Who eats the leftover?

Mitigating longevity basis risk with a reinsurance mechanism

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The market for longevity risk transfers started in the U K about a decade ago. Since then, the market has seen some significant developments in terms of the number and size of deals. However, relative to the size of the global longevity risk exposure, the present longevity risk transfer market is still very small.

The Demand and Supply Imbalance

The underdevelopment of the longevity risk transfer market may be attributed to the marked imbalance between demand and supply. To date, most of the longevity risk transfers executed are insurance-based, typically in the form of pension buy-ins, pension buy-outs or bespoke longevity swaps.

While the insurance industry has the scope and financial stability to assume longevity risk, it does not generate sufficient supply for acceptance of the risk because of its capacity constraints.1

Standardization to Attract Capital Market Investors
The growth of the longevity risk transfer market therefore depends highly on the creation of supply. One possible direction is to invite participation of capital market investors, who may be interested in the longevity asset class because of the risk premium and potential diversification benefits it offers.

To draw interest from capital market investors, longevity risk needs to be packaged as standardized products that are structured like typical capital market derivatives and linked to broad-based mortality indexes. Standardization not only fosters the development of liquidity, but also removes the information asymmetry arising from the fact that hedgers (pension plans) have better knowledge about the mortality experience of their own portfolios.

The Problem of Longevity Basis Risk

However, when using a longevity hedge that is made of standardized instruments, the hedger is subject to some residual risks. The most significant residual risk is longevity basis risk, which arises from the difference in future mortality improvements between the population associated with the hedger's own portfolio and the population(s) to which the standardized instruments are linked. It is believed that pension plans' concern about the residual risks is a major obstacle to the goal of standardization.

To address this important issue, we propose a risk management framework that allows pension plans to completely remove their longevity risk exposures with standardized hedging instruments. One part of the framework is a dynamic hedging strategy with which a pension plan can transfer the 'trend risk' (i.e., the risk surrounding the trend in longevity improvement) to capital markets, even if the securities not linked to its own population. Another part of the framework is a specially designed reinsurance treaty, called a 'customized surplus swap', which transfers the residual risks to a reinsurer who collectively manages the residual risks from the index-based longevity hedges of various pension plans. The proposed framework is illustrated in Figure 1.

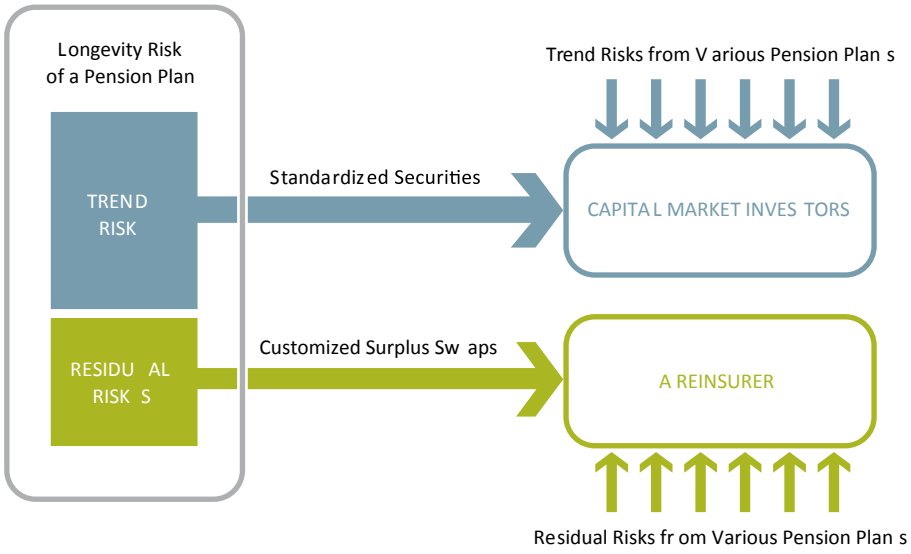


Figure 1
The proposed longevity risk management framework

A Delta Hedge

To illustrate the first part of the hedging framework, let us consider the following hypothetical situation:

- *There are 25 pension plans wishing to hedge their longevity risk exposures. Their mortality experiences are identical to 25 different national male populations, respectively.*
- *Each pension plan contains initially 3000 pensioners who are all aged 60. For simplicity, it is assumed that the pension payment to each surviving pensioner is $1 per annum.*
- *The hedging horizon is 30 years. At any time point during the hedging horizon, the only standardized hedging instrument available is a q-forward thatis linked to English and Welsh (EW) male population with a time-to-maturity of 10 years and a reference age of 75.*
- *The interest rate at all durations is 4 per cent per annum.*

A delta longevity hedge is constructed for each of the 25 plans. The derivation of the delta hedges involves a fair amount of technical work, which is detailed in the full academic paper. Table 1 shows the proportion of portfolio variance that can be reduced by each delta hedge. The results indicate that although the q-forward hedge eliminates a considerable portion of the total longevity risk, some residual risks still remain and have to be managed.

Table 1
The proportion of variance reduced by the q-forward hedge for each of the 25 pension plans under consideration

EW	79.53%	Scotland	76.57%	East Germany7	3.75%
West Germany	72.17%	France	71.36%	Portugal	70.93%
Switzerland	70.73%	Belgium7	0.52%	Finland	69.97%
Canada	68.98%	Austria	68.41%	Italy	67.59%
New Zealand6	5.78%S	pain	65.11%U	SA	64.89%
Luxembourg6	3.18%	The Netherlands	60.35%	Sweden	56.32%
Iceland	55.87%	Japan	42.07%C	zech	41.92%
Denmark	37.71%				

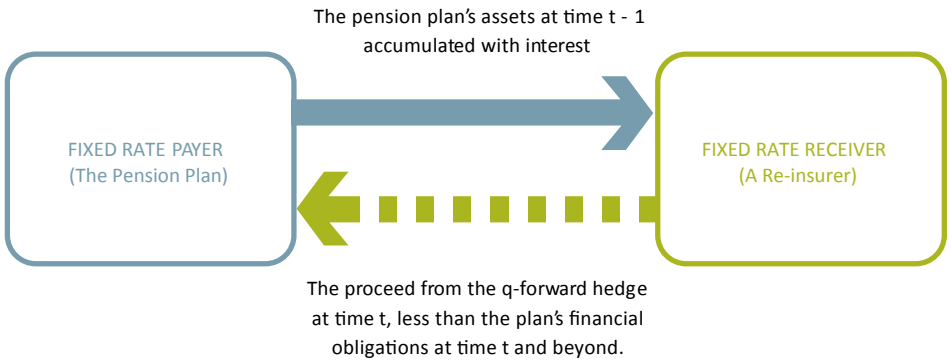


Figure 2
The exchange of cash flows in the customized surplus swap

Mitigating Longevity Basis Risk

The second part of the framework is a customized surplus swap that is created on the basis of the pension plan's time-t net position, which can be computed as follows: (1) the pension plan's assets at time t − 1 accumulated with interest, plus (2) the proceed from the q-forward hedge at time t, less (3) the plan's financial obligations at time t and beyond.

The swap is constructed in such a way that the pension plan's net position is always zero, so that no residual risk is left. As of time t – 1, (1) is fixed while (2) and (3) are random. Hence, the fixed leg of the swap is (1) and the floating leg is (2) minus (3). The pension plan is the fixed rate payer, while the counterparty (a reinsurer) is the fixed rate receiver.

The exchange of cash flows is illustrated in Figure 2. The mathematical formulations are provided in the full paper.

The rationale behind the customized surplus swap can be seen in Figure 3, which compares the variances of the net positions of the 25 pension plans (dotted lines) against the variance of the average of the 25 net positions (solid line). The comparison suggests that if a reinsurer writes customized surplus swaps with the 25 pension plans, the per contract risk that the reinsurer is subject to can be kept very low. The demonstrated diversifiability of longevity basis risk makes a strong case for transferring trend risk to capital markets while mitigating the residual risks with a reinsurance mechanism characterized by the customized surplus swap.

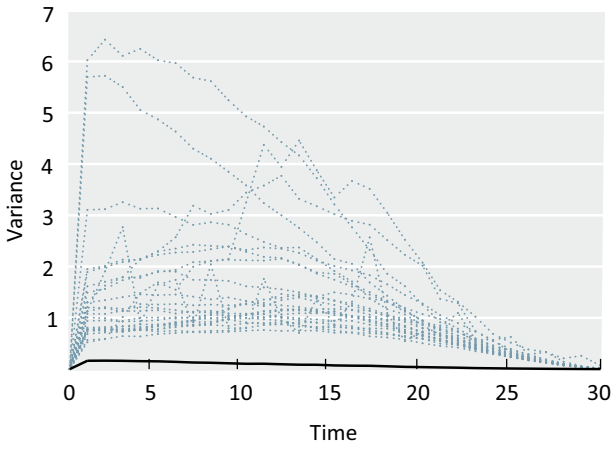


Figure 3
The variances of the net positions of the 25 pension plans (dotted lines) and the variance of the average of the 25 net positions (solid line)

REFERENCES

K.Q. Zhou and J.S.-H. Li (2015). Dynamic Longevity Hedging in the Presence of Population Basis Risk: A Feasibility Analysis from Technical and Economic Perspectives. Journal of Risk and Insurance, to appear.