to that of the assets by “buckets” by duration
- Swaps are applied over each of these buckets, thereby achieving a close, but not perfect, match of asset and liability sensitivity to interest rates
- This achieves a very similar effect and requires less rebalancing if/when liability cashflow projections change

Key Duration Buckets



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## The Actuarial Profession

### Section 5

# Practicalities of Implementation and Costs

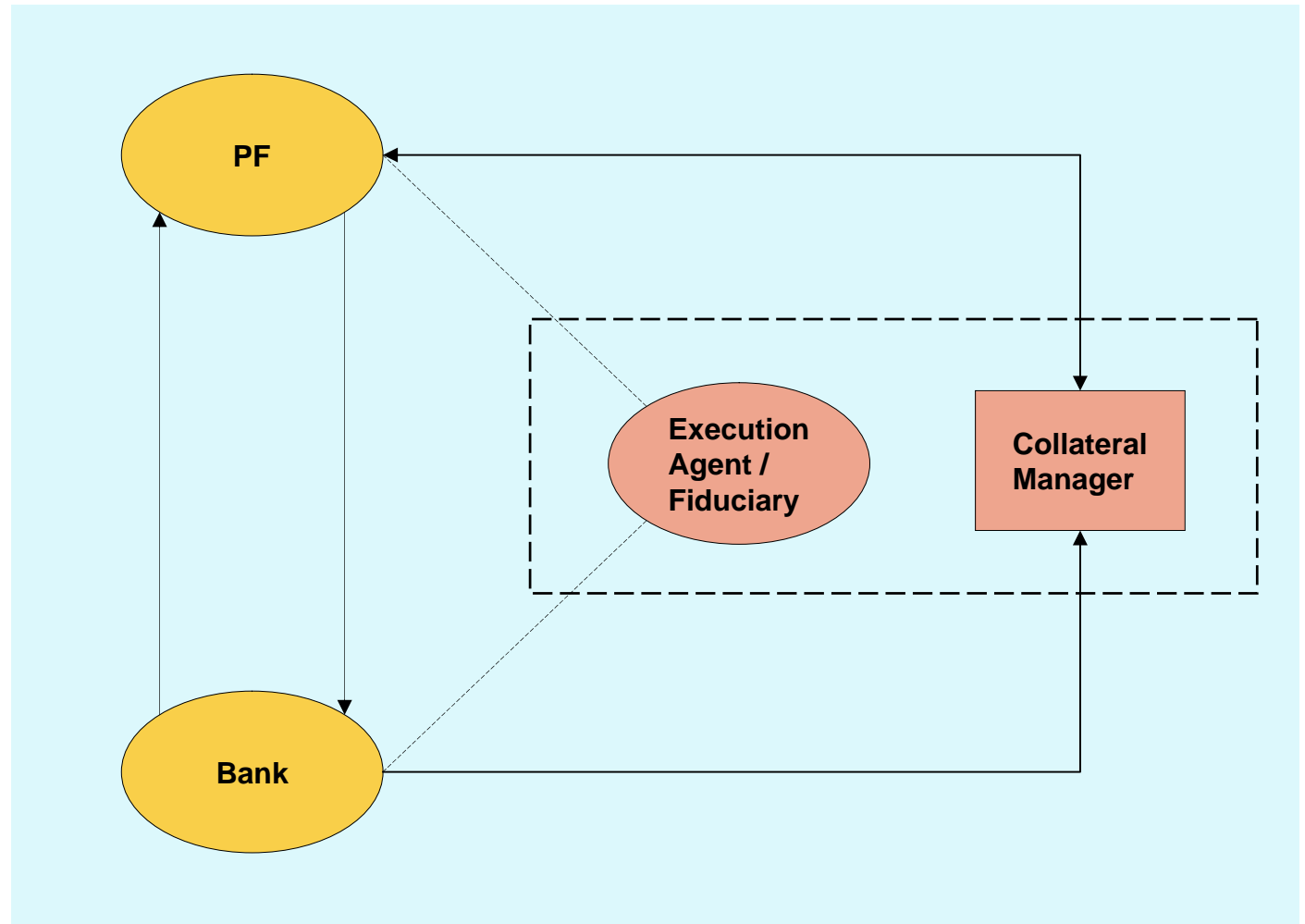
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# Implementation of a Solution

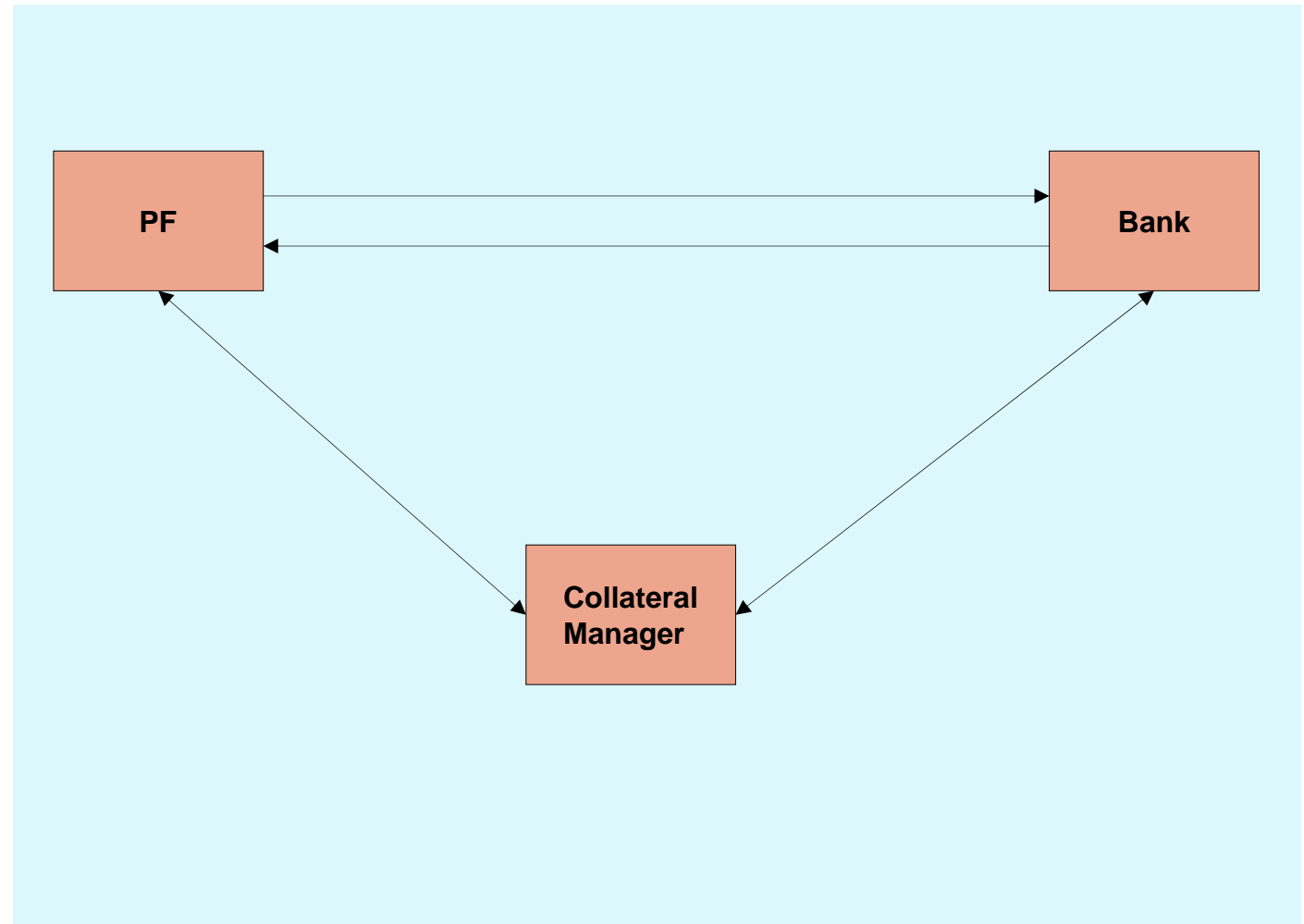
## Roles of Main Partners

- Key partners to solution are:
  - Pension Fund
  - Execution Agent / Fiduciary
  - Bank
  - Collateral Manager
- The Execution Agent / Fiduciary can also be the Collateral Manager



## Collateral Main Role

- Swaps and other derivatives involve agreeing to exchange cashflows with an investment bank
- By fully collateralising these agreements, pension fund can eliminate much of the counterparty risk
- This involves exchanging securities as collateral:
  - pension fund provides security when derivatives have value to the bank
  - bank provides security when derivatives have value to the pension fund
- The pension fund needs to mandate a collateral manager to take care of this security
- Discussed in further detail later in presentation



# Main Costs

## Mid-offer spread and Market Impact



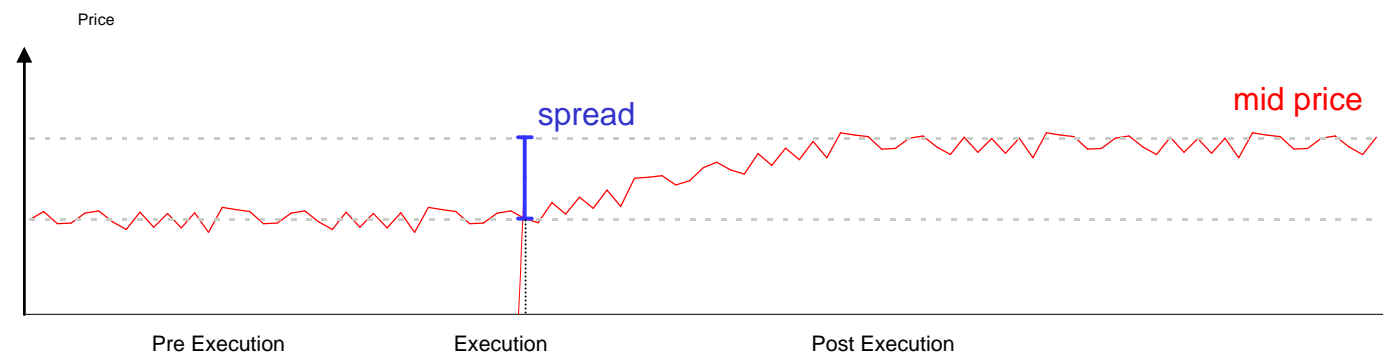
- Mid-offer spread
  - Difference between mid-price and price pension fund pays for swap
  - Interest rate swaps are very liquid and spreads are typically between  $\frac{1}{2}$  - 2 bps pa<sup>1</sup>
  - Inflation swaps are getting more liquid and spreads are typically between 3 – 6 bps pa<sup>1</sup>
  
- Market impact (mid price impact)
  - Buyer and seller action in the market will affect the price
  - Good execution is characterised by a small market impact
  - Confidentiality, experience and sensitivity is needed when executing longer dated and more tailored solutions
  - “Beauty parades” / competitive tenders are not appropriate and will negatively impact the price

### Notes

1. These are indicative spreads for Normal Market Size transactions – the spread would typically differ for a bigger transaction

# Inflation Swap Spreads

## Pricing Before and After Execution



## What are Spread Costs?

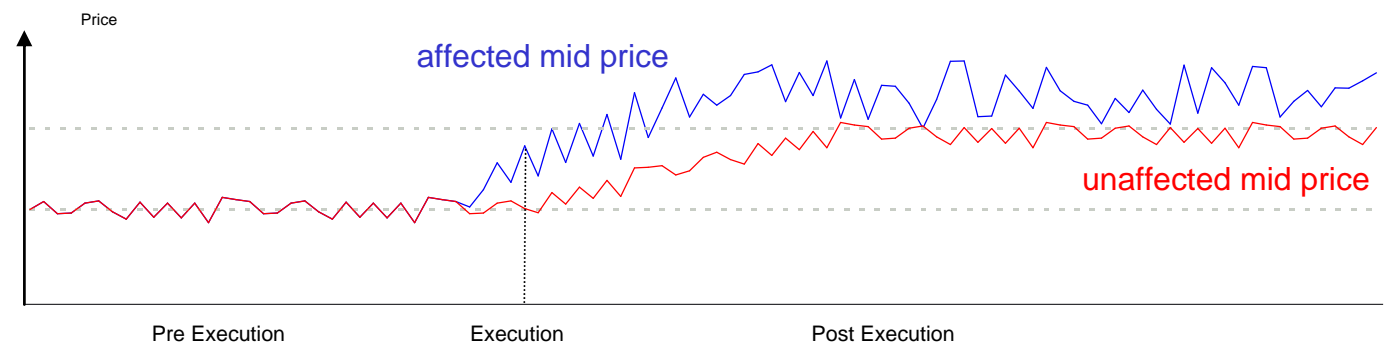
- If you enter an inflation swap, you pay a fixed rate to receive tailored inflation payments
- The mid-price is an indication of this fixed rate in the open market:
  - the actual price you pay will be higher by a spread from this mid
  - typical spreads are 3-10bps
- The spread is an explicit cost:
  - if you exit the inflation swap, you will receive a lower fixed rate to “close out” your position
  - this would crystallise the spread



# Market Impact

## Mid-price Impact

### Pricing Before and After Execution



### Factors Impacting Mid-Price

- The mid price is heavily affected by the way a trade is executed
- For example, using multiple counterparties would result in mid levels being higher than transacting with a single counterparty:
  - this is due to several counterparties trying to hedge the same risk at the same time
  - other players who were not included may also be influencing the market
- The cost of market impact can be much higher than the spread cost and is less obvious

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## The Actuarial Profession

### Section 6

# Helping Understand Employer Covenant

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# Global Pension Risk to the Balance Sheet

## Modelling the Balance Sheet

- Investment banks are experienced in measuring and modelling sponsor credit risk
- This is becoming more and more relevant, especially as pensions are now fully market-to-market
- This modelling framework is essential to understand the balance sheet impact of any strategies implemented to manage pension risk
- For example, we can model the potential impact of mark-to-market pension risk to the balance sheet of a corporate sponsor
  - we select an appropriate credit metric: eg. **Funds From Operations/Adjusted Net Debt**
  - “In Moody’s view, the A1 long-term rating category require strong cash generation with FFO/Adjusted Net Debt above 35%”<sup>1</sup>

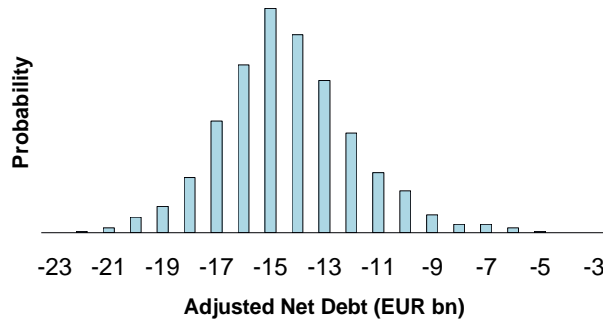
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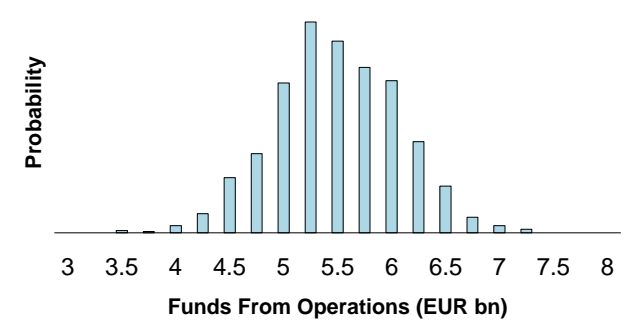
Funds From Operation/Adjusted Net Debt

- We model net debt and funds from operations separately and then combine them
- There is a 23% probability of this sponsor breaching the 35% FFO/Adjusted Net Debt threshold set by Moody's
- We can use this as a base case against which to measure any strategies to control pension risk

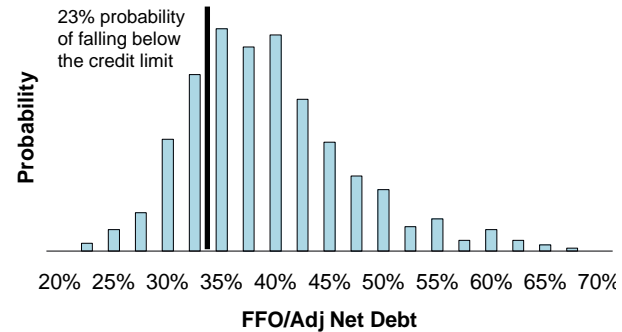
Projected Adjust Net Debt  
EUR bn end of 2006



Projected Fund From Operations (FFO)  
EUR bn end of 2006



Funds From Operation/Adjusted Net Debt  
end of 2006



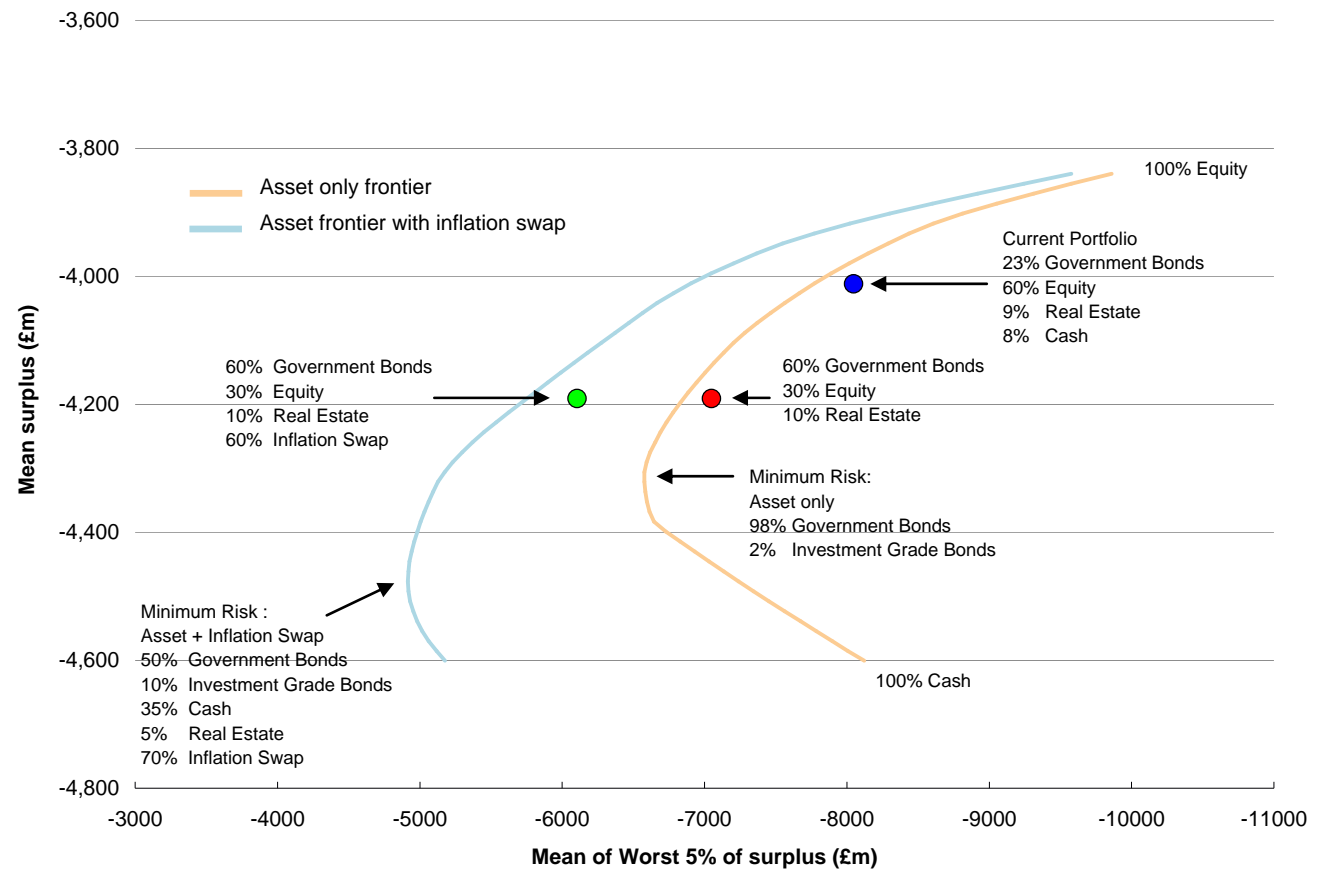
# Liability Efficient Frontier

End of 2006

- We consider ways to reduce pension risk
- The orange line shows the efficient frontier for an asset allocation optimisation while the blue line shows the efficient frontier also allowing for an inflation swap
- This pension fund can improve risk/reward efficiency firstly by reducing their equity holdings and secondly by overlaying an inflation swap
- While these charts show the improved investment efficiency of changing strategy, how will the corporate balance sheet be impacted?

## Efficient Frontiers

Asset allocation with and without an inflation swap



## The Actuarial Profession

## Helping Understand Employer Covenant

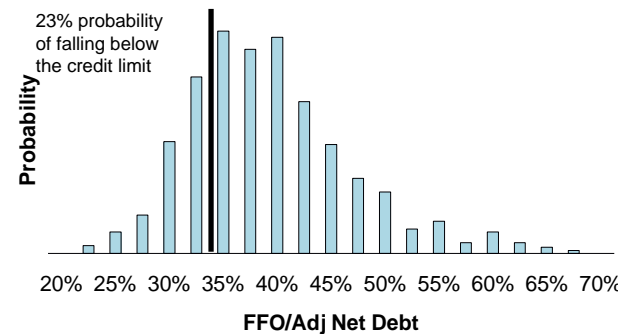
# Funds From Operation/Adjusted Net Debt

## The effect of alternative asset allocation and inflation hedging

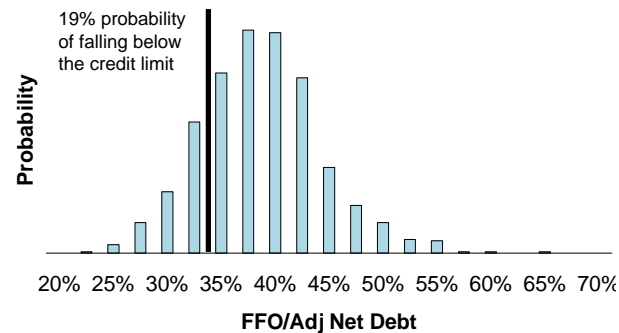
The graphs to the right show the probability distributions for the key Moody's credit metric, FFO/Adjusted Net Debt and the probability of having breached the 35% threshold by the end of 2006.

- The top graph represents the current portfolio
  - Probability of breaching Moody's credit limit of 23%
- The bottom left graph represents the Red portfolio
  - Probability of breaching Moody's credit limit of 19%
- The bottom right graph represents the Green portfolio
  - Probability of breaching Moody's credit limit of 16%
- Changing the asset allocation and overlaying an inflation swap significantly reduce the risk of breaking Moody's credit limit

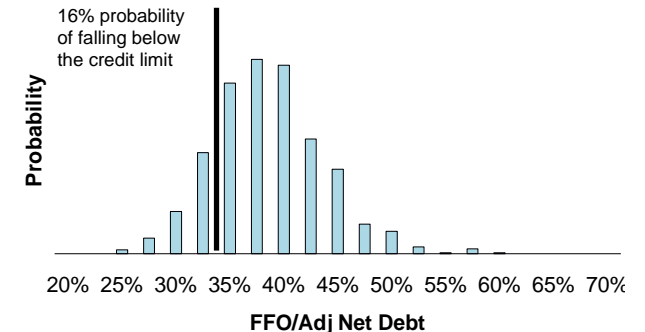
### Current Portfolio Funds From Operation/Adjusted Net Debt



### Red Portfolio (changing asset allocation only) Funds From Operation/Adjusted Net Debt



### Green Portfolio (overlay inflation swap) Funds From Operation/Adjusted Net Debt



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## The Actuarial Profession

### Section 7

## Summary: Banking Solutions

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# Summary

## Raising Funds and Contingent Assets

- Raise cash and inject funds directly into pension fund
- Raise funds but keep outside pension fund (ring-fence, escrow)
- Inject other assets into pension fund directly or via securitisation
- Letters of Credit

## Diversification and Adding Alpha

- Credit and credit derivatives
- Sell equity outperformance (call options)
- Structured equity (economic research based notes)
- Alternatives (private equity, hedge funds, property)

## De-Risk Assets

- Use swaps to improve duration/ inflation matching
- Use equity puts/collars to hedge downside risk
- Use swaptions to hedge risk of interest rates falling / inflation rising

## Sponsor/Trustee Negotiation and M&A advice

- Trustee and Sponsor negotiation advice
- Advice to Trustees on Sponsor Covenant
- M&A Advice
- Engagement with The Pension Regulator and PPF