



Munich Personal RePEc Archive

Keeping Some Skin in the Game: How to Start a Capital Market in Longevity Risk Transfers

Blake, David and Biffs, Enrico

Pensions Institute

December 2012

Online at <https://mpra.ub.uni-muenchen.de/44680/>

MPRA Paper No. 44680, posted 04 Mar 2013 14:14 UTC

Keeping Some Skin in the Game: How to Start a Capital Market in Longevity Risk Transfers

David Blake* Enrico Biffis†

December 2012

Abstract

The recent activity in pension buyouts and bespoke longevity swaps suggests that a significant process of aggregation of longevity exposures is under way, led by major investment banks and buyout firms with the support of leading reinsurers. As regulatory capital charges and limited reinsurance capacity constrain the scope for market growth, there is now an opportunity for institutions that are pooling longevity exposures to issue securities that appeal to capital market investors, thereby broadening the sharing of longevity risk and increasing market capacity. For this to happen, longevity exposures need to be suitably pooled and tranching to maximize diversification benefits offered to investors and to address asymmetric information issues. We argue that a natural way for longevity risk to be transferred is through suitably designed principal-at-risk bonds.

1 Introduction

The total amount of pension-related longevity risk exposure in private-sector corporations is globally estimated at \$25 trillion.¹ In 2006, a market started in the UK to transfer longevity risk from the pension plans of UK corporations. From 2010, this market became international, with transfers taking place in Holland, the US and Canada. However, the total value of the transfers since the market started has been little more than \$100 billion, a small fraction of the total exposure. In addition, most of the transfers have ended up with insurance and reinsurance companies.² A small proportion of the total has

*Blake (D.Blake@city.ac.uk) is at the Pensions Institute, Cass Business School, City University London, 106 Bunhill Row, EC1Y 8TZ United Kingdom.

†Biffis (E.Biffis@imperial.ac.uk) is at Imperial College Business School, Imperial College London, South Kensington Campus, SW7 2AZ United Kingdom.

¹The Life and Longevity Markets Association.

²The market was started by newly established mono-line insurers known as buyout companies. Later, larger traditional insurance companies and reinsurance companies and investment banks entered the market.

involved investment banks which have passed the risk exposure on to capital markets investors. This rate of transfer to the capital markets needs to grow significantly, since there is insufficient capital in the insurance and reinsurance industry to absorb the total exposure.

Furthermore, long-term capital markets investors need to be persuaded to hold longevity risk exposure in a form in which they are comfortable and with a suitable longevity risk premium which reflects the true level of risk they are assuming. Long-term investors, such as sovereign wealth funds, endowments, family offices, should find a longevity-linked asset an attractive one to hold in a diversified portfolio, since its return will have low correlation with the returns on other asset classes, such as financial assets, real estate and commodities. However, such investors are currently wary of longevity-linked assets. If experts in longevity risk, such as insurance companies, are trying to sell this risk on to them, is this just because they see this simply as an opportunity to gain some capital relief from their regulator, a perfectly legitimate business practice? Or is it because they have become aware that the risk is greater than they initially believed and are trying to offload it on to unsuspecting investors before the true extent of the exposure becomes more widely known?

A relevant problem here is asymmetric information. One party to the transaction knows more about what is being offered for sale than the other party. In the extreme case, the potential buyer in the transaction might be so suspicious of the potential seller's intention that they will not transact at any price: in this case, there will be no market. For a market to exist in the presence of asymmetric information, the potential seller needs to find a way of communicating to the potential buyer the true extent of the information that they have acquired about the item up for sale. In other words, they have to provide an appropriate signal to the potential buyer that they are not being sold a 'lemon'.³

In this article, we outline how a market in longevity risk transfers may grow out of the recent activity in pension liability transfers. Figure 1 provides a stylized representation of the potential participants in such a market. There are some holders of longevity risk exposures, which we may regard as 'informed'. An example is a large pension plan which has undertaken a longevity study of its members and beneficiaries, and therefore has acquired private information about its own longevity exposure. There are then holders of longevity exposures which (oversimplifying) we may regard as 'uninformed'. An example is a small pension plan which does not have the resources to undertake a longevity study of its members. There are also informed intermediaries, such as insurance companies and investment banks, which have conducted their own longevity studies of the members of pension plans, but are considering selling on their longevity risk exposure either directly to investors or to intermediaries in insurance-linked securities. Finally, there are end investors (and other intermediaries), whom we may regard as 'uninformed', in the sense that they have not conducted any longevity studies of their own, possibly because they do not have access

³A 'lemon' is something, such as a second-hand car, which is revealed to be faulty only after it has been purchased.

to the plan data needed to conduct such a study. They therefore have less information about the true extent of the longevity risk in which they are being invited to invest than those selling it, a classic case of asymmetric information.

An effective way of overcoming the problem of asymmetric information for an informed seller is to disclose information about relevant risk characteristics of the exposures being transferred (e.g., sex, age, medical status, similar details on potential beneficiaries of any survivor benefits), or to signal their quality by retaining part of the exposures. Another effective tool is to structure the risk transfer vehicle so as to minimize the sensitivity of the vehicle’s cashflows to the issuer’s private information. This would typically entail pooling and tranching the exposure, as we outline below. There is also an important role for regulators here, as they may provide incentives to disclose and use detailed information from the very same internal models used to demonstrate the capital resilience of (re)insurers and buyout firms in the primary market for longevity exposures.

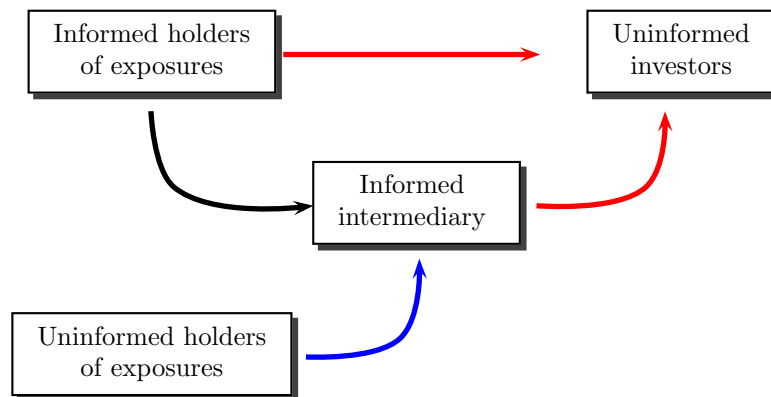


Figure 1: The participants in a market for longevity risk transfers.

2 The optimal level of securitization of longevity exposures

Securitization,⁴ in general, involves the bundling together of a set of illiquid assets or liabilities (in our case the latter or both) with a similar set of risk exposures and then the sale of this bundled package to investors. The purpose of such a bundling exercise is to reduce the idiosyncratic (or diversifiable) risk which is contained in each of the individual assets or liabilities when they are considered in isolation, while leaving the systematic (or non-diversifiable) risk to be borne by the investor. In our case, the idiosyncratic risk relates to the uncertainty surrounding the length of life of individual plan members,

⁴See Cowley and Cummins (2005), for an overview of insurance securitization.

while the systematic risk relates to the uncertainty surrounding the average length of life of the members of the group taken as a whole. We call these two types of risk idiosyncratic and systematic longevity risk, respectively.

We would not expect investors to be interested in holding idiosyncratic longevity risk, any more than they would be interested in being exposed to the idiosyncratic risk from holding just a single company's share in their investment portfolio. This is why longevity risk needs to be pooled before securitization. However, investors would be willing to invest in a particular asset class if they are appropriately rewarded for the true level of systematic longevity risk that they are assuming. So for investors to become interested in buying into this particular asset class, they need to have confidence that the premium they are being paid by buyout firms, reinsurers, and pension plans reflects the true level of systematic longevity risk underlying the transaction.

A natural way for informed sellers to persuade potential investors that this is the case is to retain some of the exposure themselves. If the seller keeps some 'skin in the game', this provides an important as well as a credible signal to investors, since longevity exposures are very capital intensive - in terms of both regulatory and economic capital requirements - for the insurance companies operating in longevity space. Investors will also realize that the larger the securitization fraction (γ) - the proportion of the total exposure that the seller seeks to offload - the greater the severity of the longevity risk exposure indicated by the seller's own assessment of longevity risk, and the lower the price the investor will offer. Since investors will try to neutralize the seller's informational advantage through a downward sloping demand curve for the longevity exposure transferred, the seller will try to securitize a fraction of exposure that is optimal, in the sense that it minimizes the cost to the seller from offloading the risk exposure. If the chosen fraction is too low, an insufficient amount of the longevity risk will be transferred to investors and the seller will have to bear higher retention costs (in terms of higher capital requirements than desired). If the fraction is too high, investors will demand too high a risk premium, thus reducing the benefits of capital relief from securitization. The seller thus faces two costs, retention costs (from the capital requirements) and liquidity costs (from the downward sloping demand curve), and will wish to minimize the sum of these costs.⁵

3 The optimal tranching of longevity exposures

How should the securitized longevity exposure be transferred to investors? The seller of the exposure wants to sell a liability, while the buyer of the exposure wants to hold an asset. How can the sale of a liability by an informed holder or intermediary become an asset to an uninformed investor? Further, we

⁵This situation is formalized in the model of DeMarzo and Duffie (1999) for example.

can assume that the investor will not want to be responsible for making the pension payments once the securitization transaction has taken place.

To answer these questions, note that the holders of the longevity exposure are really looking for a longevity risk hedge for a fraction (γ) of their current holdings. The holders need to persuade the investors to provide that hedge in exchange for receiving an appropriate longevity risk premium. When sellers are more informed, a possible way to do this is for the holders of the longevity exposure to issue a principal-at-risk bond which the investors will buy. The return on the bond will incorporate a longevity risk premium in addition to the usual credit risk premium associated with the issuer.⁶ By issuing such a bond, it is the pure longevity risk that is transferred, not the exposure itself or the obligation to make the pension payments.⁷ The securitization of longevity risk is therefore different from other forms of longevity risk transfers (such as pension buyouts) in which assets and liabilities are bundled up and transferred in their entirety.

The principal-at-risk bond will repay the principal in full if the proportion of the members from the population underlying the risk transfer who have survived between the bond's issue and maturity dates is below a preset level. However, if the proportion who have survived (i.e., the survival rate) is higher than this preset level (known as the point of attachment), the amount of principal returned to the investor will be reduced according to some preset formula. If the survival rate exceeds another preset level (known as the point of exhaustion), the investor gets no principal back.

The point of attachment will be determined to minimize the sensitivity of the bond's value to private information, and hence the cost to the holder of the exposure from issuing the bond.⁸ Multiple attachment points can be used to meet the demand of investors with different risk preferences.

In financial engineering terms, the principal-at-risk bond is a combination of a standard bond paying 100 at maturity and a call option which has been sold by the investors to the bond's issuer (in the case of a single point of attachment). The option will expire in-the-money if, on the bond's maturity date, the survival rate from the reference population (S) exceeds the preset level (S^*). The principal repayment to investors will be reduced in this case. The point of attachment is therefore the same as the strike price of the option. The option will expire worthless if S is below S^* . We can therefore write the formula for the repayment of principal as $B = 100 - \max(0, S - S^*)$, where $\max(0, S - S^*)$ means the larger of 0 and $(S - S^*)$ and is the formula for the value of a call option on its expiry date.

The seller of the bond therefore has an effective hedge against systematic longevity risk for survival

⁶The bond would typically be collateralized and issued via a Special Purpose Vehicle, a procedure that would influence the size of the credit risk premium.

⁷Should the holder of the exposure wish to do so, this responsibility could be transferred to a third party administrator who would make the pension payments.

⁸It is a central tenet of corporate finance theory that debt-like instruments can minimize the adverse effects of information asymmetry when raising capital through issuance of securities (e.g., Tirole, 2005)

rates S which lie above S^* , but bears all the longevity risk below S^* . Another way to think of this is that we have tranced the exposure at S^* with the current holder of the exposure bearing the longevity risk below S^* and investors bearing the longevity risk above S^* . The optimal tranching level will be the one that minimizes the cost to the holder of transferring the exposure, as shown in Figure 2. If S^* is set too low, the longevity risk premium demanded by investors will be excessive and the price that they will agree to pay for the bond will be too low. If S^* is set too high, the holder of the exposure bears too much of the longevity risk. A rough measure of the ex-post cost of the hedge is $B - P$, the difference between the principal actually repaid and the initial sale price of the bond. The bond issuer's objective is to choose the optimal tranching level (or, equivalently, the strike price or point of attachment) to minimize the cost of the longevity hedge to the issuer.

A key issue to address is the choice of reference population that determines the payments on the bond. So far, we have assumed that the bond issuer would prefer it if the reference population were the same as its own population of pension plan members. This would allow the bond issuer to establish a very effective hedge against its own exposure. But in a world of asymmetric information, investors who buy the bond might not feel comfortable about this, since the bond issuer will be determining the principal repayment in a manner which might be perceived to lack full transparency. Investors, however, might be more comfortable if the reference population were the same as the national population (or other publicly monitored population) since, in this case, information on survival and mortality rates are published by the country's independent official statistical agency. By doing this, asymmetric information issues are less of a concern, but a new problem emerges: using a national population index to hedge the longevity risk of a sub-group of the population introduces basis risk in the hedge. Basis risk arises because the mortality experience of the national population might differ from the sub-group being hedged. In particular, we know that members of pension plans tend to live longer than members of the population as a whole, so the national index might involve underestimating the longevity risk of the pensioner sub-group being hedged. While basis risk certainly exists, studies have shown that it can also be hedged quite effectively and so hedges and principal-at-risk bonds based on national indices can provide very good, if not 100%, hedge effectiveness (see, e.g., Coughlan et al (2011)). Hedge effectiveness can be further increased if exposures are pooled or aggregated.

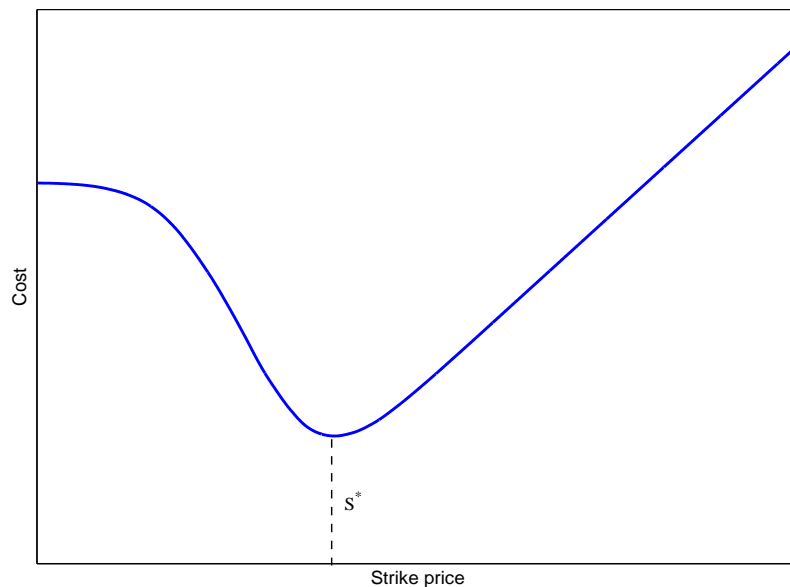


Figure 2: The optimal tranching level S^* .

4 Pooling or aggregating exposures

If multiple small exposures, such as those associated with a number of small pension plans, are pooled or aggregated together,⁹ there might be further diversification benefits,¹⁰ although any informational advantage concerning the individual longevity trends within the separate exposures will be destroyed.¹¹

A principal-at-risk bond with n diversifiable exposures will have the following repayment value: $B = 100 - \max(0, S_n - S_n^*)$, where S_n^* is the optimal tranching level (or, equivalently, strike price or point of attachment) and S_n is the average exposure when there are a total of n exposures. Figure 3 shows the diversification benefits from pooling: the expected cost to the issuer of the bond and the strike price are both lower compared with the case where the exposures are tranced separately.

Pooling and tranching are more valuable when the private information on the severity of longevity risk affects the entire pool rather than being specific to each individual exposure. This would be the case when the survival rates relate to different cohorts of pension plan members, but the underlying characteristics are similar, for example, they come from the same geographical area, social class, gender or age grouping (e.g., men in their 70s). Pooling on the basis of such factors can reduce the costs associated with asymmetric information. Further, the benefits from pooling therefore increase with the

⁹Buyout and other insurance and reinsurance companies have already been acting as aggregators and may find themselves as naturally positioned to take on this intermediary role.

¹⁰See Subrahmanyam (1991); Gorton and Pennacchi (1993) for example.

¹¹See DeMarzo (2005), for example.

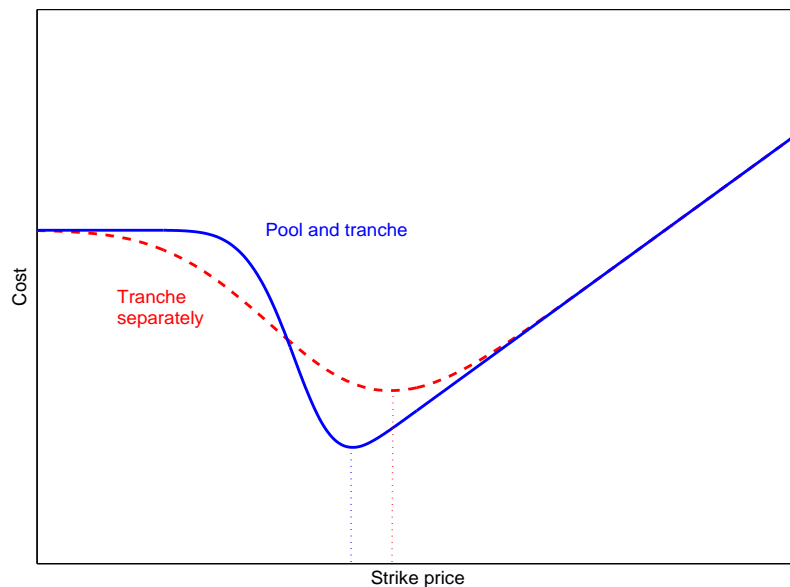


Figure 3: Tranching with and without pooling.

size of the pool.

5 Conclusions

We argue that a natural format for transferring longevity risk to end investors is a principal-at-risk bond. The bond's payments need to be structured in a way that deals with the concerns that investors will have about the seller of the bond having more information about the true level of longevity risk underlying the exposure than the investor has. This problem of asymmetric information can be managed by suitably pooling and securitizing the exposures in tranches. To give comfort to the investor that they are not being sold a 'lemon', the longevity risk hedger needs to keep some 'skin in the game', by retaining some of the exposure. To minimize the cost of the hedge, the hedger should only hedge the extreme longevity risk, that is, the longevity risk above a threshold level which we have called the optimal tranching level (or, equivalently, strike price or point of attachment). To further reduce the cost to the hedger, they should pool or aggregate their longevity exposures as much as possible. This reduces the information advantage of the seller about individual longevity trends, but it increases the degree of diversification and, in turn, might reduce the basis risk faced by hedger.

Figure 4 shows the risk transfers that might characterize the stylized longevity risk market discussed in this note. Uninformed holders of longevity risk exposures, such as small pension plans, should pool

and transfer their full exposures to informed intermediaries, since transferring exposures separately would expose them to 'cherry picking' from more informed counterparties.¹² Informed holders, such as large pension plans, will retain the fraction $(1 - \gamma_1^*)$ of their exposure and securitize the fraction γ_1^* by transferring it to (less) informed intermediaries. They could also deal directly with end investors by retaining a larger fraction $(1 - \gamma_2^*)$ of their exposure and securitizing a smaller fraction γ_2^* , possibly tranching it at an optimal level S^* . Finally, informed intermediaries would deal with end investors by pooling their exposures (say n) and tranching them at level S_n^* .¹³

The issuance of instruments linked to public longevity indices would side step asymmetric information issues but expose hedgers to basis risk. Even in this case, however, the principal-at-risk format would appear a natural solution, given the familiarity of investors in insurance-linked securities with catastrophe bonds with payoffs linked to indices or parametric triggers. It so happens that the principal-at-risk format was precisely the format chosen by Swiss Re when it issued its Vita bonds¹⁴ to hedge the extreme mortality risk it was hedging. So we have a very successful precedent in the form of mortality bonds which should help promote an equally successful capital market in longevity risk transfers.

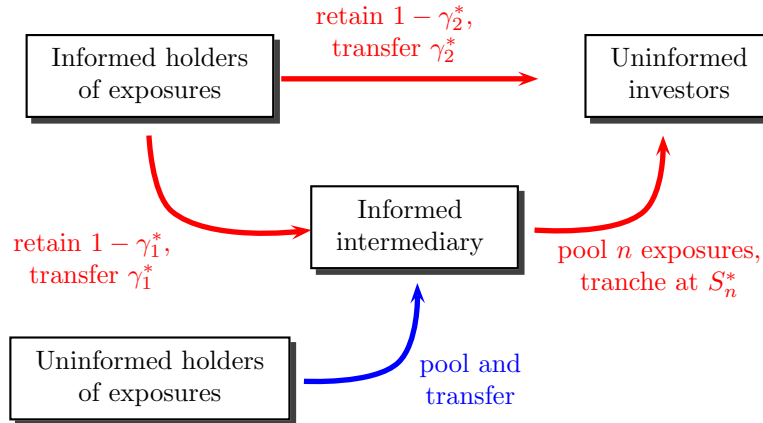


Figure 4: The market for longevity risk transfers.

¹²We note that figures 1 and 4 encompass both cases of informed and uninformed sellers of longevity exposures. In the first case, the investors face the 'buyer's curse' (the risk of ending up with a 'lemon') when buying from more informed counterparties. In the second case, the uninformed holders of exposures face the 'seller's curse' (of being exposed to 'cherry picking') when selling to more informed counterparties.

¹³For a more formal analysis together with proofs of the propositions discussed in this paper, see Biffis and Blake (2010, 2012).

¹⁴See "Swiss Re transfers \$180 million of extreme mortality risk" (accessed 1 July 2012).

References

- Biffis, E. and D. Blake (2010). Securitizing and tranching longevity exposures. *Insurance: Mathematics and Economics*, vol. 46:186–197.
- Biffis, E. and D. Blake (2012). Informed intermediation of longevity exposures. Tech. rep., to appear in *The Journal of Risk and Insurance*, available at SSRN: <http://dx.doi.org/10.2139/ssrn.2177347>.
- Coughlan, G., M. Khalaf-Allah, Y. Ye, S. Kumar, A. J. Cairns, D. Blake and K. Dowd (2011). Longevity hedging 101: A framework for longevity basis risk analysis and hedge effectiveness. *North American Actuarial Journal*, vol. 15(2):150–176.
- Cowley, A. and J. Cummins (2005). Securitization of life insurance assets and liabilities. *Journal of Risk and Insurance*, vol. 72(2):193–226.
- DeMarzo, P. (2005). Pooling and tranching of securities: A model of informed intermediation. *Review of Financial Studies*, vol. 18(1):65–99.
- DeMarzo, P. and D. Duffie (1999). A liquidity based model of security design. *Econometrica*, vol. 67(1):65–99.
- Gorton, G. B. and G. G. Pennacchi (1993). Security baskets and index-linked securities. *The Journal of Business*, vol. 66(1):1–27.
- Subrahmanyam, A. (1991). A theory of trading in stock index futures. *Review of Financial Studies*, vol. 4(1):17–51.
- Tirole, J. (2005). *The theory of corporate finance*. Princeton University Press.