PART I: AN INTRODUCTION TO DEPENDENCE MODELING

Six years after the U.S. recession ended, the global economy is still haunted by its complications. The latest addition to the financial turmoil came when Greece in July became the first advanced economy to fall into arrears to the IMF, as its second bailout expired (Udland, 2015). Moreover, despite efforts to clean up the banks, and put in place regulations aimed at restoring trust and confidence in the financial system, the banks continue to trade in derivatives in many of the same ways they did before the crash. In many cases they do so on a larger scale and with precisely the same unknown risks. (Partnoy & Eisinger, 2013)

To help avoid a recurrence of the financial disaster from the 2008 bankruptcy of Lehman Brothers, to J.P. Morgan's 2012 trading losses, more care has to be taken when modeling and analysing financial risk.

INTRODUCTION

To calculate the value at risk (VaR) for a portfolio of different asset classes, we must analyse the total risk of the portfolio. While recent literature within quantitative finance has dealt extensively with the modeling and quantification of individual risk factors influencing pricing and asset allocation, less attention has been given to the analysis of dependence across financial markets. (Backman, 2015).

The purpose of this series of articles is to investigate how the dependency structure between separate types of risk affect portfolio risk. Specifically, we develop a joint modeling framework for equity and credit risk. Using a portfolio of corporate bonds and an asset representing a stock market index (henceforth *equity*), the various aspects of the framework can be illustrated.

Before we go on to describe the risks that an investor in our portfolio is exposed to we give a very brief description of a corporate bond.

CORPORATE BONDS

A bond is a debt obligation, and consequently investors who buy corporate bonds are lending money to the company issuing the bond. In return, the company makes a legal commitment to pay interest on the nominal value, and return the nominal on maturity. The yield on corporate bonds is very closely linked to the underlying *credit risk*, as will be described below.

MARKET RISK

Market risk concerns the risk of change to values of holdings due to movements of market prices. The term spans several types of risk, including, but not limited to, equity, interest rate and currency risk. Our portfolio of corporate zero-coupon bonds is exposed to equity, interest rate and credit risk. Here, equity risk is rather straight forward. The value of our equity asset is directly linked to the stock market level.

The interest rate risk is a little bit more involved since the value of the bond *depends* on the interest rate in a more indirect way. E.g., consider a bond that offers 2 % interest. A year later the market experiences a positive shift of the relevant yield curve, and the interest rate increases to 3.5 %. The bond that was issued will still pay 2 % interest, making it less attractive compared to newly issued bonds that will pay an interest rate of 3.5 %. Hence, the bondholder will experience a drop in the market value of the bond paying 2 % interest. We say that the bond holder is exposed to interest rate risk.

The credit risk is rather more complicated though, and below we outline the nature of this risk.

CREDIT RISK

One of the key risks to corporate bond holders is that the company issuing the bond may default on the bond, failing to make timely payments of interest or the nominal value. This is known as *credit risk*, and describes the loss incurred to a party when a counterparty of a contractual agreement is unable to fulfill its obligation under the contract.

The creditworthiness of a company, is monitored by credit rating agencies using credit rating systems. The ratings are issued and published by credit rating agencies, where Standard & Poor's, Moody's and Fitch Group are the three largest, holding a collective global market share of roughly 95 % (Alessi, 2015). Commonly, credit ratings are classified into seven different rating categories, where the rates from excellent to poor are stated as follows: AAA, AA, A, BBB, BB, B, CCC with the addition of a default rating D. The rating convention may vary across agencies, but is principally the same.

When the rating for a bond changes it affects the market value of that bond, since the change means it is more, or less, likely that the issuing company will default on its obligation to repay. If the likelihood of default goes up, i.e. the rating changes to a worse level, e.g. from A to BBB, the value of the bond goes down and vice versa.

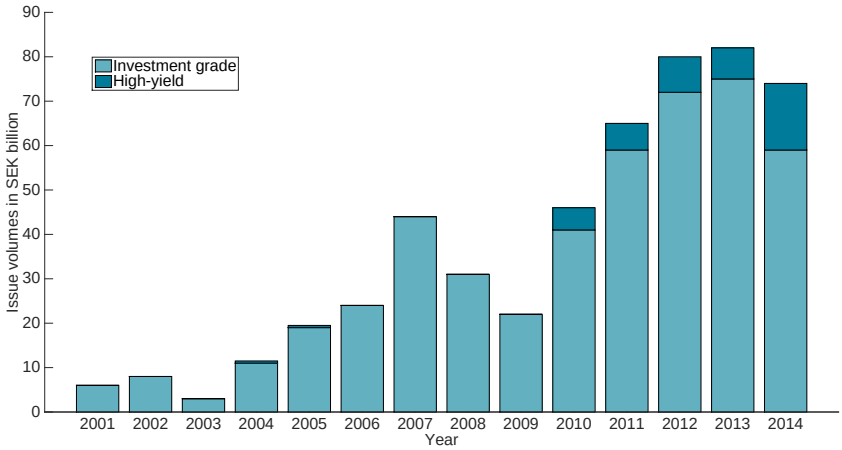

Figure 1: Issue volumes on the Swedish market for corporate bonds. Note: Interpretation of data from Dealogic. The statistics does not necessarily cover all the issues on the market, since the statistics are based on information that market participants report voluntarily. For those bonds without a credit rating, the allocation into investment grade or high yield is based on the banks' credit assessments of the companies (Bonthron, 2014).

JUSTIFYING THE NEED FOR DEPENDENCE MODELING

The Swedish corporate bond market has since year 2004 increased sevenfold from a volume of SEK 10 bn to more than SEK 70 bn in 2014 (Bonthron, 2014). At the same time, the share of high-yield bonds, i.e. a bond with low or no credit rating, is also increasing (refer to Figure 1). High-yield bonds are by definition more exposed to credit risk than higher quality bonds since they are closer to default.

Furthermore, we expect a dependency between the equity and credit risk factors. It is highly plausible that the market value of a bond issued by a company displays dependency to the stock issued by the same company, especially so for high-yield bonds which are closer to equity than higher quality bonds in the capital structure of a company. We may also extend our assumption to include the existence of a dependency structure between a stock market index and corporate bonds issued by large companies that make up a substantial part of that same stock market index.

A growing corporate bond market means more investors will have portfolios that are exposed to both equity and credit risk. At the same time, with the scheduled implementation of Basel III for banks in 2019, and Solvency II for European insurance companies in 2016, the regulatory requirements for many types of institutional investors are increasing. It is without doubt that the dependence structure connecting several risk factors, among those equity and credit risk, becomes an important issue to analyse and understand.

SUMMARY

In this article we have introduced the concept of dependence modeling and given an introduction to the risks associated with our portfolio of corporate zero-coupon bonds and an equity asset. In the next article, "Part II: A Joint Framework in Dependence Modeling", we will present a simulation framework designed to capture and describe the joint evolution of these risks.

References

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