Dissertation Seminar
Structural Credit Risk Modelling

Academic Year: 2016/2017   **Instructor:** Nuno Silva
September – December 2016   **Max. number of students:** 6

Seminar Description

The literature on credit risk modelling is vast. Generically models are divided between reduced form models and structural models. The latter distinguish from the first by directly linking default to the value of the firm. This course will start by comparing the two approaches. We will then review the main assumptions behind the most relevant structural models, namely Merton (1974), Black and Cox (1976), Leland (1994) and Zhou (2001). Industry standards like Moodys-KMV EDF and the CreditGrades model will be also addressed. This course will focus on understanding the main features of each of these models with the mathematics of continuous time finance being largely overpassed. The use of structural credit risk models in corporate finance, firm valuation and hedge fund strategies such as capital structure arbitrage will be also emphasized.

Seminar Content

Bond markets are by far the largest financial asset class with more than 100 trillion dollars in outstanding debt securities. In addition, credit linked derivatives such as credit default swaps have grown fast during the last decade. Not surprisingly credit risk is a hot topic for the financial industry. In the case of those firms that have publicly listed shares or for which the price of derivatives is available, structural credit risk models have proved to beat reduced form approaches by incorporating markets daily information. But the list of applications of this type of models goes far beyond the measurement of credit risk. Examples of dissertation topics:

• The main goal of structural credit risk models is to produce credit risk metrics (e.g. credit spreads, probabilities of default, distance to default). In the case of credit spreads, these can then be compared with observed CDS and bond spreads. Students can choose a model, apply it to a set of firms (there are several possible ways to estimate the model) and then check if the model has a good fit with the data. Students can also explore the effect of each parameter on models' output as this will help them fully understand the model (e.g. under Merton (1974) equity is a strictly increasing function of asset volatility, while this is no more the case in Black and Cox (1976)). Doing a horse race between two or more models is also a possibility. Another interesting exercise is to think what would be the capital increase needed by a certain firm to decrease its credit spread up to a certain level.

• Explore capital structure arbitrage strategies. Capital structure arbitrage strategies consist of simultaneously going long/short on financial securities contingent on firms' assets (equities, CDS, options) exploring differences between actual and model prices. A student willing to work for a hedge fund could think of implementing a strategy of this type using historical data and then check whether this could have led to a positive alpha. Results should depend heavily on the choice of the model, but even within each model one can think of different entering and exiting strategies. Creativity is welcome.

•Students interested in corporate finance may want to see the trade-off theory of capital structure working in practice. In this regard, one could use Leland (1994) model or similar to find the optimal capital structure of a group of firms. In addition, it could be interesting to check how the optimal capital structure changed with the euro area sovereign debt crisis and how companies in different countries reacted.

• Valuation. The models learnt in this course are often used to value equity in the case of non-listed troubled firms. Students can pick one firm and compare the results delivered by some of the structural models suggested with the ones obtained using other more traditional approaches (DCF, relative valuation). During this project the student will have to i) value the firm assets using the methodologies learnt in the firm valuation course, ii) assume a statistical process for the evolution of the market value of assets (e.g. a diffusion process as in Merton (1974) or a jump diffusion process as in Zhou (2001)); judge what are the most reasonable parameter values based on listed peer companies.

Seminar Objectives

The thesis project has mainly two objectives. First, students should end up with a good understanding of the structural credit risk modelling literature and the links to related fields such as corporate finance and option pricing. Understanding the assumptions made by each model and their potential impact on the results should be a big advantage when dealing with quantitative analysts or using industry software. Second, the student should be able to apply at least one of these models and critically analyze the results. The dissertation should be written in English.

This workshop will give students a good overview of the structural approach to credit risk modelling. Classes will introduce the main models in the field, but students are expected to read most of the suggested literature on their own focusing on the differences between each model rather than understanding the mathematical derivation of the pricing formulae. As students finish their literature review they should decide on the objective of their thesis and choose which model(s) they will apply using real data. At this stage students are expected to talk with each other and discuss the results they are obtaining. Ideally, we will have at least two students implementing the same model (different purposes) and two students working with the same purpose (different models). Critical assessment of the results obtained is key. To successfully complete the master thesis, students are expected to be highly dedicated to the project throughout the course.

Bibliography / Recommended Textbook(s) / Additional Readings

Lando, D., 2004, Credit risk modeling: Theory and applications, Princeton Series in Finance.
Bielecki, T. and M. Rutkowski, 2002, Credit risk: Modelling, valuation and hedging, Springer.

In addition, students should read Moody's-KMV EDF and CreditGrades technical documentation as well as parts of articles cited in classroom.

Biography

Nuno Silva is an economist at the Economics and Research Department at Banco de Portugal since 2009, working in the Financial Intermediation Division. He has a Licenciatura in Economics from Universidade Nova de Lisboa and a M.Sc. degree in Operational Research and Finance from the University of Southampton. Nuno's research at Banco de Portugal has focus on credit risk modelling and its transmission. He has also been involved in monitoring the monetary and financial conditions of the Portuguese economy, as well as the recent institutional reforms in the European Union.

Contact(s) and Office Hours

E-mail: nunomarquessilva@gmail.com
Office hours by appointment only.

Schedule

Session 1 (Monday, 5th September, 18h30-20h)
- Introduction to the main goals of the dissertation workshop and discussion of student's interests and objectives.
- Introduction to structural credit risk modelling: Merton (1974) model.

Session 2 (Monday, 12th September, 18h30-20h)
- Overview of other structural credit risk models.

Session 3 (Monday, 19th September, 18h30-20h)
- Overview of other structural credit risk models.
- Discussion of related topics: corporate finance, capital structure arbitrage, pricing of structured products, simulation approach.

Deadline (Monday, 26th September): One page report with brief outline of the thesis (model chosen, firm(s), objective, data sources).

Session 4 (individual meetings) (Monday, 10th October, 18h30-20h)
- Discussion on project objectives, data issues and estimation methods.

Deadline (Monday, 10th October): First draft of the literature review.

Session 5 (individual meetings) (Monday, 24th October, 18h30-20h)
- Discussion on the first results obtained and possible ways to improve the thesis.

Deadline (Monday, 7th November): First complete draft.

Session 6 (individual meetings) (Monday, 21st November, 18h30-20h)
- Discussion on possible ways to improve the thesis.

Deadline (Monday, 28th November): Revised draft.

Session 7 (Friday, 16th December, 18h30-20h)
- Presentation and peer discussion.

Deadlines

Deadline to complete Study Plan (to defend in February)	28/12/2016
1st Submission Deadline to MSc Student Affairs	4/01/2017
Dissertation Defense Period	13/02/2017 to 24/02/2017
Deadline to complete Study Plan (to defend in May)	28/03/2017
2nd Submission Deadline to MSc Student Affairs	3/04/2017
Dissertation Defense Period	8/05/2017 to 19/05/2017