The Actuarial Profession
making financial sense of the future

Forecasting mortality using the market

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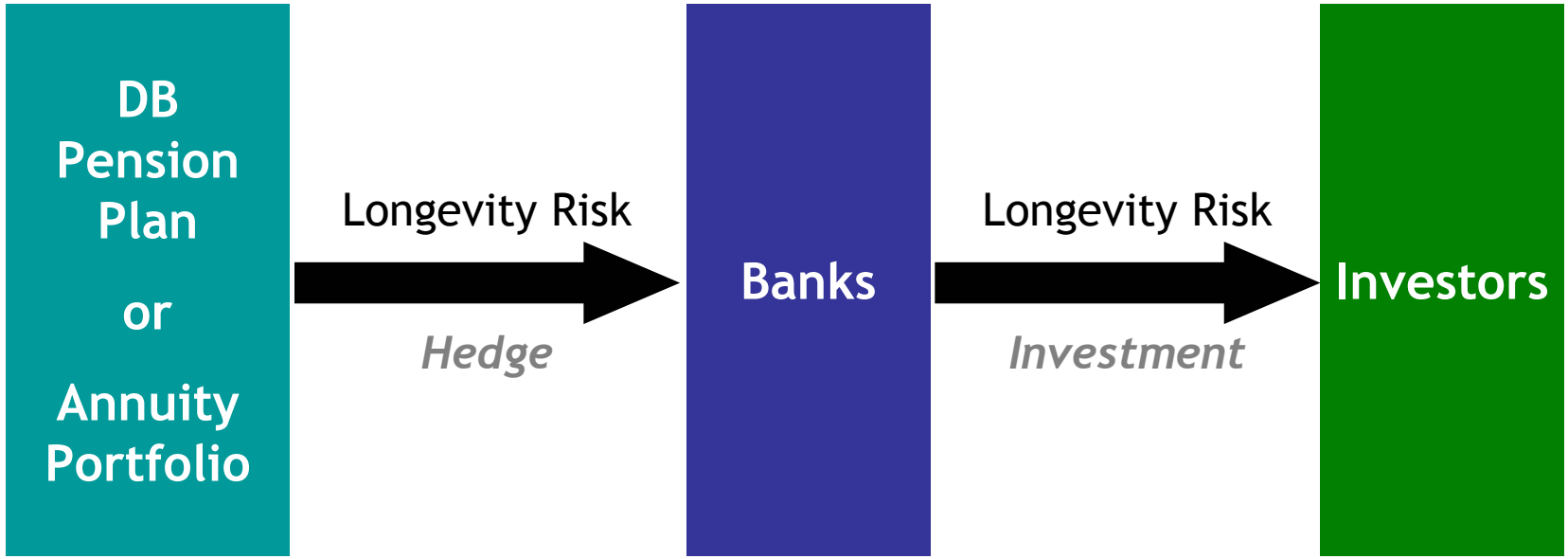
The market for longevity and mortality risk transfer provides forecasts for future mortality rates

- Forecasts for future mortality and longevity are embedded in the prices of life-contingent transactions
  - Bulk annuity transfers
  - Pension buyouts
  - Longevity & mortality derivatives and securities

- With enough data and a liquid market these forecasts can be extracted from transaction prices

- When a liquid market develops, these forecasts should be important inputs for all forecasters

The development of a liquid market requires capital markets risk transfer instruments



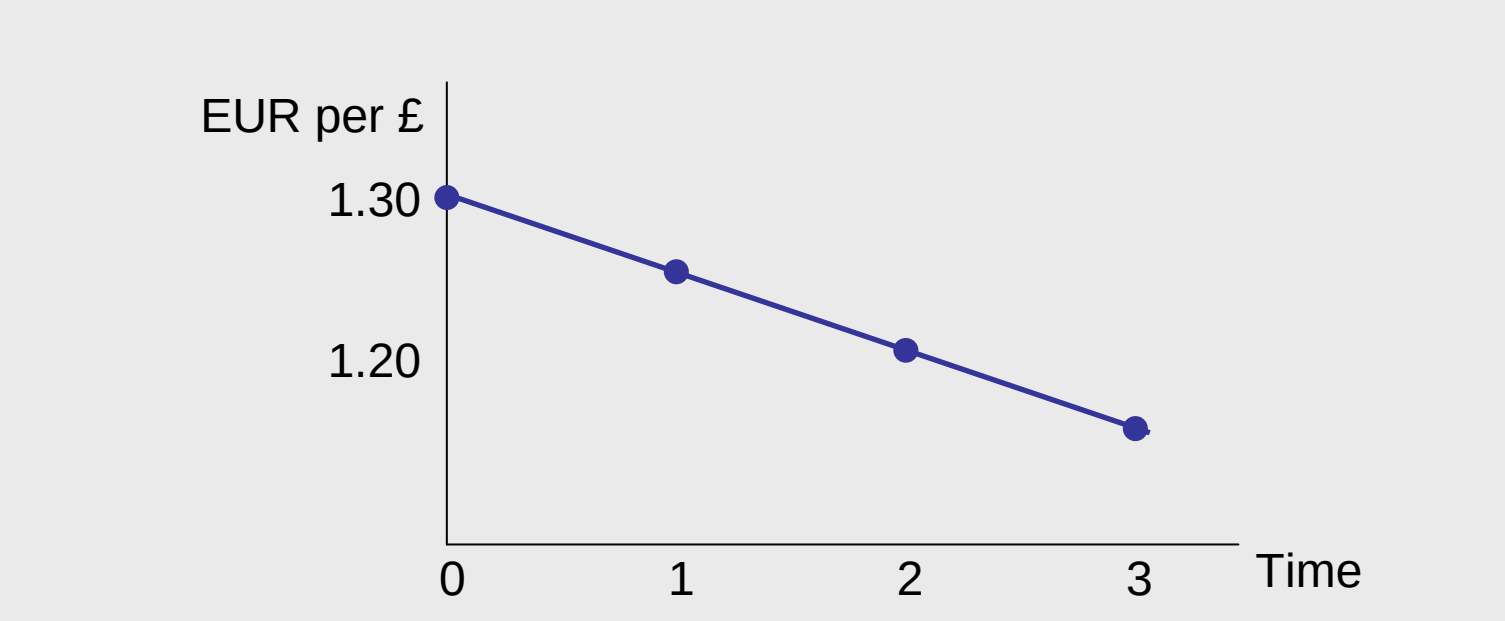
- These transactions are already happening
  - E.g. Lucida January 2008

Why should we take market-derived forecasts seriously?

- Market participants have made monetary decisions based on them, so have a significant incentive to get them right
- Market prices reflect aggregate view of the future based on all up-to-date qualitative and quantitative data
- These market-implied forecasts are the basis of risk-neutral pricing which is used to value financial contracts

Market observed “Forward rates” and “forward prices” are key variables for these forecasts

- A forward rate is a rate for a future period that can be “locked in” today
  - E.g. forward FX rates lock in a known FX rate at a future time
  - A simple example for to illustrate the principles:



Why are FX forward rates forecasts for future FX rates?

- FX forward rates reflect the market's determination of "break-even" FX rates

Example: You will receive $100 in 1 year and consider two different strategies

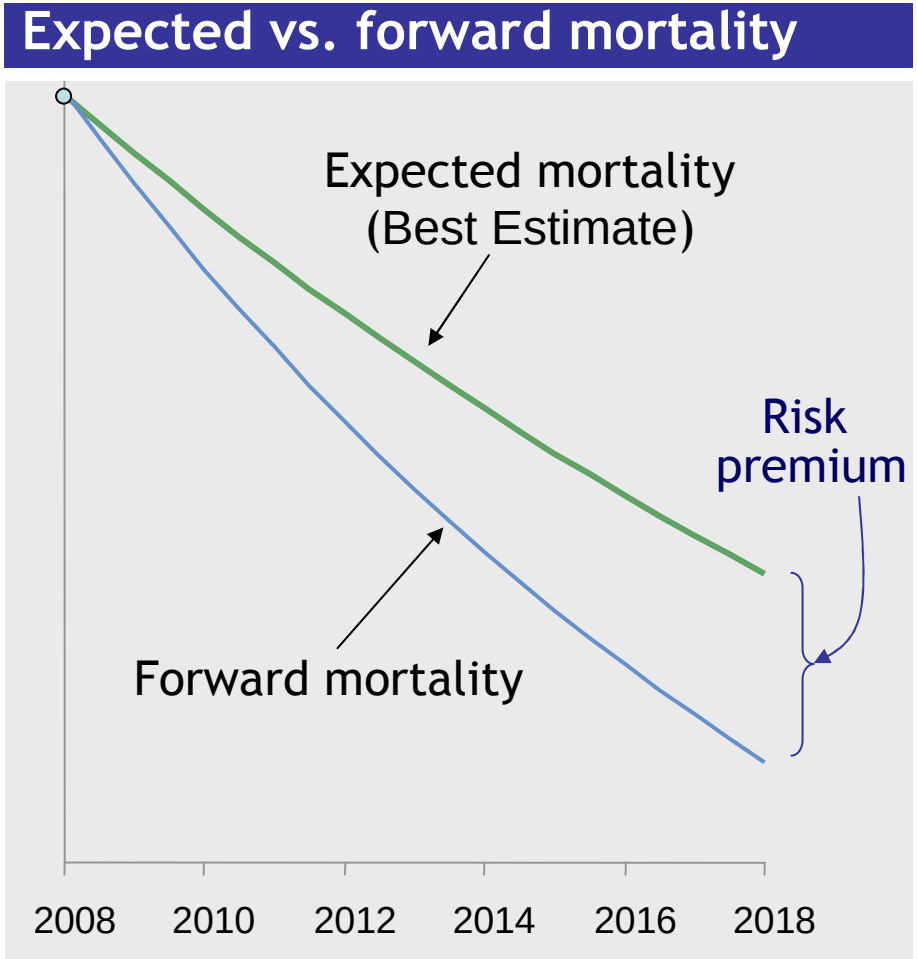
- Strategy 1:
  - Convert into sterling at the prevailing FX rate in 1 year's time
- Strategy 2:
  - (i) Borrow the present value of $100 now
  - (ii) Convert into sterling at today's FX rate
  - (iii) Invest the proceeds for 1 year in a sterling deposit account
  - (iv) Use the $100 you will receive in 1 year to pay off the loan
- The 1-year FX forward rate is the rate in 1 year that gives the same sterling amount for each strategy

Mortality forward rates are similar in providing a forecast of future mortality rates

- A forward mortality rate is a mortality rate for a future period that can be “locked in” today
- Reflects market expectations about future mortality rates
- However forward mortality rates are not quite the same as the market’s expected mortality rates
  - Because there is a **risk premium** in the mortality market
  - This reflects what an investor requires to assume the risk

Forward mortality rates are generally expected to lie below expected mortality rates

- There are more market participants with exposure to longevity risk (i.e., they lose if mortality rates fall) than those with the opposite exposure
- Longevity risk hedger must pay a “risk premium” to persuade others to take on their longevity risk
- So the mortality forward rate is below the expected (best estimate) rate by an amount which is effectively the risk premium



Market forward rates can be observed by looking at prices for different transactions

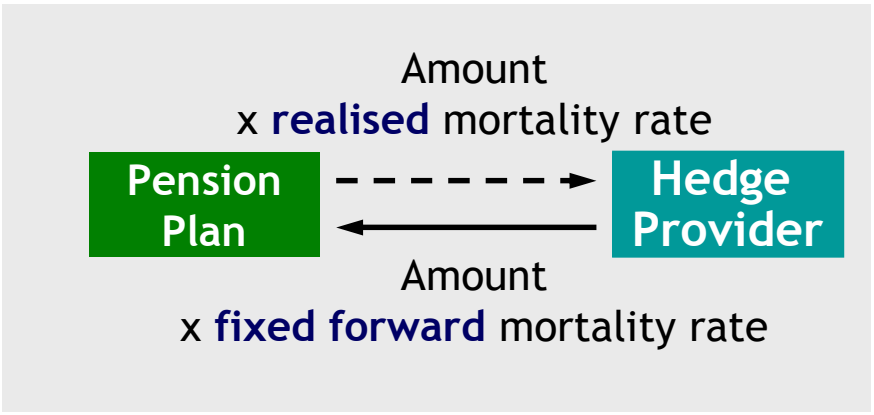
- Examples:
  - Forward rate contracts ← most direct
  - Futures
  - Swaps
  - Other financial instruments

- In the latter forward rates are implied rather than directly observable and need to be calculated

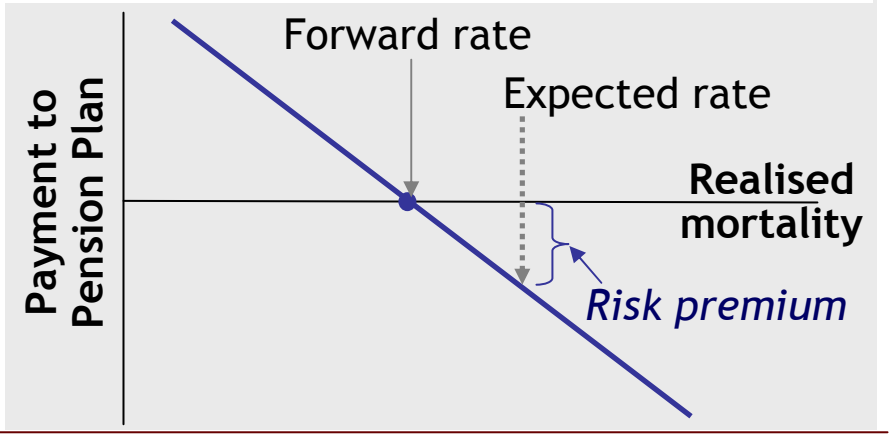
A mortality forward rate contract or "q-Forward"

- Enables forward rates to be observed directly
- Contract exchanges a fixed mortality rate (the forward rate) for realised mortality rate at maturity
- Provides a hedge of pension longevity risk
- The future value of the liability is "locked in" with respect to longevity risk
- q-Forwards have traded (e.g. Lucida)

q-Forward (mortality forward)



Payout from q-Forward



Bulk annuity transfers and longevity swaps also reflect mortality forwards, but indirectly

- Annuity/pension prices depend on the level of expected mortality rates for different ages at different times in the future (with a risk premium)
  - These are forward mortality rates

- So mortality forecasts are reflected in every mortality/longevity transaction

- If there are enough transactions with pricing transparency, mortality forward rate can be backed out of traded prices

Conclusion

- Forecasts for future mortality and longevity are embedded in the prices of life-contingent transactions
- These forecasts are credible because their outcome has a monetary impact on market participants
- Market prices reflect aggregate view of future mortality rates based on all up-to-date qualitative and quantitative data
- All forecasters should take the market's view of future mortality rates as an input into their forecasting process