Collateralised Debt Obligation Portfolio Optimisation

THE UNIVERSITY OF AUCKLAND
FACULTY OF ENGINEERING
Department of Engineering Science

BY: MIN GIH CHOI

SUPERVISED BY: DR. MICHAEL O'SULLIVAN, DR. CAMERON WALKER

Introduction

Billions of dollars worth of collateralised debt obligations (CDOs) are issued every year, with CDO portfolios being worth hundreds of millions of dollars. A portfolio is comprised of individual assets or *obligations*. Such large investments need to be managed, and usually this is done manually under the discretion of a manager proposing potential obligation trades. A method of optimisation was developed for this problem.

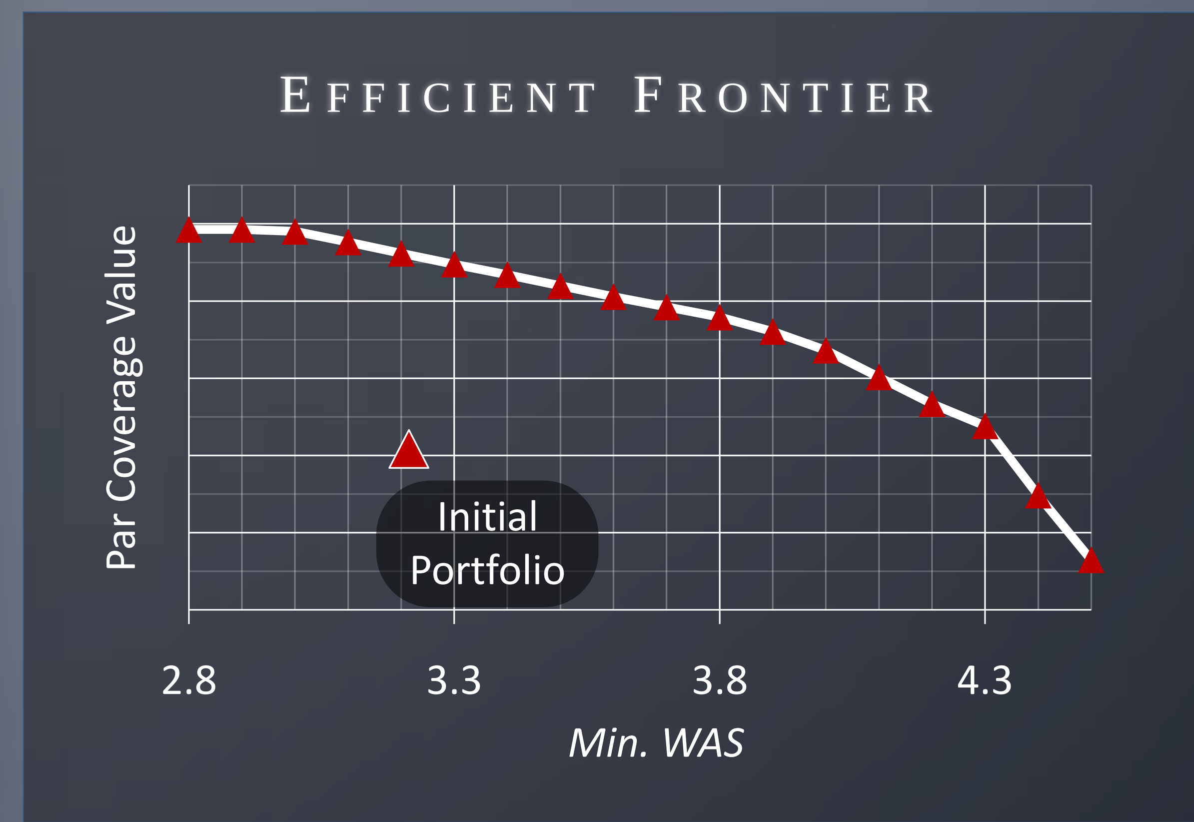
Image from: http://vikaskalyanshetty.wordpress.com/

Modelling Approach

A calculation which would provide an indication of the value of the portfolio can be carried out, known as the *Par Coverage value*. In association with a classified investment company, such calculations were reformulated into a mixed integer linear programme (MILP), in order to identify an 'improved' portfolio, through maximising the Par Coverage value of any given CDO portfolio.

The formulation was implemented in the Python using open-source solvers *CBC*, and *Dippy* through the *PuLP* interface. Heuristic Algorithms were also coded into Dippy in attempt to speed up integer solution convergence.

Results



The Par Coverage value was maximised for a given minimum WAS.

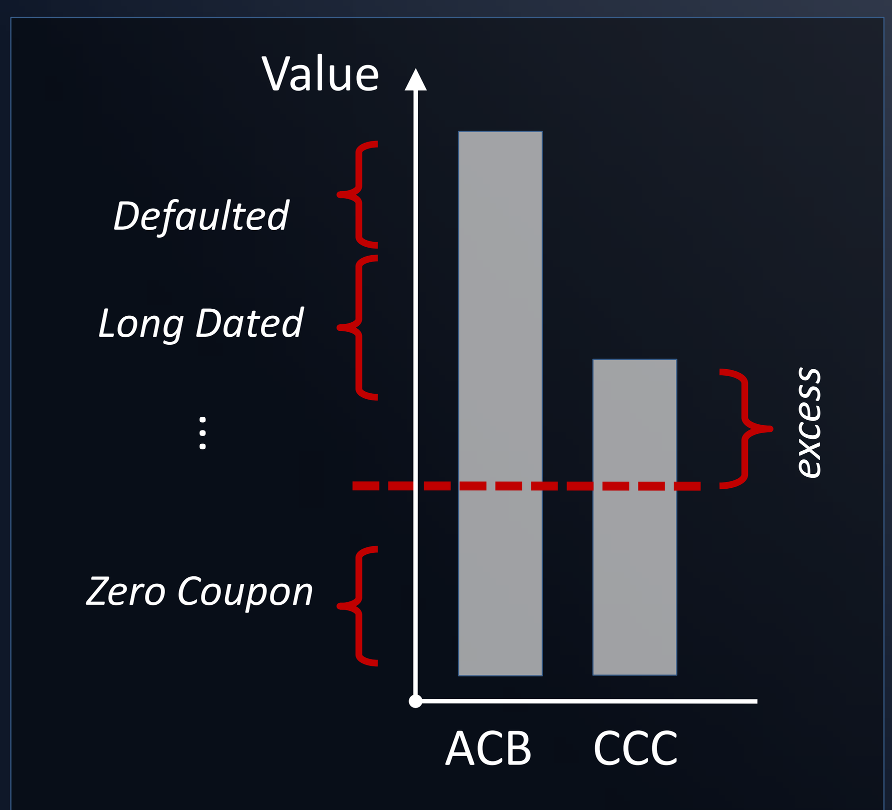
Due to the inverse relationship of these two values, an efficient frontier was able to be produced.

It is beneficial to have both high Par Coverage and high WAS values.

Conclusions

- The formulation was able to produce optimised portfolios with higher Par Coverage values than the initial portfolio, for any given input list of obligations.
- The solve speed was improved through the implementation of two heuristics
- Due to the potential for commercial application, only open-source software packages were used.

Par Coverage Value

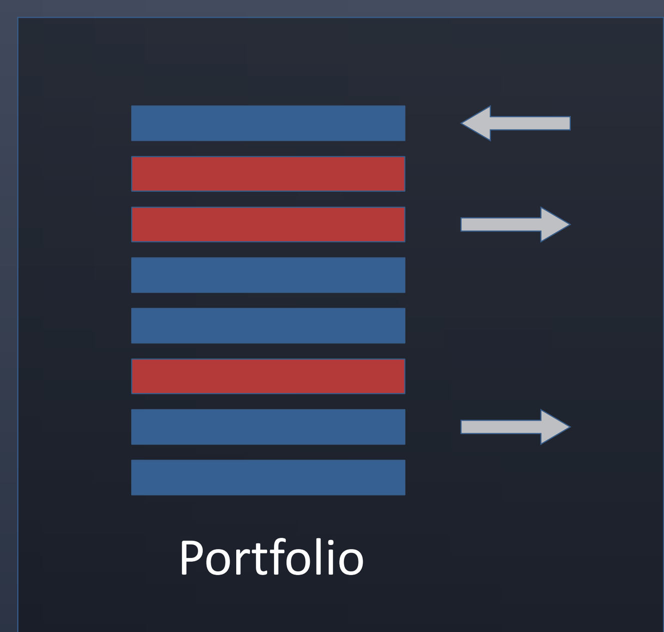


The Par Coverage Value is obtained from the complex interaction of certain obligation categories.

The different categories of obligations (*Defaulted, Long Dated, Zero Coupon, and Discount*) are calculated separately and summed to obtain the Aggregate Collateral Balance (ACB).

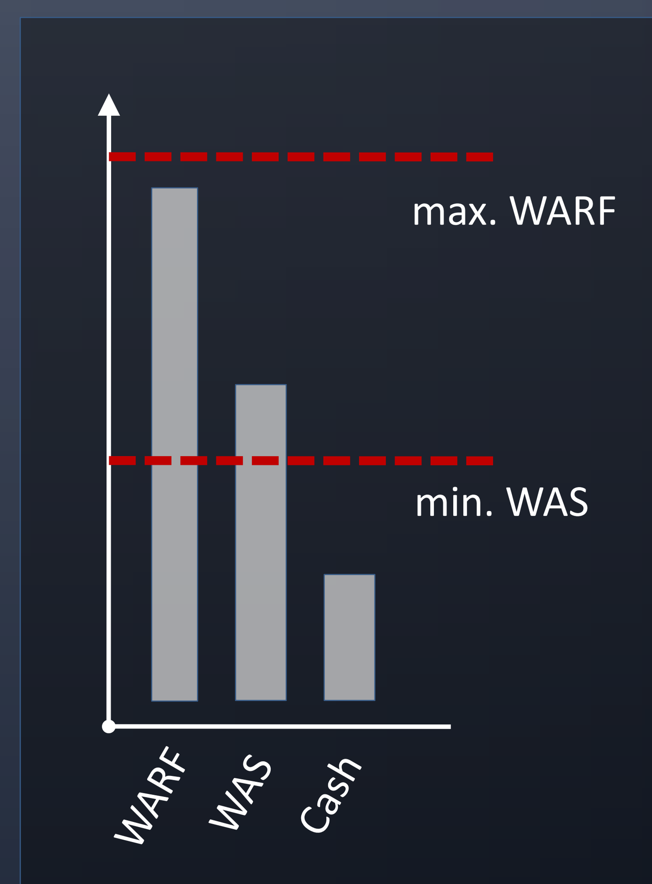
A specifically ordered combination of another category – *CCC rated* obligations – is constructed and an *excess value* must be obtained.

Buy/Sell



Obligations are purchased or sold in integer block sizes in attempt to improve the Par Coverage Value

Thresholds



The final portfolio must adhere to specified *threshold levels* for some additional calculated values:

- The *Weighted Average Spread* (WAS) must be higher than a minimum WAS;
- The *Weighted Average Rating Factor* (WARF) must be lower than a maximum WARF;
- There must be enough Principal Cash to purchase obligations.

Solve Speed

With an estimated ${}^{1000}C_{200}$ potential portfolios that could be considered from an input list of obligations, solving speed was an issue.

A heuristic algorithm was also incorporated to run simultaneously with the MILP solver, in an attempt to provide the solver with potentially better feasible integer solutions. This would mean less combinations would have to be solved, speeding up convergence the to feasible integers solutions.