# On the Failure (Success) of the Longevity Bond Market

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# Remarks

- 2001, Survivor Bonds
- 2002, London
- 2005, London, L1, the first attempt to issue a longevity bond
- 2006, Chicago, L2
- 2007, Taipei, L3, the second attempt to issue a longevity bond
- 2008, Amsterdam, L4; 2009, New York, L5; 2010, Sydney, L6; 2011, Frankfurt, L7; 2012, Waterloo, L8; 2013, Beijing, L9; 2014, Santiago, L10
- Note some of the success stories, e.g., Kortis Capital Ltd, 2010, Aegon, 2013
- Failure versus success

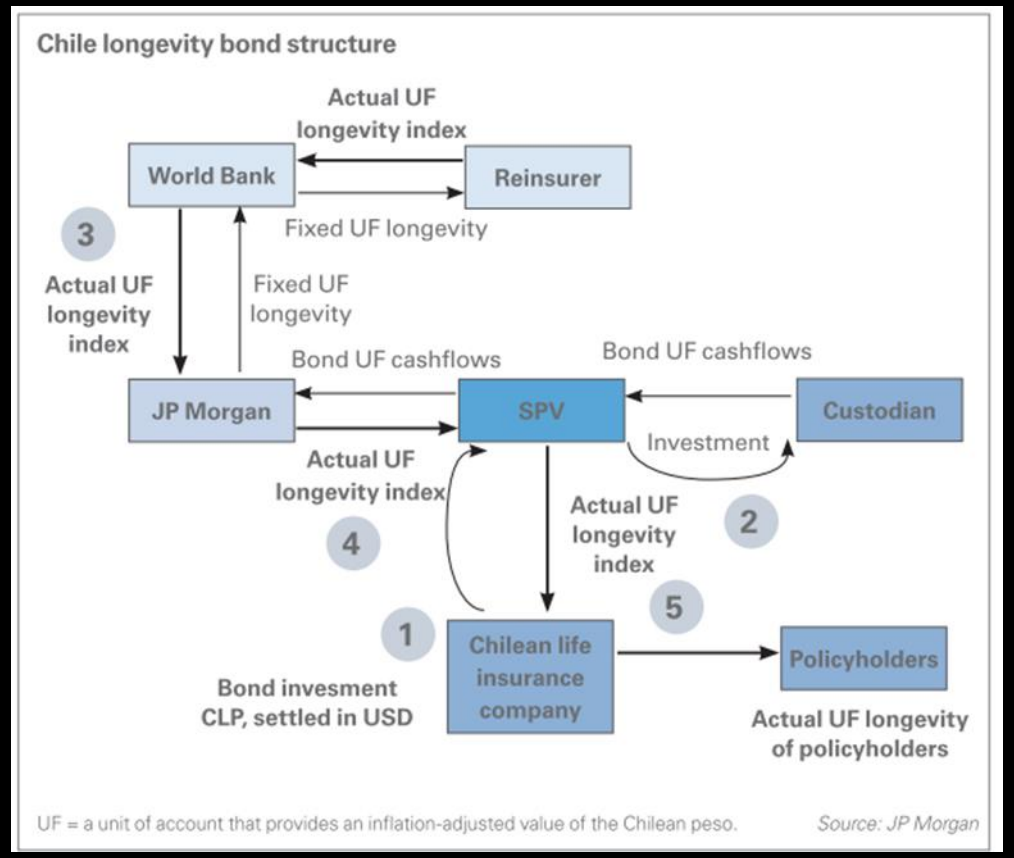
# Agenda

- The new life markets and what's been happening
- Longevity bonds may hedge cash flow or value
- The EIB and World Bank proposed issues in 2004 and 2007 respectively and those were structured for cash flow hedging
- Structure of the longevity bond issues proposed by the EIB and World Bank
- Reasons proposed in the literature for the failure of these proposed issues
- A different story and rationale for failure
- Concluding observations

# 2014 Longevity Risk Transfer

| Fund / Sponsor | Provider(s) | Solution | Size | Date | Coverage |
|---|---|---|---|---|---|
| BT Pension Scheme | Prudential Insurance Company of America | Pensioner bespoke longevity swap | £16 billion | Jul 2014 | Read more |
| Total UK Pension Plan | Pension Insurance Corporation / Hannover Re | Buy-in and longevity reinsurance transaction | £1.6 billion | Jun 2014 | Read more |
| Royal London | RGA International Reinsurance Co. | Longevity reinsurance transaction | £1 billion | May 2014 | Read more |
| AkzoNobel | Legal & General / Prudential | Buy-in, bulk annuity and longevity reinsurance | £3.6 billion | Mar 2014 | Read more |
| Aviva | Swiss Re / Munich Re / SCOR | Pensioner bespoke longevity swap | £5 billion | Mar 2014 | Read more |

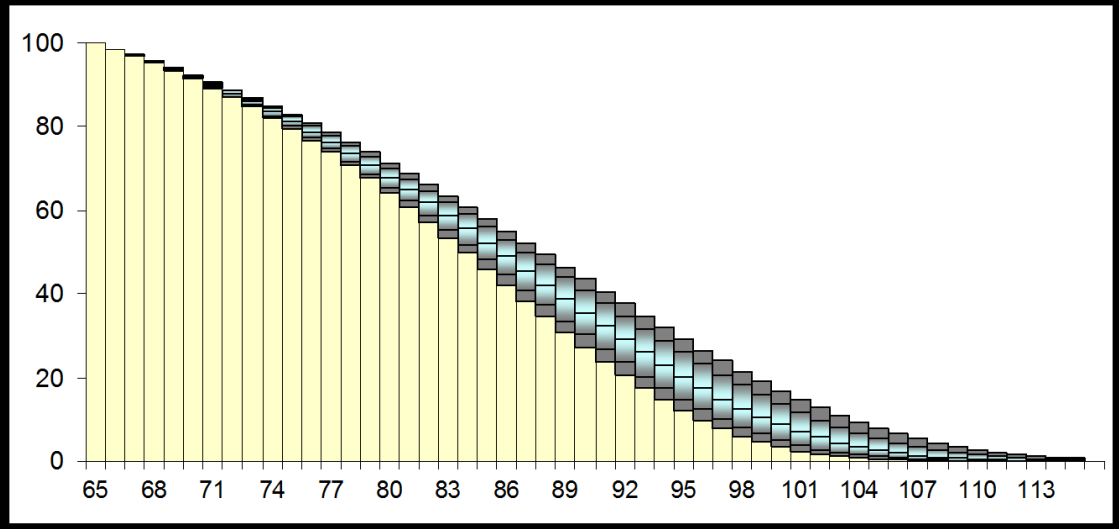
# Longevity Bond structure




- Excessive cost of capital for hedger and no capital relief
- Longevity risk transferred to reinsurer rather than capital markets
- Credit risk would remain with the hedger
- Bond leaves the hedger with basis risk

# More on the structure of longevity bonds

- The bar height in the chart represent the expected percent of the cohort of 65 year olds that survive to each age and a 90% confidence interval overlays that expected percentage.
- The shaded areas represent the uncertainty in the payment scheme.
- The uncertainty increases with age before decreasing again
- While it shows the uncertainty in payments, it also shows that the uncertainty is concentrated at some older ages.
- A bond offering a cash flow hedge is designed to alleviate all the uncertainty and so more capital is required.



# Comments on the failed issues

- The failed issues were proposed by intermediaries, i.e., the EIB and World Bank, for pension funds and life insurers.
- The failed bond issues were structured for cash flow hedges for the pension provider or insurer with annuity business
- Each failed issue had a maturity of 25 years

# A Moral Hazard story

# Financial Market Values

- Suppose that financial markets are complete and that $\Omega$ represents the set of states of nature.
- Recall that one basis stock exists for each state of nature and that stock pays one dollar in a particular state $\omega$ and zero otherwise. Hence all other assets can be described as a portfolio of the basis stock.
- Let $p(\omega)$ denote the price of the basis stock.
- Letting b be the promised repayment on a zero coupon bond, $\Pi(\omega)$ be the corporate payoff and $P(\omega)$ be the sum of the basis stock prices from zero to $\zeta$, the bond value D and the stock value S may be represented as

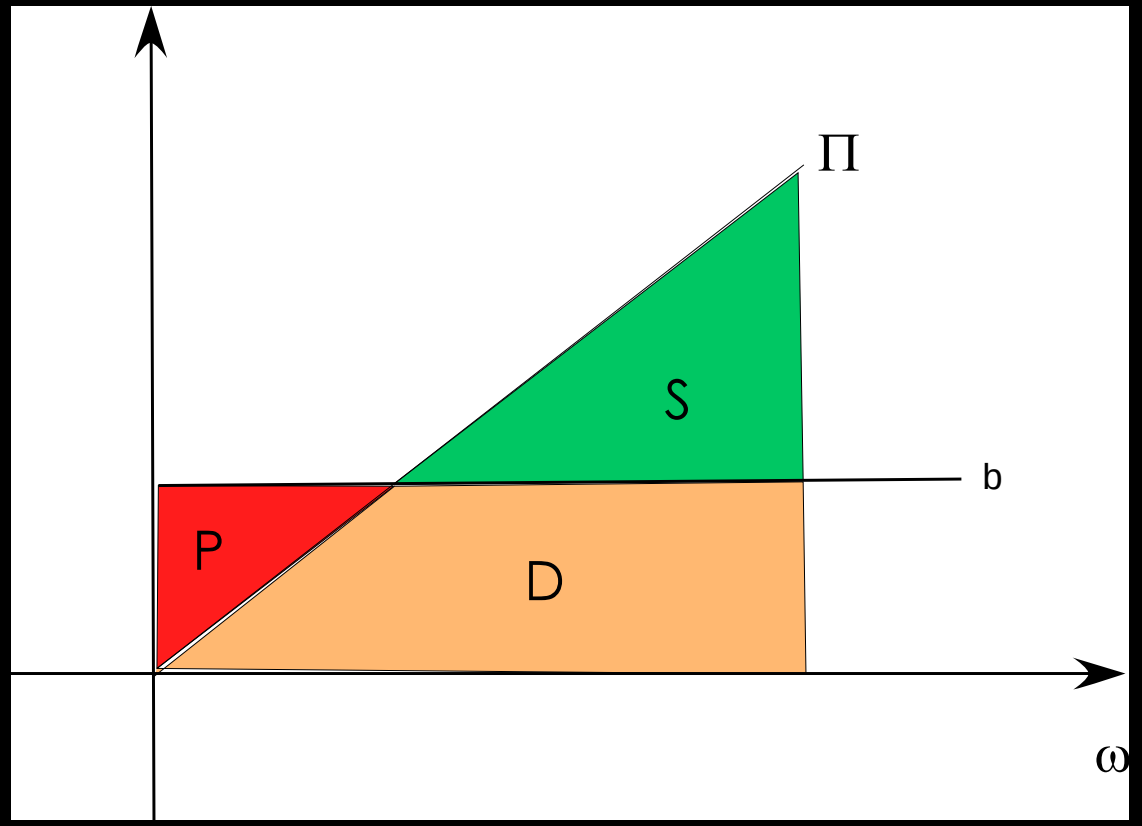
$$D = \int_{\Omega} \min\left\{\Pi(\omega), b\right\} dP(\omega) \qquad S = \int_{\Omega} \max\left\{0, \Pi - b\right\} dP$$

# The basics of financial market values

- Suppose a corporation is levered and that debt issue generates credit risk.
- The bond and stock values are shown in the figure
- The put option value P is also shown. This is the value put to bondholders in the event of insolvency.

$$P = \int_{\Omega} \max\{0, b - \Pi\}\, dP$$

$$= \int_{0}^{\delta} (b - \Pi)\, dP$$



# The basics

- In the absence of insolvency risk, the debt would be safe and that value is B where

$$B = \int_{\Omega} b \, dP$$
$$= D + P$$

- Normally the value of the corporate debt would be thought of as D where D can also be represented as D = B – P, i.e., the corporate debt is the value of safe debt minus the value of the put since the debt is put to the bondholders.
- Now, however, suppose that there is a quasi-governmental guarantee on the debt. For simplicity, suppose the guarantee is complete.
- Then rather than putting the loss to the bondholders, the firm puts it to the government and the government backs the shortfall on the promise. Then the corporate debt value is B = D + P.
- This is one way of thinking about systemic risk, e.g., a bank thought to be too large to fail because the resultant economic chaos threatens too much economic activity. In this case the government provides all or part of the put option value. It also distorts incentive in the process.

# The life insurer

- Consider the same story from the perspective of a life insurer selling annuities.
- Suppose that $\Gamma$ is the random payoff of the insurer; it represent the payoff of the premium income invested by the insurer.
- Suppose that L is the random liability on the books of annuity business sold by the life insurer.
- For simplicity, suppose the insurer only has books of annuity business so that the payoff to the insurer's equity holders is $\Pi = \Gamma - L$
- Given no insolvency risk the value of the liability is $V_T$

$$V_T = \int_\Omega L \, dP$$

# The life insurer

- Given insolvency risk and letting $\zeta$ be the upper bound on the states of nature, the value of the annuity book is $V_L$

$$V_L = \int_\Omega \min\{\Gamma, L\}\, dP$$
$$= \int_0^\delta \Gamma\, dP + \int_\delta^\zeta b\, dP$$

- The value of the put option on the liability is

$$P = \int_\Omega \max\{0, L - \Gamma\}\, dP$$
$$= \int_0^\delta (L - \Gamma)\, dP$$

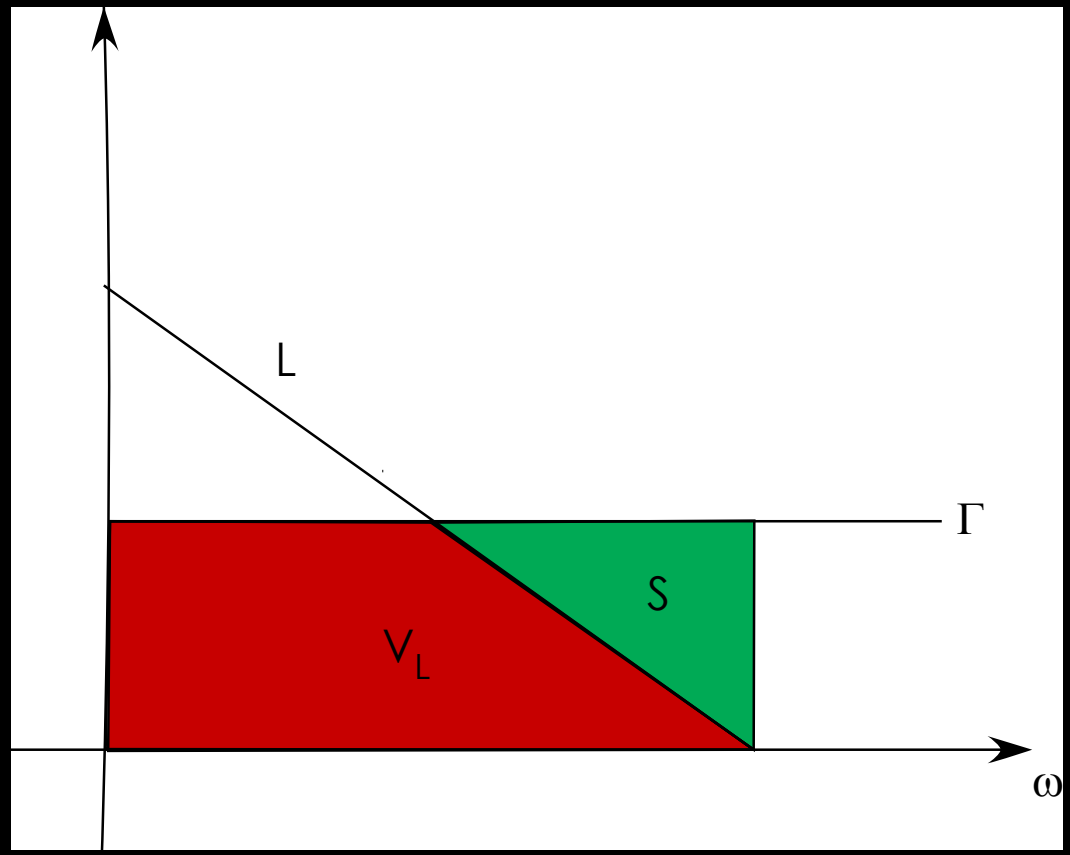
- Note that $V_L = V_T - P$

# The insurer story

- Suppose $\Gamma$ is uncorrelated with the liability and that L is decreasing in state. Then the stock and liability values are S and $V_L$ respectively.
- The stock value of the annuity provider with no quasi-governmental guarantee is

$$S = \int_{\Omega} \max\{0, \Gamma - L\}\, dP$$

$$= \int_{\delta}^{\zeta} (\Gamma - L)\, dP$$



# The insurer story

- The corporate value of the insurer with no quasi-governmental guarantee is

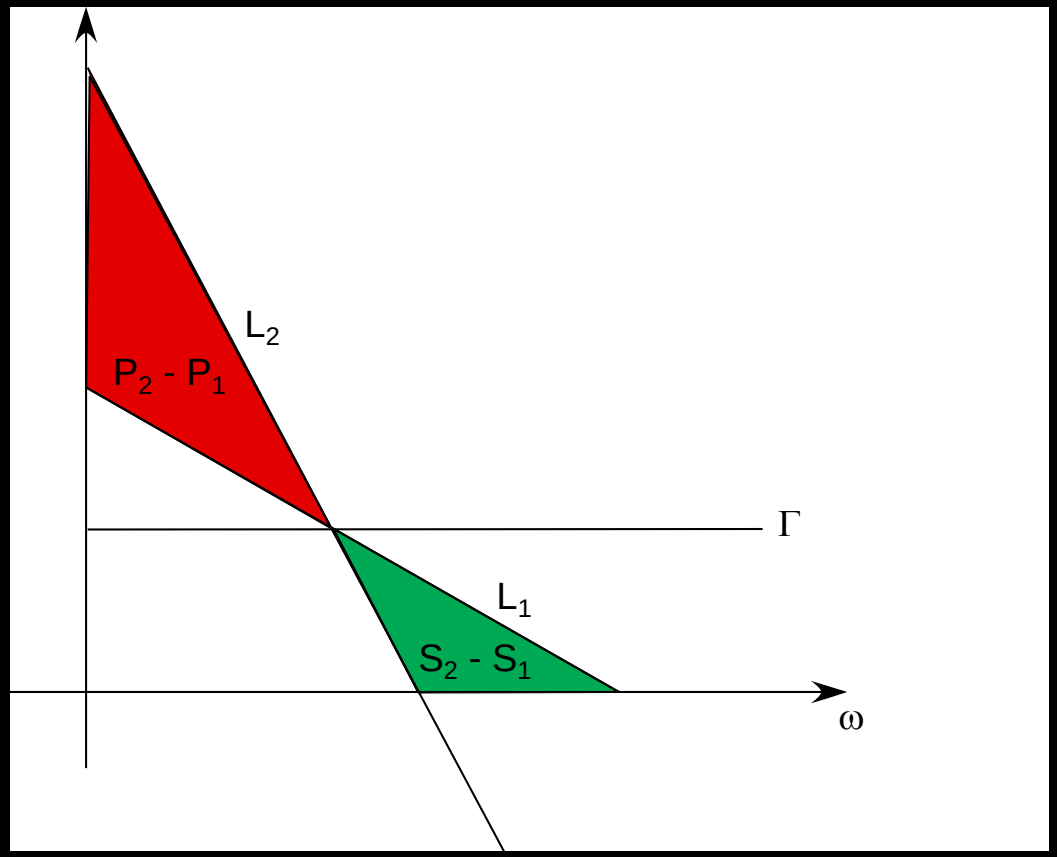
$$\begin{aligned} V &= S + V_L \\ &= \int_\Omega \max\{0, \Gamma - L\}\, dP + \int_\Omega \min\{\Gamma, L\}\, dP \\ &= \int_\Omega \Gamma\, dP \end{aligned}$$

- The corporate value of the insurer with the guarantee is

$$\begin{aligned} V_G &= S + (V_L + P) \\ &= \int_\Omega \Gamma\, dP + P \\ &= V + P \end{aligned}$$

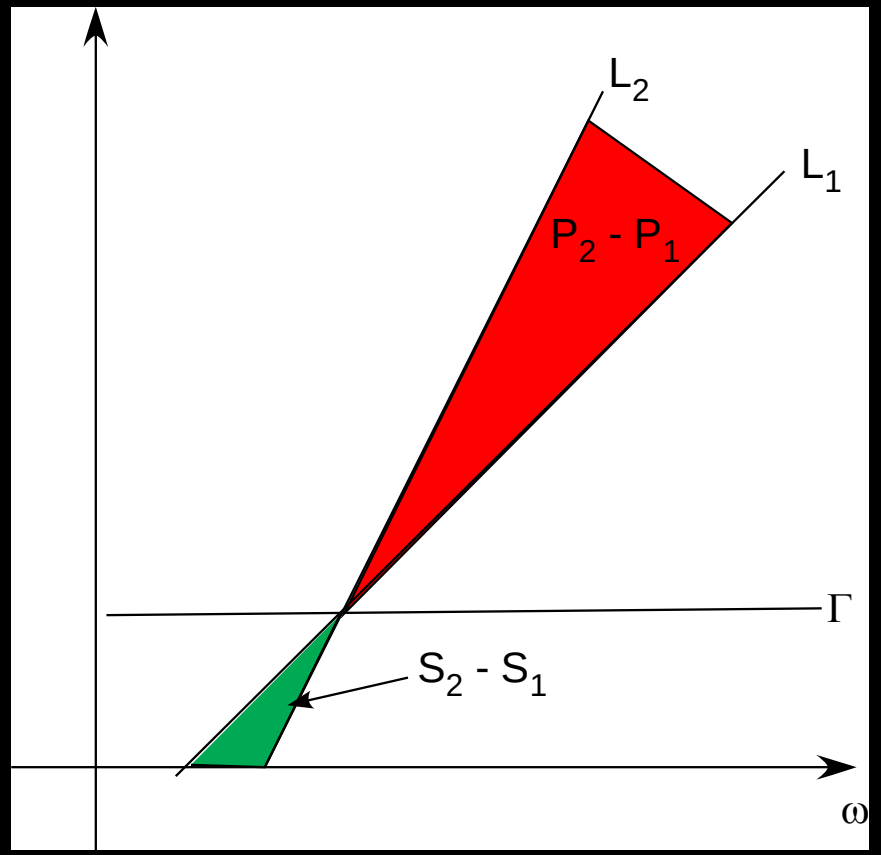
# Insurer incentives

- Suppose $L_2$ is riskier than $L_1$.
- The annuity provider with the quasi-governmental guarantee has the incentive to switch to the riskier book of annuity business because that increases stock value and put value, i.e., $S_2 - S_1 > 0$ and $P_2 - P_1 > 0$.
- The corporate value with the quasi-governmental guarantee is larger for the riskier book of business than the safer, i.e., $V_{G_2} > V_{G_1}$.
- The same result follows if the liability functions are correlated with the asset payoff.



# More on insurer incentives

- Suppose that the liability is increasing in state
- Let $L_2$ be riskier than $L_1$
- The annuity provider with the quasi-governmental guarantee has the incentive to switch to the riskier book of annuity business because that increases stock value and put value, i.e., $S_2 - S_1 > 0$ and $P_2 - P_1 > 0$.
- The corporate value with the quasi-governmental guarantee is larger for the riskier book of business than the safer, i.e., $V_{G_2} > V_{G_1}$.
- Not all increasing L generate this result if L and $\Gamma$ are positively correlated.



# Concluding Remarks

- Hedging longevity risk is seemingly a very good idea
  - It may be done with a cash flow hedge or with a value hedge
  - It protects the ability of the insurer to fulfill its promise to pay annuitants
  - Hedging via capital markets transfers the risk to those most capable of bearing it and circumvents the problems with credit risk that remain if the hedge is done through the (re)insurance mechanism
- There is a moral hazard problem in addition to the other problems noted in the literature that can create problems for the successful issue of a longevity instrument
- The cash flow hedges have failed while the value hedges like Kortis Capital and Aegon have succeeded
  - Note in each case it was the corporation desiring the hedge that created the capital market instrument and so the moral hazard problem had already been solved
- An intermediary such as the EIB or World Bank must resolve the moral hazard problem in addition to the other problems before the market for longevity risk can be successful