



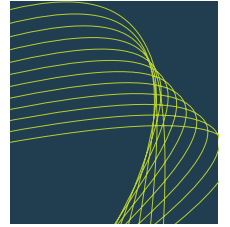
Technical Note

The q-forward

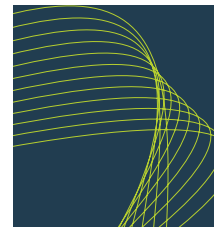
(Life & Longevity Markets Association)

29 October 2010

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1. Introduction

The q-forward or 'mortality' forward is a financial derivative that can be used to manage or actively take exposure to mortality risk. It is a cash settled forward contract linked to the mortality rates of a given population. The letter 'q' is reference to mortality probability (or simply mortality) to which the instrument facilitates direct exposure.

Since longevity is inverse in nature to mortality risk, market participants can also use the contract to hedge longevity risk. The q-forward was first introduced as an instrument for hedging longevity risk and mortality risk in 2007 (Coughlan et al. (2007)).

A q-forward term sheet proposed as a template for use in transactions has also been developed by the LLMA and is available separately – see *Sample Term Sheet: q-forward* (LLMA (2010a)). In addition, the LLMA has developed a spreadsheet to assist in the valuation of this instrument – see *q-forward Valuation Spreadsheet* (LLMA (2010b)).

2. Definition

A q-forward is an agreement between two counterparties to exchange at a future date (the maturity of the contract) an amount equal to the realized mortality rate of a given population at that future date (the floating leg), in return for a fixed mortality rate agreed upon at the inception of the contract (the fixed leg).

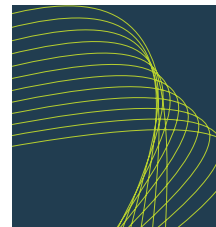
The floating leg of the instrument references the uncertain future mortality rate of a given population, as reflected by an appropriate index, which might be a national population mortality index, or other agreed index or combination of indices. The fixed leg is the fixed rate that a counterparty to the transaction would wish to receive for committing to pay the floating leg of the transaction or vice versa.

The flows of the transaction are illustrated graphically in Exhibit 1. The fixed mortality rate will be paid regardless of realized mortality at maturity. The reference rate used for settling the floating leg of the contract is the realized mortality rate at the maturity date for the appropriate index specified at inception of the transaction.

The q-forward instrument is a zero-coupon fixed-for-floating mortality swap, which is effectively a single exchange of payments at maturity of the instrument.

In a q-forward transaction, a longevity protection buyer would be the Floating Rate Payer whilst a longevity protection seller would be the Fixed Rate Payer.

Such a q-forward transaction may be between a pension fund or annuity provider (protection buyer) and a life insurance provider (protection seller). If the actual realized mortality is less than expected (i.e., realized longevity is longer than expected), the protection buyer receives a net payment, which compensates them for the increase in their longevity-linked liability.



3. Floating rate payment

The floating rate payment used to settle the q-forward will be determined by the realized value of mortality rates for the index underlying the contract specified at inception of the transaction.

The value of the index used to determine the floating rate payment is typically calculated by an independent Index Calculation Agent – not to be confused with the Calculation Agent for the transaction, which may be one of the counterparties to the transaction.

4. Fixed rate payment

The fixed rate payment is agreed at the time of trading by the parties to the transaction. It is essentially the estimate of the future mortality rate of the index referenced in the transaction at the maturity date – the forward mortality rate - plus or minus bid/offer costs for entering into the transaction. The mid forward mortality rate will likely be different from the best estimate of the future mortality rate predicted by mortality tables. The difference between mortality rates predicted by mortality tables and the parties entering into the transaction is reflective of differing mortality assumptions the parties to the transaction assume to those used to calculate the mortality tables. This difference is illustrated in Exhibit 2 as the difference between Expected Mortality rates (determined from base mortality tables), and Expected Mortality rates with Risk Premium, and is referred to as the risk premium.

5. Cash flows

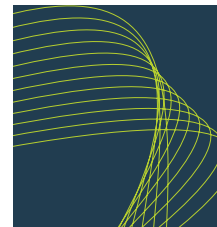
The only cash flows exchanged in a q-forward are at maturity. Contract settlement allows for netting, so that there is a net payment from one counterparty at maturity.

Consider an example in which a longevity protection seller pays the fixed mortality rate and receives the floating mortality rate on a q-forward contract with maturity T . The fixed mortality rate for the transaction is the forward mortality rate agreed between the parties at time $t = 0$ corresponding to the forward time period T for the index and is denoted by $q_{\text{forward}}(0:T)$. The actual floating mortality rate is the realized mortality rate for the index at time T and is given by $q_{\text{realized}}(T)$. A net payment is made at maturity T - the Net Payoff Amount (NPA) is given by:

$$NPA(T) = \text{Notional} \times [q_{\text{realized}}(T) - q_{\text{forward}}(0:T)] \quad (1)$$

If $NPA(T)$ is a positive number, this cashflow is an amount receivable by the protection seller. If $NPA(T)$ is a negative number, this is an amount payable by the protection seller.

It is seen the fixed rate payer (longevity protection seller) has a short longevity position, since the fixed rate payer benefits if realized mortality rates rise above expectations (i.e., longevity falls below expectations). By contrast a floating rate payer (longevity protection buyer) such as a pension plan would receive the fixed rate and pay the floating (realized) mortality rate, benefiting if realized mortality rates fall below expectations (i.e., longevity rises above expectations).



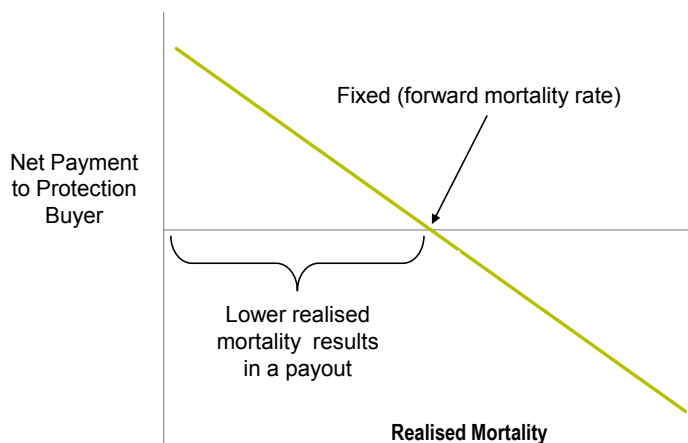
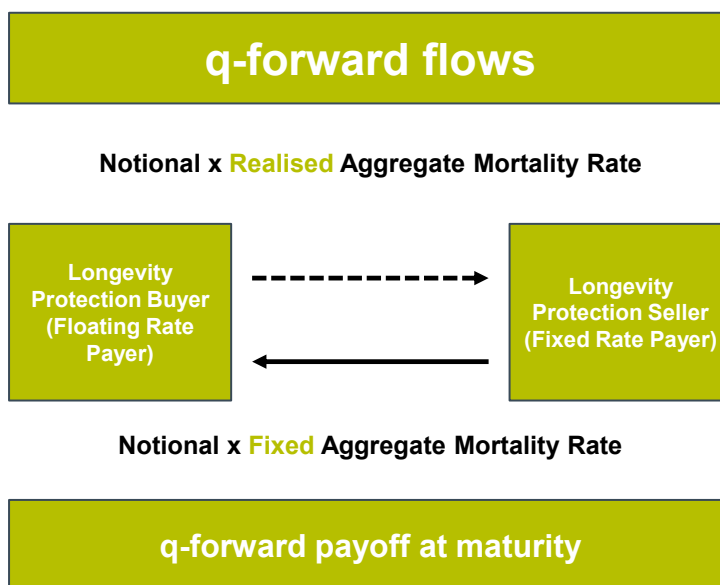
6. References

LLMA (2010a) *Sample Term Sheet: q-forward* [www.llma.org]

LLMA (2010b) *q-forward Valuation Spreadsheet* [www.llma.org]

Coughlan, G.D., Epstein, D., Sinha, A. and Honig, P. (2007). "q-forwards: Derivatives for transferring longevity and mortality risk", J.P. Morgan: London, 13 March [www.lifemetrics.com].

Exhibit 1: Cash flows associated with an q-forward contract.



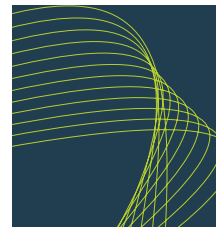
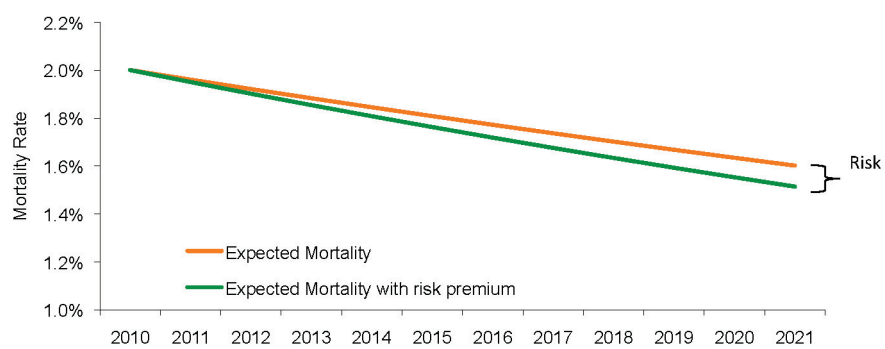


Exhibit 2: Valuation and pricing of a q-forward contract



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