Proposal for a postdoctoral position

Chair *Data Analytics and Models for Insurance* - 2017-2019

Use of stochastic deflators for the calculation of the economic value of life insurance contracts

DAMI is a research chair financed by BNP Paribas Cardiff which is interested in the problems related to the Data and Models in Insurance (http://chaire-dami.fr/). It proposes a postdoctoral position within the framework of her research orientation "Models for insurance".

Characteristics of the station

We seek one doctor in actuarial science or quantitative finance with a strong interest for the questions specific to the insurance and quantitative modelling. Work comprises a theoretical part as well as the development of applications using tools like R or Python.

The financing is planned for one year duration with possibility of extension by 6 months or one year.

The position is based in Lyon, within the SAF laboratory.

Remuneration is to be discussed per the profile the candidate.

Research topic

The general calculation framework of the economic value of a life insurance contract is presented in chapters 4 and 5 of Laurent *et al* (ed.) [2016].

In a schematic way, the value of such a contract is comparable at the "price" of the contract seen as a credit derivative from the various financial risk factors to which the insurer is subjected (rate, actions, credit, *etc.*). Consequently, the methods based on the arbitrage free assumption in finance of market are used. Their use however is made delicate because of:

- the lack of observable price (see FÉLIX and PLANCHET [2015]),
- the impossibility of an analytical description of the function of determination of cash-flows per the risk factors, cash-flows being obtained *via an* algorithm (see chapter 4 of LAURENT *et al.* (ed.) [2016]).

The practitioners are simply modelling the risk factors under a risks neutral probability (of which the choice among the whole of the possible probabilities is only seldom discussed), which avoids clarifying the form of the market prices of the implicitly associated risk.

In addition to the difficulties induced using this modelling "risks neutral" in model ALM of production of flows (see FÉLIX and PLANCHET [2016]), coherence between the "historical" modelling used for example in

the ORSA (see chapter 4 of Laurent *et al.* (ed.) [2016]) and the modelling of the factors for pricing is not assured.

In this context, an alternative consists in using stochastic deflators, as in DASTARAC and SAUVEPLANE [2010] what makes it possible to use scenarios generated under the historical probability, the pricing of the options being then integrated in the actualization kernel.

With this kind of approach, the functions of reaction used in the construction of cash-flows do not have consequently to be wide any more with beaches of "extreme" values, current under the probability *Q* but rare under *P.*

The difficulty is moved on the level of the construction of the actualization process (deflator), which implies to explicitly model the "market prices of the risk".

A synthesis of this approach is described in CAJA and PLANCHET [2010] and an example of implementation for savings contracts with a simplified economic environment is proposed in DASTARAC and SAUVEPLANE [2010]. The authors explicitly build the deflator in a market with two assets (actions and bonds) by introducing a risk on the market prices of risk.

One can also mention the work of DUBAUT [2015], which is based on the framework proposed in TURC *et al.* [2009]. This framework is a special case of the more general approach presented in CHRISTENSEN *et al.* [2010], which exploits the properties of the Nelson-Siegel representation of the risk-free rates seen as an affine model of interest rate.

The research will thus consist in building a deflator integrating the major financial sources of risk to which the insurer is exposed (rate, action, credit, inflation) and to describe an operational framework for the calculation of economic values of life insurance contracts within a realistic framework, usable by an insurer for calculations which it carries out within the framework of pillar 1 of Solvency 2. This operational framework will be declined at the same time from a theoretical point of view, with a formal description of the model and from a practical point of view, with an implementation in R or Python.

Contact

Frédéric PLANCHET
Professeur à l'Université Claude Bernard, Lyon 1
Laboratoire SAF
Frederic.planchet@univ-lyon1.fr

References

CAJA A., PLANCHET F. [2010] « La mesure du prix de marché du risque : quels outils pour une utilisation dans les modèles en assurance ? », *Assurances et gestion des risques*, Vol.78 (3/4).

CHRISTENSEN J.H.E.; DIEBOLD F.X.; RUDBUSH G.D. [2010] « The Affine Arbitrage-Free Class of Nelson-Siegel Term Structure Models », Federal Reserve Bank of San Francisco, WP n°2007-20.

BONNIN F., COMBES F., PLANCHET F., TAMMAR M. [2015] « Un modèle de projection pour des contrats de retraite dans le cadre de l'ORSA », *Bulletin Français d'Actuariat*, vol. 14, n°28.

DASTARAC H., SAUVEPLANE P. [2010] « Les déflateurs stochastiques : quelle utilisation en assurance ? », Mémoire d'actuaire, ENSAE.

DUBAUT E. [2015] « Risque à la hausse des taux : le modèle MENIR », Mémoire de M2, ISFA.

FÉLIX J.P., PLANCHET F. [2016] « Groupe de travail Risque-Neutre : synthèse des travaux », Chaire DAMI, Réf. 1227-20 v1.2 du 16/12/2016.

FÉLIX J.P., PLANCHET F. [2015] « Calcul des engagements en assurance-vie : quel calibrage 'cohérent avec des valeurs de marché' ? », L'Actuariel, n°16 du 01/03/2015.

LAURENT J.P., NORBERG R., PLANCHET F. (editors) [2016] *Modelling in life insurance – a management perspective*, EAA Series, Springer.

PLANCHET F., LEROY G. [2013] « Risque de taux, spread et garanties de long terme », la Tribune de l'Assurance (rubrique « le mot de l'actuaire »), n°178 du 01/03/2013.

TURC J., UNGARL S., KURPEL A., HUANG C. [2009] « Filtering the interest rate curve : the MENIR framework », Société Générale, Fixed Income du 27/11/2009.