Optimal securitization of SME loans: the selection problem

Arnaud Germain

UCLouvain
Dessus de la ville 16, 5660 Couvin
Belgium

Joint work with: F. Vrins

Securitization is a powerful tool for central banks to stimulate the local economy: by purchasing SME loans bought from commercial banks, central banks can form credit pools, keep the first loss piece, and sell the senior tranche to investors. The junior tranche acts as a guarantee for the holders of the senior tranche, leading to a lower risk premium. This decreases the cost of money for corporates and, consequently, boosts the economic activity.

This securitization process triggers a complex decision problem, which is the identification of the optimal set of loans out of N to be securitized for the sake of maximizing a given objective function, f. The optimization space is the set of N-dimensional vectors $\boldsymbol{\omega}$ whose entries are binary decision weights ($\omega_i = 1$ if loan i is selected, $\omega_i = 0$ otherwise), where N is very large in practice. The objective function can take different forms but is typically non-linear in the decision weights. In addition, the decision problem is subject to budget and diversification constraints. All this together leads to a non-linear high-dimensional constrained integer (NP-hard) optimization problem. Of course, it is always possible to rely on derivative-free algorithms, but the convergence to a satisfactory local optimum is often disappointing.

In this paper, we consider the viewpoint of an investment fund leaning against a central bank willing to maximize the capital release resulting from the securitization process. In this case, the objective function f features the ratio of the Expected Loss (EL) over the Weighted-Average Life (WAL) of the pool. In order to tackle this problem in a reasonable amount of time, we revisit the initial optimization program in order to (i) relax the binary constraint, (ii) reduce the dimensionality of the problem and (iii) address the non-linearity of the objective function. First, we tackle the dimensionality and binary issues via clustering: the loans are aggregated in clusters, such that the selection problem collapses to determining the vector of optimal exposure to each cluster. The vector of binary weights will be determined in a second step, by selecting sequentially the loans that are closest to the centroids. Second, we linearize the EL of the senior tranche (which is a non-linear function of the loss on the pool, hence, of the decision weights) thanks to the Large Homogeneous Portfolio approximation combined with a quadrature technique and Glover linearization scheme. We propose an analytical expression for the WAL accounting for prepayment using a continuous-time expression of the PSA prepayment model, which is standard in the mortgage-backed security industry. Our algorithm is proven to be very competitive compared to several benchmarks, such as derivative-free algorithms (Nelder-Mead), random selection or the best out of a set of portfolios built from heuristics, both in terms of the objective function and computation time.