UNIVERSITÉ LIBRE DE BRUXELLES, UNIVERSITÉ D'EUROPE

Solvay Brussels School
Economics & Management

MEMOIRE

Présenté en vue de l'obtention du Master en Ingénieur de gestion, à finalité Advanced Management

Refinancing risk and its impact on distressed company valuation

Romain Hup

Directeur: Professeur Yassine Boudghene
Commissaire: Professeur Catherine Dehon

Année académique 2013- 2014

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Abstract

The main objective of this dissertation is to develop a model to assess the impact of refinancing risk on a company value and observe how the latter will react to a refinancing operation. A literature study of the current credit risk models determines that none of these models are designed to take this refinancing risk into account. This dissertation therefore presents a model based on a cash flow approach to value the refinancing exposure of a company. The model concludes that the refinancing exposure represents a hidden debt for a distressed company. This hidden debt locks a part of the firm's value and has a negative impact on both the equity and debt values of a firm. When a company successfully conducts a refinancing operation that reduces its exposure, the equity and debt values react positively as the hidden debt decreases. These conclusions are verified by the study of five distressed companies.

Acknowledgements

I would like to express my deep gratitude to Professor Boudghene, my supervisor, for his guidance and useful critiques of this research work. My grateful thanks are also extended to Bernard Lalière, Head of High Yield Fixed Income at Petercam Institutional Asset Management, for his regular feedbacks and valuable support. I also wish to acknowledge the help provided by the whole Institutional Fixed Income department of Petercam in accessing the financial data required to write my dissertation. I also would like to thank my parents for the support and conducive environment they provided me during my whole studies. Finally, my special thanks are extended to my classmates that made this five years at Solvay so exciting, especially Florence, Guillaume, Nicolas and Thibaut.

Executive Summary

When financing their long-term operations by issuing shorter-term debt, companies are required to refinance their debt on a regular basis and are faced with uncertainty regarding the future underlying interest rate. This situation, known as refinancing risk, may have an important impact on the liquidity of a distressed company and might ultimately force it to default. A distressed company is indeed faced with uncertainty about its future outlooks and will have to pay a premium when refinancing its debt in order to compensate for the increased risk. Intuitively, this premium should therefore negatively influence the value of a firm. On the other hand, the latter is expected to react positively to a refinancing operation.

The goal of this dissertation is to develop a practical model in order to measure the exposure of a firm to the refinancing risk and ultimately confirm or infirm the intuition regarding the impact of this risk on a distressed company value. This dissertation will therefore study the refinancing risk from the perspective of an outside investor. The model presented in this dissertation is based on the Asset Liability Refinancing Gap model developed by Yann Ait Mokhtar for Exane. However, due to the little information publicly available, the model has been adapted and completed by the author.

The methodology used to answer this research question is based on a three-step process. It starts by a literature review of the existing valuation models and observes whether and how they take the refinancing risk into account. It then presents a model specifically designed to value the refinancing risk, the " Refinancing gap model", and provides theoretical answers to the research question. Finally, it applies the model to existing companies and observes whether the theoretical conclusions are confirmed by reality. Each step of the process relates to a chapter of the dissertation.

It appears from the literature review that none of the current models takes the refinancing risk into account when modelling the probability of default of a firm and indirectly its value. As a matter of fact classical structural models assume that a company defaults as soon as its firm value falls below a given threshold. Although this threshold depends on the specificities of the model,

structural models rely only on economic distress to trigger off the default of a firm. By doing so, they fail to take another kind of distress into account, that is to say the financial distress. Financial distress occurs when the company faces difficulties to honour its financial obligations and is therefore considered a cash flows or liquidity issue. Refinancing risk is therefore a subset of this liquidity risk as uncertainty regarding the refinancing terms directly impacts the liquidity of a firm. As a consequence, classical structural models either assume that the company will be able to refinance its total debt under the current terms in the future or that the company will stop existing at the maturity of the outstanding debt. These assumptions are obviously not verified in reality and require the development of a new model to deal with the refinancing risk.

This new model, called the “Refinancing gap model”, is based on a cash flow approach of the refinancing risk. In fact the company has to finance its future activities, yielding a known cash flow, by borrowing at an unknown rate. This situation is similar to a swap position for the company, in which it receives fixed cash flows from operating activities and has to pay an interest rate on its future debt that will only be determined when the debt is rolled over. This swap should be considered an off balance sheet item and is similar to a hidden debt in the case of a distressed company whose expected refinancing terms have worsened. The value of this swap represents the exposure of the firm to the refinancing risk. As this exposure is considered a hidden debt, it directly influences the value of both equity and debt. On one hand, this hidden debt increases the total leverage of the firm, hence the credit risk of the debt. As a consequence, the credit spread on the debt will also increase, which will negatively impact the value of the debt. On the other hand, the hidden debt represents the part of the value of the firm which is locked due to the refinancing exposure and is therefore currently not available for the shareholders, resulting in a lower value of the equity. As part of the value of the firm is therefore locked and not attributed to either the shareholders or the debt holders, the actual value of the firm, equal to the sum of the equity and he debt value, is lower than the one of a similar firm without exposure to the refinancing risk.

A distressed company with an exposure to the refinancing risk has various options to reduce this exposure. These operations (i.e. capital increase, assets disposal, etc) will have a positive impact on the liquidity of the firm, hence reducing the exposure and the value of the hidden debt. In turn a reduction in the hidden debt will positively affect the equity and debt value, hence the actual firm value. On one hand, the reduction in the hidden debt decreases the leverage of the firm and consequently its credit risk. On the other hand, the refinancing operation will unlock part of the firm value, which will directly be transferred to the equity.

In theory the refinancing gap model is therefore able to explain how the refinancing exposure affects a firm value and how the latter reacts to refinancing operations. The model was finally applied on existing companies to test whether it predicts accurately the equity and debt value of distressed companies in real terms. It turned out that the refinancing gap model is efficient to predict the stock price of distressed companies and improves the accuracy of classical structural models when forecasting the bond spread.

Indeed the refinancing gap model has successfully predicted the stock prices of the four studied companies presenting a positive refinancing exposure, both before and after the refinancing operations. Furthermore, it outperformed significantly the classical structural models used as a benchmark. Moreover, the model successfully predicts the magnitude of the stock price variation when the firm announces its refinancing operations, which is impossible by means of the classical structural models. It is clear that these models provide forecasts that are usually contrary to the stock market reaction. Considering that the refinancing exposure locks part of the value of the firm to the detriment of the shareholders therefore appears to be a relevant approach. Moreover this is in line with the stock market reaction to such exposure.

On the other hand, the refinancing gap model systematically predicts bond spreads that are higher than those of classical structural models, hence improving the accuracy of these models. Moreover, the biggest improvements appear for companies that face a considerable refinancing exposure. As a consequence, it proofs that the refinancing risk significantly impacts the bond spread of a distressed company and justifies partly the "underprediction" of the classical structural models. However, the Refinancing gap model still fails to accurately predict the real bond spread and only provides a closer estimation. By considering the refinancing risk in addition to the economic distress, the refinancing gap model therefore takes into account a wider range of financial triggers. However, the refinancing gap model does not consider the liquidity issue in its broad sense. This limitation might explain the remaining difference between modelled and observed spreads

Following these conclusions about the refinancing gap model as well as its limitations, improvements to this model can be proposed as future research directions. Firstly, a statistically significant quantitative study could be conducted to confirm or infirm the results of this dissertation. Secondly, other proxies for the refinancing premium could be used. Finally, the accuracy of the refinancing gap model could be improved by trying to include the liquidity risk in general or by using more advanced, computing-intensive structural models.

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Introduction

In November 2008 Standard & Poor's[1] announced that 1,6 trillion euros of European debt would mature over the next three years in a context of unfavourable bond market conditions. As a consequence, Standard & Poor's warned that a growing number of companies might have to struggle to refinance their debt resulting in a refinancing cost which will be on average 200bp higher than before August 2007. When financing their long-term operations by issuing shorter-term debt, companies are indeed required to refinance their debt on a regular basis and are faced with uncertainty regarding the future underlying interest rate. This situation, known as refinancing risk, may have an important impact on the liquidity of a distressed company and might ultimately force it to default. A distressed company is indeed faced with uncertainty about its future outlooks and will have to pay a premium when refinancing its debt in order to compensate for the increased risk. Intuitively, this premium should therefore negatively influence the value of a firm. On the other hand, the latter is expected to react positively to a refinancing operation.

The goal of this dissertation is threefold: to develop a practical model to measure the exposure of a firm to the refinancing risk and ultimately confirm or infirm the intuition regarding the impact of this refinancing risk on a distressed company valuation and finally observe how the latter reacts to a refinancing operation. In the framework of the dissertation, a distressed company is defined as a company whose outstanding debt is considered speculative by rating agencies. Moreover, the company value will be studied from the point of view of the equity (stock price) and debt (bond spread) values. Finally, a refinancing operation will be defined as an operation that reduces the refinancing exposure of the company. This dissertation will therefore study the refinancing risk from the perspective of an outside investor. The approach of this dissertation will be exhaustive and detailed in order to allow any financial investor to apply the model in practice, whatever his level of knowledge in credit risk modelling.

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[1] STANDARD & POOR'S, "Credit Trends: Gaping Refunding Pipeline In Europe Intensifies Financial Challenges", 2010, p.1.

The methodology used to answer this research question is based on a three-step process. It starts by a literature review of the existing valuation models and observes whether and how they take the refinancing risk into account. It then presents a model specifically designed to value the refinancing risk, the " Refinancing gap model", and provides theoretical answers to the research question. Finally, it applies the model to existing companies and observes whether the theoretical conclusions are confirmed by reality. Each step of the process relates to a chapter of the dissertation.

The first chapter of the dissertation will start with an introduction of the credit risk and its measurement. Then it will highlight the different reasons that may trigger off the default of a company and define one of them, more specifically the refinancing risk. It then presents the different ways to forecast the credit risk and deep dives into one of them, the structural model. In this section, the intuition and limitation of the most famous structural models (Merton and CreditGrades amongst others) will be introduced. Finally, the last section will study whether structural models take the refinancing risk into account or not.

The second chapter starts by introducing the intuition of the Refinancing gap model and presents step by step how to apply it, based on a practical framework. It then explains how this refinancing gap impacts a firm's value and how to adapt the structural models to take the refinancing risk into account. Finally, it highlights the different actions that a distressed company can take to solve its liquidity issues and the impact these have on the company value, in the light of the refinancing gap.

The last chapter represents the practical implementation of the Refinancing gap model presented in chapter 2. It will study five companies that all faced an important exposure to the refinancing risk and decided to use one or several of the refinancing operations introduced in chapter 2 to reduce this risk. For each company, it will present the background of the firm as well as the reasons that led to the refinancing exposure. It will also use the refinancing gap model to compute both the equity and debt values of the firm and compare them with classical structural model estimations. It will then explain the refinancing operation and compare the predicted outcome (by the refinancing gap model and classical structural model) with the reality. Finally, it extends the model to a company facing a negative exposure to refinancing risk

Finally, the conclusion presents the limitations of the Refinancing gap model and proposes four research directions to complement this dissertation and improve the Refinancing gap model.

The refinancing gap model presented in this dissertation is based on a model initially developed by Yann Ait Mokhtar for Exane and called the “Asset Liability Refinancing gap”. However, as this model has been developed internally by a financial company, little information is publicly available. This dissertation is therefore based on the author’s interpretation of the information available and has been completed by his own research. Moreover, due to the amount of time required to become familiar with a company history and apply the model in practice, this dissertation will focus on a relatively limited panel of companies. Therefore this dissertation does not aim at providing a statistically exhaustive confirmation of the refinancing gap model through a quantitative study. Instead, it aims at showing the intuition of the refinancing gap models through relevant cases.

Chapter 1

Refinancing risk and literature review

A company with a maturing debt is facing uncertainty about the conditions under which it will be able to refinance it. This issue, known as refinancing risk, can affect significantly the liquidity of a company and force it to default. Refinancing risk is therefore a subset of the credit risk. The goal of this chapter is to present the main models forecasting credit risk, observe how they potentially take into account the refinancing risk and highlight their limitations.

The first section of this chapter will introduce the credit risk and its measurement. Then it will highlight the different reasons that can trigger off the default of a company and define one of them, i.e. the refinancing risk. The second section will present the different ways to forecast the credit risk while the third one deep dives into one of them, the structural model. In this section, the intuition and limitation of the most famous structural models will be introduced. Finally, the last section will study whether structural models take the refinancing risk into account or not.

Section 1: introduction to credit and refinancing risk

When entering into a financial transaction, an investor is facing several risks, the more important ones being the market risk and the credit risk. The market risk[2] is "the risk of a change in value of a financial asset due to a change in the market conditions (interest and exchange rates amongst others)". The market risk is therefore not linked directly with a single company or a financial product.

On the other hand, the credit risk[3] is "the risk that an issuer might default or fail to fulfil entirely his obligation due to a change in its credit quality". The credit risk therefore depends on the

[2] DARRELL, Duffie and SCHAEFER ,Stephen, Credit Risk: Pricing, Measurement, and Management, Princeton, Princeton University Press, 2003, p.3.
[3] ibid.

issuer and can lead to large losses for the lender. As a consequence, the latter will require to be rewarded for his exposure to this risk. This reward will take the form of a premium on the risk-free interest rate used when there is no credit risk. The premium therefore represents the compensation for the risk of default and is computed accordingly.

1.1 Credit risk measurement

In order to assess the credit risk of a counterparty, financial regulators have developed several frameworks. Amongst them, Basel and its subsequent updates are the most famous ones. The bank of the International Settlements laid down the Basel rules in 1988 to allow all lenders to measure the possible credit risk in a coherent and similar way and to make sure they have put aside enough capital to face potential credit losses. This approach has been developed for financial institutions but can be used by any investor.

Basel defines[4] credit risk as:

« The risk of loss from a borrower/counterparty's failure to repay the amount owed (principal or interest) to the bank on a timely manner based on a previously agreed payment schedule ».

A more comprehensive definition also includes value risk[5]:

« The risk of loss of value from a borrower migrating to a lower credit rating (opportunity cost of not pricing the loan correctly for its new level of risk) without having defaulted ».

In order to model the credit risk, Basel used the following formula[6]:

EL = PD * EAD * LGD

[4] STEPHANOU, Constantinos, and Juan Carlos Mendoza. "Credit risk measurement under Basel II: an overview and implementation issues for developing countries." *World Bank Policy Research Working Paper* 3556 (2005), p.6.
[5] Ibid.
[6] ibid.

Where:

- EL is the expected loss over a period of time of a financial product or a portfolio
- PD is the probability of default over a period of time
- EAD, or exposure at default, is the amount due to the counterparty at the moment of default. It is therefore a measure of the extend to which an investor is exposed to the counterparty in case of a default event
- LGD, or loss given default, is the fraction of exposure that will be lost in the event of default

While the exposure at default is constantly known for a company, the probability of default and the loss given default are uncertain and must therefore be predicted by models. In order to accurately work, these models must take into account all the reasons that may force a company to default. These reasons are presented in the next section.

1.2 Study of default triggers

According to Davydenko[7], several reasons can lead to the default of a firm. He divides them into two categories: financial and economic distress. Financial distress occurs when the company faces difficulties to honour its financial obligations. Although the business might seem fundamentally sound, a temporary decline in cash flows may result in the inability of the firm to make the scheduled debt payments. On the other hand, economic distress arises when the prospects of the firm are deteriorating and the value of the business is decreasing. Financial distress can therefore be seen as a cash flow issue, while economic distress is linked to the value of a company.

Davydenko observes that at default, most firms are both economically and financially insolvent. On average, the market value of assets at default is equal to only 60% of the face value of debt. Moreover, liquidity ratios are below the industry median in 80% of the defaulting firms. He concludes that[8] “persistent economic distress seems to drive financial distress”. Indeed, firms in

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[7] DAVYDENKO, Sergei A. "When do firms default? A study of the default boundary." *A Study of the Default Boundary (November 2012). EFA Moscow Meetings Paper*. 2012, p.2.
[8] ibid.

economic distress are losing money and therefore need to sell their liquid assets to pay the money back to their creditors and suppliers until they reach financial distress. However, this conclusion should not be seen as a generality. Low-value firms are distinct from low-liquidity firms in a substantial amount of observed default events. Around 13% of firms default with low asset value despite their liquid assets in excess of current liabilities. Furthermore, at least 10% of firms default, although their asset value is higher than the face value of debt. These firms are therefore economically solvent, but have major liquidity problems triggering off the default event. Finally, many distressed low-value and low-liquidity firms are able to postpone default over several years. Indeed, a majority of economically insolvent companies succeed in delaying the default for at least a year. Davydenko concludes that neither economic nor financial distress taken alone can fully explain the default of a company.

Moreover, as different firms default at very different asset values and as there are as many firms defaulting when their assets are low as the firms that do not, it is hard to define a boundary separating defaulting from surviving companies. Davydenko and Leland[9] both determine the threshold value "of assets that equalizes the number of defaults above the boundary with the number of no defaulting firms below it » as being equal to 68% of the face value of debt. Leland found that structural models calibrated with this threshold generate on average long-term default probabilities that are in line with the observed data. Although appealing at first glance, the Davydenko study yields totally different results when companies are analysed on an individual basis: one-third of defaults occurs at values above this boundary and could not be predicted by structural models. Moreover, an equal number of companies below it do not default for a least one year, although the default had been predicted by structural models.

As explained by Davydenko, a transitory liquidity problem can trigger off default, if the firm is prevented from raising new financing against its assets. If the required amount of cash cannot be raised, the temporary liquidity issue will force the firm to default, despite its sound economic fundamentals. In his study, Davydenko[10] found that liquidity shortages lead to default only when

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[9] LELAND, Hayne E. "Predictions of default probabilities in structural models of debt." *The credit market handbook: Advanced modeling issues (H. Gifford Fong, Editor)* (2006), p.42.

[10] DAVYDENKO, Sergei A. "When do firms default? A study of the default boundary." *A Study of the Default Boundary (November 2012). EFA Moscow Meetings Paper*. 2012, p.8.

external financing is hard to obtain due to restrictive covenants or a depressed state of the market

In the absence of such restriction, firms will raise new cash to overcome liquidity shortages as long as the business remains valuable. Therefore, if external financing is costless, the firm does not default, except in case of economic distress. Between those two extreme situations, the firm might be able to raise new financing to face its liquidity issue and refinance its debt albeit under unfavourable terms. If the company is in a distressed setting, it might indeed have to pay a premium on its debt. This premium will worsen even more the financial distress of the company and eventually trigger default sooner than expected.

This problem, known as refinancing risk, is presented in the next section and is a subset of the credit risk.

1.3 Refinancing risk

Refinancing risk relates[11] to the uncertainty regarding the terms and conditions when a company has to refinance its debt. When the firm issues new bonds to replace the maturing ones, the market price of the new bonds can be higher or lower than the required principal payments of the maturing bonds. Depending on the market conditions and the fundamentals of the firm, a profit or a loss can therefore occur, when the debt is refinanced. In the extreme case, the firm might be unable to refinance its debt and has to default. The notion of refinancing can be extended to any need of cash to solve a liquidity issue. This is the uncertainty in general about the cost of issuing new debt.

Refinancing a debt is also known as rolling it over; hence refinancing risk is also called rollover risk.

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[11] HE, Zhiguo, and WEI Xiong. "Rollover risk and credit risk." *The Journal of Finance* 67.2 (2012), p.5.

Section 2: Credit risk modelling

Over the last decades, researchers and practitioners have developed a large number of models to assess the probability of default of a company. The relevant literature divides these models into two categories, the ones using accounting information and the others using the market price of financial assets. These different approaches are presented in the subsection underneath. Moreover, the limitations of each approach regarding the refinancing risk assessment are highlighted.

2.1 Accounting based models

2.1.1 Econometrics models

These models[12] use data from the financial statements to forecast a company's bankruptcy risk. This was originally done through a regression analysis with discriminating factors, but has recently evolved to Probit and Logit models to define a function S of the form:

$$S(x_i) = \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$$

The vector $\bar{X}$ contains the relevant risk factors which depend on the company profile (industry, privately vs. publicly owned, etc). The table 1 presents an overview of typically used factors in these models.

[12] STEPHANOU, Constantinos, and Juan Carlos Mendoza. Credit risk measurement under Basel II: an overview and implementation issues for developing countries. *World Bank Policy Research Working Paper* 3556 (2005), p.8.

Table 1: Overview of typically used factors in econometrics models[13]

Information category	Parameters
Company type	Industry group
	Geography
	Age of company
	Total sales / assets / equity
Financial Ratios	Equity/assets
	Debt/equity
	Sales/assets
Profitability	Historical profitability
	Profitability growth rate
	Profit/ assets
Market data	Volatility of stock price

The outcome of econometric models may either be a ranking of the probability of default of several companies or an assessment of the risk of default of a given company.

2.1.1.1 Altman Z-Score

The most famous of these models is the Z-Score developed by Edward Altman in 1968. The Z-score is a combination of five weighted business ratios used to estimate the likelihood of financial distress, as described in the following formula:

[13] Ibid.

$Z = 1.2*T_1 + 1.4*T_2 + 3.3*T_3 + 0.6*T_4 + 1.0*T_5$ where[14] :

T1 = Working Capital / Total Assets. It's a measure of the net liquid assets of the firm relative to the total capitalization. Shrinking liquidity is a warning sign of financial trouble

T2 = Retained earnings / Total assets. This is a measure of the cumulative profitability of the company over time

T3 = Earnings Before Interest and Taxes / Total Assets. This ratio is a measure of the true productivity of the firm's assets, independent of any tax or leverage factor

T4 = Market Value of Equity / Book Value of Total Liabilities. It's a measure of how much the firm's assets can decline in value before the liabilities exceed the assets and the firm becomes insolvent.

T5 = Sales/ Total Assets. The ratio is a measure of how effectively the firm uses its assets to generate sales.

Companies[15] with a Z-Score above 2,99 are considered being in the safe zone and thereby not likely to fall into bankruptcy. Those with a Z Score between 1,8 and 2,99 are located in the grey area, meaning that their future is uncertain and that there is a chance the company goes bankrupt within the next two years of operations. Finally, companies with a Z-Score below 1, 80 are in the distress zone indicating a high probability of bankruptcy over the short term.

The initial formula has been defined by studying publicly traded manufacturing companies. Altman and other researchers have developed new models to deal with private and non-manufacturing companies. Moreover, they have continuously updated the parameters of the model taking into account recent market trends.

In its initial paper, Altman[16] claims that the model is 72% accurate in predicting bankruptcy over a two-year window. Moreover, in 2000[17], Altman ran subsequent tests and found out that the

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[14] ALTMAN, Edward I. "Predicting financial distress of companies: revisiting the Z-score and ZETA models." *Stern School of Business, New York University* (2000), p.10.
[15] ALTMAN, Edward I. "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy." *The journal of finance* 23.4 (1968), p.602.
[16] ibid.
[17] ALTMAN, Edward I. "Predicting financial distress of companies: revisiting the Z-score and ZETA models." *Stern*

updated versions of the model were accurate in 80 to 90% of the cases to predict bankruptcy over a one-year window.

2.1.1.2 Econometrics models and refinancing risk

Although none of the famous econometrics models are taking the refinancing risk into account, these models could be designed to include it. One can indeed add a factor that serves as a proxy for the refinancing risk such as the credit premium (expected future refinancing rate minus current one). However, the aim of these econometrics models is not predicting ***when*** a firm will actually go bankrupt, but rather measuring how closely a firm looks like other companies that have previously filed a petition in bankruptcy. These models therefore fail to predict the probability of default of a company and can not be used to predict the impact of the refinancing risk on the value of a firm.

2.1.2 Credit rating models

Credit rating models are models created by rating agencies to assess the creditworthiness of a company, hence its credit risk level. A rating can either be allocated to a company in general or to a specific bond in particular and is an indication of the future credit risk of this company or bond. The credit rating represents the opinion of a particular rating agency about the ability and willingness of an issuer to meet his financial obligations. Therefore, different rating agencies may grant a different rating to the same company. There are three major rating agencies: Fitch, Standard & Poor's and Moodie's. Each of them uses a specific grading hierarchy for both short and long-term obligations. The table 2[18] shows the correspondence between the three companies and their meaning.

School of Business, New York University (2000), p.18.

[18] BANK FOR INTERNATIONAL SETTLEMENT. "Long-term Rating Scales Comparison." *www.bis.org.* n.d. 24 Mai 2014.

Table 2: Comparison of long -term credit ratings between agencies and their meaning

<table>
<tr><td>Standard & Poor’s

Fitch</td><td>Moody’s</td><td>Meaning</td></tr>
<tr><td>AAA</td><td>Aaa</td><td>Highest grade credit</td></tr>
<tr><td>AA</td><td>Aa</td><td>Very high grade credit</td></tr>
<tr><td>A</td><td>A</td><td>High grade credit</td></tr>
<tr><td>BBB</td><td>Baa</td><td>Good credit grade</td></tr>
<tr><td>BB</td><td>Ba</td><td>Speculative grade credit</td></tr>
<tr><td>B</td><td>B</td><td>Very speculative credit</td></tr>
<tr><td>CCC</td><td>Caa</td><td rowspan="3">Substantial risk, near default</td></tr>
<tr><td>CC</td><td>Ca</td></tr>
<tr><td>C</td><td></td></tr>
<tr><td>D</td><td>C</td><td>Default</td></tr>
</table>

Companies with a rating higher or equal to BBB are called “investment grade” companies, while those with a lower rating are named “Junk, high yield, speculative or non-investment grade”.

2.1.2.1 Moody’s methodology

Each rating agency uses its own methodology to determine the ranking of a given company. The one developed by Moody’s is based[19] on a multi-factor analysis. Moody’s analysts determine a set of key-factors that fall into two categories: the global, where factors are common to all companies in any industry and the industry-oriented which are selected to capture the specificity of a given industry. These factors can be either qualitative or quantitative and are constantly updated. Quality and experience of management as well as assessment of corporate governance are some of the global factors. Examples of industry-oriented ones include size and efficiency of a fleet for the shipping industry. Each factor is subdivided into several sub-factors to which a particular weight is then allocated. Each sub-factor is calculated for the studied company and is

[19] MOODY’S INVESTORS SERVICE. "Rating methodology : Global shipping industry." (2009), p.4-10 passim.

allocated a rating factor, based on a mapping grid specific to each sub-factor. Finally, Moody's analysts use a last grid to compute the final rating based on each sub-factor weight. Once the rating has been computed by the analysts, the outcome is presented to the rating committee that might decide to adjust the rating to take into account company-specific elements that are not included in the multi-factor analysis, such as regulatory and litigation risk.

Based on historical data, each rating agency computes the probability that a company with a given rating defaults within a certain timeframe. Credit ratings can therefore be used to compute the probability of default. The figure 1 provides the cumulative probability of default for timeframes going from one year to twenty for each Moody's rating.

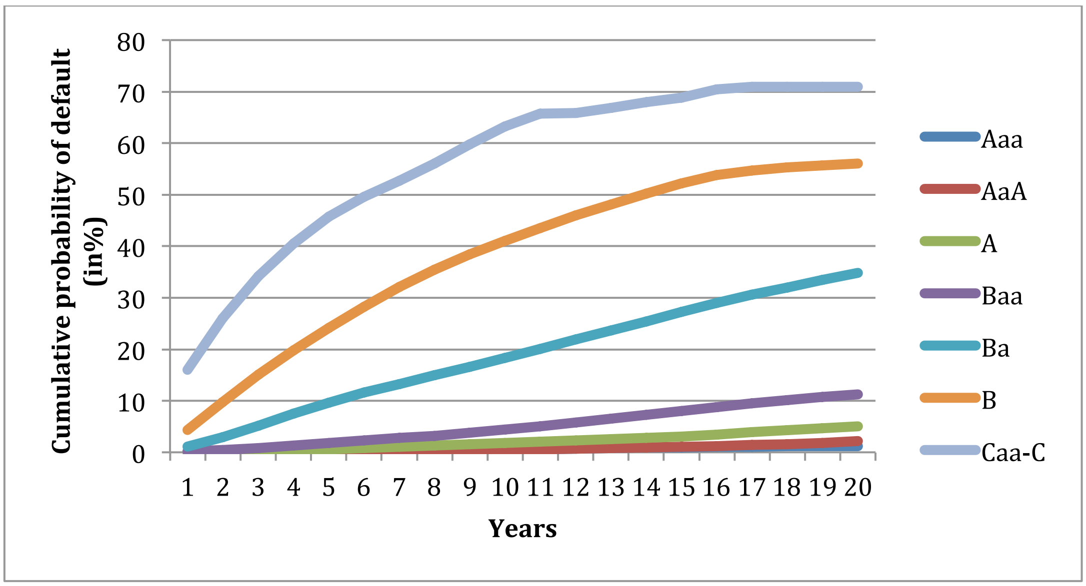

Figure 1: Moody's cumulative default rates between 1970 and 2008[20]

The observed probability of default largely differs across ratings, a lower rating leading to a higher probability of default. As mentioned by Hull[21], the probability of default of the investment grade category tends to be a direct, growing function of the horizon. High rated companies are indeed considered to be financially healthy in their first year but as time passes, the probability of encountering financial distress increases. On the other hand, while the probability of default of

[20] MOODY'S INVESTORS SERVICE. " Corporate Default and Recovery Rates, 1920-2010." (2011), p.24.
[21] HULL, John. *Options, futures and other derivatives*. Pearson education, 2012. 2nd ed. p.522.

initially lower rated companies also increases with the horizon, the marginal probability is decreasing. Hull explains[22] this observation by the fact that the first years are critical for initially unhealthy companies. Once they have survived this trouble period, they will usually recover so that the marginal probability decreases afterwards. Moreover, the graph shows that probability of default is always positive whatever the horizon, even short term, except for the highest rated companies.

2.1.2.2 Credit rating models and refinancing risk

Credit rating models are effectively taking the refinancing risk into account. Rating agencies indeed look at the refinancing exposure either directly in their model as a global factor or indirectly by adjusting the rating during the rating committee to reflect the risk. However, although company rating is an appealing source of information regarding credit risk, one must be cautious when using it as a prediction of default probability. Such probability is indeed computed, using a historical set of data comprising companies of similar risk-profile but with a different history. Moreover, credit ratings are not frequently updated and therefore do not offer the most up-to-date information. For all these reasons, credit rating models are not efficient to predict the impact of refinancing risk on the value of a firm.

2.2 Market based models

As previously mentioned, the market-based models use the market price of financial products to extract the probability of default of a company. There are two different categories of market-based models, namely the reduced form and the structural one. The differences between both categories lie in the assumptions regarding information as well as the default trigger.

Reduced form models[23] are developed to take into account the sudden nature of a default. Hence, they consider default an exogenous event driven by a stochastic process. Therefore, they assume[24] that a firm default is an unexpected event, whose likelihood is driven by a default-

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[22] ibid.
[23] WANG, Yu. Structural Credit Risk Modeling: Merton and Beyond. Risk Management 16 (2009). p.30.
[24] BENITO, Enrique and Flavan, Silviu. A comparison of credit risk model, Carlos III University in Madrid, March 2005

intensity process, such as the Poisson Jump process.[25] Such default intensity process is extracted[26] from the market price of defaultable financial instruments such as credit default swaps and bonds. As a consequence, the market is the only source of information that reduced form models use to model credit risk.

Structural models were initiated by Merton in 1974 and aim to provide a relationship between default risk and capital structure. They assume[27] that a company will default when it is unable or unwilling to meet its financial obligation. The default is thus an endogenous event and will occur when the assets value of the company will fall below a given threshold. The assets value is modelled as a stochastic process and the threshold varies according to the structural model considered.

Structural models therefore assume[28] the perfect knowledge of a precise set of information, akin to the ones held by companies internally. This perfect information assumption therefore implies that the default is predictable. On the other hand, reduced form models only rely on observable data from the financial markets. Therefore, the restricted information makes the default unpredictable. Based on this information, Jarrow and Protter[29] claim that the key distinction between both categories is not the characteristic of the default time (predictable versus unpredictable) but rather the range of information available. They also show that by reducing or narrowing the information set available, a structural model can be transformed into a reduced form one.

The main disadvantage[30] of the structural models is their difficulty of implementation. They are indeed analytically complex and computationally intensive. Reduced form models, on the other hand, are easy to implement and calibrate, but lag behind regarding their prediction power. In the

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[25] In probability theory, a Poisson process is a stochastic process that counts the number of events and the time points at which these events occur in a given time interval

[26] ELIZALDE, Abel. Credit risk models III: reconciliation reduced-structural models. 2006. p.1.

[27] ELIZALDE, Abel. Credit risk models II: Credit risk models II: Structural models. 2005. p.1.

[28] JARROW, Robert A., and PHILIP Protter. "Structural vs reduced form models: A new information based perspective." Journal of Investment Management 2.2 (2004). p.2.

[29] ibid

[30] WANG, Yu. "Structural Credit Risk Modeling: Merton and Beyond." Risk Management 16 (2009). p.32-33 passim.

first attempt to compare both categories, Arora and al[31] show that structural models constantly outperformed reduced form ones in both default and spread forecasting.

Moreover, as mentioned by Elizalde[32], reduced form models, by relying on exogenous events, "lack the link between credit risk and the information regarding the firms' financial situation incorporated in their assets and liabilities". They are therefore less able to provide interpretation to default event.

For these reasons, structural models are widely used in counterparty credit risk analysis and capital structure monitoring, while reduced-form ones are used on credit security trading floors.

2.2.1. Market based models and refinancing risk

Reduced form models indirectly take into account the refinancing risk when modelling the probability of default. The default intensity process of these models is indeed extracted from the market price of defaultable financial instruments. If these financial instruments are correctly priced by the markets, their spreads should therefore reflect the refinancing risk of the underlying company. However, as it is impossible to extract from the market price the part of the spread due to this refinancing exposure, reduced form models do not allow to study the sole effect of the risk on the firm value. Moreover, as it is impossible to accurately predict the future price of these defaultable financial instruments, reduced form models are not useful to study the impact of future refinancing operations.

The link between structural models and refinancing risk will be presented in section 4, following the presentation of the more famous structural models in section 3.

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[31] ARORA, Navneet, JEFFREY R. Bohn, and FANLIN Zhu. "Reduced form vs. structural models of credit risk: A case study of three models." *Journal of Investment Management* 3.4 (2005). p.19-20.
[32] ELIZALDE, Abel. Credit risk models III: reconciliation reduced-structural models. 2006. p.1-2.

Section 3: Structural models

In this section, the main structural models and their limitation are introduced. Emphasis will be placed on the rationale behind each model. The goal of this section is indeed to provide intuition about how they model the probability of default and what are the factors triggering it.

3.1 Merton model

The first structural model was presented by Merton[33] in 1974 in a paper that initiated the use of statistics and mathematics in credit risk modelling. In his paper, Merton develops a framework to link the asset value of a firm to its credit risk. The assumptions and formulas of the Merton model are described in appendix 1.1

3.1.1 Model

Merton built his model by considering the easiest financial structure possible for a firm[34]: At time t, a given company has assets $A_{t,}$ financed by equity E_t and zero-coupon debt D_t. This zero-coupon debt has a face value K and a maturity T > t. Thanks to the balance sheet relationship, the following equality obtains:

$$A_t = E_t + D_t$$

The pay-off at maturity T of the debt will depend on the asset value. When the value of the firm's assets at maturity exceeds K, the bondholders receive the full notional amount and the shareholders receive the residual assets value V_t – K.

On the other hand, when the asset value at maturity is lower than K, the firm cannot face its financial obligation and defaults. The company is therefore liquidated and the bondholders receive the firm value V_t , while the shareholders receive nothing. As the shareholders never have to compensate for the bondholder's loss, the equity value E_t cannot be negative.

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33 MERTON, Robert C. "On the pricing of corporate debt: The risk structure of interest rates." *The Journal of Finance* 29.2 (1974). p.450.

34 WANG, Yu. "Structural Credit Risk Modeling: Merton and Beyond." Risk Management 16 (2009). p.30-31 passim.

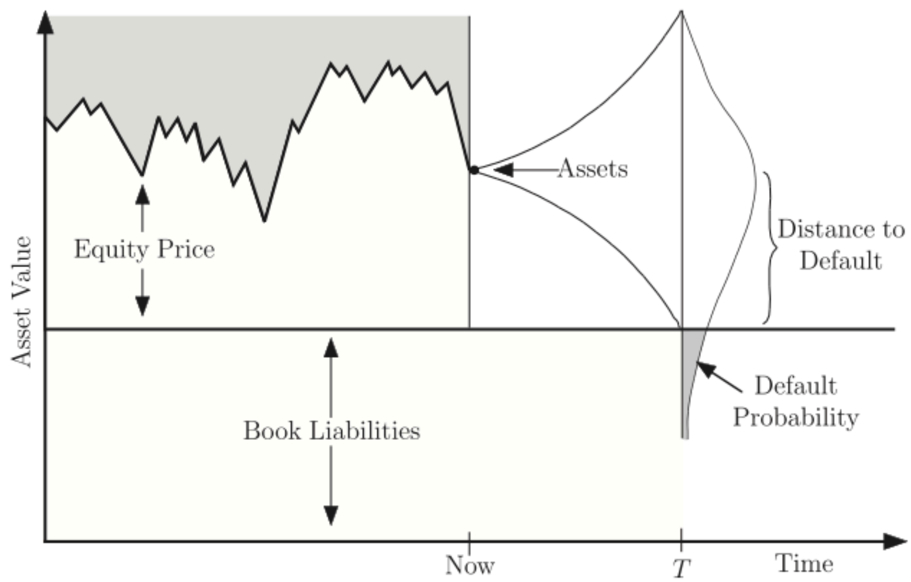

Figure 2: Schematic representation of the Merton model[35]

The figure 2 illustrates the dynamics of the Merton Model. Over time, the total debt is constant and equal to K while the asset value fluctuates. Hence, the total equity value also fluctuates over time and depends on the asset value. As stated before, the firm will only default, if the firm value (equals to the total asset value) at maturity falls below the facial amount of the debt, $V_t < K$. The facial amount of debt is therefore the default barrier in the Merton Model. One can model the asset value distribution at maturity by simulating various paths for the asset value process, following the stochastic diffusion process presented here above. In the Merton model, the distribution of default is assumed to follow a normal distribution. The shaded area of this distribution is the probability of default.

Based on these observations, the equity value of the company at time T can be written as [36]

$E_T = \max(A_T - K; 0)$.

[35] DARRELL Duffie and Stephen Schaefer, *Credit Risk: Pricing, Measurement, and Management*, Princeton, Princeton University Press, 2003, p.54.
[36] SUNDARESAN, Suresh. "A Review of Merton's Model of the Firm's Capital Structure with Its Wide Applications." *Annu. Rev. Financ. Econ.* 5.1 (2013). p.3.

This is exactly the payoff of a European call option written on underlying asset A_T with strike price K maturing at T. Similarly, the debt value of the company at time T can be written as[37]

$D_T = \max(A ; K)$

This payoff can be replicated with the following portfolio

$D_T = K - \max(K\text{-}A; 0)$

In other words, the payoff of the debt at time T is equivalent to holding the face value of the debt and selling a European put option on the underlying asset A_T with strike price K maturing at T.

The figure 3 illustrates the payoff of both debt and equity, depending on the asset value

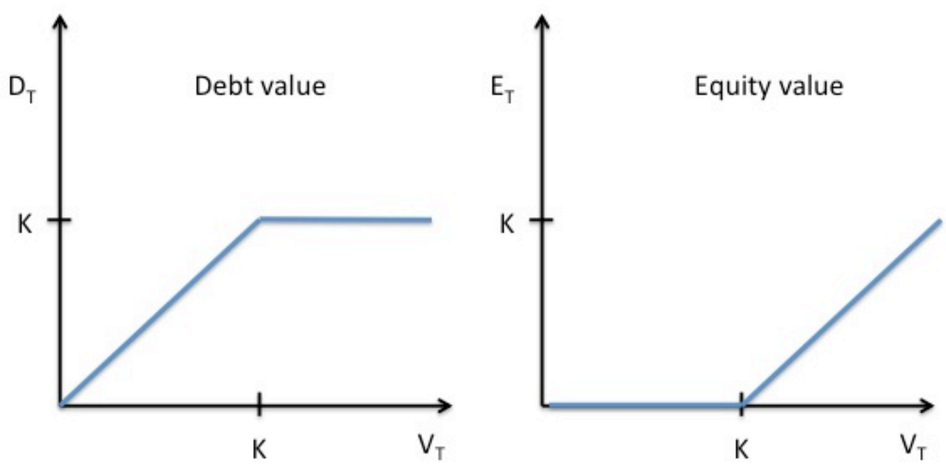

Figure 3: Equity and debt value as a function of the assets value

[37] ibid.

The probability of default in the Merton model is therefore given by the probability that the asset's value at maturity is lower than the facial value of the debt. In other words, the firm will default when the shareholder's call option on the asset underlying matures out-of-money.

3.1.2 Shortcomings

Although appealing on paper, the Merton model suffers, in practice, from a lack of precision in its predicting power. Van Beem[38] studied a panel of Dutch companies and compared the spread predicted with the Merton model with the market data. He observed that modelled spreads are zero for short maturities, as solvent companies are not supposed to default on the short term. However, market data yields a positive credit spread as well as a positive probability of default. He explained this discrepancy by the Merton assumptions regarding the firm's asset value process. As the process follows a slow evolution, the default event can never happen unexpectedly and the barrier will not be reached within a short period of time.

Moreover, in the long run, credit spread decreases in the Merton model, but is increasing in the market. This is, one more time, due to the assumptions of this model. According to Merton, firms cannot issue additional debt before maturity. As the asset value process includes a positive drift[39], the distance between the asset value and the constant facial value of the debt increases and the firm is less likely to default.

Beside these two observations, Sundaresan[40] and Wang[41] highlight three more shortcomings of the Merton model.

Firstly, the debt structure of a firm is nearly always more complicated than a simple zero-coupon bond. Debt issued by companies often involves intermediary coupons and covenants[42].

Secondly, a firm can only default at debt maturity. Therefore, a firm's asset value can drop below

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[38] VAN BEEM, J. " Credit risk modeling and CDS valuation :An analysis of structural models." University of Twente (2010). p.22.
[39] ibid.
[40] SUNDARESAN, Suresh. "A Review of Merton's Model of the Firm's Capital Structure with Its Wide Applications." Annu. Rev. Financ. Econ. 5.1 (2013). p.5.
[41] WANG, Yu. "Structural Credit Risk Modeling: Merton and Beyond." Risk Management 16 (2009). p.32.
[42] A covenant is a promise in an indenture, or any other formal debt agreement, that certain activities will or will not be carried out

the facial value of the debt at time t (t < T) and yet recover before maturity. In reality, the firm would have defaulted at t but not according to the Merton model. The Merton model is therefore non-path dependant.

Thirdly, the term structure of interest rate observed in reality is not flat, but varies in time, while the Merton model assumes a constant risk-free rate known with certainty in advance.

3.2 Extensions

3.2.1 Debt structure

As explained before, one of the shortcomings of the Merton model is that the entire debt of a firm is considered a single zero-coupon bond. This simplified situation is totally unrealistic and firms usually issue coupon-bearing debt and attach covenants to the debt issues.

Moreover, the usual valuation technique used to price a coupon-bearing bond, which consists in considering such a coupon-bearing bond as a portfolio of zero-coupons, does not apply to the Merton model. Indeed, if the firm defaults[43] on a coupon payment, then it will automatically default on all the subsequent payments. The default on one payment is therefore not independent of the other payment.

A solution to this problem was brought by Geske[44]. After deriving a formula to price a compound option[45], he observed that the equity of a company with coupon-bearing debt outstanding, could be considered such an option. Indeed, at every coupon payment date, the stockholders have the option of buying the next option and keeping the control of the firm by paying the coupon. When they are unable or unwilling to make the payment, they will default on the debt and the bondholders will take over the firm and receive the value of the firm. Similarly, at maturity of the coupon debt, the stockholders have the option to repurchase the claims on the firm from the bondholders by paying off the principal.

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[43] MERTON, Robert C. "On the pricing of corporate debt: The risk structure of interest rates." *The Journal of Finance* 29.2 (1974). p.460.
[44] GESKE, Robert. The valuation of corporate liabilities as compound options. *Journal of Financial and Quantitative Analysis*, 1977, vol. 12, no 04, p. 541-552.
[45] A compound option is an option for which the underlying security is another option

Although Geske allows considering more complex debt structures than Merton, his structural model still assumes that the default is expected, as the firm can only default at the coupon or principal payment dates.

3.2.2 First-passage model

While the Merton model assumes that a firm only defaults when its value at maturity is below the face value of the debt, in reality a firm can default at any time and for different reasons. The first-passage models have been created to solve the problem of this limitation, as the firm will default when its asset value drops below a given default barrier for the first time. These models[46] are therefore path dependant and equity is now modelled as a down-and-out option[47]. When the asset value of the company reaches the default barrier, the equity will indeed be worth nothing and the company will be liquidated. Such default barrier can be seen as a covenant on the debt and therefore, the value of the debt will be higher than predicted by the Merton model. Similarly, as default may happen at any time, the probability of pay-off to the shareholders is lower and therefore, equity will be worth less than according to the Merton model.

The literature offers a wide range of first-passage models that differentiate themselves by their default barrier specification. They can be classified into two categories: exogenous models that are defined outside the model and endogenous models, where the barrier is defined inside the model.

3.2.2.1 Exogenous barrier

The initial first-passage model, created by Black and Cox[48] in 1976 included an exogenous barrier. In such a model, the default barrier is defined outside the model and does not depend on the shareholders. Black and Cox modelled an exponential safety covenant, which allows the debt holders to take control of the firm, when this covenant is breached, in other word when the value of the company is lower than the covenant threshold. The company defaults on its outstanding

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[46] BLACK, Fischer and COX, John C. Valuing corporate securities: Some effects of bond indenture provisions. *The Journal of Finance*, 1976, vol. 31, no 2, p. 351-367.
[47] A down and out option is an option that ceases to exist when the price of the underlying security hits a specific barrier price level
[48] BLACK, Fischer et COX, John C. Valuing corporate securities: Some effects of bond indenture provisions. The Journal of *Finance*, 1976, vol. 31, no 2, p. 351-367.

debt and the shareholders do not receive anything. The value of the default barrier is determined according to the firm specifics (leverage ratio, credit rating, etc).

Bryis & de Varenne[49] modified the Merton model and allowed it to default before maturity. They used a default barrier that equals the face value of the debt discounted at the risk-free interest rate. Therefore, the company will default whenever its asset value is lower than the present value of the face value of the debt.

3.2.2.2 Endogenous barrier

An endogenous default barrier is defined within the model, meaning that the barrier level is modelled as a shareholders' decision[50]. At each coupon payment date, the shareholders decide whether to pay the debt or not, depending on the prospect of the firm. They will pay only if it maximizes the equity value in the future. Moreover, they will adapt the endogenous barrier accordingly. Between the payments, the firm will not default as long as the asset value is higher than the barrier. The endogenous barrier might be lower than the coming debt payment. In this case, the firm will not default, although it is not able to service its debt but shareholders will rather issue equity. The rationale behind this is that shareholders have decided that it is in their interest to keep the control of the firm thanks to favourable prospects.

Leland[51] was the first academician to consider such endogenous barrier in his study on the optimal capital structure of a company.

3.2.3 Interest rate process

Another limitation of the Merton model presented above is the constant interest rate known with certainty. The majority of the extensions presented above also make this assumption for the sake of simplification. However, this assumption is not verified in reality and market observations show a different interest rate term structure, presenting various shapes and depending on the time,

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[49] BRIYS, Eric et DE VARENNE, François. Valuing risky fixed rate debt: An extension. *Journal of Financial and Quantitative Analysis*, 1997, vol. 32, no 02, p. 239-248.
[50] VAN BEEM, J. " Credit risk modeling and CDS valuation :An analysis of structural models." *University of Twente* (2010). p.24.
[51] LELAND, Hayne E. et TOFT, Klaus Bjerre. Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads. *The Journal of Finance*, 1996, vol. 51, no 3, p. 987-1019.

geography, etc.

Several structural models use the stochastic interest rate process of Vasicek to address this issue and make the interest rate dependent on the time. The Vasicek model is used to describe the evolution of interest rates using a single market risk. By using stochastic interest rates, these models are better able to replicate the interest rate term structure, hence leading to more accurate results. However, a disadvantage[52] of the Vasicek interest rate model is that it allows the interest rate to become negative. It's therefore of the utmost importance to select the parameter values properly in order to avoid such situations, as mentioned by Longstaff & Schwartz[53].

Nevertheless, using stochastic interest rates adds even more complexity to the structural model, which becomes harder and longer to process.

3.2.4 Asset value process

All the structural models presented so far use a diffusion process to simulate the asset value of a firm. Under such diffusion process, the range of possible value taken by the asset value at a given period of time is limited, making a sudden drop impossible. Therefore, the firm can never default unexpectedly. As a conclusion, a financially healthy firm has a short-term credit spread equal to zero, as it cannot default. This conclusion is however rejected by market observations.

The most famous model designed to address this problem was developed by Zhou[54] in 1997. He uses a jump-diffusion process to model the company asset value and therefore allows random jumps to appear. Therefore, a default can now occur either from the marginal change in the asset value or from the unexpected shock[55]. The firm value is then equal to the default barrier in the first case, but might be below in the second case. Zhou justifies the unexpected jump as being[56] « new important information becoming available to the investors » such as lawsuits or hostile takeover announcement.

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[52] FELIX, Jean-Paul. Notes de cours : Marchés financiers en temps continu et modélisation de taux. Université de Picardie, 2010.
[53] LONGSTAFF, Francis A. et SCHWARTZ, Eduardo S. A simple approach to valuing risky fixed and floating rate debt. *The Journal of Finance*, 1995, vol. 50, no 3, p. 789-819.
[54] ZHOU, Chunsheng. A jump-diffusion approach to modeling credit risk and valuing defaultable securities, 1997.
[55] VAN BEEM, J. " Credit risk modeling and CDS valuation :An analysis of structural models." *University of Twente* (2010). p.26.
[56] Ibid.

A structural model with a jump-diffusion process is therefore a combination of both reduced and structural form models. On one hand, it allows unexpected default events to occur just like in reduced-form ones. On the other hand, it gives some explanation about the reasons of default, like structural models do. However, this model requires tough parameter estimation and is therefore difficult to use in practice

3.3 CreditGrades model

Although appealing in theory, all the models presented above suffer from their complexity when used in practice. They indeed rely on information that is not readily observable in the market, such as the asset value and asset volatility. Practitioners therefore need to use proxies to estimate these required data, resulting in a lack of precision of the models. To overcome this issue, a group of banks led by Goldman Sachs, Deutsche Bank, JP Morgan and Riskmetrics developed the CreditGrades model, a model that relies only on observable market data to compute the credit spread of the debt. This model is based on the first-passage models with exogenous barrier initiated by Black and Cox but introduces a stochastic barrier instead of a fix one, in this way solving the issue of null short term credit-spread as explained below.

CreditGrades[57] assumes a stochastic process V that follows a geometric Brownian motion, like in the Merton model. However, in the CreditGrades model, V represents an approximation of the asset value on a share basis instead of the total asset value. This approximation is equal to the equity value plus the value in case of default:

$$V = S + LD$$

CreditGrades defines default as the first time V crosses the default barrier. This default barrier is set equal to the recovery value, the amount of the company assets that remain in case of default. However, empirical studies of recovery rates[58] show uncertainty in the recovery value. They

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[57] FINGER, Christopher, FINKELSTEIN, Vladimir, LARDY, Jean-Pierre, *et al.* CreditGrades technical document. *RiskMetrics Group*, 2002, p. 1-51.
[58] Hu, H. and Lawrence, L. (2000). Estimating Recovery Rates, JPMorgan document

observe an extreme variance of this recovery rate distribution. Not only does it depend on the industrial sector of the firm, but also on factors such as the default cause (triggered by financial or operational difficulties) and default outcome (restructuration or liquidation). For this reason, the default barrier is also assumed to follow a stochastic process. However, the recovery value may become uncertain over time.

The figure 4[59] shows how the model works in practice. The default barrier, equal to the recovery value (LD), varies over time around its initial value. The asset value follows a stochastic process and as soon as its value falls below the variable barrier, the company will default. By considering a variable, uncertain default barrier, a firm may default on a really short term. Hence, the credit-spread is not null at inception. This represents an alternative to the jump-diffusion model presented above. More information about the CreditGrades model can be found in appendix 1.2

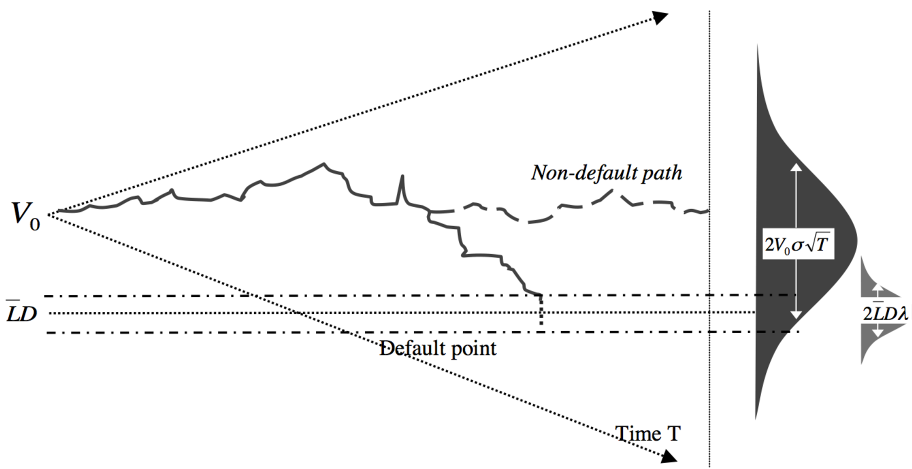

Figure 4: Schematic representation of the CreditGrades model

[59] FINGER, Christopher, FINKELSTEIN, Vladimir, LARDY, Jean-Pierre, *et al.* CreditGrades technical document. *RiskMetrics Group*, 2002, p. 7.

3.4 Accuracy of models

The question of their accuracy has arisen out of the development of structural models and their growing use by practitioners. In the first study of its kind, Jones & al[60] assessed the performance of the Merton model in practice. They use the model to price corporate bonds and compare the results with the real data. They conclude that the Merton model has the tendency to 'underpredict' the credit spread of a company's debt. This observation is confirmed by other studies, led by Eom & al[61]. In conclusion, the bond value computed by the Merton models is too high in comparison with the observed one and the model is not accurate enough to be used in practice.

In their Study, Eom & Al[62] decided not only to assess the Merton model but also to compare the accuracy of different extensions. They test three extensions: Geske (coupon-bearing bond), Longstaff & Schwartz (exogenous barrier first-time passage), Leland & Toft (endogenous barrier first-time passage). They observe that all models has the tendency to "underpredict" the observed spread and therefore present substantial pricing errors. The Geske model is the worst predictor amongst the four models and underestimates the spread with a mean absolute error of 70%. Using a stochastic interest rate enables the Longstaff and Schwartz model to show a small increase in the model, but the spreads are still too low. Moreover, the results are really sensitive to the Vasicek parameters chosen in the model. On the contrary, in the Leland & Toft model the results depends on the coupons specification of the bond. These observations do not depend on the credit quality of the considered company and therefore hold for both investment grade and high yield firms.

Although the CreditGrades model was created more than a decade ago, few researches have been properly informed about its accuracy. In 2009 Jaretzke[63] conducted the most extensive study to date involving the CreditGrades model and the only one to include a period of crisis in its sample.

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[60] JONES, E. Philip, MASON, Scott P., et ROSENFELD, Eric. Contingent claims analysis of corporate capital structures: An empirical investigation. *The Journal of Finance*, 1984, vol. 39, no 3, p. 611-625.
[61] EOM, Young Ho, HELWEGE, Jean, et HUANG, Jing-zhi. Structural models of corporate bond pricing: An empirical analysis. *Review of Financial studies*, 2004, vol. 17, no 2, p. 499-544.
[62] EOM, Young Ho, HELWEGE, Jean, et HUANG, Jing-zhi. Structural models of corporate bond pricing: An empirical analysis. *Review of Financial studies*, 2004, vol. 17, no 2, p. 499-544.
[63] JARETZKE, Dominik. CDS Model and Market Spreads Amid the Financial Crisis. Maastricht University. 2010

He observed the spread of 106 North American companies (37 being high-yield and 69 investment grade). He found that CreditGrades model prices the spread reasonably well, although it has a tendency to underestimate. The model also shows high correlation with the market spreads. Moreover, the accuracy is better for high-yield obligators than investment grade ones although the absolute gap between spreads is higher for high yield obligators.

Section 4: Structural models' limitations and link with refinancing risk

All the structural models presented in the last section suffer from the same two limitations. These two limitations explain why the refinancing risk is not taken into account by these models.

Firstly, all the structural models presented in section 3 assumed that the company will be able to refinance its debt under the same terms as the initial ones. In the end, this assumption is the same as considering a perpetual debt, as only the coupons are paid, the face value of the debt to be paid at each maturity being equal to the cash received at the new debt issue[64]. These models therefore assume no loss or gain can be made due to the refinancing of the debt. As explained above, in practice this assumption does not hold, as refinancing exposure can lead to a loss or a profit when rolling the debt over.

Secondly, the structural models assume that a firm will only default when its asset value fall behind a given threshold. By doing so, these models only rely on economic distress to trigger a firm default, without considering the implication of a poor liquidity (financial distress) on the default event. The refinancing risk in therefore not taken into account as the refinancing exposure can lead to a liquidity trouble triggering default.

The differences presented in the last section between structural models spreads and reality could therefore be explained by both the reliance of such models on the sole economic distress to trigger the default of a company and the assumptions of no loss or gain when rolling the debt over. By focusing only on the asset value, structural models therefore don't capture all the elements provoking a firm's default.

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[64] discounting put aside

Very few researches have been conducted to overcome this limitation of structural models and the only model taking into account the refinancing risk has been developed by He and Xiong[65]. However, the goal of their paper is to study the market liquidity impact on credit spread and, although they consider refinancing risk in their approach, their model does not provide a comprehensive approach for the valuation of such risk. Nevertheless, it provides some interesting insights about how to approach the issue.

When the firm has to refinance its debt, it will issue new bonds at the current market price, which can be higher or lower than the required principal payments of the maturing debt. Equity holders are therefore the « residual claimants » of the rollover gains or losses. Therefore, the net cash flow to the equity holders is equal to the cash payout of the firm minus the after-tax payment plus the rollover gain/loss. The rollover gain/loss has a direct impact on the equity cash flow. Moreover, the model assumes that shareholders issue new equity to absorb the rollover loss, hence diluting the value of existing shares. As a result, the equity value is jointly determined by the fundamentals of the firm and the expected future rollover gains/losses. Shareholders will buy more shares and bail out the maturing debt holders as long as the equity value remains positive. As soon as it is not the case anymore, the firm defaults and the bond holders take over the firm. He and Xiong show that equity holders will choose to default at a higher threshold than according to other structural models, leading to higher credit spread.

This model therefore lacks flexibility as it considers that shareholders automatically issue new equity to absorb the rollover loss. As a consequence, this model does not allow to study the impact of refinancing operations on the equity and debt value. Moreover, the model does not quantify the risk but only uses it to model the spread.

Section 5: Summary

The goal of this chapter was to introduce the refinancing risk and study whether the classical structural models are taking this risk into account when computing the credit spread of a firm. It appears that all the widely used structural models rely only on the asset value to trigger off the default of a firm, without considering the implication of poor liquidity. Structural models are

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[65] HE, Zhiguo et XIONG, Wei. Rollover risk and credit risk. *The Journal of Finance*, 2012, vol. 67, no 2, p. 391-430.

therefore only able to forecast economic default at the expense of the financial one. The next chapter will present a model developed by Exane specifically to take the refinancing risk into account.

Chapter 2

Refinancing Gap model

In chapter 1, it has been proven that none of the usual structural models were designed to deal with the refinancing risk. This chapter will therefore present a model, called the "Asset Liability Refinancing Gap", which has been specifically created to deal with the refinancing risk. This model developed by Yann Ait Mokhtar for Exane allows to quantify the risk and compute the impact of the equity of a firm and debt value.

It will start by introducing the intuition of the model before presenting step by step how to apply it, based on a practical framework. The second section will explain how this refinancing gap impacts the value of a firm and how to adapt the structural models to take the refinancing risk into account. Finally, the last section highlights the different actions a distressed company can take to solve its liquidity issues and the impact they have on the company value, in the light of the refinancing gap.

The approach followed to compute the refinancing risk exposure is based on the Asset Liability Refinancing Gap model (ALRG) developed by Yann Ait Mokhtar for Exane. However, as this model has been developed internally by a financial company, little information is publicly available. This dissertation is therefore based on the author's interpretation of the information available and has been completed by his own research.

Section 1: Presentation

Yann Ait Mokhtar, head of quantitative research at Exane, has developed another approach to the rollover issue[66]. He observed that the classical structural models failed to predict the stock behaviour of distressed companies trying to avoid bankruptcy. He explained theses discrepancies by the assumptions made regarding the debt. As highlighted before, all structural models assume that the company has the possibility to refinance its debt at the present conditions at any time in the future.

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[66] EXANE BNP PARIBAS, Capital Structure Optimization : CDS and share price, ALRG model and country risk, 2013

However, the future financing terms are not currently known. Therefore, the company has to finance its future activities, yielding a known cash flow, by borrowing at an unknown rate[67]. This situation is similar to a swap position for the company, in which it receives fixed cash flows from operating activities and has to pay an interest rate on its future debt, that will only be determined when the debt has been rolled over. This swap should be considered an off- balance sheet item and is similar to a hidden debt or a hidden receivable, depending on the sign. Ait Mokhtar calls this swap "the refinancing gap or the asset liability swap".

The firm's value must therefore be adjusted to include this hidden debt/receivable, which is added/subtracted to the sum of the equity and debt values. The rationale behind this is that the current equity and debt are not sufficient to allow the company to meet its full operating potential in the future. In order to reach this full potential and therefore receive all the predicted cash flows, the firm will have to refinance its debt in the future. If it does not, the company might come short of cash and face liquidity issues. This hidden debt therefore locks a part of the firm value which is not available for neither shareholders or bondholders. However, the classical valuation models only take into account the current debt and the equity market expected value and do not consider the impact of future refinancing.

If the firm is able to borrow under the same terms in the future as the current ones, there is no refinancing gap and the classic equality applies.

However, if the financing terms worsen in the future, the company will have to pay a higher interest rate on the refinanced debt. It will therefore be costlier for the firm to keep its business operating and the refinancing gap value will be positive. The current debt value must therefore be adjusted to take this higher cost into account. As a consequence, the debt and equity value are negatively impacted. This situation is illustrated on the figure 5.

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[67] EXANE, The Asset Liability Refinancing Gap model : Valuation and Arbitrage of indebted companies, January 2009

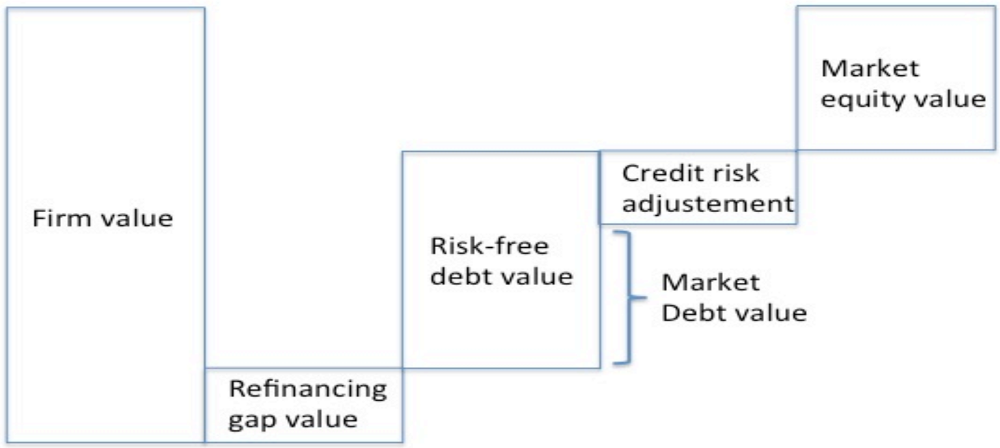

Figure 5: Firm value breakdown when positive refinancing exposure

On the other hand, when the refinancing terms improve in the future, the firm will borrow at a lower interest rate on the refinanced debt. It will therefore be cheaper for the company to operate the business and the refinancing gap value will be negative. This refinancing gap is therefore considered a receivable for the company and will increase the current firm value. In fact, the latter does not take into account this improvement and is only based on equity and debt market value. This situation is illustrated on the figure 6.

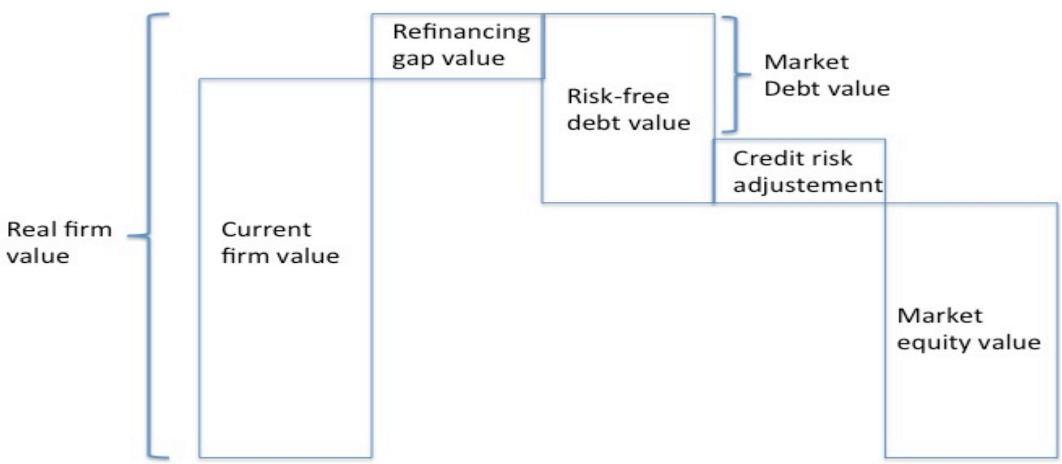

Figure 6: Firm value breakdown when negative refinancing exposure

By doing so, the current debt value is adjusted to take into account the future expected cost or gain on the debt, hence reflecting a more accurate view of the company.

Section 2: Valuation

In this subsection, the refinancing gap valuation rationale will be introduced step by step. It will start with an overly simplified case that will present the intuition behind the refinancing gap valuation. Then, a generalized example will be used to emphasize the main factors influencing the value. Finally, a complete framework will be detailed. The goal of this framework will be to highlight the required information as well as the different steps to value the refinancing gap.

2.1 Basic case

The following example applies to an overly simplified company and is used to explain the basics of the refinancing gap valuation.

Company X will receive a single free cash flow of 150€ after ten years. This company is financed partly by a coupon bond with a face value of 100€ and a maturity of five years. The company currently pays 2% interest on its debt. If the company wants to receive the free cash flow, it will have to survive until year 10, meaning that it will have to refinance its debt, in year 5 and this for five more years. However, the debt is expected to be more expensive in the future and the current estimate (five year forward rate in five years) is 4%. Company X will therefore pay an extra 2% interest rate on its debt for the last five years of its existence, which is equal to 2€ per year or 10€ in total. The value of the refinancing gap is thus equal to 10€ (without taking discounting into consideration).

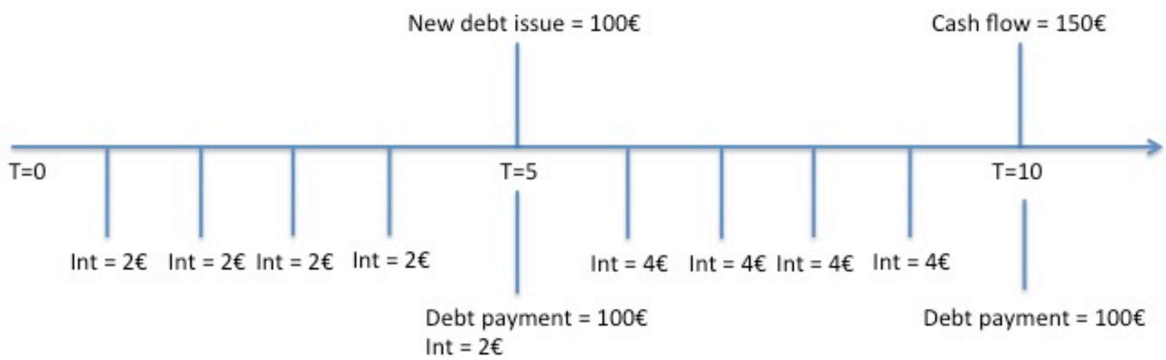

Figure 7: Cash flows illustration

The refinancing gap value can therefore be approximate to the following formula:

Refinancing gap = credit premium * Time * Face value of debt

2.2 Generalization

This second example represents a more realistic company and is used to show the main factors influencing the refinancing gap value.

Company Y currently has 500€ in cash on its bank account. It receives a known after-coupon free cash flow of 100€ every year. It is partly financed by debt and has two outstanding coupon bonds with maturity of respectively three and five years and a coupon rate of 2, 5% paid annually. The face value of both bonds is respectively 1200€ and 600€. Company Y therefore pays 40€ interest per year on the outstanding debt. It uses the yearly free cash flow to meet this financial obligation and has a cash increase of 100€ at the end of each year.

As shown on figure 8, the increase in cash over the years can be represented as a rising line. Until year 3, the firm does not have to pay back any debt and is accumulating cash. In year ,3 the first principal payment of 1200€ is due. However, the company has only 800€ cash in reserve and therefore must borrow 400€ to pay to its creditors. In year 4, the company receives its annual after coupon free cash flow of 100€ and has no principal payment due during the year. It will therefore use this cash to partially buy back the new debt issued the year before. The outstanding debt is thus equal to 900€ (600€ of old debt maturing in year 5 and 300€ on debt issued in year 3). In year 5, the second principal payment is due and the firm will pay 600€ to its creditors. As the company only has the yearly free-cash flow in reserve, it will borrow 500€. The total debt outstanding has thus a face value of 800€. As of year 6, the company will use its yearly increase in cash to buy back a part of the debt until year 13 when the newly issued debt will be fully paid. The company therefore has chosen the maturity of the new debt accordingly. The first debt of 400€ issued in year 3 will have a maturity of 10 years and the second debt of 500€ issued in year 5 a maturity of 8 years.

Assuming that the credit spread is forecasted to increase to be equal to 3, 5% for all maturities, the company will pay a credit premium of 1% on the future debts. The extra financing cost due to credit-spread increase is therefore equal to 43€ (without taking discounting into consideration).

The new formula to price the refinancing gap is:

$$\sum(\text{outstanding debt} * \text{credit premium})$$

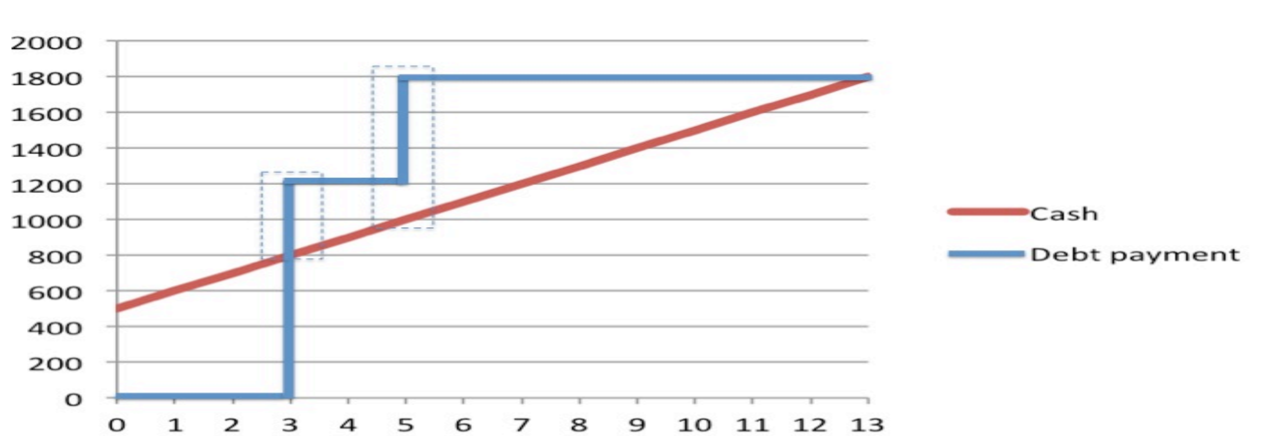

Figure 8: Refinancing exposure illustration

It is important to note that this example considered the after-coupon free-cash flow. Therefore, all considerations regarding the interest rate were not taken into account. In reality, the firm will have to pay a higher interest rate on the new debt, impacting the cash available. For simplicity purposes, this example assumed that the cash available for the company was constant whatever the interest rate.

2.3 General framework

In order to generalize the previous example and compute the refinancing gap for any company, we developed a practical framework. This framework shows in three steps how to value the refinancing gap at time t=0. All the parameters used in the formulas are then presented exhaustively.

2.3.1 Formulas

The first steps consists in computing the refinancing exposure or the amount to be refinanced on a given year t:

$$RE_t = -\sum_{n=0}^{t} ERCF_n + Cash_0$$

Where:

$ERCF_n$ is the equity residual cash flow net of dividend payments

$$ERCF_n = FCF_n^U - int.payments * (1 - t_c) - princip.debt\ repayments - dividend$$

t_c is the effective tax rate at t=0

$Cash_0$ is the treasury at t=0

Then, one must compute the credit premium at t=0 or the additional interests rate that a company will pay when refinancing its debt comparing to the current one

$$CP_0 = -(1 - t_c^0) * \left(k_d^{-1} - \left(r_f^0 + CDS^M\right)\ \right)$$

Where:

k_d^{-1} is the cost of debt at t=-1

r_f^0 is the risk-free rate at t=0

CDS^M is the M-year CDS spread

M is the weighted average maturity of the outstanding debt at t=0

The last step consists in computing the total cost of refinancing or refinancing gap at t=0

$$RG_0 = \left(\sum_{t=0}^{T} \frac{(RE_t * CP_0)}{(1+r_f^0)^t}\right) * \frac{1}{1-P_D^M}$$

Where:

T is the first year the refinancing exposure becomes negative

P_D^M is the M-year probability of default of the company

2.3.2 Parameters explanation

2.3.2.1 Refinancing exposure

As explained in the second example the amount to refinance is not equal to the facial debt which is due in a given year. The company will indeed use its cash reserve rather than borrowing to cover the debt payments.

As explained in the previous example, the framework assumes that any surplus of cash in a given year will be used to buy back part of the outstanding debt. The framework is therefore dynamic and relies on the assumption that debt can be bought back at any time. As a consequence, the framework computes the net shortage of cash in every year.

It is therefore required to compute the amount of cash available on every year in the future as well as the outflow of cash due to the debt. This is equal to the equity residual cash flow net of dividend payments. Six parameters are required to compute it.

2.3.2.1.1 Surplus of cash at t

The surplus of cash at t: Over the past years the company might have accumulated a reserve of cash and other very liquid assets such as treasury bills, commercial paper and money market holdings. This cash is available in case of emergency or to avoid having to refinance the debt entirely. In order to find the amount of surplus of cash at t, one must look into the annual report of the company and look for the "cash and cash equivalent" account on the balance sheet.

2.3.2.1.2 The free cash flows projection of every year

Every year the company will have a net cash inflow or outflow that will increase or decrease its initial cash reserve. This net cash inflow or outflow is equal to the free cash flow of the company, which represents the total cash received or given in the day to day operations of the company (operating cash flows) as well as the cash spent in the investment (investing cash flows). These free-cash flows are usually forecasted by the financial analysts over a period of time going from three years to ten years, with an average of five years. When no more projections are available, it is usual to assume a constant annual growth rate of the free-cash flows.

The surplus of cash and free cash flow projections must however be carefully considered when the company presents consolidated accounts. Indeed, in these consolidated accounts, the company will include all the assets of its subsidiaries, liabilities and equity into its own account according to the full consolidation method, provided it has control over these subsidiaries[68]. Nevertheless, the company does not have a direct claim on the cash reserves of its subsidiaries which therefore cannot be included in the refinancing gap computations. Moreover, the same issues arose until recently for joint-ventures, in which a company was involved and which was included into the company's financial accounts using the proportionate method. According to this method, the assets, liabilities and equity of a joint-venture were included in the financial statement of the company proportionally to its stake in the company. This method is not used anymore but one should pay attention to it while applying this framework in the past. The current

[68] Control is presumed to exist when the parent company: holds, directly or indirectly, over 50% of the voting rights in its Subsidiary; holds, directly or indirectly less than 50% of the voting rights, but has power over more than 50% of the voting rights by virtue of an agreement with other investors; has power to govern the financial and operating policies of the Subsidiary under a statute or an agreement; has power to cast majority of votes at meetings of the board of directors, or has power to appoint or remove the majority of the members of the work all the cash available, by acquiring securities.

method, namely the equity method, which is also used when a company owns between 20% and 50% of another one, consists in reporting proportionally the net income of this other company in its own annual account and therefore presents the same risks. One must therefore analyse carefully the financial accounts and look into the notes to be sure not to take into account the information relating to the subsidiaries and other investments.

2.3.2.1.3 Dividends paid

Although the free-cash flow represents the net cash inflow or outflow of a company, all this cash is not saved by the company. The latter might indeed decide to distribute part of this cash to its shareholders. The last parameter to determine the amount of cash available every year is therefore the dividend policy of the company. These numbers are usually forecasted by the financial analysts just like the free-cash flow. When no projections are available, two options are possible. One can either compute the ratio dividend per free cash flow and apply it to the future FCF or apply a constant annual growth rate to the current dividend.

2.3.2.1.4 Interest expenses on outstanding debt

As the free cash flow used in this framework represents the net cash inflows or outflows of an unlevered company, it does not take into account the interest expenses due on the outgoing debt. These expenses must therefore be taken into consideration and can either be subtracted from the accumulation of cash or added to the debt. In this framework, a simplified approach is used to deal with interest expenses. The first step is computing the weighted average interest rate on the issued debt. This average is computed by taking the respective face value and interest rate of every outstanding debt. The weighted average interest rate is then applied to the outstanding debt on a given year to find the interest expenses of this year. The amount of debt outstanding decreases over time as part of it comes to maturity. A table including the information for every debt issue can usually be found in the appendixes of the annual report. As these interest expenses are not taken into account when projecting the free cash flow, one must consider the interest tax shield on the outstanding debt. The company may indeed deduct these expenses. This framework will therefore consider the after tax interest rate. The effective tax rate t_c can be found in financial analysts' reports.

2.3.2.1.5 Debt payment

The company will have to pay back the face value of all the outstanding debt according to the repayment schedule. This repayment schedule is usually included in the appendixes of the annual report. In this framework, the convertible debt is considered a regular debt and is therefore not assumed to be exercised and converted into equity by the holders.

2.3.2.1.6 Refinancing interest expenses

Finally, the company will also have to pay interests on the debt issued to finance the refinancing gap. These interests will substitute to the interest expenses on the outgoing debt as soon as part of it comes to maturity. These refinancing interest expenses are computed each year by applying the refinancing interest rate to the refinancing gap (see below for more explanation). [69] The refinancing interest rate used is the after tax one, for the same reason as in the interest expenses on outstanding debt.

2.3.2.2 Refinancing premium

As explained before, the terms under which the company will finance this gap in future are unknown at the time of the valuation. However, it is likely than these terms will be different from the ones on the maturing debt. If the new debt is cheaper to issue, the company will book a virtual profit, whereas it will lose money if the debt becomes more expensive. In order to compute this gain/loss, one must compute the refinancing premium. This premium is defined as follows : the difference between the average interest rate on the maturing debt and the expected interest rate on the debt when the refinancing occurs.

2.3.2.2.1 Expected credit spread

However, this expected interest rate cannot be determined with certainty before the rolling over of the debt and a proxy must therefore be used to approximate it. Two different methods can be

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[69] As the refinancing interest expenses requires the refinance gap value to be computed and the refinancing gap requires the refinancing interest expense, a problem of circularity arises. Therefore, it's required to use a spreadsheet application to apply the framework

used in this framework to compute the proxy: the first one consists in using the yields[70] on the outgoing traded debts of the company. The second one relies on the CDS[71] prices quoted on the debt of the firm.

In theory[72], both methods should give the same results as the CDS spread is supposed to be equal to the bond spread for the same borrower and maturity. This equality comes from the non-arbitrage assumptions and can be justified by considering the following portfolio: a long position on a bond and a long position on a CDS quoted on this bond. As the CDS will hedge the default risk of the bond, this portfolio is equivalent to a risk-free asset. The return on this portfolio, which is equal to the bond yield y minus the CDS premium c, is therefore equal to the risk-free rate r:

$$y - c = r \text{ or } c = y - r$$

By definition, the CDS spread is thus equal to the bond spread. If it is not the case, an arbitrageur should be able to gain some benefit from this situation and earn a certain profit without taking any risk. The choice of the risk-free rate is therefore of the utmost importance when comparing bond and CDS spread, as different risk-free instruments will yield different spreads and hence different arbitrage opportunities. This issue will be developed in the next subsection.

However, in reality, discrepancies are observed when comparing both spreads. Several reasons explain these discrepancies and are highlighted in a study from the National Bank of Belgium[73]:

- Market premium: Corporate bond markets are often less liquid than the CDS, which explains why a liquidity premium is observed in the bond, yields. Studies show that the CDS spread incorporates a lower liquidity premium than the bond spread, resulting in a smaller CDS spread. The greater liquidity of the CDS market can be explained by several

[70] Yield : in this case, the yield to maturity. It's the total return an investor will receive if he holds the bond to maturity
[71] The credit default swap, or cds, is a swap designed to transfer the credit exposure of fixed income products between parties
[72] HULL, John, PREDESCU, Mirela, et WHITE, Alan. The relationship between credit default swap spreads, bond yields, and credit rating announcements. *Journal of Banking & Finance*, 2004, vol. 28, no 11, p.10.
[73] DE WIT, Jan. *Exploring the CDS-bond basis*. National Bank of Belgium, 2006. p.7-13

reasons[74]. Firstly, an investor who wants to liquidate its CDS position does not have to sell it on the market, but can draw up a contract on the same CDS in the opposite direction. This is not possible for bonds. Secondly, there is no limit in the amount of CDS contracts that can be traded as supply is unlimited. Thirdly, the CDS market on a given underlying company is not fragmented as the bond market. Indeed, the latter is made up of successive issuances. Finally, CDS sellers are more active in the market while part of bond investors purchase bonds as part of a "buy and hold" strategy. Several studies consider market premium the highest source of discrepancies.

- Accrued interest: In case of default, a bond does not generally pay accrued interest to bondholders. On the other hand, under standard CDS contract, the buyer has to pay the accrued premium up to the credit event.
- Cheapest to deliver bond: In the case of physical delivery after a credit event, the buyer is generally free to choose the bond he wants to deliver from a basket of deliverable bonds. He will therefore choose the cheapest to deliver one, giving him a delivery option. Since CDS sellers will likely end up with the least favourable bonds, if the different deliverable bonds are trading at different spreads, they must be compensated by a higher premium for the risk they are taking.
- Counterparty risk: The two parties in a CDS contract bear exposure to each other's ability to fulfil their respective obligations. The risk is limited to the premium payment for the CDS sellers. However, the buyer faces greater uncertainty as the seller could default and therefore might not be able to pay the buyer, should the underlying company default, too. The difference between par and recovery value is therefore at stake. CDS buyers will tend to accept to pay a lower premium to take the counterparty risk into account.

Moreover, several studies, amongst which Blanco & al[75] and Coudert & Gex[76], have analysed the long-run relationship between CDS and bond spread. They found out that the CDS market is leading the bond market, meaning that CDS spreads are adjusting more quickly to new

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[74] COUDERT, Virginie et GEX, Mathieu. Credit default swap and bond markets: which leads the other. *Financial Stability Review, Banque de France*, 2010, vol. 14, no 2010, p.163.
[75] BLANCO, Roberto, BRENNAN, Simon, et MARSH, Ian W. An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. *The Journal of Finance*, 2005, vol. 60, no 5, p.28.
[76] COUDERT, Virginie et GEX, Mathieu. Credit default swap and bond markets: which leads the other. *Financial Stability Review, Banque de France*, 2010, vol. 14, no 2010, p.3-4.

information than bond spreads do. Informed traders are indeed more likely to turn to the CDS market because of the highest liquidity as explained before.

In this framework, we have opted to use the CDS spread to estimate the future refinancing cost. The highest liquidity of the CDS market combined with its swifter reaction to new information makes CDS spread a better estimator than the yield spread. Moreover, the fragmentation of the bond market due to the successive issuances would make the study of bond spreads more complicated.

The maturity of the CDS will depend on the rollover policy selected**.** When no data are available for the corresponding CDS maturity, one will usually infer it from the maturity available on the market, using linear approximation. For a non-negligible amount of companies, the only quoted CDS maturity is 5 years. Given that the average debt maturity is often close to 5 years, using the 5-year CDS is a reasonable approximation.

2.3.2.2.2 Risk-free rate

Once the credit spread has been computed, the next step consists in computing the forecasted interest rate, which is equal to the sum of the credit spread and the risk-free rate. In recent years the choice of the risk-free rate has been at the heart of a large debate between practitioners and academicians. The government bond has been the reference for a long time. The rationale behind this choice[77] was that a bond issued by a government in its own currency has no credit risk and therefore its yields must be equal to the risk-free rate. However, the yield on government bond tends to be much lower than the yield on other zero or very low credit risk instruments. Hull[78] explains this lower yield in the case of the US Treasury bond by three elements. Firstly, the financial institutions have to use the treasury bills to fulfil a variety of regulatory requirements. Secondly, a financial institution has to hold substantially less capital to support an investment in Treasury bonds than the capital required to support a similar investment in low risk corporate bonds. Finally, interest on Treasure bonds is not taxed at the state level, whereas interest on other fixed income investments is. These three

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[77]HULL, John C., PREDESCU, Mirela, et WHITE, Alan. Bond prices, default probabilities and risk premiums. *Default Probabilities and Risk Premiums (March 9, 2005)*, 2005. p.3.
[78] Ibid.

reasons explain why US financial institutions hold a large amount of Treasury bonds and therefore allow the US treasury to issue bonds at a lower interest rate. The same reasoning applies to government bonds from other countries.

Recently professionals have given up government bonds to use the swap zero curve[79]. This curve is usually computed using Libor, deposit rates and swap rates. The rates for maturities less than one year are Libor deposit rates. They represent the short-term rates at which a financial institution is willing to lend funds to another financial institution through the interbank market. The borrowing institution must have an acceptable credit rating defined as a rating higher or equal to Aa. Longer rates are tougher to comprehend. Hull defines the n-year swap rate as “the rate of interest on an n-year loan that is somehow structured so that the obligator is certain to have an acceptable credit rating at the beginning of each accrual period. Therefore, the rates calculated from the swap zero curve are very low risk rates but are not risk free. They are also liquid rates that are not subject to special tax treatment. »

In this framework, the 10-year swap rate in the main currency of the company will be used.

2.3.2.2.3 Cost of debt

The cost of debt is assumed to be equal to the interest rate on the most recent debt issued by the company

2.3.2.2.4 Credit premium and tax shield

As mentioned before, an indebted company is allowed in many countries to deduct its interest expenses, hence lowering the amount of taxes to be paid. This mechanism is known as the interest tax shield. As the company’s future interest rate has changed, so has the interest tax shield. A company that must pay a 1% premium on its debt in the future will indeed increase proportionally its tax shield, hence lowering the effective refinancing cost for the company. The credit premium must therefore be adjusted to take the tax shield into account and is equal to:

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[79] HULL, John, PREDESCU, Mirela, et WHITE, Alan. The relationship between credit default swap spreads, bond yields, and credit rating announcements. *Journal of Banking & Finance*, 2004, vol. 28, no 11, p.12.

Effective tax premium = $(1-t_c)$ * computed tax premium

The same reasoning applies for the negative tax premium: the company will pay a lower interest rate in the future, hence a lower tax shield. The company gain must therefore be adjusted to take this loss in tax shield into account.

2.3.2.3 Total cost of refinancing

2.3.2.3.1 Refinancing gap length

The company will have to refinance its debt as long as its cumulative debt payments are higher than the cumulative accumulation of cash. It means that the company will borrow money until it has enough cash to pay back its entire debt and to finance its operation only by means of its free cash flows. An alternative explanation is to consider that the company will stop rolling over its debt as soon as the cash surplus released by its operations is sufficient to pay back all its debt.

Once the gap length has been determined, one has to decide the rolling over policy that is to be applied. Two options are considered in this framework.

The first one consists in assuming that the debt is rolled over at a given frequency. This frequency is equal to the current average maturity of the debt. By doing so, the framework assumes that the company is not changing its debt management policy and is simply rolling over its maturing debt over the average maturity of its entire debt. This method also assumes that the future refinancing terms will be equal to the one of the first rolling over. In reality, this assumption only holds, if there is no new information that might change the refinancing terms in the future.

The second option assumes that the debt financing the yearly cash deficit has a maturity equal to the end of the refinancing gap. The rationale behind this approach is that, as the company knows when it will be able to operate without additional debt, the easiest way to refinance its maturing debt is to choose a maturity equal to the end of the refinancing period. By doing so, it will not be necessary to refinance again the debt in future and there is therefore no longer any refinancing risk, as all the terms have been fixed now. The maturity of the future new debt issue will therefore decrease over the years, as the end of the refinancing gap is getting closer. However, this method requires computing the refinancing premium for different maturities while the first one only requires one computation.

The following example highlights the differences between both methods.

Company X has the following outstanding debt: 100€ maturing in 3 years and 200€ maturing in 6 years. According to the framework, it will face a refinancing gap for the next 12 years. It is assumed that no other cost related to the debt is to be financed in the future.

According to the first method, the weighted average maturity of the outstanding debt is equal to 5 years. Therefore, the 100€ will be refinanced in 3 years for 5 years. Then, in 8 years, the company will once again roll over the 100€ until year 13. As the refinancing gap will have disappeared by year 12, the company will have paid back the 100€ one year earlier than scheduled (year 12 instead of year 13). Similarly, the 200€ will be refinanced in year 5 and then in year 10. It will be paid back after two years, therefore three years ahead of schedule. This process is illustrated on figure 9.

The second method assumes that the 100€ will be refinanced only once by a new debt of maturity of 9 years and the 200€ with a new debt of maturity of 7 years as shown on figure 10.

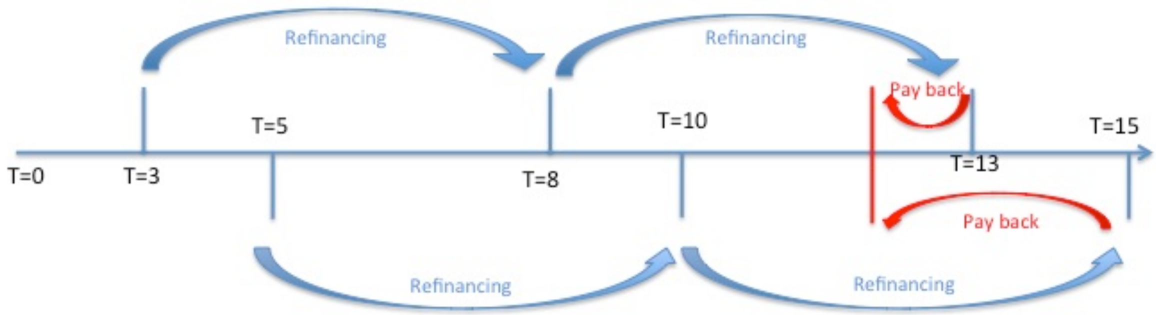

Figure 9: Fixed frequency debt rolling over illustration

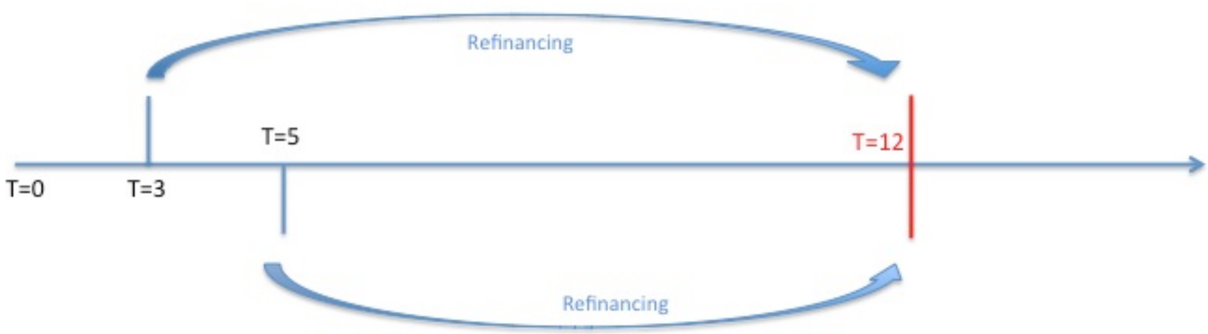

Figure 10: End of gap debt rolling over illustration

The difference of outcomes between both methods will depend on the expected interest rate curve shape of the company. If the curve is flat and the interest rates constant for both maturities, both methods will give the same results. In the case of an upward slope, the method using the lowest maturity will yield a lower refinancing cost. In the case of distressed companies, the gap length is usually higher than the average maturity on the outstanding debt and therefore the first method will be favoured by companies, as the refinancing cost will be lower. The situation is exactly the opposite when the curve is downward sloping.

In the case of distressed companies, the interest rate curve is generally downward sloping as there is considerable uncertainty about the ability of the company to survive in the short term. It might therefore be efficient for the distressed company to issue long maturity debt in order to benefit from the lower interest rate. However, it is very unlikely that the distressed company will be able to successfully issue a debt with a long maturity and a high face value. The market will indeed be reluctant to invest on the long run in a company with negative financial perspectives.

This framework will favour the first method both for practical reasons as well as for financial accuracy.

2.3.2.3.2 Discounting

Given that the refinancing gap is considered a hidden debt, this framework will use the cost of debt (Kd) as the discount factor.

2.3.2.3.3 Time value

The refinancing gap value computed previously is based on the assumptions that the future free cash flows are known and certain and that the debt refinancing occurs immediately after the need appears. However, the refinancing, although required, might be delayed and there is some uncertainty regarding the free cash flows projection. As a consequence, the refinancing gap value includes a “time value”, just like an option does, which accounts for the uncertainty. This time value is difficult to quantify and this framework will use a proxy in the form of the default probability of the company. As a matter of fact the probability of default depends on the free cash flow expectation as well as on the refinancing or not of the debt and therefore encompasses both parameters of the time value. The rationale behind the use of the probability of default is that the framework only computes a value as long as the company does not default. As soon as the company defaults, there are no more free cash flow projections nor any refinancing risk and the refinancing gap value is therefore nil. However, one cannot predict the default occurrence when computing the refinancing gap value and adapt the results as a consequence. This framework therefore proposes to correct the refinancing gap value by taking the probability of default into account, hence the time value.

A company with a probability of default equal to 20% will therefore have a time value equal to 1/0,8 = 25% on the intrinsic refinancing gap value. The final refinancing gap value is therefore equal to 125% of the intrinsic one. The probability of default used is the one stated by Bloomberg. Bloomberg use the Merton distance-to-default measure to predict the probability of default and adjust the results to take additional economically and statistically relevant factors into account.

Section 3: Company valuation

Once the refinancing gap value has been computed, the last step consists in applying a structural model to value the debt and equity of the company. In this framework, three structural models are considered. Each of them allows refining the results of the previous ones, but also adds some complexity.

3.1 Merton model

As explained before, the Merton model is the simplest existing structural model. In order to use this model, the framework assumes that all the debt issued by a company can be considered a zero coupon. The face value of this zero coupon is equal to the sum of the total face value of the outstanding debts, while its maturity is the weighted average maturity of the outstanding debts. As presented in appendix 1.1, five parameters are required to apply the Merton model:

- Asset or firm value: as the asset value of a company is not directly observable in the markets, it is the goal of financial analysts to estimate this value. Given that estimations vary according to the financial analyst, this framework will use the average price from the financial reports available for a given company.
- Debt value: in the classical Merton model, the debt value is typically equal to the sum of the total face value of the outstanding debt. However, as explained before, the refinancing gap is considered a hidden debt/receivable so that the equality A = E + D does not hold anymore. The correct equality when the refinancing risk is taken into account becomes A = E + D + RG. In order to include the refinancing risk in the Merton model, one must

therefore take the debt value as the sum of the face value of the total outstanding debt and the refinancing gap[80]. The company will thus default earlier than in the classical Merton model, as soon as the asset value drops below the "real" debt level including the refinancing gap. The shareholders will decide to default when they realize that the assets of the firm will not be able to meet the current financial obligations (on the outstanding debt) and the future expected additional cost of refinancing.

- Time to maturity: the time to maturity of the debt is equal to the weighted average time maturity of all the outstanding debts
- Risk-free rate: As explained before, the most commonly used risk-free rate amongst practitioners is the swap rate. This framework will therefore use the 10-year swap rate in the reference currency of the company.
- Volatility of assets: as for the assets value, the assets volatility is not observable in the market. However, as mentioned in appendix 1.2, Lardys and al show that the volatility of assets can be estimated when using the equity volatility. According to their study, one must compute the equity volatility over a 1000 days window to obtain the most accurate results and then apply the following formula to extract the assets volatility: $\sigma = \sigma_S^* \frac{S^*}{S^* + \bar{L}D}$

Once these five parameters have been computed, one will find the Equity and debt value by applying the revised version of the Merton formula presented in appendix 1.1:

The equity value is directly equal to the value of a call option on the underlying assets with a strike price equal to the sum of the debt value and the refinancing gap.

The current refinancing gap value is equal to the present value of the beforehand computed refinancing gap value, discounted at the cost of debt ke.

Finally, the debt value is equal to the difference between the assets value and the sum of the

[80] However, the yearly refinancing gap will not be actualized until the beginning of the studied period. In order to apply the refinancing gap to structural models, the refinancing gap will indeed be added to the face value of the debt. For the sake of consistency, the refinancing gap value must therefore be calculated at the same time as the face value of debt, namely the weighted average debt maturity.

equity and refinancing gap value. This value is slightly different from the present value of the face value, discounted at the risk-free rate minus the value of a put option on the underlying assets with a strike price equal to the sum of the debt value and the refinancing gap.

3.2 Simplified CreditGrades model

In order to overcome the limitations of the Merton model as highlighted in chapter 1, the framework will use the CreditGrades model to refine the results. This model is called 'simplified', because it also assumes that all the debt issued by a company can be considered a single zero coupon. The face value of this zero coupon is equal to the sum of the total face value of the outstanding debts, while its maturity is the weighted average maturity of the outstanding debts, just like in the Merton model.

In order to use the CreditGrades model, nine parameters are required, as presented in appendix 1.2:

- Initial stock price: it is equal to the stock price at the beginning of the considered period
- Reference stock price: The reference stock price is the target stock price estimated by financial analysts. This framework will therefore use the average of the different prices disclosed in financial reports
- Reference stock volatility: The framework will use the same reference stock volatility as in the Merton model. The rationale used in a) was indeed first developed in the case of the CreditGrades model
- Debt per share: This parameter is equal to the sum of the debt per share usually computed for the CreditGrades model and the refinancing gap value per share. The classical debt per share ratio is based on financial data from consolidated statements and requires a two-step process. Firstly, one must compute the total liabilities that participate in the financial leverage of the firm, namely the principal value of all financial debts, short and long-term borrowings and convertible bonds as well as quasi debts (i.e. capital leases and preferred shares). Non-financial liabilities such as accounts payable, reserves or deferred taxes are not taken into account. Then, this debt value must be divided by the number of shares outstanding. The refinancing gap value per share is simply the computed value divided by the number of outstanding shares.

- Global debt recovery: This framework will use the value usually selected by practitioners and equal to 0, 5. This value was estimated by Hu and Lawrence[81] using Standard&Poor database containing actual recovery rate for non-financial US firms which defaulted.
- Volatility of default barrier: Similarly, Hu and Lawrence estimated this volatility to be equal to 0, 3. This value has become the reference amongst practitioners.
- Time to maturity: the time to maturity of the debt is equal to the weighted average time maturity of all the outstanding debts
- Risk-free rate: The same risk-free rate as in the Merton model will be used, namely the 10-year swap rate in the reference currency of the company.
- Firm recovery rate: In order to assess the firm recovery rate, this framework will use a credit report from Credit Suisse[82]. In this report, Credit Suisse computed the recovery rate for a range of industries. The firm recovery rate will therefore be selected using the industry recovery rate of the firm in this report.

The outcome of the CreditGrades model is the estimated credit spread of the debt. The yield on the debt is therefore equal to the sum of this spread with the risk-free rate. The value of the debt can be found by actualizing the face value of the debt with this yield.

The current value of the refinancing gap is the same as in the Merton model: it is equal to the present value of the refinancing gap value, discounted using the cost of debt.

Finally, the equity value is equal to the assets value used in the Merton model minus the sum of the debt and refinancing gap value.

3.3 Complete CreditGrades model

The simplified CreditGrades model assumes that the debt can be modelled as a single zero-coupon bond. This is however not the case and the complete CreditGrades model will be able to deal with more complex debt structure.

The parameters used in this model are exactly the same one as in the simplified version.

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[81] Hu, H. and Lawrence, L. (2000). Estimating Recovery Rates, JPMorgan document
[82] CREDIT SUISSE, Leveraged Finance Outlook and 2013 Annual Review, 2013

However, the framework will compute the credit spread for every maturity, by step of one year. Moreover, one will be able to draft the credit-spread curve estimated by the model. The maturity parameter in the CreditGrades model will therefore be adapted according to the spread desired. For example, in order to find the one-year spread, the model will use a maturity of one year.

Once all the spreads have been computed, every outstanding debt will be discounted using the spread of the appropriate maturity. Therefore, the debt maturing in one year will be discounted by the 1-year spread plus the risk-free rate, while the one maturing in 10 years will be discounted by the 10-year spread plus the risk-free rate.

The total debt value will be equal to the sum of the discounted face value of the total outstanding debt, while the refinancing gap value will be equal to the one used in the simplified model. Finally, the equity value is still equal to the assets value used in the Merton model minus the sum of the debt and refinancing gap value.

Section 4: Refinancing operations for distressed companies

Distressed companies have various options to improve their liquidity and avoid going bankrupt. Yann Ait Mokhtar[83] classifies these options in three categories, according to the balance sheet item involved:

1. Assets
    - Disposal: An asset disposal means that the company sells part of its activities in exchange of cash. Distressed companies will usually sell non-core business related activities in order to improve their cash position. Thanks to this improvement in cash position, the company will not have to refinance itself as early as originally needed.
    - Sale & lease back: In a sale & lease back operation, a company sells an asset to a third party and immediately leases it back for the long term. The company is therefore able to keep using the assets but does not own them anymore. This kind of operation is useful when a company needs to untie an investment in an asset (due to a liquidity issue for example), but the asset is still needed for the company to operate.

[83] EXANE, The Asset Liability Refinancing Gap model : Valuation and Arbitrage of indebted companies, January 2009

2. Equity
    - Capital increase: The company sells, either to its current shareholders or to new ones, new shares in the company. As the total number of outstanding shares increases, the equity value gets diluted amongst shareholders.
3. Debt
    - Prolonging average maturity: By issuing new bonds with a longer maturity, the company will delay its refinancing need, as the cash shortage will occur later.
    - Issuing new bonds to make early repayments on existing debt. By issuing new debt under the current financial terms, the company is able to avoid having to refinance its debt under more expensive terms in future. This operation will also increase the average maturity of the debt.

These five operations will directly improve the liquidity of the company, hence reducing the risk of default and the credit spread. Moreover, they have a direct incidence on the refinancing risk exposure. On the one hand, the asset and equity oriented refinancing operations will bring a surplus of cash in the company allowing it to face more debt payments before having to refinance itself. On the other hand, debt oriented refinancing operations delay the moment when the company has to pay back its debt, hence the refinancing risk. By lowering the credit spread and reducing the refinancing risk exposure, the refinancing operations therefore reduce the value of the refinancing gap of a company.

Such decrease in the value of the refinancing gap benefits to both the debt and equity holders. A reduced refinancing gap indeed induces a lower exposure to liquidity risk, hence a lower probability of default. The credit spread will therefore tighten and the outstanding debt value increases. This value is transferred by the shareholders.

Moreover, the decrease in the refinancing gap value induces a lower hidden debt for the company. As this hidden debt represents the part of the firm values which is locked due to the refinancing risk, the reduction in the refinancing gap value will directly be transferred to the equity holders.

Shareholders and debtholders can therefore both benefit from a lower refinancing gap value. This observation is at odd with classical structural model's conclusions, as explained in the next example.

4.1 The case of financially healthy companies

In some cases financially healthy companies may benefit from a negative refinancing gap. This situation occurs when the expected refinancing cost is lower than the current interest rate on the outstanding debt. When this occurs, the company will be able to refinance its debt at a lower rate in future, hence booking a profit. This profit is not taking into account by the classical company valuation model and represents an increase in the firm value. When such company decides to realize one of the operations mentioned above to deleverage its financial structure, it might lead to a decrease in the value of the firm. The operation will indeed increase its cash position and therefore lower its exposure to the positive refinancing terms. As a consequence, the refinancing gap value will increase and ultimately reach zero, negatively impacting the value of the firm.

4.2 Capital increase example

The following example highlights the difference between classical structural models and the refinancing gap model regarding the impact of refinancing operations on the equity and debt values. Although classical structural models predict that a capital increase will negatively impact the stock price, the refinancing gap model shows that the stock price may react positively under some circumstances. This observation is confirmed by facts, as explained below.

Company X has an estimated asset value of 100€. The sum of its total face value of debt is equal to 50€ with an average maturity of 4 years. The refinancing gap value at year 4 is equal to 30€. The current equity, debt and refinancing gap values computed are the following:

Table 3: Initial equity, debt and refinancing gap values according to classical and refiancing gap models

Equity = 35 €	Classical models	Refinancing gap model
Equity Share price	55€ 0,55€	35€ 0,35€
Debt	45€	43€
Refinancing gap	0€	22€

When comparing both models, one can notice that the spread on the debt is higher in the refinancing gap model, leading to a lower debt value. This situation is explained by the sole reliance of the classical models on the economic default, while the refinancing gap model also takes part of the liquidity issue into account. The refinancing gap model therefore covers a wider range of default triggers, which justifies the higher credit spread. Moreover, the refinancing gap accounts for more than 20% of the value of the firm, which directly impacts the equity value as only 78% of the value of the firm is currently available, the remaining 22% being locked by the refinancing gap.

In order to improve its liquidity, the company will raise 25€ in a capital increase. This operation represents an increase by 50% of the number of shares outstanding, from 100 to 150. These 25€ will be used to deleverage the company and payback half of the debt before maturity (the face value of the debt is 50€ and it will pay back 12, 5€ of each maturity in order to keep the same average maturity). Thanks to this operation, the future credit spread of the company tightens and becomes in line with the current spread. Therefore, the refinancing gap disappears and its value is nil.

The new values of equity and debt become:

Table 4: Post equity increase equity, debt and refinancing gap values according to classical and refiancing gap models

	Classical models	Refinancing gap model
Equity Share price	77€ 0,51€	77€ 0,51€
Debt	23€	23€
Refinancing gap	0€	0€

As the refinancing risk disappears thanks to the capital increase, both classical structural models and the refinancing gap one give the same results. However, the evolution of value before and after the capital increase is totally different. The magnitude of increase is indeed higher in the refinancing gap model for both the debt and the equity values.

This change in value in the refinancing gap model can be divided into the following categories:

Table 5: Breakdown of value exchanges in the Refinancing gap model

	Before	After	Refinancing gap reallocation	Capital increase and debt payback	Value transfer from E to D
Equity	35	77	+ 22	+ 25	- 5
Debt	43	23		- 25	+ 5
Refinancing gap	22	0	- 22		

Three effects influence directly the change in value:

- The capital increase improves the liquidity of the company, which reassures the markets. As a consequence, the future credit spread tightens and becomes in line with the current one. There is no refinancing gap anymore and its former value is transferred to the equity holders. As the hidden debt disappears, it indeed unlocks part of the value of the firm and as a consequence, shareholders capture a bigger part of the assets value.
- The cash from capital increase directly impacts the equity value and similarly decreases the debt value by the same amount as the cash is used to partially pay back the debt.
- As the cash from the capital increase is used to pay back part of the debt, the leverage of the company decreases. This decrease leads to a tightening of the credit spread on the outstanding debt. The probability of default is indeed lower as the asset value process is less likely to fall below the new debt level. As a result, the remaining debt is worth more than before. This increase in value comes from a transfer from the shareholders to the debt holders. In the Merton model, this transfer of value is represented by a decrease in the put value sold by the debt holders. This put is indeed worth less than before because the probability of default of the company decreases.

Moreover, the share price will also react positively to the capital increase. It will indeed increase from 0, 35€ to 0, 51€. Considering that the stock issue will be carried out at the market price[84], a capital increase will be accretive for the stock price as long as the reduction in the refinancing gap is higher than the value transferred from shareholders to debt holders. It explains why the stock price of distressed companies with a high refinancing gap will react positively to a capital increase.

This observation is in contradiction with the prediction of the classical structural models. For example, the CreditGrades model forecasts a decrease from 0, 55€ to 0, 52€ due to the transfer of value to the debt holders. As these models do not take the refinancing issue into account, they only consider the transfer of value between shareholders and debt holders[85].

[84] If the issue is not done at the market price, a dilution effect will appear. This effect will not change the results as shown in the chapter 3

[85] And the equity dilution when the issue is not done at the market price

The Refinancing gap model prediction was confirmed by Exane in 2009. Exane analysts[86] noticed that the stock price of 47 distressed companies increased by 18% on average after a capital increase, while the structural models predicted a decrease. This conclusion highlights the importance of the liquidity issue for distressed companies and the relevance of the refinancing gap model when valuing this kind of firms.

Section 5: Summary

This chapter presented an approach to value the refinancing risk. This approach is based on computing the total cost of the debt refinancing operation based on the expected future terms. It provided a complete framework, the refinancing gap model, to apply in practice this approach. Then, it explained how this exposure to the refinancing risk influences the value of a firm. Finally, it introduced several refinancing operations and also the way they impacted the value of the firm, in the light of the Refinancing gap model. It appears that the refinancing risk has, in theory, a negative impact on both the equity and debt value. On one hand, a part of the firm value is locked as a hidden debt, at the expense of the equity value. On the other hand, the hidden debt increases the leverage, hence the credit spread. Moreover, the refinancing gap model concludes that a refinancing operation can be accretive for both the equity and debt when the initial refinancing exposure is important.

[86] EXANE BNP PARIBAS, Capital Structure Optimization : CDS and share price, ALRG model and country risk, 2013

Chapter 3

Applications of the Refinancing gap model

This chapter outlines the practical implementation of the Refinancing gap model presented in chapter 2. It will study five companies. All of them faced an important exposure to the refinancing risk and decided to use one or several of the refinancing operations introduced before to reduce this risk. For each company, it will present a background of the firm as well as the reasons which led to the refinancing exposure. It will then use the refinancing gap model to compute both the stock price and bond spread of the firm and compare them with the estimations of classical structural models. Finally, it will explain the refinancing operation and compare the predicted outcome (by the refinancing gap model and classical structural model) with the reality. The first four companies were in a distressed situation and therefore had a positive exposure, while the last one had a negative exposure. Both positive and negative exposure situations will therefore be tested. The excel sheets for the five companies are available in appendix 2

Section 1: Lafarge

Nom	Lafarge		
Refinancing operations	Capital increase, assets disposal, bond issue, other		
Before refinancing operations (Jan 09)	Reality	CreditGrades	Refinancing gap model
Stock price in €	36	78,39	41,6
Bond spread in bp	500	174	335
After refinancing operations (20 Feb 09)	Reality	CreditGrades	Refinancing gap model
Stock price in € (% change)	48,25 (+33%)	50,71 (-35%)	49,68 (+20%)
Bond spread in bp (absolute change)	300 (-200)	107 (-67)	111 (-224)

Figure 11: Overview of Lafarge's case

1.1 Description and initial situation

Lafarge is a French industrial company, which is the world leader in building materials. The company is specialized in three major products, namely cement, construction aggregates and concrete and is active in fifty countries. Until 2008, Lafarge's biggest markets were Europe and North America, totalling more than half of the global turnover. The company was therefore highly dependent on infrastructure projects in the developed countries. As the maturity of these markets threatened Lafarge's activities, the company decided to focus its development on the emerging markets, which accounted for more than two-thirds of the world cement consumption. To this end, Lafarge acquired[87] in 2008 Orascom Ciment, an Egyptian based company with a strong presence in the Middle East and Africa. Orascom Ciment was a subsidiary of the Orascom Group, the first Egyptian multinational corporation and had promising financial forecasts. Thanks to this acquisition, Lafarge will shift the majority of its earnings to high-growth emerging markets.

Lafarge paid €8,8 billion in exchange for 100% of Orascom Ciment. Moreover, it took on 1, 2 billion of net debt and included it in its accounts. The operation was paid by cash (€6 billion) and equity (2,8 €). The cash part was financed thanks to a credit agreement Lafarge concluded with

[87] LAFARGE. *Lafarge Acquiert Orascom Cement, Le Leader Cimentier Du Moyen-Orient Et Du Bassin Méditerranéen*. *www.lafarge.fr*. N.p., 10 Dec. 2007. Web. 17 June 2014.

30 banks for a value of €7,2 billion under the following terms:

- €1,8 bn with 1-year maturity
- € 2,3 bn with 2-year maturity
- € 3,1 bn with 5 years maturity
- Average interest rate: 5,8%

The equity side consisted of a capital increase of 22,5 million of shares fully allocated to Nassef Sawiris, the majority shareholder of Orascom Group.

At the end of 2008 there were therefore 193 million of shares outstanding and the total debt value amounted to €18, 3 billion, up from €9,6 billion one year earlier. This debt level led to financial ratios that were too high for an investment grade company. Financial analysts therefore feared a downgrade of Lafarge's credit rating in the high yield category. This fear was confirmed by a downgrade by S&P and Moody's to BBB-, the last investment grade category. Moreover, the debt of the company was assigned a negative outlook. Given this situation, an increased number of investors looked for guarantee and bought CDS's. This led to a sharp increase in the CDS price, from 500bp to 925bp.

As shown on figure 12, one third of this debt had to be paid back within three years. As the company did not have enough treasuries to face its obligation, it would have to refinance it on the debt market.

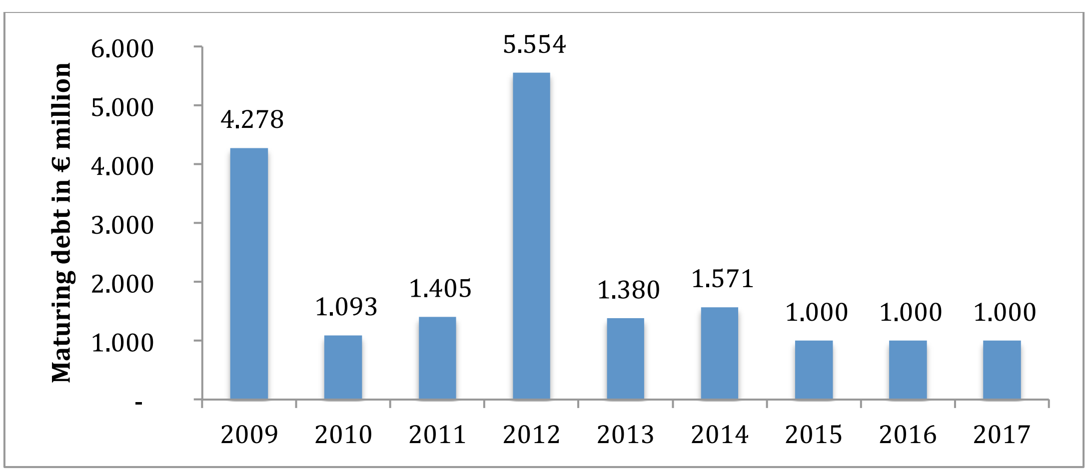

Figure 12: Lafarge's debt payment schedule

However, due to the increased leverage, the situation had worsened and it would have to pay a premium on its new debt in comparison with the outstanding one. This new situation increased even more the pressure on the Lafarge's bonds and CDS and impacted the stock prices.

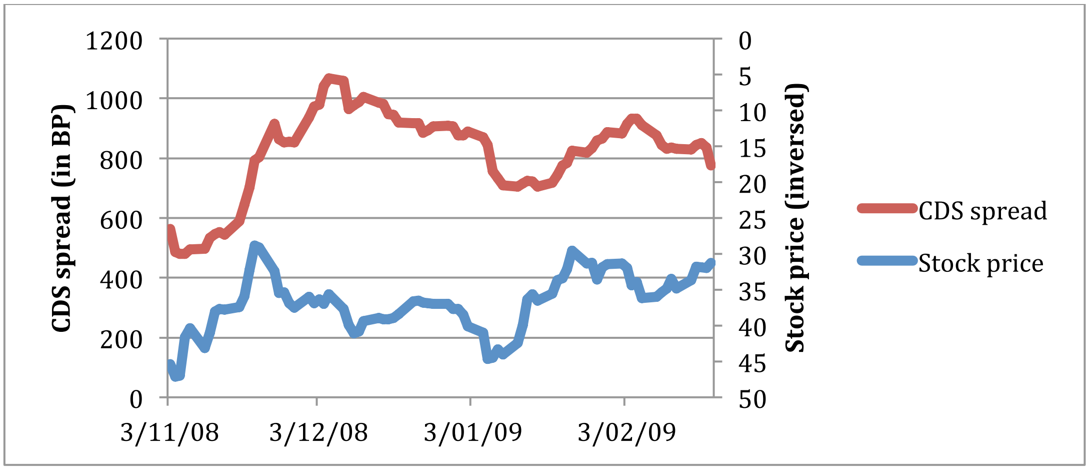

Figure 13: Evolution of Lafarge's CDS spread and stock price between October 2008 and February 2009

The latter fluctuated between 31€ and 44€ over the December 08 – February 09 period with an average of 36€. This is far from the financial analysts' averaged estimation of 50€ and structural models prediction of 78€. This discrepancy between observed value and financial forecasts can be explained by the refinancing gap that Lafarge was facing in the beginning of 2009. The refinancing gap model indeed estimated the refining gap value to amount for 27% of the company value. By taking this refinancing gap into account, the fair stock price is computed equal to 41,6€, much closer to the observed stock price.

Similarly, the 4-year[88] bond spread also increased significantly over the period to 500 bp at the beginning of February, up from 300bp. Classical structural models predicted a spread of 174bp which is only equal to one third of the observed spread. On the other hand, the refinancing gap predicted a spread of 335bp, twice the one forecasted by classical structural models but still 32% lower than the real one.

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[88] The oustanding bond selected for the study is the one whose maturity is the same as the weighted average maturity considered in the refinancing gap model

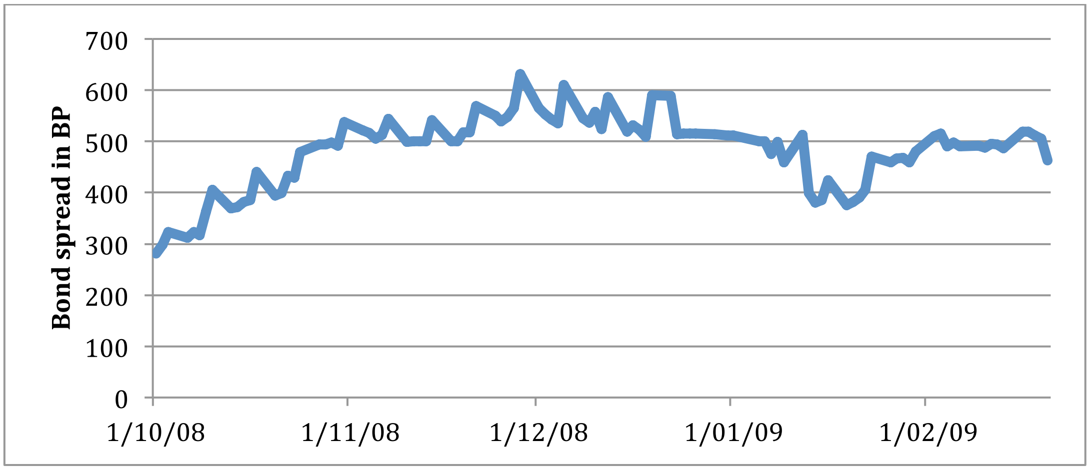

Figure 14: Evolution of Lafarge's 4-year bond spread between October 2008 and February 2009

1.2 Refinancing operations

In order to reduce its leverage and strengthen its financial structure, on 20 February 2009 Lafarge announced[89] a huge plan that was supposed to reassure the financial markets. This plan included several financial operations:

- A disposal of non-strategic assets for a €1bn value, including amongst others the sale of its Chilean assets to Brescia Group
- A dividend decrease as well as a reduction in costs, investment and working capital requirement for a total value of €1bn
- A new bond issue with face value of €2,5bn and maturity between 2014 and 2017 (average maturity of six years). The average interest rate on this debt is equal to 7,63% and is therefore lower than the one expected from CDS price
- A capital increase for a value of €1, 5 bn. Lafarge will issue 90 million of shares at a forty percent discount in comparison with the closing price before the announcement. The total number of outstanding shares after the capital increase will amount to 283 million. The proceeds will be used to pay back part of the maturing debt and to decrease the leverage.

The markets reacted extremely well to this liquidity improvement and at the end of June the stock

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[89] LAFARGE. Lafarge lance une augmentation de capital de 1,5 milliard d'€. *lafarge.fr*. N.p., 10 Apr. 2009. Web. 17 June 2014.

price increased by around 30% in comparison with the beginning of year average, to 48,25€. Similarly, the CDS spread decreased from 925bp to 300bp as the refinancing exposure of Lafarge disappeared. The refinancing gap value is indeed equal to €400 million and represents only 1, 3% of the firm value.

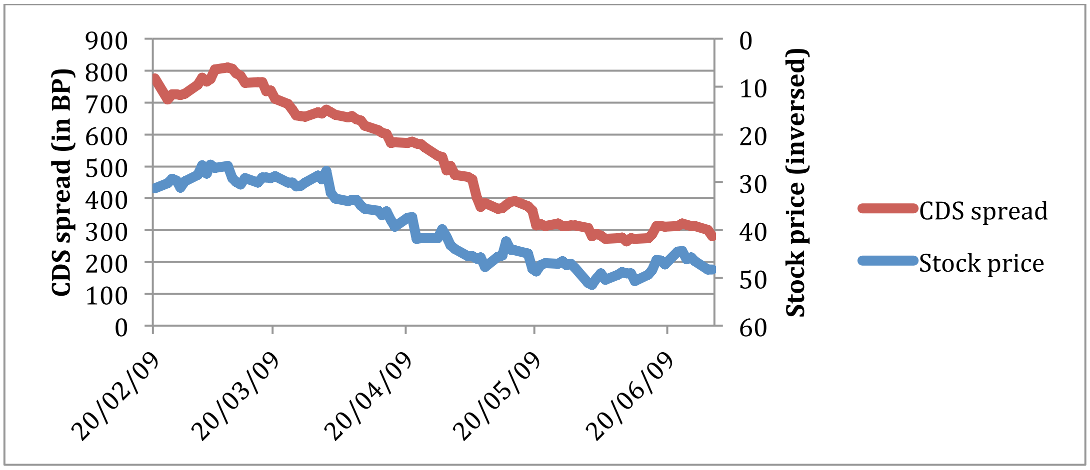

Figure 15 Evolution of Lafarge's CDS spread and stock price between February 2009 and June 2009

This observation is the opposite of what classical structural models predicted. According to them, the capital increase will lead to a dilution of the equity value and a transfer of value from the shareholders to the debt holders due to the lower spread on the debt, hence a lower stock price. The CreditGrades model therefore forecasted a decrease by 35% of the stock price by the end of June 2009.

On the other hand, the refinancing gap model correctly predicted a stock increase. According to the model, the price will rise to 49,66€, representing an increase of 20%. Moreover, this price is close to the observed price of 48,25€. This stock increase is due to the transfer of the refinancing gap value to the equity holders as the refinancing risk disappeared. This transfer of value more than offset the diluting effect of the capital increase and the lower yield on the outstanding debt.

Similarly, the bond spread also reacted positively to the refinancing operations and went down to 300bp at the end of June, representing a decrease of 200bp. Once again, the classical structural models failed to predict the exact spread and forecasted 107bp. This estimation is similar to the one of the refinancing gap model (111bp). However, the refinancing gap model successfully predicted the magnitude of the decrease. The spread indeed decreased by 200 bp in reality while the refinancing gap model forecasted a decrease by 231bp.

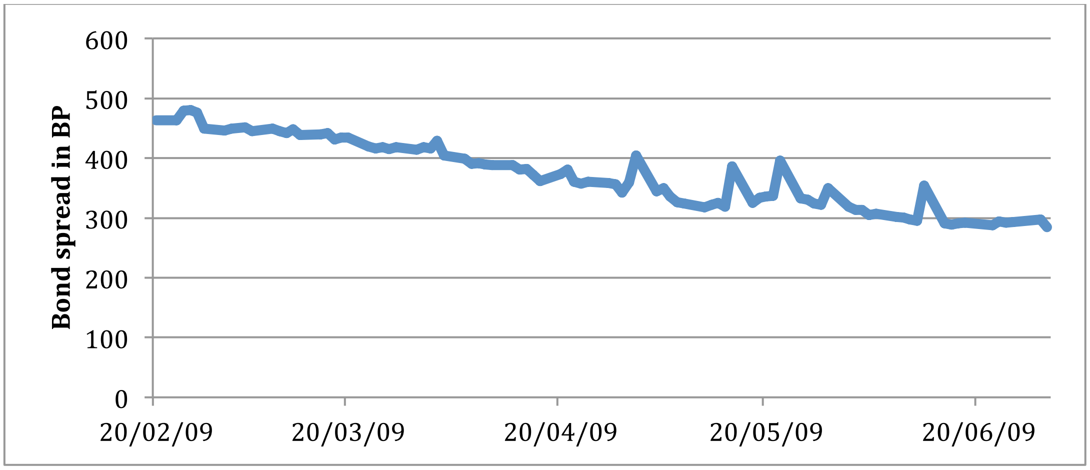

Figure 16: Evolution of Lafarge's 4-year bond spread between February 2009 and June 2009

1.3 Conclusion

The Refinancing gap model successfully predicts the initial and final stock price, hence the magnitude of the change. It therefore provides an appealing explanation to the surprisingly positive reaction of the stock price following the announcement of the refinancing operations. Classical structural models are indeed not able to predict such reaction and forecast a decrease of the stock price.

Although the refinancing gap model is not able to correctly predict the initial and final bond spread, it offers a closer estimation than the classical structural models. Moreover, he successfully forecasted the magnitude of change in the bond spread.

	Initial stock price	Final stock price	% of stock price incease/ decrease	Initial bond spread	Final bond spread	Magnitude in BP of spread increase/ decrease
Refinancing gap model	✓	✓	✓	✗	✗	✓
CreditGrades model	✗	✓	✗	✗	✗	✗

Figure 17: Predictive power of Refinancing gap and classical structural models

Section 2: Pernod Ricard

Nom	Pernod Ricard		
Refinancing operations	Capital increase, assets disposal		
Before refinancing operations (Mar 09)	Reality	CreditGrades	Refinancing gap model
Stock price in €	40	46,44	40,19
Bond spread in bp	430	153	171
After refinancing operations (15 Apr 09)	Reality	CreditGrades	Refinancing gap model
Stock price in € (% change)	42,62 (+6%)	42,5 (-8,5%)	42,89 (+5%)
Bond spread in bp (absolute change)	267(-160)	126 (-27)	127 (-44)

Figure 18: Overview of Pernod Ricard's case

2.1 Description and initial situation

Pernod Ricard is a French company that produces distilled beverages. The company is organized in two entities, namely "beverages" and "distribution". Pernod Ricard owns a portfolio of various brands including Ricard, Havana Club, Mumm and Jacob's Creek. Its products are distributed in 70 countries, the biggest markets being Europe and North America. Over the last decade, Pernod Ricard has launched a strategy of "premiumisation" of its portfolio, aiming to become the global leader in the premium beverage segment. As part of this strategy, on 31 March 2008 it announced[90] the acquisition of Vin & Sprit. Vin & Sprit is a Swedish producer and distributor of alcoholic beverages that belonged to the Swedish government. The company is best known for its "Absolut" brand of vodka. Absolut is the number one premium vodka worldwide and is the best sold premium spirit brand in the United States. This acquisition allowed Pernod Ricard to add an iconic vodka brand to its portfolio while becoming the co-leader in the global wine and spirit industry and the sole leader in the premium segment.

Pernod Ricard offered a price of $5, 3 billion in exchange of 100% of the stock. Moreover, it took on $0, 3 billion of debt in its own financial account for a total price of €5, 6 billion. The operation was fully financed by debt and Pernod Ricard concluded a credit agreement with a pool of banks

[90] PERNOD RICARD. Pernod Ricard acquiert Vin & Sprit et devient co-leader mondial de l'industrie des vins et spiritueux. *Pernord-ricard.fr*. N.p., 31 Mar. 2008. Thu. 18 June 2014.

for the total value of the deal. At the end of 2008 the total debt value amounted to €13, 5 billion up from €6, 5 billion.

The acquisition led to a highly leveraged financial structure that ultimately triggered a rating downgrade with negative outlook from the three main rating agencies. Pernod Ricard therefore lost its Investment Grade rating and become a High Yield company. S&P justified this decision by the too high debt per EBITDA ratio of the company following the acquisition and claimed that in order to keep this rating unchanged in the future, Pernod Ricard would have to deleverage to an adequate level of debt. Following these rating downgrades, the bondholder's willingness to hedge credit risk increased and the CDS spread was put under pressure, rising from 2% before the acquisition to 7, 4% at the end of the year. Moreover, the company will have to refinance a significant part of its debt during the next four years.

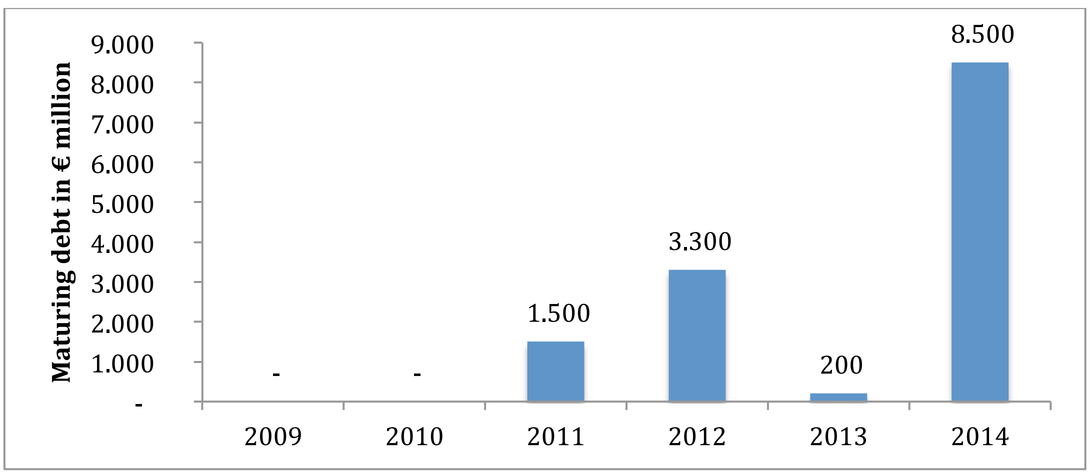

Figure 19: Pernod Ricard's debt payment schedule

As the CDS spread has sharply increased over the last six month, the interest rate that Pernod Ricard will need to pay on its new debt will be higher than the current one, possibly leading to a liquidity problem. This situation will worsen the CDS spread even more.

Between the credit downgrade of October 2008 and April 2009, the stock price decreased by around 30% from 57€ to 40€. Similarly, the CDS spread rose from 2% to 5, 92%.

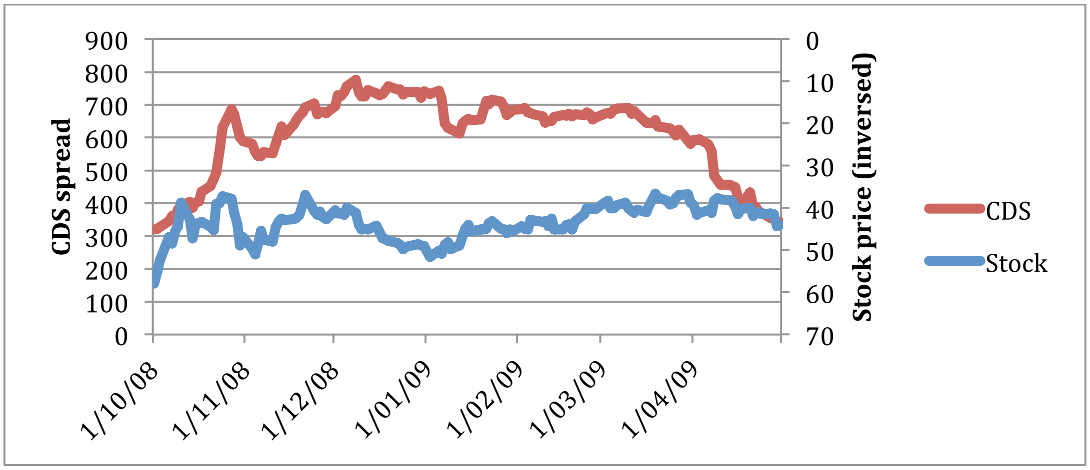

Figure 20 Evolution of Pernod Ricard's CDS spread and stock price between October 2008 and April 2009

Classical structural models and financial analyst reports predicted a higher price at the beginning of 2009. They set a target price of 46,44€, 15% higher than the market price. This difference in price can be explained by the refinancing risk not taken into account by financial analysts. This refinancing risk came from an expected interest rate on the future debt, which is 3, 28% higher than on the outstanding debt. This premium must be considered a cost for the company. According to the refinancing gap model, the value of this gap is equal to 10% of the value of the firm and directly lowered the equity value. The refinancing model predicts a stock price of 40, 19€, which is in line with the observed market price.

Moreover, the refinancing gap model predicts a 5-year bond spread slightly higher than the one of the classical structural models, 171 bp instead of 153bp. These forecasts are however 260bp to 280bp too low in comparison with the average bond spread over the period.

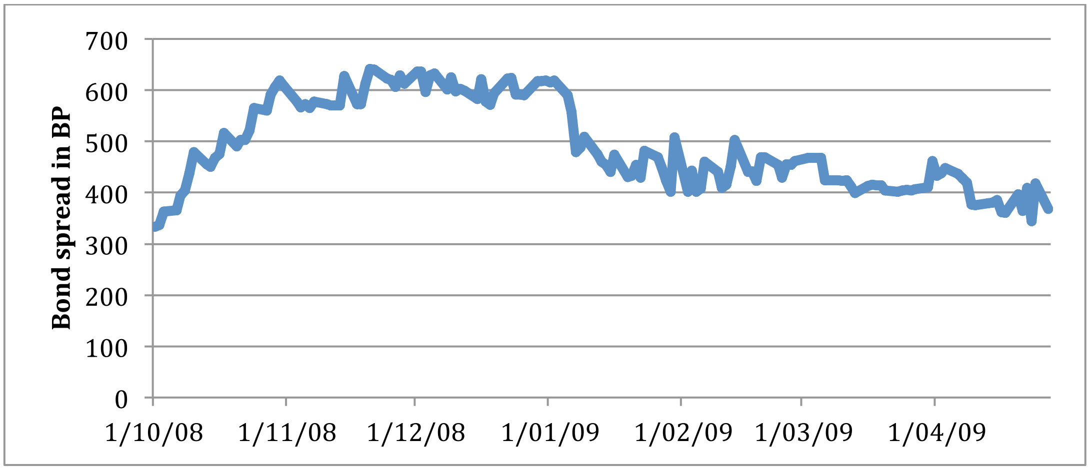

Figure 21: Evolution of Pernod Ricard's 5-year bond spread between October 2008 and April 2009

2.2 Refinancing operations

In order to regain its investment grade rating and reassure the markets, on 15 April 2009 Pernod Ricard announced[91] a capital increase combined with an assets disposal:

- Capital increase: Pernod Ricard issued 38, 8 million of shares for a total value of €1,04 billion. The company will use the cash to pay back the first tranche of the credit agreement. The new outstanding number of shares is therefore 250 million. The operation was successfully completed in May.
- Assets disposal: Pernod Ricard sold its subsidiary "Wild Turkey" to Company for an amount of €500 million

Moreover, Pernod Ricard successfully refinanced part of its debt for an amount of €800 million at an appealingly low interest rate of 7% and a maturity of 5 years. At the end of June, the total face value of the outstanding debt amounted to €12,5 billion.

Thanks to these refinancing operations, Pernod Ricard was therefore able to decrease its leverage and calm the markets. The CDS spread immediately reacted positively to the announcement and

[91] PERNOD RICARD. Pernod Ricard accélère son désendettement avec la cession de Wild Turkey pour 575 m$ et son intention de lever 1 md € au moyen d'une augmentation de capital. *Pernord-ricard.fr*. N.p., 8 Apr. 2009. Thu. 18 June 2014.

fell to 3, 5% over the next month. This CDS spread was in line with the credit spread Pernod Ricard paid on the outstanding debt, showing that the market did not fear the refinancing risk anymore. The refinancing gap value was indeed divided by four following the increase in liquidity and therefore amounted to only 2, 5% of the total firm value.

Similarly, the shareholders welcomed positively the capital increase and assets disposal and the stock price rose to 42,62€ on average during the next three months following the announcement, representing an increase of 6%.

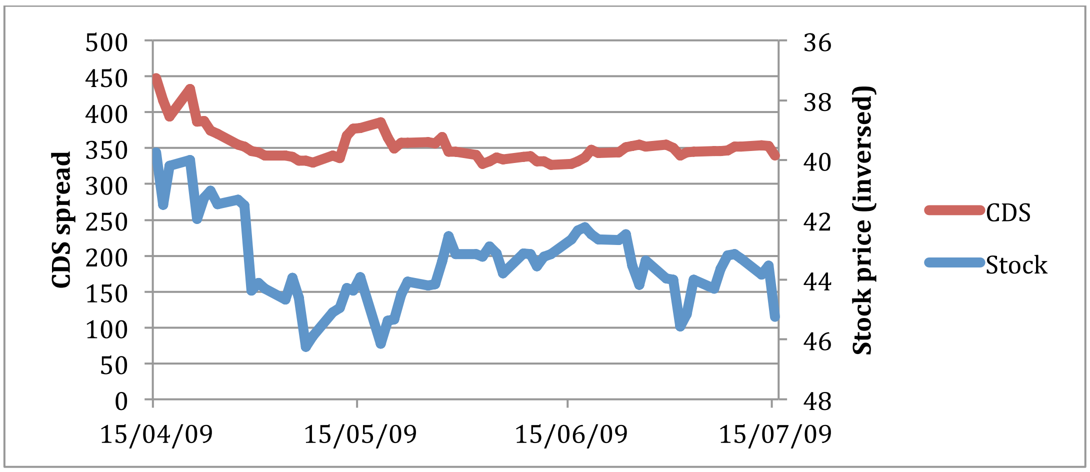

Figure 22: Evolution of Pernod Ricard's CDS spread and stock price between April 2009 and July 2009

As explained in chapter 2, classical structural models typically react negatively to a capital increase announcement as the equity value is diluted amongst a higher number of shareholders. The Pernod Ricard case was no exception and CreditGrades model predicted a decrease by 8, 5% of the stock price.

According to the refinancing gap model on the other hand, the stock price is assumed to increase by 5% up to 42,89€. This prediction is once again in line with the observed average price of 42, 62 and can be explained by the sharp decrease in the refinancing gap value. As mentioned in the previous paragraph, the refinancing cost has indeed been divided by five following the announcement and this decrease in the hidden debt has been transferred to the shareholders. The refinancing gap model justifies the observed stock price increase by the higher transfer value to the shareholders than the dilution effect due to the capital increase and the transfer from shareholders to debt holders due to the lower credit risk of the firm.

Similarly, the 5-year bond spread reacted positively and decreased by 160bp to 267bp. Both classical structural and refinancing gap models fail to predict this observation. Their estimations are indeed 137bp too low (130bp instead of 267bp). In this case, the refinancing gap model is not able to predict the magnitude of change (44bp instead of 120bp).

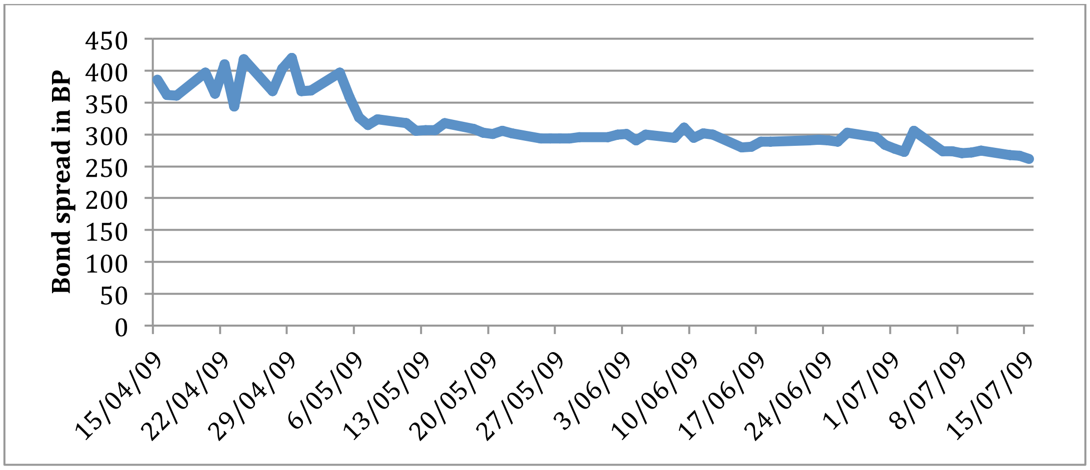

Figure 23: Evolution of Pernod Ricard's 5-year bond spread between April 2009 and July 2009

2.3 Conclusion

The Refinancing gap model successfully predicts the initial and final stock price, hence the magnitude of the change. On the other hand, classical structural models fail to forecast both the initial price and the magnitude of change. According to them, the stock price is supposed to decline due to the equity dilution following the capital increase.

Although both classical structural models and refinancing gap model fail to predict the initial and final bond spread, the refinancing gap model forecast higher spread which shows the interest of taking the refinancing exposure into account.

	Initial stock price	Final stock price	% of stock price incease/ decrease	Initial bond spread	Final bond spread	Magnitude in BP of spread increase/ decrease
Refinancing gap model	✓	✓	✓	✗	✗	✗
CreditGrades model	✗	✓	✗	✗	✗	✗

Figure 24: Predictive power of Refinancing gap and classical structural models

Section 3: PPR

Nom	PPR		
Refinancing operations	Assets disposal		
Before refinancing operations (Jan 08)	Reality	CreditGrades	Refinancing gap model
Stock price in €	89	95,67	88,27
Bond spread in bp	160	22	31
After refinancing operations (24 Jan 08)	Reality	CreditGrades	Refinancing gap model
Stock price in € (% change)	93 (4,5%)	95,67 (-)	91,96 (+4,2%)
Bond spread in bp (absolute change)	172(+12)	22(-)	25 (-6)

Figure 25: Overview of PPR's case

3.1 Description and initial situation

PPR, known as Kering since 2013, is a French multinational company which is a global leader in clothing and accessory. The firm is currently organized in three divisions, namely Luxury, sport and lifestyle. PPR is active in 120 countries and has in its portfolio many iconic brands such as Gucci, Puma, Balenciaga and Boucheron. Over the latest decade the company has followed a policy of acquisition in order to strengthen its portfolio, while refocusing on luxury and sport at the expense of its distribution division (Printemps amongst others). In April 2007, PPR announced[92] that the company had bought 27,1% of Puma and was planning to launch a public takeover bid in thefollowing weeks. Puma is a German manufacturer of athletic and casual footwear as well as sportswear. Puma has been considered by financial analysts too small to survive and compete alone against its two rivals, Adidas and Nike. Puma therefore represented the perfect target for PPR in order to develop its sports division.

The deal amounted to €5,2 billion and was financed by treasury and debt. The total face value of debt reached €8 billion, up from €5,5 bn. The deal was welcomed positively by financial analysts, but rating agencies were sceptical about PPR ability to keep its investment grade rating.

[92] PUMA. Puma welcomes PPR as its new strategic shareholder and its voluntary take-over offer. *Puma.com*. N.p., 10 Apr. 2007. Fri. 19 June 2014.

According to S&P, PPR will not be able to continue its acquisition policy and conserve its investment grade rating at the same time. S&P therefore advised PPR to dispose some of its assets in order to come back to a more reasonable leverage ratio. Moreover, the financial structure of the company is such that it will have to refinance more than half of its debt over the next two years. Given the uncertainty about its future rating as well as the negative prospects for the luxury industry due to the financial crisis, the company will have to pay a premium of around 1,5% in comparison with its current average interest rate.

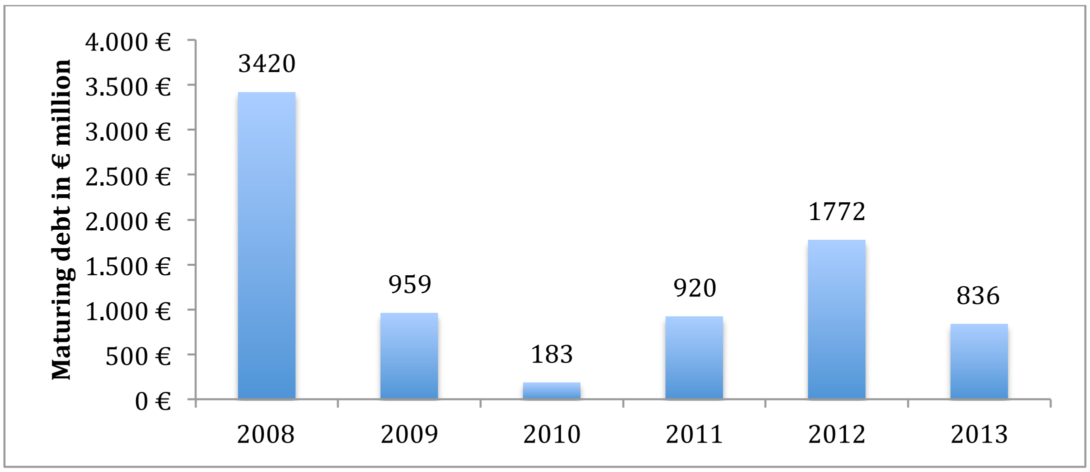

Figure 26: PPR's debt payment schedule

Financial analysts estimated the fair price of the company stock at the beginning of 2008 to be comprised between 95 and 105€. However, the averaged observed price between January 1st and January 23rd was equal to 89€, about 10% lower than the target price. On the other hand, the refinancing gap model computed a target price of 88,27€ per share, which is closer to the actual price. The model has achieved this accuracy by taking into account the refinancing risk, the refinancing gap value representing 7% of the firm value for an amount of €1,25 billion.

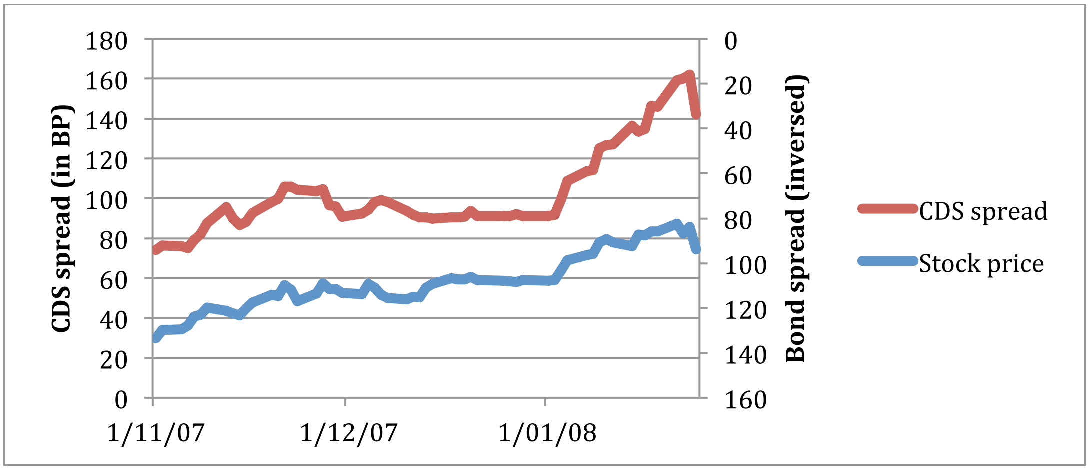

Figure 27: Evolution of PPR's CDS spread and stock price between November 2007 and January 2008

Similarly, the average 3-year bond spread over the three first weeks of January 2009 was equal to 160bp. This actual spread failed to be predicted by both the classical structural models (22bp) and the refinancing gap (31bp). However, the forecast of the refinancing gap model is 30% higher in absolute terms.

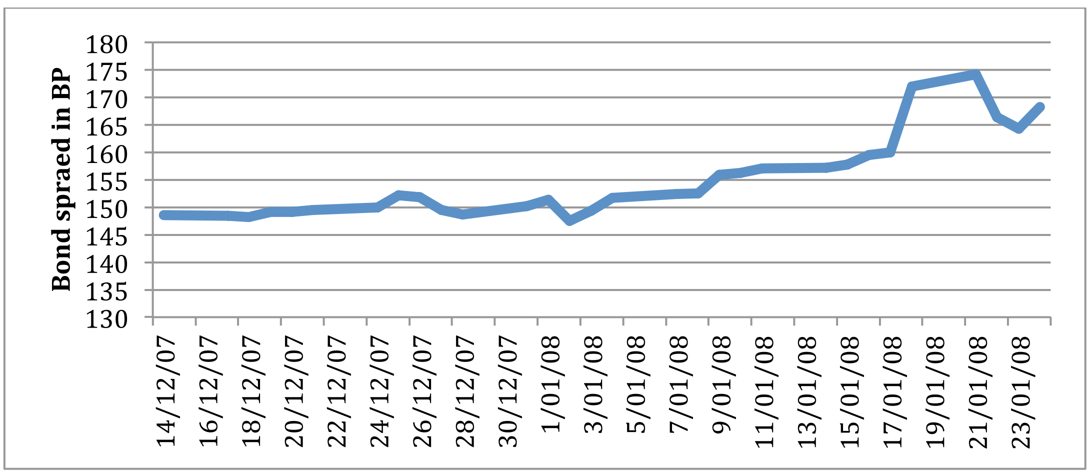

Figure 28: Evolution of PPR's 3-year bond spread between December 2007 and January 2008

3.2 Refinancing operations

In order to comply with rating recommendations by the agencies and increase its liquidity, PPR announced[93] on January 24th that it would sell its subsidiary "Yves Saint-Laurent Beauté" to L'Oreal for a total amount of €1,2 billion. YSL Beauté commercializes under license fragrance brands such as Cacharel, Diesel or YSL and also owns the cosmetics brand "Roger & Gallet". The brand struggled to reach profitability when it operated under the PPR management. PPR executives therefore claimed that a company such as l'Oréal would be in a better position to exploit YSL Beauté 's full potential thanks to its expertise in fragrance and cosmetics.

Surprisingly, the stock price reacted extremely well and increased by 12% on the day of announcement and stabilized around 93€ over the next two weeks, representing a 4, 5% rise.

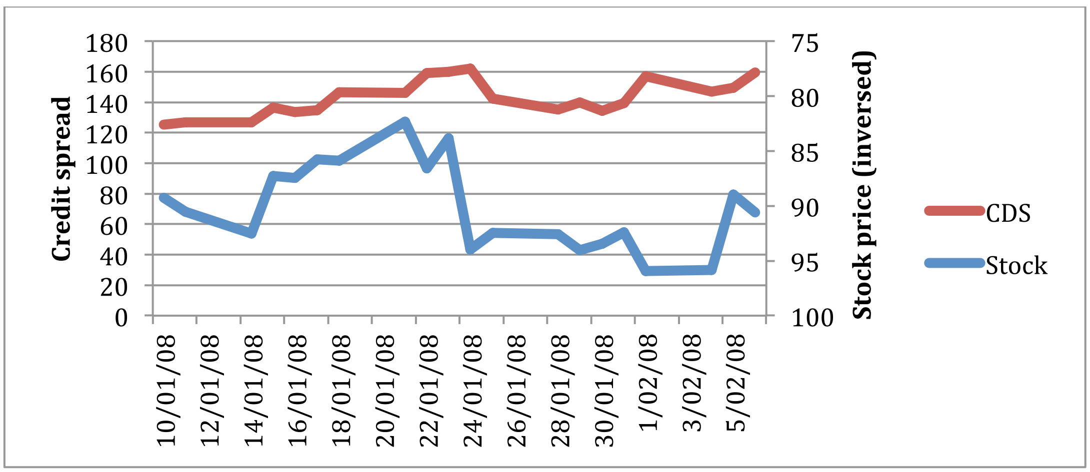

Figure 29: Evolution of PPR's CDS spread and stock price between January 2008 and February 2008

This surprised financial analysts because the disposal price was in line with their estimation and the stock price was therefore supposed not to vary following the news (the loss of future cash flow was indeed perfectly compensated by the increase in cash following the disposal, such as the firm value and the equity value did not change). This stock behaviour can be explained by the improved liquidity of PPR following the operation. Thanks to the disposal proceeds, the company will be able to refinance its maturing debt without having to go on the debt market. Therefore, the

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[93] LE FIGARO. L'Oréal s'offre Yves Saint Laurent Beauté . *Lefigaro.fr*. N.p., 24 Jan. 2009. Fri. 19 June 2014.

refinancing gap lost half of its value that was directly transferred to the shareholders, hence an increase of the stock price. According to the refinancing gap model, the target stock price following the disposal was equal to 91,96€. This price was really close to the observed one and represents an increase of 4,2% comparing to the target price before the operation.

The YSL Beauté disposal was therefore accretive for the shareholders. However, the market price quickly plummeted due to the bad luxury industry outlook and was therefore not able to sustain the target price.

Finally, while both models predicted a spread around 25bp (which represents a 25% decline in the case of the refinancing gap model and a stabilisation for classical structural ones), the actual bond spread slightly increased to 172bp.

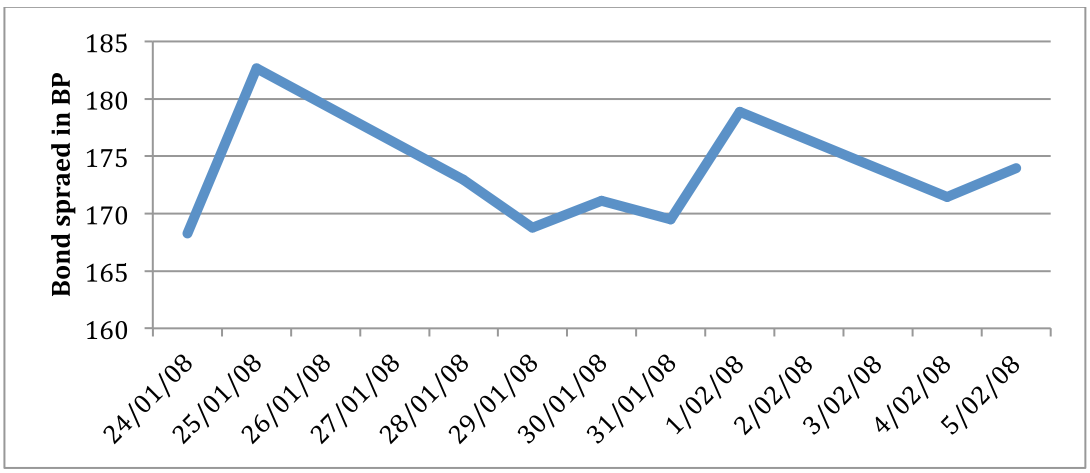

Figure 30: Evolution of PPR's 3-year bond spread between January 2008 and February 2008

3.3 Conclusion

Although the classical structural models predict that an asset disposal at a fair price does not affect the stock price, PPR's reacted positively to the disposal. The refinancing gap model is able to explain this increase in stock price. Moreover, it offers closer to reality prices than classical structural models.

Similarly, the refinancing gap model forecasts a higher bond spread than the classical structural models, both initially and after the refinancing operations. However, these spreads are still far from the reality.

	Initial stock price	Final stock price	% of stock price incease/ decrease	Initial bond spread	Final bond spread	Magnitude in BP of spread increase/ decrease
Refinancing gap model	✓	✓	✓	✗	✗	✗
CreditGrades model	✗	✓	✗	✗	✗	✗

Figure 31: Predictive power of Refinancing gap and classical structural models

Section 4: TUI AG

Nom	TUI AG		
Refinancing operations	Assets disposal		
Before refinancing operations (Sep 08)	Reality	CreditGrades	Refinancing gap model
Stock price in €	5	13,89	6,79
Bond spread in bp	1972	315	402
After refinancing operations (12 Oct 08)	Reality	CreditGrades	Refinancing gap model
Stock price in € (% change)	7,68 (53%)	13,89 (-)	9,55 (+40%)
Bond spread in bp (absolute change)	2148 (+176)	315 (-)	315 (-87)

Figure 32: Overview of TUI AG's case

4.1 Description and initial situation

TUI AG is a German multinational travel and tourism company. It owns travel agencies, airlines, cruise ships and retail stores. TUI AG is one of the world's largest tourist firms and is divided in four subsidiaries: TUI Travel, Hapag Lloyd, Hotels and Cruises. TUI AG significantly suffered from the financial crisis starting in 2008 and the general drop in leisure expenses that followed. Moreover, the company faced a severe liquidity issue at the end of 2008. It would have to refinance more than half of its debt over the next three years. However, its cash flow generation is not high enough to face these financial obligations and its reserve of cash, although appealing on paper, is nearly entirely in the form of a loan to TUI travel and is restricted until 2011. Out of the € 1,7 billion cash reserve, only €300 million was directly available to TUI AG. This is very low given TUI AG corporate needs and working capital was swinging. Moreover, the leverage ratio was also considerable and the total face value of debt amounted to €5,3 billion. This liquidity issues triggered a rating downgrade at the beginning of December 2008, from BB- to B+ according to S&P. This downgrade directly impacted the CDS market. Investors indeed grew increasingly worried about TUI AG's ability to meet its next financial obligations and the 5-year CDS soared from 8, 68% before the announcement to more than 12% two months later. This led to a potential credit premium of around 12% if TUI needed to refinance its debt at this moment, in comparison with the average interest rate it was currently paying on its outstanding debt. This situation worsened even more the liquidity trap in which TUI AG was. Altogether it looked like a vicious circle for the company.

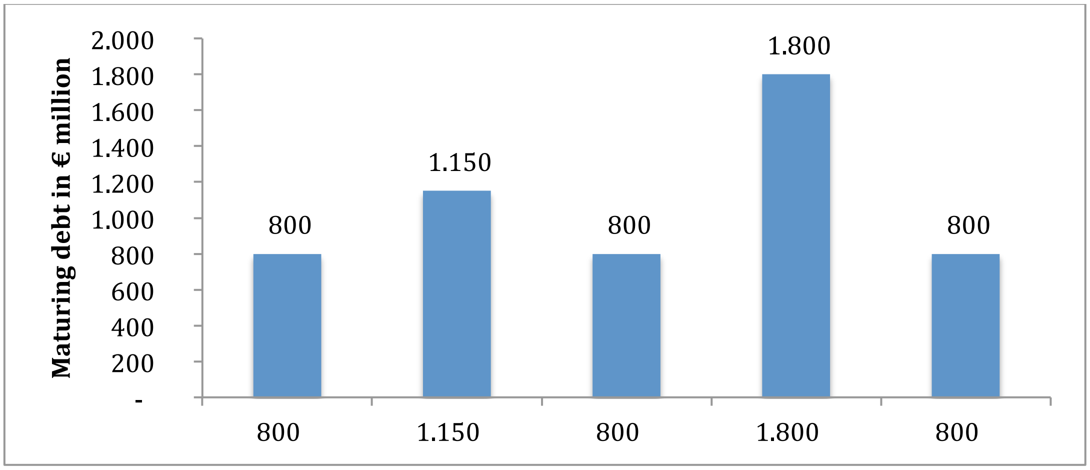

Figure 33: TUI AG's debt payment schedule

According to the refinancing gap model, the value of this liquidity trap amounted to 30% of the total assets value, for a value of more than €2,5 billion. This refinancing gap could therefore have a great negative impact on the stock price, which was verified by the historical data. Over the last six months (August 2008 – January 2009), the stock price tumbled by around 66% and the price in the beginning of February fluctuated around 5€

This observation is close to the computation of the refinancing gap model. The model indeed predicts a target price around 6,5€ when refinancing risk is taken into account. On the other hand, classical structural models predicted a target price around 14€ which is more than two times the observed price and therefore appears unrealistic.

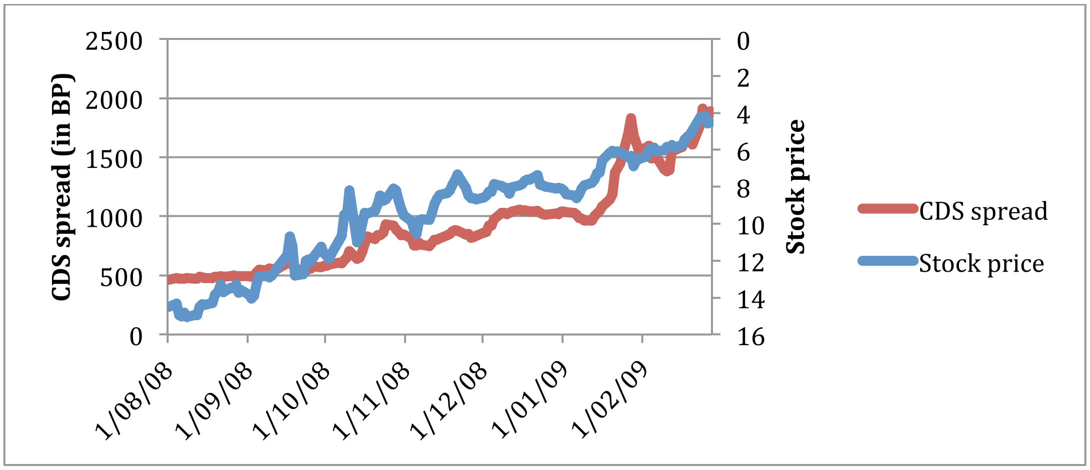

Figure 34: Evolution of TUI AG's CDS spread and stock price between January 2008 and February 2008

The 3-year bond spread reacted sharply to this distressed situation and was be multiplied by four to 1972bp. Although both structural and refinancing gap models failed to predict this level of spread, the refinancing gap model forecasted a spread 30% higher in absolute terms than the classical structural models (402bp instead of 315bp).

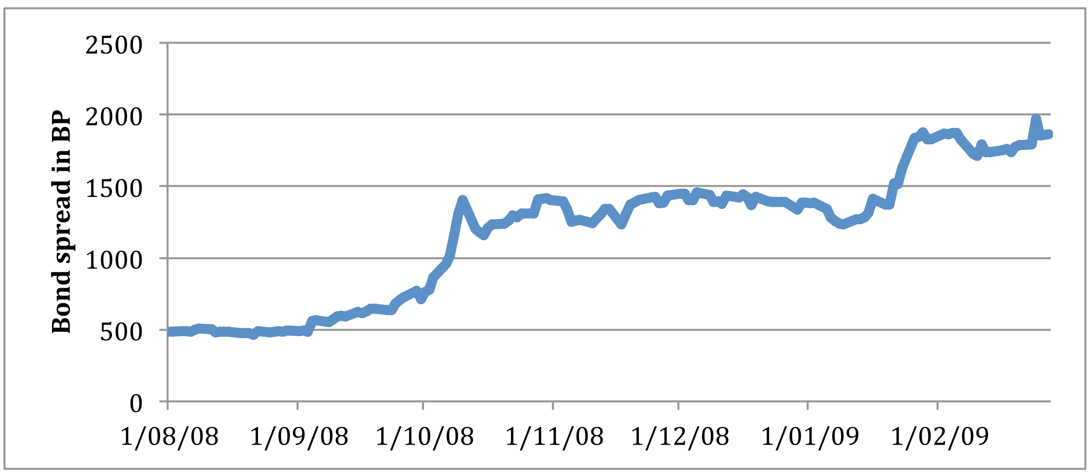

Figure 35: Evolution of TUI AG's 3-year bond spread between August 2008 and February 2009

4.2 Refinancing operations

In order to solve this liquidity issue, on October 12, 2008 UI AG announced its willingness to sell its shipping division, Hapag-Lloyd. TUI AG was indeed willing to refocus on the tourism business and the cash inflow from the operation would solve a significant part of the liquidity issue. Rumours claimed that TUI AG had entered into negotiations with the German consortium Albert Ballin KG and that they had agreed on the following terms:

- Hapag-Lloyd total value is estimated at €4,45 billion out of which €1,3 billion represents the net debt
- Albert Ballin KG will pay €2,7 billion in cash in exchange of 2/3 of the shares
- TUI AG will conserve 1/3 of the shares in the new entity.

However, on February 27, TUI AG announced that it had come to an agreement with Albert Ballin KG, but under slightly different terms than the ones presented in the press the weeks before: TUI AG indeed will keep 43,33% of the shares in the new entity. The net proceed received by TUI AG will amount to €1,6 billion. TUI AG's management did not announce at that time what they were planning to do with the cash. Although financial analysts would like the firm to pay back its debt in order to deleverage, a clause in case of assets disposal included in a bond issue contract stated that the disposal proceeds must be reinvested at last one year later at the latest in new assets. The remaining cash must then be used to pay back a given debt in priority.

The stock price reacted extremely positively to the announcement and increased by 53% over the next two months to 7,68€. This observation is in contradiction with classical structural model prediction. As the disposal price was in line with the market expectation, these models indeed assume that the decrease in future cash flow is fully compensated by the inflow of cash, such as the firm value and hence the equity values remain the same. Therefore, the stock price should not react to the disposal announcement.

The refinancing gap model predicts an increase by 40% of the stock price (to 9, 55€), which is in line with the observation. This sharp increase in price can be explained by the reduction of the liquidity and refinancing risks. These risks decreased and so did the value of the refinancing gap. The latter was divided by six thanks to the disposal and only amounted to 5% of the total firm value. This decrease in value was transferred to the shareholders, hence the stock price increased.

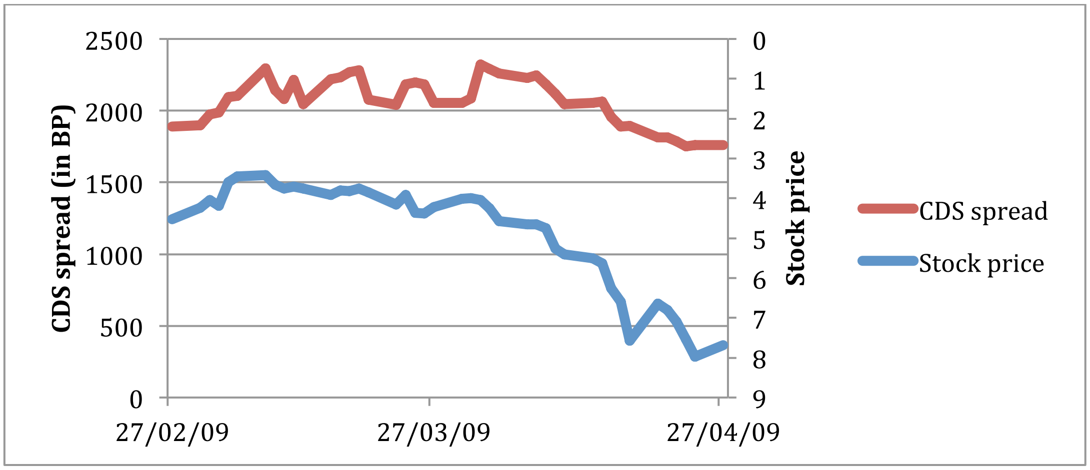

Figure 36: Evolution of TUI AG's CDS spread and stock price between February 2008 and April 2008

Finally, the 3-year bond spread increased by nearly 200 to 2148bp over the next two months. This observation is in contradiction with both structural and refinancing gap models that predicted either a spread decline (in the case of the refinancing gap model, by 150bp to 337bp) or a stabilisation (classical structural models, to 315bp).

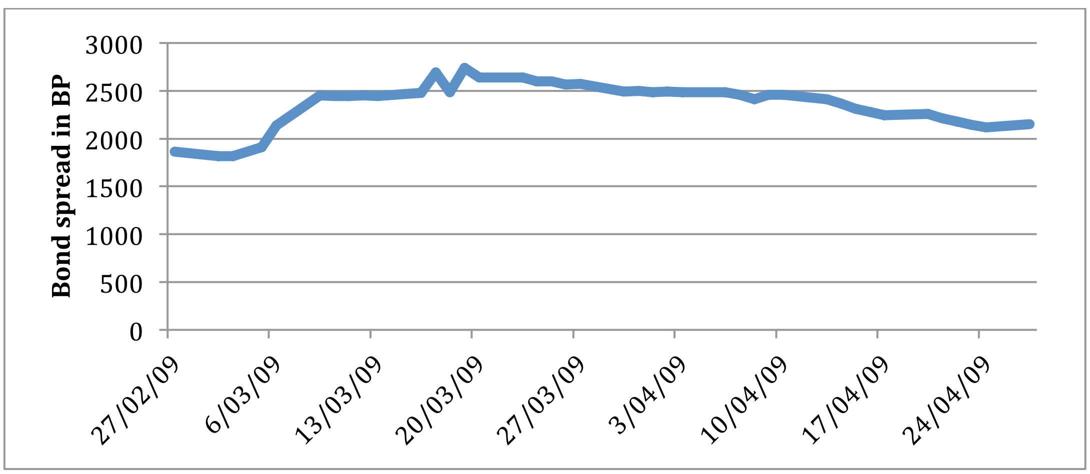

Figure 37: Evolution of TUI AG's 3-year bond spread between February 2009 and April 2009

4.3 Conclusion

The sharp increase in TUI AG's stock price following Hapag-Lloyd is correctly predicted by the refinancing gap model. On the other hand, classical structural models assume that no variation is anticipated. Moreover, the refinancing gap model forecasts stock prices that are closer from reality, both before and after the refinancing operations.

Regarding the bond market, the Refinancing gap model predicts a spread which is 50% higher in absolute terms than the one predicted by classical structural models, yet far from the observed one.

	Initial stock price	Final stock price	% of stock price incease/ decrease	Initial bond spread	Final bond spread	Magnitude in BP of spread increase/ decrease
Refinancing gap model	✓	✓	✓	✗	✗	✗
CreditGrade s model	✗	✓	✗	✗	✗	✗

Figure 38: Predictive power of Refinancing gap and classical structural models

Section 5: KPN

Nom	KPN		
Refinancing operations	Capital increase		
Before refinancing operations (Jan 13	Reality	CreditGrades	Refinancing gap model
Stock price in €	2,8	3,62	4,36
Bond spread in bp	202	212	227
After refinancing operations (5 Feb 13)	Reality	CreditGrades	Refinancing gap model
Stock price in € (% change)	1,7 (38%)	2,76 (-24%)	2,81 (-36%)
Bond spread in bp (absolute change)	190 (-12)	83 (-129)	83 (-144)

Figure 39: Overview of KPN's case

5.1 Description and initial situation

KPN is a Dutch landline and mobile telecommunications company. The firm is organized around two main divisions: the fixed line division, which counts around six million customers in the Netherlands and the mobile division, which is active in the Netherlands, Germany, Belgium, France and Spain and has 33 million subscribers. Its main markets are the Netherlands and Germany. Although KPN cash generation appears attractive with an EBIDTA of €4 billion in 2012, the company suffered from a high level of debt, contracted to finance past acquisitions. The face value on the outstanding debt had amounted to more than €14 billion at the end of 2012 and its debt/EBITDA ratio was close to three. Moreover, KPN was facing both a sharp competitive environment triggering a price war in its two core markets and a poor outlook for the telecommunication business in general.

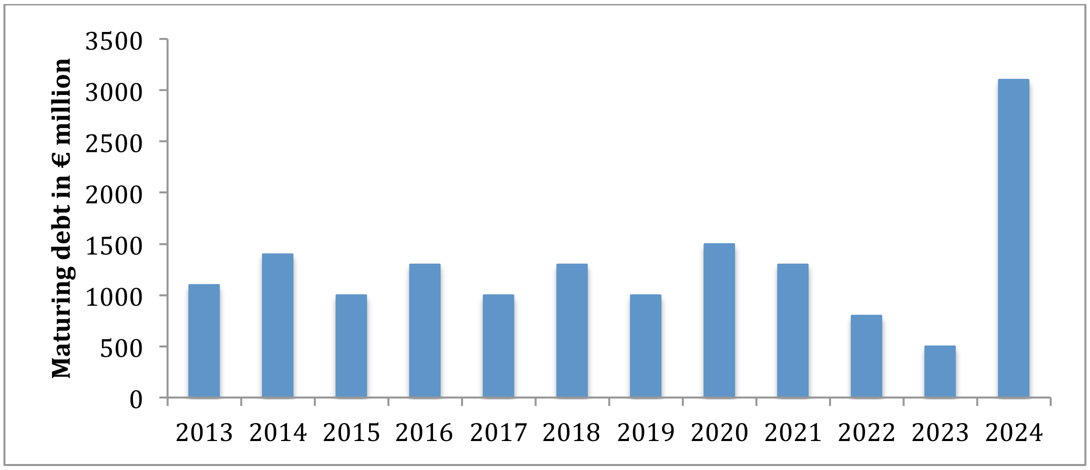

Figure 40: KPN's debt payment schedule

In January 2013, KPN investment grade rating was therefore threatened as S&P placed the rating under credit watch for potential downgrade and Fitch warned that the maximum leverage ratio for an investment grade company might be exceeded over the coming year. Due to the negative competitive environment and the uncertainty regarding the credit rating, the stock price lost 30% over the last four months, to 2,8€ beginning of February. This price was 25% lower than the financial analysts' target price of 3,6€. This under-performance of the stock price can be explained by the general pessimism of the investors regarding the telecom sectors in Europe.

On the other hand, the refinancing gap model predicts a higher price than financial analysts do. According to the model the target price of KPN stock must be around 4,36€ per share. This 15% premium can be explained by the attractive refinancing terms the company will incur in future. Based on the CDS spread, KPN will indeed pay an interest rate of 4, 1% instead of 3,5% at that time. The company will therefore save 1,2% on its future interest debt payment. This saving represents a direct gain for the shareholders which is not taken into account by the classical forecast models. The present value of this future savings amount to €1,1 billion and must be added to the estimated firm value.

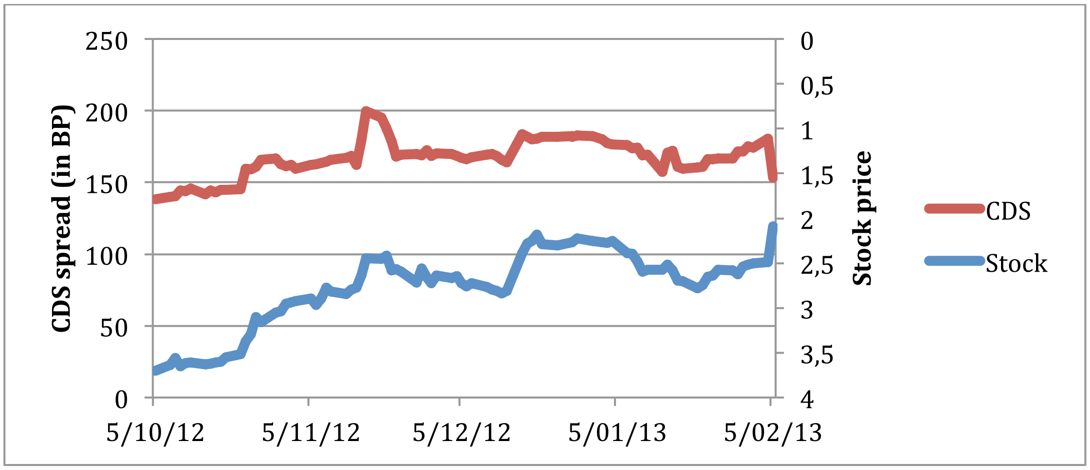

Figure 41: Evolution of KPN's spread and stock price between October 2012 and February 2013

Moreover, the 10-year bond spread increased by 30bp to around 202bp on average at the end of January 2013. This is 25bp lower than the refinancing gap estimation of 227bp. However, the classical structural models predicted a spread of 212bp which is more in line whith the observation. In the case of a company with a negative refinancing exposure, the refinancing gap model has therefore the tendency to overestimate the spread and offers less accuracy than classical structural models.

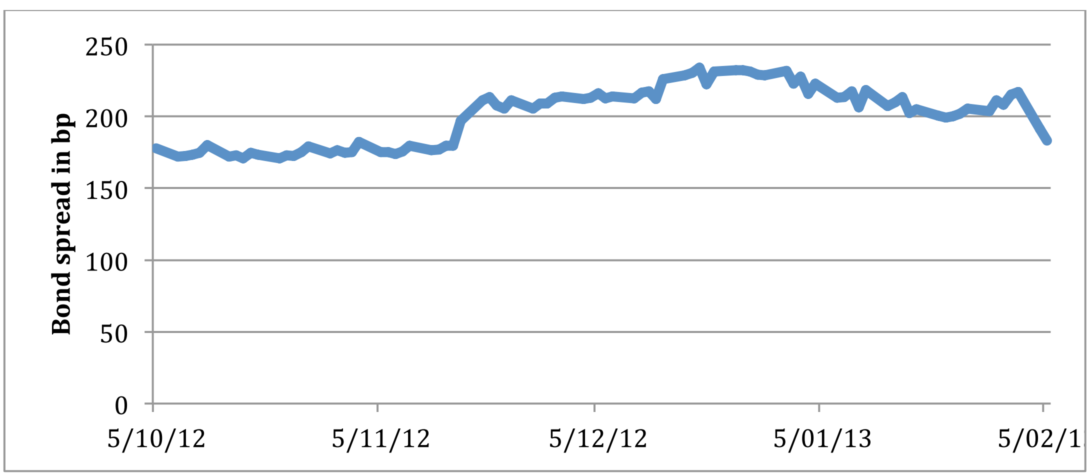

Figure 42: Evolution of KPN 10-year bond spread between February 2009 and April 2009

5.2 Refinancing operations

On February 5th 2013, KPN announced[94] that it intended to raise €4 billion of capital through a right issue. The company justified this operation by its willingness to improve and deleverage its financial structure in order to maintain its investment grade rating. The operation will consist in the creation of 2, 8 billion new shares to be sold at a 35% discount for a new total of 4, 2 billion outstanding shares.

As expected, the financial markets reacted negatively to the news and the stock price lost 38% of its value over the next month. This stock behaviour is explained by the important dilution of the equity value due to the capital increase, the number of outstanding shares being multiplied by three. However, the classical models failed to predict the exact magnitude of this decrease. The predicted range is indeed comprised between 25% and 30% depending on the model. The refinancing gap model on the contrary, successfully forecasted a 36% decrease, close to the actual one.

The accuracy of the refinancing gap model is explained by the change in future refinancing needs. As highlighted before, KPN will be able to refinance its future debt at a lower cost than the outstanding one. This situation represents a saving for the shareholders that directly increases the firm value, hence the equity value. By raising a considerable amount of capital, KPN improves its liquidity and therefore reduces the amount of debt that will need to be rolled over. As a consequence, KPN's exposure to the future interest rates decreases and the company will not benefit to the same extent from the appealing future refinancing terms. The savings for the shareholders will therefore drop and so will the equity value. At the end, the decline in stock price is explained by the combined effects of dilution and lower exposure to positive refinancing terms.

It is however important to note that both classical and refinancing gap models predict a target price which is comprised between 2,6€ and 2,8€ and is therefore far from the observed one.

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94 THE NEW YORK TIMES. KPN to Raise 4 Billion Euros to Fend Off Rivals. *nytimes.com*. N.p., 5 Feb. 2013. Sun. 20 June 2014.

Financial analysts explained this situation by the overreaction of the investors to the increased competition and the negative outlook of the telecom market in Europe. They however remain confident that the stock prise will tend to its target price once the investors are reassured.

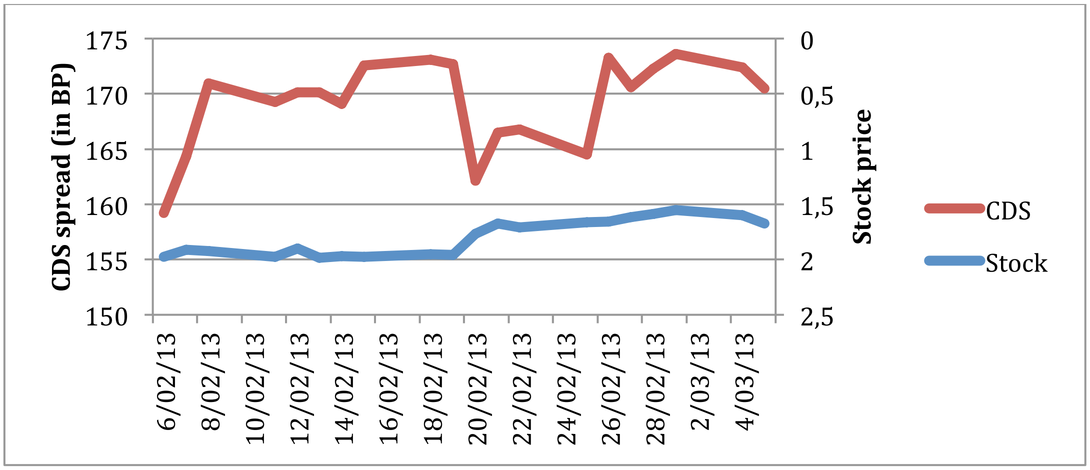

Figure 43: Evolution of KPN's spread and stock price between February 2013 and March 2013

The 10-year spread first reacted negatively to the capital increase announcement and increased by 20bp. However, the spread went down to its initial level after three weeks, around 190bp. Both structural and Refinancing gap model predicts the same target spread of 83bp which is more than 100bp too low.

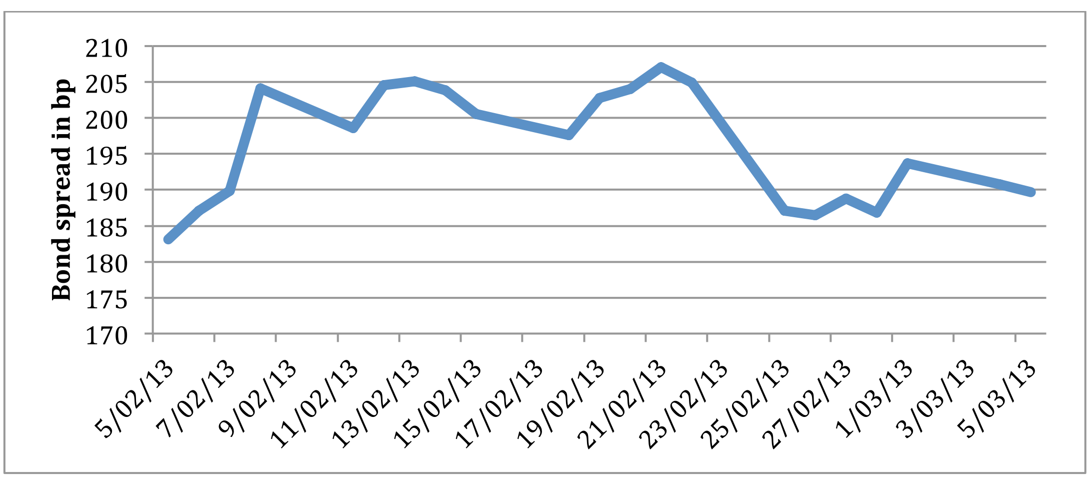

Figure 44: Evolution of KPN 10-year bond spread between February 2009 and April 2009

5.3 Conclusion

Although both classical structural and Refinancing gap models fail to predict the stock price before and after the refinancing operations, the refinancing gap model correctly anticipates the magnitude of the price decrease.

Moreover, in this case of a company with a negative refinancing exposure, the Refinancing gap model has the tendency to over predict the observed spread and offers less accurate results than the classical structural models.

	Initial stock price	Final stock price	% of stock price incease/ decrease	Initial bond spread	Final bond spread	Magnitude in BP of spread increase/ decrease
Refinancing gap model	✗	✗	✓	✗	✗	✗
CreditGrades model	✗	✗	✗	✗	✗	✗

Figure 45: Predictive power of Refinancing gap and classical structural models

Section 6: Summary

This chapter outlined the practical application of the Refinancing gap model to five companies with an exposure to the refinancing risk. It appears that the refinancing gap model is better equipped to predict the stock price of a distressed company before and after a refinancing operation than the classical structural models. This observation therefore proves the relevance of the refinancing approach when dealing with distressed companies. However, predictive power of the refinancing gap model seems less appealing when dealing with companies facing a negative refinancing exposure, although it correctly predicts the magnitude of change of the stock price.

Finally, the refinancing gap model offers higher bond spreads than those predicted by classical structural models. The refinancing gap model therefore improves the accuracy of these structural models in the case of company with a positive refinancing exposure. However, the forecasted spreads are still far from reality.

The refinancing gap model therefore appears to be a useful tool for equity analysts and can serve as a basis for further research in credit modelling.

Conclusion

The focus of this dissertation was to study the impact of the refinancing risk on the value of a firm and how the latter reacts to refinancing operations. It was intuitively assumed that, by forcing companies to pay a higher future interest rate, refinancing risk influences negatively the probability of default of a firm, hence its value. On the other hand, refinancing operations were expected to improve the liquidity of the company and consequently reduce its refinancing exposure. In order to be in a position to answer this question thoroughly and confirm or infirm these intuitions, this dissertation first analysed the existing literature over the default modelling and its influence on the firm value before presenting a model that deals with the refinancing risk.

It appears from the literature review that none of the current models takes the refinancing risk into account when modelling the probability of default of a firm and indirectly its value. As a matter of fact classical structural models assume that a company defaults as soon as its firm value falls below a given threshold. Although this threshold depends on the specificities of the model, structural models rely only on economic distress to trigger off the default of a firm. By doing so, they fail to take another kind of distress into account, that is to say the financial distress. Financial distress occurs when the company faces difficulties to honour its financial obligations and is therefore considered a cash flows or liquidity issue. Refinancing risk is therefore a subset of this liquidity risk as uncertainty regarding the refinancing terms directly impacts the liquidity of a firm. As a consequence, classical structural models either assume that the company will be able to refinance its total debt under the current terms in the future or that the company will stop existing at the maturity of the outstanding debt. These assumptions are obviously not verified in reality and require the development of a new model to deal with the refinancing risk.

This new model, called the “Refinancing gap model”, is based on a cash flow approach of the refinancing risk. In fact the company has to finance its future activities, yielding a known cash flow, by borrowing at an unknown rate. This situation is similar to a swap position for the company, in which it receives fixed cash flows from operating activities and has to pay an interest rate on its future debt that will only be determined when the debt is rolled over. This swap should be considered an off balance sheet item and is similar to a hidden debt in the case of a distressed company whose expected refinancing terms have worsened. The value of this swap represents the exposure of the firm to the refinancing risk. As this exposure is considered a hidden debt, it directly influences the value of both equity and debt. On one hand, this hidden debt increases the total leverage of the firm, hence the credit risk of the debt. As a consequence, the credit spread on the debt will also increase, which will negatively impact the value of the debt. On the other hand, the hidden debt represents the part of the value of the firm which is locked due to the refinancing exposure and is therefore currently not available for the shareholders, resulting in a lower value of the equity. As part of the value of the firm is therefore locked and not attributed to either the shareholders or the debt holders, the actual value of the firm, equal to the sum of the equity and he debt value, is lower than the one of a similar firm without exposure to the refinancing risk.

A distressed company with an exposure to the refinancing risk has various options to reduce this exposure. These operations (i.e. capital increase, assets disposal, etc) will have a positive impact on the liquidity of the firm, hence reducing the exposure and the value of the hidden debt. In turn a reduction in the hidden debt will positively affect the equity and debt value, hence the actual firm value. On one hand, the reduction in the hidden debt decreases the leverage of the firm and consequently its credit risk. On the other hand, the refinancing operation will unlock part of the firm value, which will directly be transferred to the equity.

In theory the refinancing gap model is therefore able to explain how the refinancing exposure affects a firm value and how the latter reacts to refinancing operations. The model was finally applied on existing companies to test whether it predicts accurately the equity and debt value of distressed companies in real terms. It turned out that the refinancing gap model is efficient to predict the stock price of distressed companies and improves the accuracy of classical structural models when forecasting the bond spread.

Indeed the refinancing gap model has successfully predicted the stock prices of the four studied companies before and after the refinancing operations. Furthermore, it outperformed significantly the classical structural models used as a benchmark. Moreover, the model successfully predicts the magnitude of the stock price variation when the firm announces its refinancing operations, which is impossible by means of the classical structural models. It is clear that these models provide forecasts that are usually contrary to the stock market reaction. Considering that the refinancing exposure locks part of the value of the firm to the detriment of the shareholders therefore appears to be a relevant approach. Moreover this is in line with the stock market reaction to such exposure.

On the other hand, the refinancing gap model systematically predicts bond spreads that are higher than those of classical structural models, hence improving the accuracy of these models. Moreover, the biggest improvements appear for companies that face a considerable refinancing exposure. As a consequence, it proofs that the refinancing risk significantly impacts the bond spread of a distressed company and justifies partly the “underprediction” of the classical structural models. However, the Refinancing gap model still fails to accurately predict the real bond spread and only provides a closer estimation. By considering the refinancing risk in addition to the economic distress, the refinancing gap model therefore takes into account a wider range of financial triggers. However, the refinancing gap model does not consider the liquidity issue in its broad sense. This limitation might explain the remaining difference between modelled and observed spreads

Following these conclusions about the refinancing gap model as well as its limitations, four improvements to this model can be proposed as future research directions.

Firstly, the last chapter of this dissertation applied the refinancing gap model on five different distressed companies. This sample is too small to draw any conclusion regarding the accuracy of the model from a statistical point of view. One could therefore decide to apply the model on a statistically representative sample of companies in order to confirm or infirm the predictive power of the model. This quantitative study would only require to process the financial data available and apply the framework presented in chapter 2, without having to master the whole history of each company as required by this dissertation.

Secondly, the refinancing gap model uses the relevant CDS spread to predict the future cost of refinancing. However, few companies have a CDS quoted on their outstanding debt and an even smaller proportion amongst them has a CDS which is sufficiently liquid. The approach proposed in the dissertation therefore limits the range of company on which the Refinancing gap model can be applied. To overcome this limitation, one could replicate the results presented in this dissertation using other proxies such as the CDS spread estimated by Bloomberg for companies without traded CDS.

Thirdly, the refinancing gap model allows to improve the classical structural models by taking into account the refinancing risk. However, these models still fail to include liquidity in general as a default trigger. This observation therefore opens a wide area of research to ultimately propose a comprehensive model including all the elements influencing the credit risk of a firm.

Finally, this dissertation used two structural models to apply the refinancing gap model. These models, the Merton and the CreditGrades model, were chosen for reasons of easiness of use and the presence of the required parameters needed to use them. In the context of this dissertation, it was indeed impossible to use computing-intensive models or ones which require the access to advanced financial data. However, these two models are not the most performing ones in the structural models category. One could therefore use the approach developed in this dissertation and extend it to more advanced structural models. This should, in principle, improve the credit spread predictive power of the current refinancing gap model.

Bibliography

- ALTMAN, Edward I. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. The journal of finance 23.4 (1968).

- ANDERSON, Ronald W., SUNDARESAN, Suresh, et TYCHON, Pierre. Strategic analysis of contingent claims. European Economic Review, 1996, vol. 40, no 3, p. 871-881.

- ARORA, Navneet, Jeffrey R. Bohn, and Fanlin Zhu. Reduced form vs. structural models of credit risk: A case study of three models. Journal of Investment Management 3.4 (2005).

- BANK FOR INTERNATIONAL SETTLEMENT. Long-term Rating Scales Comparison. www.bis.org. n.d. 24 Mai 2014.

- BENITO, Enrique and Flavan, Silviu. A comparison of credit risk model, Carlos III University in Madrid, March 2005

- BLACK, Fischer and COX, John C. Valuing corporate securities: Some effects of bond indenture provisions. The Journal of Finance, 1976, vol. 31, no 2, p. 351-367.

- BLANCO, Roberto, BRENNAN, Simon, et MARSH, Ian W. An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. The Journal of Finance, 2005, vol. 60, no 5.

- BRIYS, Eric and DE VARENNE, François. Valuing risky fixed rate debt: An extension. Journal of Financial and Quantitative Analysis, 1997, vol. 32, no 02, p. 239-248.

- COUDERT, Virginie et GEX, Mathieu. Credit default swap and bond markets: which leads the other. Financial Stability Review, Banque de France, 2010, vol. 14, no 2010.

- CREDIT SUISSE, Leveraged Finance Outlook and 2013 Annual Review, 2013

- DARRELL, Duffie and SCHAEFER, Stephen, Credit Risk: Pricing, Measurement, and Management, Princeton, Princeton University Press, 2003.

- DAVYDENKO, Sergei A. When do firms default? A study of the default boundary. A Study of the Default Boundary (November 2012). EFA Moscow Meetings Paper. 2012,

- DE WIT, Jan. Exploring the CDS-bond basis. National Bank of Belgium, 2006.

- ELIZALDE, Abel. Credit risk models II: Credit risk models II: Structural models. 2005.

- EOM, Young Ho, HELWEGE, Jean, et HUANG, Jing-zhi. Structural models of corporate bond pricing: An empirical analysis. Review of Financial studies, 2004, vol. 17, no 2, p. 499-544.

- EXANE, Capital Structure Optimization : CDS and share price, ALRG model and country risk, 2013.

- EXANE, The Asset Liability Refinancing Gap model : Valuation and Arbitrage of indebted companies, January 2009

- FELIX, Jean-Paul. Notes de cours : Marchés financiers en temps continu et modélisation de taux. Université de Picardie, 2010.

- FINGER, Christopher, FINKELSTEIN, Vladimir, LARDY, Jean-Pierre, et al. CreditGrades technical document. RiskMetrics Group, 2002.

- GESKE, Robert. The valuation of corporate liabilities as compound options. Journal of Financial and Quantitative Analysis, 1977, vol. 12, no 04

- HE, Zhiguo, and WEI Xiong. Rollover risk and credit risk. The Journal of Finance 67.2 (2012)

- Hu, H. and Lawrence, L. (2000). Estimating Recovery Rates, JPMorgan document

- HUANG, Jing-zhi et ZHOU, Hao. Specification analysis of structural credit risk models. In : AFA 2009 San Francisco Meetings Paper. 2008

- HULL, John C., PREDESCU, Mirela, et WHITE, Alan. Bond prices, default probabilities and risk premiums. Default Probabilities and Risk Premiums (March 9, 2005), 2005.

- HULL, John, PREDESCU, Mirela, et WHITE, Alan. The relationship between credit default swap spreads, bond yields, and credit rating announcements. Journal of Banking & Finance, 2004, vol. 28, no 11,

- Hull, John. Options, futures and other derivatives. Pearson education, 2012. 2nd ed.

- JARETZKE, Dominik. CDS Model and Market Spreads Amid the Financial Crisis. Maastricht University. 2010

- JARROW, Robert A. et PROTTER, Philip. Structural vs reduced form models: A new information based perspective. *Journal of Investment Management*, 2004, vol. 2, no 2.

- JONES, E. Philip, MASON, Scott P., et ROSENFELD, Eric. Contingent claims analysis of corporate capital structures: An empirical investigation. The Journal of Finance, 1984, vol. 39, no 3, p. 611-625.

Journal of Investment Management 2.2 (2004).

- LAFARGE. Lafarge Acquiert Orascom Cement, Le Leader Cimentier Du Moyen-Orient Et Du Bassin Méditerranéen. www.lafarge.fr. N.p., 10 Dec. 2007. Web. 17 June 2014.

- LAFARGE. Lafarge lance une augmentation de capital de 1,5 milliard d'€. lafarge.fr. N.p., 10 Apr. 2009. Web. 17 June 2014.

- LE FIGARO. L'Oréal s'offre Yves Saint Laurent Beauté . Lefigaro.fr. N.p., 24 Jan. 2009. Fri. 19 June 2014.

- LELAND, Hayne E. "Predictions of default probabilities in structural models of debt." The credit market handbook: Advanced modeling issues (H. Gifford Fong, Editor) (2006),

- LELAND, Hayne E. et TOFT, Klaus Bjerre. Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads. The Journal of Finance, 1996, vol. 51, no 3, p. 987-1019.

- LONGSTAFF, Francis A. et SCHWARTZ, Eduardo S. A simple approach to valuing risky fixed and floating rate debt. The Journal of Finance, 1995, vol. 50, no 3, p. 789-819.

- MERTON, Robert C. "On the pricing of corporate debt: The risk structure of interest rates." The Journal of Finance 29.2 (1974).

- MOODY’S INVESTORS SERVICE. " Corporate Default and Recovery Rates, 1920-2010." (2011)

- MOODY’S INVESTORS SERVICE. "Rating methodology : Global shipping industry." (2009)

- PERNOD RICARD. Pernod Ricard accélère son désendettement avec la cession de Wild Turkey pour 575 m$ et son intention de lever 1 md € au moyen d’une augmentation de capital. Pernord-ricard.fr. N.p., 8 Apr. 2009. Thu. 18 June 2014.

- PERNOD RICARD. Pernod Ricard acquiert Vin & Sprit et devient co-leader mondial de l’industrie des vins et spiritueux. Pernord-ricard.fr. N.p., 31 Mar. 2008. Thu. 18 June 2014.

- PUMA. Puma welcomes PPR as its new strategic shareholder and its voluntary take-over offer. Puma.com. N.p., 10 Apr. 2007. Fri. 19 June 2014.

- STANDARD & POOR’S, “Credit Trends: Gaping Refunding Pipeline In Europe Intensifies Financial Challenges“, 2010

- STEPHANOU, Constantinos, and MENDOZA, Juan Carlos. "Credit risk measurement under Basel II: an overview and implementation issues for developing countries." World Bank Policy Research Working Paper 3556 (2005).

- SUNDARESAN, Suresh. "A Review of Merton's Model of the Firm's Capital Structure with Its Wide Applications." Annu. Rev. Financ. Econ. 5.1 (2013).

- THE NEW YORK TIMES. KPN to Raise 4 Billion Euros to Fend Off Rivals. nytimes.com. N.p., 5 Feb. 2013. Sun. 20 June 2014.

- VAN BEEM, J. " Credit risk modeling and CDS valuation :An analysis of structural models." University of Twente (2010). p.22.

- WANG, Yu. "Structural Credit Risk Modeling: Merton and Beyond." Risk Management 16 (2009). p.30.

- ZHOU, Chunsheng. A jump-diffusion approach to modeling credit risk and valuing defaultable securities, 1997.

Financial reports and analysis

<u>Lafarge</u>

- Lafarge, Annual Report 2007, 2007

- Lafarge, Annual Report 2008, 2008

- Exane Derivatives, Lafarge special report, 3 March 2009

- Deutsche Bank, First quarter results review,7 May 2009

<u>Pernod Ricard</u>

- Societe Generale Cross Asset Research, Pernod Ricard : Focus on credit metrics vs shareholder interests, 19 November 2009

- ING, Pernod Ricard :Premiumisation, if well executed, will continue, 15 January 2009

- Credit Suisse, Pernod Ricard: V&S Acquisition – Short Equity / Long Credit, 10 April 2008

- Societe Generale Cross Asset Research, PERNOD RICARD :Slightly too optimistic, weren't they?, 13 February 2009

- Societe Generale Cross Asset Research, PERNOD RICARD : Able to hold a drink, 31 July 2008

- Merril Lynch, Low appetite for risk dilutes investment case, 19 September 2008

- Morgan Stanly, Pernod Ricard : Good start but growth drivers are weakening, 30 October 2008

- Deutsche Bank, Pernod Ricard, 30 0ctober 2008

- Merril Lynch, Pernod Ricard : Spirits industry sales appear resilient – are they?, 31 October 2008

- Moody’s Investors Service, Credit Opinion: Pernod Ricard S.A., 31 July 2008

- Moody’s Investors Service, Credit Opinion: Pernod Ricard S.A., 25 May 2009

- Moody’s Investors Service, Credit Opinion: Pernod Ricard S.A., 14 January 2008

- Moody’s Investors Service, Pernod Ricard : corporate profile, February 2009

- Pernod Ricard, Annual Report 2006, 2006

- Pernod Ricard, Annual Report 2007, 2007

- Pernod Ricard, Annual Report 2008, 2008

- Pernod Ricard, Acquisition of Vin & Sprit, 31 March 2008

- Morgan Stanley, Pernod Ricard : Absolute Premium, 1 April 2008

- Oddo Securities, Pernod Ricard Focus, 10 April 2008

- Oddo Securities, Focus Pernod Ricard, 19 September 2008

- Standard & Poor’s, RatingDirect : Pernod Ricard, 3 October 2008

- Goldman Sachs, Pernod Ricard, 5 November 2008

- Standard & Poor’s, RatingDirect : Pernod Ricard, 28 November 2008

- Goldman Sachs, Pernod Ricard, 9 February 2009

- Oddo Securities, Pernod Ricard Focus, 19 February 2009

- BNP Paribas Equity Research, Pernod Ricard, 9 April 2009
- J.P. Morgan, Pernod-Ricard SA, 9 April 2009
- Merril Lynch, Pernod Ricard : Upgrade to Buy, 21 April 2009
- Standard & Poor's, RatingDirect : Pernod Ricard, 30 April 2009

PPR

- Aurel, PPR prêt pour le rebon, 10 March 2009
- BNP Paribas Equity Research, 22 January 2009
- Citi, PPR, 28 October 2008
- Deutsche Bank, PPR : 2010 Forecasts up 15%, 3 August 2009
- Deutsche Bank, PPR : Still some medium-term concerns, 21 April 2009
- Deutsche Bank, PPR : What more bad news ? , 19 February 2009
- HSBC Global Research, Flashnote : PPR, 5 February 2009
- J.P. Morgan, PPR SA, 12 August 2008
- J.P. Morgan, PPR SA, 20 February 2009
- Morgan Stanley, PPR, 6 November 2008
- Natixis Securities, Morning news : PPR, 10 December 2008
- Oddo Securities, Flash credit : PPR, 25 September 2008
- PPR, Annual Report 2006, 2006
- PPR, Annual Report 2007, 2007
- PPR, Annual Report 2008, 2008
- Standard & Poor's, RatingDirect : PPR, 16 December 2008
- Standard & Poor's, RatingDirect : PPR, 29 May 2009

- Standard & Poor’s, RatingDirect : PPR, 30 May 2008
- Unicredit Markets & Investment Banking, Credit flash : PPR, 19 February 2009
- Unicredit Markets & Investment Banking, Credit flash : PPR, 29 August 2008

TUI AG

- BNP Paribas, TUI, 2 October 2008
- Natixis, Flash : TUI, 1 April 2008
- Oddo Securities, Focus : TUI, 18 Mai 2008
- Oddo Securities, Focus : TUI, 24 October 2008
- Société Générale Cross Assets Research, TUI AG, 16 February 2009
- TUI AG, Annual Report 2006, 2006
- TUI AG, Annual Report 2007, 2007
- TUI AG, Annual Report 2008, 2008
- West LB, Equity Research : TUI, 16 April 2008
- West LB, Equity Research : TUI, 16 April 2009

KPN

- Credit Suisse, KPN, 5 February 2013
- ING, KPN focus, January 2013
- KPN, Annual Report 2011, 2011
- KPN, Annual Report 2012, 2012
- Mizuho, KPN, 12 February 2013
- Société Générale, Corporate news : KPN, 20 February 2013

Appendix to chapter 1

Section 1: Merton model computation[95]

1.2 Assumptions[96]

i. The markets are perfect:
   - There is a sufficient number of investors with comparable wealth levels so that each investor believes that he can buy and sell as much of an asset as he wants at the market price.
   - There are no transaction costs, taxes or problems with indivisibilitiesof assets
   - There is an exchange market for borrowing and lending at the same rate of interest.
   - Short sales of all assets, with full use of the proceeds, are allowed.

ii. Trading in assets takes place continuously in time

iii. The Modigliani-Miller theorem, which states that the value of the firm is invariant to its capital structure holds

iv. The risk-free interest rate r is constant and known with certainty

v. The evolution of the firm's assets value V_t follows a stochastic diffusion process:

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[95] Wang, Yu. "Structural Credit Risk Modeling: Merton and Beyond." Risk Management 16 (2009). p.30.

[96] MERTON, Robert C. "On the pricing of corporate debt: The risk structure of interest rates." *The Journal of Finance* 29.2 (1974). p.450.

$dV = (\alpha V - C)\,dt + \sigma V dz$

Where :

α is the instantaneous expected rate of return of the firm per unit of time

C is the total dollar payouts by the firm per unit of time either to its shareholders or liabilities-holders (dividends or interests payments) if positive and is the net dollars received by the firm from new financing if negative

σ^2 is the instantaneous variance of the return on the firm per unit of time

dz is a standard Gauss-Wiener process.

As stated by Merton[97], all these assumptions are not necessary for the model to hold, but have been chosen for convenience. Hence, the perfect market assumption can easily be relaxed. Stochastic interest rates can also be used and make « fairly innocuous modification » to the results, making assumption IV optional. Finally, Merton observes that [98]« If, for example, due to bankruptcy costs or corporate taxes, the MM theorem does not obtain and the value of the firm does depend on the debt-equity ratio, then the formal analysis of the paper is still valid ». At the end, the only required assumption is the asset value stochastic diffusion process.

1.2 Debt and equity valuation

As explained in chapter 1, the payoff of the equity at maturity is equal to the value of a European call option on underlying asset At, while the payoff of debt is the same as a portfolio made up of the face value of debt K and a short position in a put option on underlying asset At. Therefore, the value of both debt and equity at time t ($0<t<T$) is:

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[97] SUNDARESAN, Suresh. "A Review of Merton's Model of the Firm's Capital Structure with Its Wide Applications." *Annu. Rev. Financ. Econ.* 5.1 (2013). p.2-3.

[98] MERTON, Robert C. "On the pricing of corporate debt: The risk structure of interest rates." *The Journal of Finance* 29.2 (1974). p.460.

E_t = Call (A_t, K, r, T-t, σ)

D_t = PV(K)- Put(A_t, K, r, T-t, σ)

Thanks to the put-call parity, the two expressions above can be verified and the Merton model is therefore verified. Indeed:

$$\text{At} =^1 \text{Et} + \text{Dt} =^2 \text{Call} + \text{PV(K)} - \text{Put} =^3 \text{At}$$

1) By financial equality

2) By Merton assumptions

3) By put-call parity

In order to find the value of both equity and debt at time t, Merton applied the Black & Scholes option pricing formula, which was discovered in 1973:

$$D_t = V_t\Phi(-d_1) + De^{-r(T-t)}\Phi(d_2)$$

$$E_t = V_t\Phi(d_1) - De^{-r(T-t)}\Phi(d_2)$$

Where $\Phi(.)$ is the cumulative standard normal distribution function and

$$d_1 = \frac{ln\left(\frac{V_t}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}} \qquad d_2 = d_1 - \sigma\sqrt{T-t}$$

As shown by figure 2, the probability of default in the Merton model is given by the probability that the asset value at maturity is lower than the facial value of the debt. In other words, the firm will default when the shareholder's call option on the asset underlying matures out-of-money. According to the Black & Scholes formula, the risk-neutral probability of such event is given by

PD = $\Phi(-d_2)$

This equation shows that the probability of default depends solely on the inverse leverage of the firm (V/D), the volatility of the firm's assets and the time to maturity.

1.3 Credit Spread

Knowing that the debt can be replicated by a portfolio made up of the face value of the debt and a short position in a put option on the asset value underlying, it appears that the spread between credit-risky debt and an otherwise identical risk-free debt is simply determined by the value of this put option. We indeed have

Risky debt = risk-free debt – put option

The credit spread is therefore only influenced by the maturity of the debt, the leverage and the business risk (volatility) of the firm.

In order to derive the credit spread from the firm debt value, one must use the following relationship based on the present value of the risky debt:

$D_t = Ke^{-y(T-t)}$ where y is the credit spread

Solving this equation for y and substituting the debt value with the results above gives an expression for the debt yield:

$$y_t = -\frac{ln\left[\left(\frac{V_t}{K}\right)\Phi(-d_1) + e^{-r(T-t)}\Phi(d_2)\right]}{T-t}$$

The figure 46 shows a representation of the credit spread depending on the maturity and for three different categories of leverage of a firm.

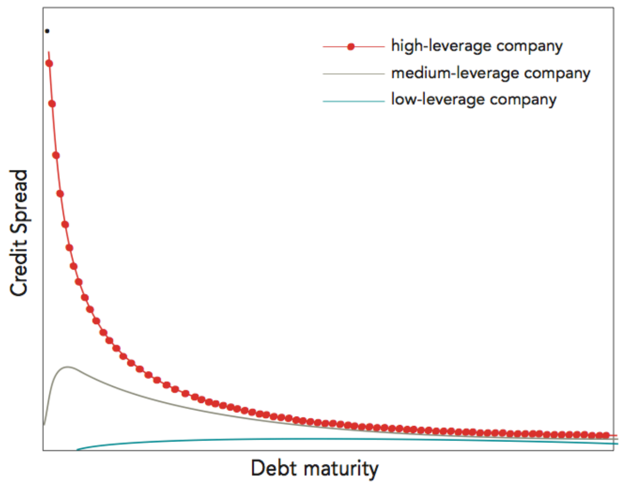


Figure 46: Evolution of credit spread as a function of the maturity, for three different leverages[99]

The following observations can be made:

- A company with a low leverage ratio has a flatter credit spread structure and its initial spread is close to zero. This observation is explained by the sufficient assets to cover the short-term liabilities of such leveraged companies. Spreads are slowly increasing over time to reflect future uncertainties, but start to decline at a large horizon.
- A company with a medium leverage ratio has a « humped-shape » credit spread structure. On the very short term, spreads are low because the company has enough assets to cover debts. However, on the short horizon, fluctuations in the asset value can easily results in insufficient assets to cover the debt, hence a sharply increasing shape. Finally, the structure gradually drops for longer maturities.
- A company with a high leverage ratio has a downward sloping credit spread structure. It starts very high and decreases over time. This is explained by the higher period of time granted to the firm to grow its assets in order to cover its liabilities at maturity.

[99] SUNDARESAN, Suresh. "A Review of Merton's Model of the Firm's Capital Structure with Its Wide Applications." *Annu. Rev. Financ. Econ.* 5.1 (2013). p.2-3.

Section 2: CreditGrades model computation[100]

Creditgrades offers a closed-form formula to model probability of default that involves only six market observable parameters.

$P(t) = \Phi\left(-\frac{A_t}{2} + \frac{\log(d)}{A_t}\right) - d\Phi\left(-\frac{A_t}{2} - \frac{\log(d)}{A_t}\right)$ where

$$d = \frac{S_0 + \bar{L}D}{\bar{L}D} e^{\lambda^2} \qquad\qquad A_t^2 \left(\sigma_S^* \frac{S^*}{S^* + \bar{L}D}\right)^2 t + \lambda^2$$

S_0 = initial stock price

S^* = reference stock price

σ_S^* = reference stock volatility

D = debt per share

L = global debt recovery

λ = percentage standard deviation of the default barrier

The initial stock price represents the price of the stock as traded on the market at the initiation of the model, while the reference stock price is the price estimated by financial analysts. The magnitude of difference between both prices depends on the market conditions and whether analysts consider the current price to reflect reality or not. Reference stock volatility can either be computed using historical volatilities or implied ones. This will be developed in the next subsection.

[100] FINGER, Christopher, FINKELSTEIN, Vladimir, LARDY, Jean-Pierre, *et al.* CreditGrades technical document. *RiskMetrics Group*, 2002, p. 1-51.

The debt-per-share is computed, using a specific methodology explained in the CreditGrades notice. The ratio is based on financial data from consolidated statements and requires a two-step process. Firstly, one must compute all liabilities that participate in the financial leverage of the firm, namely the principal value of all financial debts, short and long-term borrowings and convertible bonds, as well as quasi debts (i.e. capital leases and preferred shares). Non-financial liabilities such as accounts payable, reserves or deferred taxes are not taken into account. This debt value must be divided by the number of shares.

Finally, the last two parameters concern the global recovery L, which defines the default barrier and are its average and its percentage standard deviation. They have been estimated by Hu and Lawrence (2000) using Standard&Poor's database containing actual recovery rate for non-financial US firms that defaulted. They estimate the Lbarre and lambda to be 0, 5 and 0, 3 respectively. Practitioners usually use these values when dealing with CreditGrades.

To extract the credit spread form the CreditGrades survival probability, two additional parameters must be introduced: the risk-free interest rate r and the recovery rate R on the underlying debt. R differs from L in that R is the expected recovery rate on a specific class of a company debt, while L is the expected recovery average over all debt classes. Therefore, R will be lower than L for an unsecured debt, since the secured debt included in L will have a higher recovery. The credit spread for a maturity t according to the CreditGrades model is given by:

$$C^* = r(1-R)\frac{1-P(0)+e^{r\xi}\left(G(t+\xi)-G(\xi)\right)}{P(0)-P(t)e^{-rt}-e^{r\xi}\left(G(t+\xi)-G(\xi)\right)} \text{ where}$$

$$\xi = \frac{\lambda^2}{\sigma^2} \qquad\qquad z = \sqrt{\frac{1}{4}+\frac{2r}{\sigma^2}}$$

$$G(u) = d^{z+1/2}\Phi\left(-\frac{log(d)}{\sigma\sqrt{u}} - z\sigma\sqrt{u}\right) + d^{-z+1/2}\Phi\left(-\frac{log(d)}{\sigma\sqrt{u}} + z\sigma\sqrt{u}\right)$$

3.3.1 Volatility estimation

Although equity volatility can easily be computed using historical or implied data, it is not the case for the total assets volatility. Structural models therefore need to use optimization techniques to compute the firm volatility. CreditGrades deals with this issue by introducing the following relationship between equity and asset volatility:

$$\sigma = \sigma_S^* \frac{S^*}{S^* + \bar{L}D}$$

This formula is derived from both the definition of V above and the use of limit calculus in the CreditGrades computation model. The asset value can therefore be seen as equal to a weighted value of the equity value where the weighting factor is similar to one minus the leverage.

The only parameter required to compute the asset volatility is therefore the equity volatility. The latter can be estimated using two different methods: the historical one, where equity volatility is computed based on equity prices over a given period, or the implied one, where the volatility is extracted from the price of options on the underlying stock. Finkelstein and Lardy, the two lead creators of the CreditGrades model, compared the spread generated by CreditGrades using both methods with the observed one for a set of companies. They examined historical volatility over a window of 252, 500, 750, 1000 and 1250 days, historical volatility using an EMWA of decay factor 0, 94 and implied volatility. They observe that the historical volatility with a 1000 days window offers the most accurate results and is robust over the whole set of data considered. Although this method has a tendency to underestimate volatility for the best quality firms, the model appears to offer the best performance for speculative grade companies. As the focus of this thesis is on the study of distressed companies, this is not an issue for the next chapters.

Appendix to chapter 3

These appendix presents for each of the five companies an overview of the excel sheets used to compute the refinancing exposure and value the debt and equity. For each company, the following information are presented:

- Assumptions and data used in the model with their corresponding sources
- Projection of cash inflow and outflow leading to the equity residual cash flow net of dividend payments before and after the refinancing operations
- Refinancing gap computation before and after the refinancing operations
- Company valuation with the stock price and credit spread using Merton model, simplified CreditGrades and complete CreditGrades before and after the refinancing operations
- Figures presenting graphically the exposure to the refinancing risk

1. Lafarge

1.1 Assumptions and data

Financial projections (in € million)							
Year of study	2009						
Cash at t=0	1.591						2008 financial report
FCF forecast							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	Deutsche Bank 05/09 report
	1.522	1.603	1.686	1.792	1.996	2.133	
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	
	2.473	2.577	2.684	2.796	2.903	3.005	
Dividend forecast							
	2009	**2010**	**2011**				Deutsche Bank 05/09 report
	(570)	(570)	(627)				
Debt amorization							
	2009	**2010**	**2011**	**2012**	**2013**		
	(4.278)	(1.093)	(1.405)	(5.554)	(1.380)		Deutsche Bank 05/09 report
	2014	**2015**	**2016**	**2017**			
	(1.571)	(1.000)	(1.000)	(1.000)			

Merton model			
Time to maturity	4		Average weighted maturity
Risk-free rate	3,50%		Bloomberg

CreditGrades model			
Initial stock price	38		Bloomberg
reference stock price	50		Deutsche Bank 05/09 report
reference stock valatility	29,00%		Bloomberg
debt per share	71,04	51,98	Own computation
global debt recovery	50%		assumption
percentage standard deviat	30%		assumption
Firm recovery rate	45%		Credit Suisse

Refinancing operations (M€)

		2009	2010	2011	2012	2013
Asset disposals		1.000				
Equity capital increase		1.500				
New debt issue		2.500				
Changes in interest expenses		(191)	(191)	(191)	(191)	(191)
Changes in debt amortization						
New debt interest rate	7,63%					
other measures		1.000				

1.2 Projection of cash inflow / outflow

Assets	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Surplus cash	1.591	-	-	-	-	-																	
Operating FCF		1.522	1.603	1.686	1.792	1.996	2.133	2.473	2.547	2.624	2.702	2.783	2.867	2.953	3.041	3.133	3.227	3.324	3.423	3.526	3.632	3.741	3.853
Dividends		(570)	(570)	(627)	(636)	(646)	(656)	(665)	(675)	(686)	(696)	(706)	(717)	(728)	(739)	(750)	(761)	(772)	(784)	(796)	(808)	(820)	(832)
		200																					
Liabilities																							
Interest expense		(836)	(798)	(736)	(656)	(339)	(261)	(171)	(114)	(57)													
Debt amortization		(4.278)	(1.093)	(1.405)	(5.554)	(1.380)	(1.571)	(1.000)	(1.000)	(1.000)	-	-											

1.3 Refinancing gap computation

Refinancing gap valuation

W/o capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cumulated liabilities	-	5.114	7.268	9.786	16.523	19.339	22.418	25.000	27.605	30.227	31.862	33.459	35.008	36.494	37.905	39.225	40.437	41.519	42.452	43.211	43.767	44.092	44.152
Cumulated FCF	1.591	2.543	3.576	4.635	5.791	7.141	8.618	10.426	12.297	14.235	16.242	18.319	20.469	22.694	24.997	27.380	29.846	32.397	35.036	37.767	40.591	43.512	46.532
Annual RG	1.591	(4.162)	(1.121)	(1.459)	(5.581)	(1.467)	(1.602)	(775)	(733)	(684)	371	480	602	739	892	1.063	1.255	1.468	1.706	1.972	2.267	2.596	2.961
Cumulated RG	1.591	(2.571)	(3.692)	(5.151)	(10.732)	(12.199)	(13.800)	(14.575)	(15.307)	(15.992)	(15.620)	(15.141)	(14.539)	(13.800)	(12.908)	(11.845)	(10.591)	(9.123)	(7.416)	(5.444)	(3.177)	(581)	2.381
Cost of the RG		(145)	(209)	(291)	(607)	(690)	(780)	(824)	(865)	(904)	(883)	(856)	(822)	(780)	(730)	(670)	(599)	(516)	(419)	(308)	(180)	(33)	-
Actualization factor		0,84	0,89	0,94	1,00	1,06	1,12	1,19	1,26	1,34	1,42	1,50	1,59	1,69	1,79	1,90	2,01	2,13	2,26	2,40	2,54	2,69	2,85
Actualized RG value		(173)	(235)	(309)	(607)	(651)	(694)	(692)	(686)	(676)	(623)	(569)	(516)	(462)	(408)	(353)	(298)	(242)	(185)	(128)	(71)	(12)	-

With capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cumulated liabilities	-	6.804	8.886	11.218	17.648	19.864	22.236	26.495	28.134	29.704	30.197	30.612	30.940	31.173	31.302	31.318
Cumulated FCF	1.591	8.543	9.576	10.635	11.791	13.141	14.618	16.426	18.297	20.235	22.242	24.319	26.469	28.694	30.997	33.380
Annual RG	1.591	148	(1.049)	(1.272)	(5.275)	(865)	(895)	(2.451)	233	368	1.513	1.662	1.822	1.992	2.174	2.367
Cumulated RG	1.591	1.739	690	(583)	(5.858)	(6.723)	(7.618)	(10.069)	(9.837)	(9.468)	(7.956)	(6.293)	(4.471)	(2.479)	(306)	2.062
Cost of the RG		-	-	(4)	(38)	(43)	(49)	(65)	(63)	(61)	(51)	(40)	(29)	(16)	(2)	-
Actualization factor		0,84	0,89	0,94	1,00	1,06	1,12	1,19	1,26	1,34	1,42	1,50	1,59	1,69	1,79	1,90
Actualized RG value		-	-	(4)	(38)	(41)	(44)	(54)	(50)	(45)	(36)	(27)	(18)	(9)	(1)	-

	W/O	**With**
Intrisic RG value	(8.588)	(367)
Time value factor	1,11	1,11
RG value	**(9.542)**	**(407)**

1.4 Company valuation

Merton	Before refinancing		After refinancing		
Asset value	30.000		Asset value	30.000	
Debt Value	27.823		Debt Value	17.188	
Time to maturity	4		Time to maturity	4	
Risk-free rate	3,50%		Risk-free rate	4%	
Standard deviation of asset	13%		Standard deviation of asse	13%	
Equity	6.600	34,2 € per share	Equity	15.066	53,24 € per share
Debt	15.430		Debt	14.614	
ALRG	7.970		ALRG	320	

Creditgrades simplified					
Initial stock price	38		Initial stock price	38	
reference stock price	50		reference stock price	50	
reference stock valatility	29%		reference stock valatility	29%	
debt per share	144		debt per share	70	
global debt recovery	50%		global debt recovery	50%	
SD default barrier	30%		SD default barrier	30%	
time	4		time	4	
Firm recovery rate	45%		Firm recovery rate	45%	
risk-free rate	3,50%		risk-free rate	4%	
CDS Spread	3,35%		CDS Spread	1,11%	
Equity	8.133	42,14 € per share	Equity	13.647	48,22 € per share
Debt	13.897		Debt	16.033	
ALRG	7.970		ALRG	320	

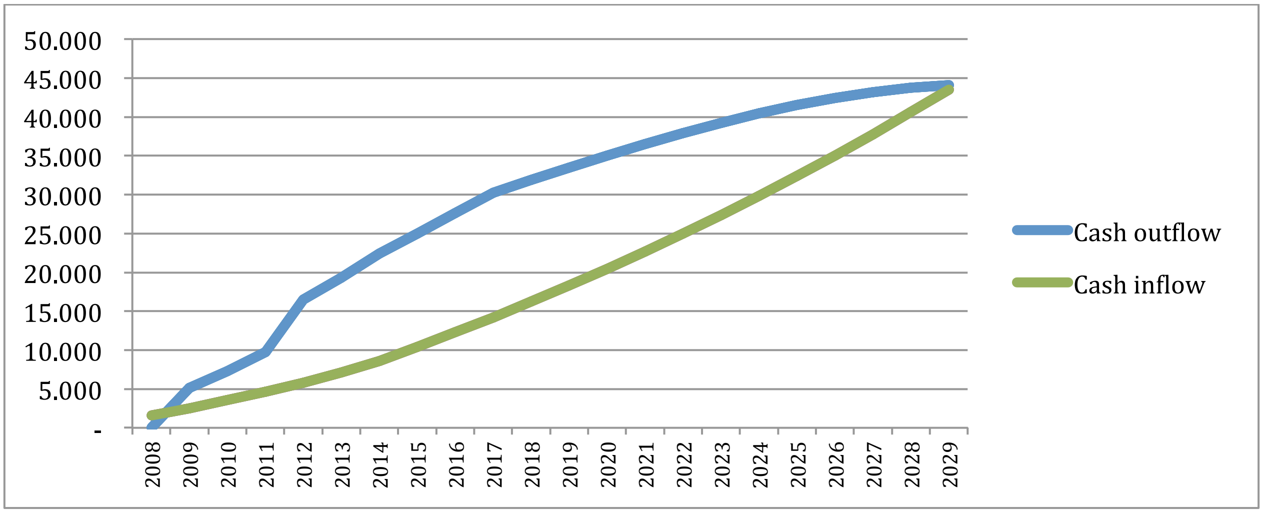
Creditgrades complete

Maturity	Spread	Face value	Real value	Maturity	Spread	Face value	Real value
1	8,52%	4.278	3.793	1	1,15%	2.778	2.652
2	5,07%	1.093	921	2	1,04%	1.093	998
3	3,92%	1.405	1.124	3	1,06%	1.405	1.225
4	3,35%	5.554	4.223	4	1,11%	5.554	4.619
5	3,00%	1.380	997	5	1,15%	1.380	1.094
6	2,76%	1.571	1.079	6	1,19%	1.571	1.186
7	2,59%	1.000	653	7	1,22%	3.500	2.516
8	2,46%	1.000	621	8	1,24%	1.000	684
9	2,36%	1.000	590	9	1,26%	1.000	652
10	2,28%	-	-	10	1,27%	-	-

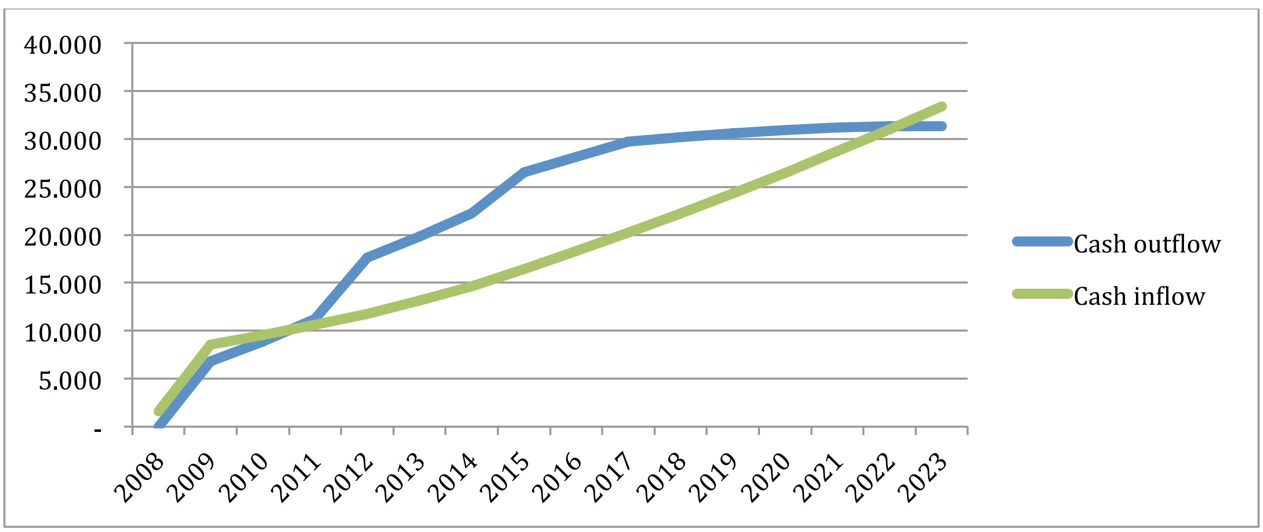
Equity	8.029	41,6 € per share	Equity	14.053	49,66 € per share
Debt	14.001		Debt	15.627	
ALRG	7.970		ALRG	320	

1.5 Refinancing exposure illustration

Before the refinancing operations



After the refinancing operations



2. Pernod Ricard

2.1 Assumptions and data

Financial projections (in € million)

Year of study	2009							
Cash at t=0	530							2008 financial report
FCF forecast								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	Merril Lynch 02/09 report
	723	1.083	1.140	1.204	1.334	1.472	1.618	
Dividend forecast								
	2009	**2010**	**2011**	**2012**	**2013**			Merril Lynch 02/09 report
	(288)	(128)	(128)	(440)	(483)			
Debt amorization								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**		
	-	-	(1.500)	(3.300)	(200)	(8.500)		2008 financial report

Merton model

Time to maturity	5		Average weighted maturity
Risk-free rate	3,50%		Bloomberg

CreditGrades model

Initial stock price	42		Bloomberg
reference stock price	55		Deutsche Bank 05/09 report
reference stock valatility	35,27%		Bloomberg
debt per share	61,35	52,33	Own computation
global debt recovery	50%		assumption
percentage standard deviation	30%		assumption
Firm recovery rate	37,80%		Credit Suisse

Refinancing operations (M€)

		2009	2010	2011	2012	2013
Asset disposals		500				
Equity capital increase		1.000				
New debt issue		800				
Changes in interest expenses			(191)	(191)	(191)	(191)
Changes in debt amortization						
New debt interest rate	7,63%					
other measures						
Debt buyback		(1.000)		1.000		

2.2 Projection of cash inflow / outflow

Assets	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Surplus cash	530	-	-	-	-	-										
Operating FCF		723	1.083	1.140	1.204	1.334	1.472	1.618	1.667	1.717	1.768	1.821	1.876	1.932	1.990	2.050
Dividends		(288)	(128)	(128)	(131)	(133)	(136)	(139)	(141)	(144)	(147)	(150)	(153)	(156)	(159)	(162)
Liabilities																
Interest expense		(702)	(702)	(702)	(624)	(452)	(442)									
Debt amortization		-	-	(1.500)	(3.300)	(200)	(8.500)	-	-	-	-	-				

2.3 Refinancing gap computation

Refinancing gap valuation

W/o capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cumulated liabilities	-	702	1.404	3.606	7.581	8.505	17.697	18.543	19.340	20.083	20.763	21.371	21.899	22.336	22.672	22.894
Cumulated FCF	530	965	1.920	2.932	4.005	5.206	6.542	8.022	9.547	11.119	12.740	14.412	16.134	17.910	19.741	21.628
Annual RG	530	(267)	253	(1.190)	(2.902)	277	(7.856)	634	727	830	941	1.063	1.195	1.339	1.495	1.665
Cumulated RG	530	263	516	(674)	(3.576)	(3.298)	(11.154)	(10.521)	(9.793)	(8.964)	(8.022)	(6.960)	(5.765)	(4.426)	(2.931)	(1.265)
Cost of the RG		-	-	(23)	(121)	(112)	(379)	(357)	(333)	(305)	(273)	(236)	(196)	(150)	(100)	(43)
Actualization factor		0,82	0,86	0,90	0,95	1,00	1,05	1,11	1,16	1,22	1,29	1,36	1,43	1,50	1,58	1,66
Actualized RG value		-	-	(25)	(128)	(112)	(360)	(323)	(286)	(249)	(212)	(174)	(137)	(100)	(63)	(26)

With capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cumulated liabilities	-	1.702	2.404	3.606	7.530	8.252	17.236	17.712	18.131	18.487	18.774	18.985	19.114	19.153	19.153	19.153
Cumulated FCF	530	3.265	4.220	5.232	6.305	7.506	8.842	10.322	11.847	13.419	15.040	16.712	18.434	20.210	22.041	23.928
Annual RG	530	1.033	253	(190)	(2.851)	479	(7.648)	1.004	1.106	1.216	1.334	1.460	1.594	1.737	1.831	1.887
Cumulated RG	530	1.563	1.816	1.626	(1.225)	(746)	(8.394)	(7.390)	(6.283)	(5.067)	(3.733)	(2.274)	(680)	1.058	2.888	4.776
Cost of the RG		-	-	-	(18)	(11)	(124)	(109)	(93)	(75)	(55)	(34)	(10)	-	-	-
Actualization factor		0,82	0,86	0,90	0,95	1,00	1,05	1,11	1,16	1,22	1,29	1,36	1,43	1,50	1,58	1,66
Actualized RG value		-	-	-	(19)	(11)	(118)	(99)	(80)	(61)	(43)	(25)	(7)	-	-	-

	W/O	With
Intrisic RG value	(2.195)	(463)
Time value factor	1,14	1,14
RG value	**(2.494)**	**(528)**

2.4 Company valuation

Merton	Before Refinancing		After Refinancing		
Asset value	21.200	ML april 2009	Asset value	21.200	
Debt Value	15.994		Debt Value	13.028	
Time to maturity	5		Time to matu	5	
Risk-free rate	3,50%		Risk-free rate	4%	
Standard deviation of asset	20%		Standard dev	20%	
Equity	8.490	38,58 € per share	Equity	10.556	40,92 € per share
Debt	10.684		Debt	10.215	
ALRG	2.026		ALRG	429	

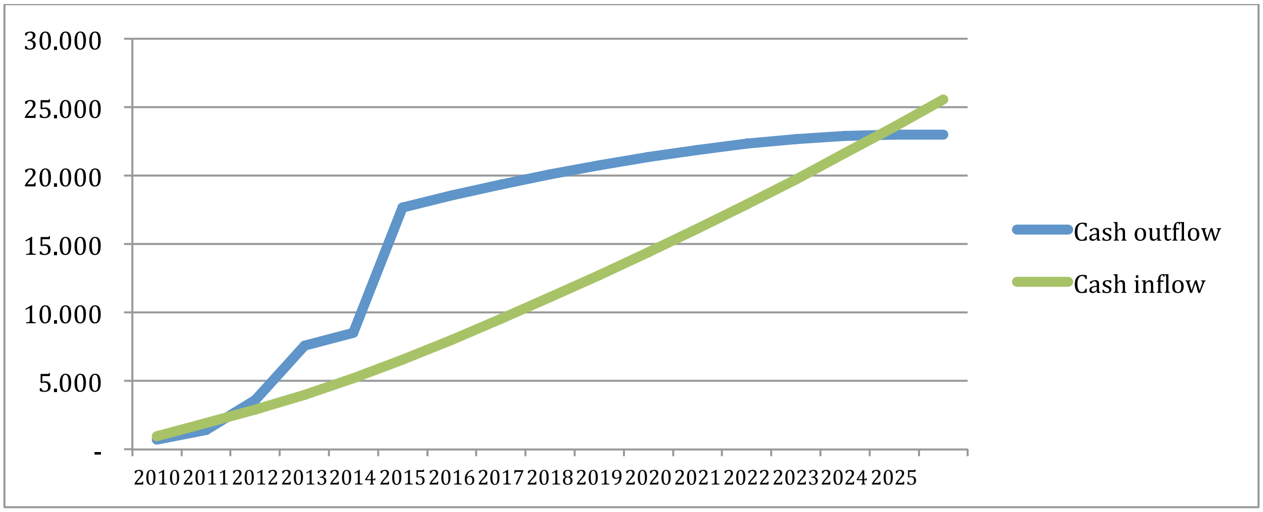
Creditgrades simplified					
Initial stock price	42		Initial stock p	42	
reference stock price	55		reference sto	55	
reference stock valatility	35%		reference sto	35%	
debt per share	72,69		debt per shar	54,37	
global debt recovery	50%		global debt re	50%	
SD default barrier	30%		SD default ba	30%	
time	5,16		time	5,16	
Firm recovery rate	45%		Firm recovery	0,4547	
risk-free rate	3,50%		risk-free rate	0,035	
CDS Spread	1,72%		CDS Spread	1,29%	
Equity	8.861	40,27 € per share	Equity	11.008	42,67 € per share
Debt	10.313		Debt	9.763	
ALRG	2.026		ALRG	429	

Creditgrades complete

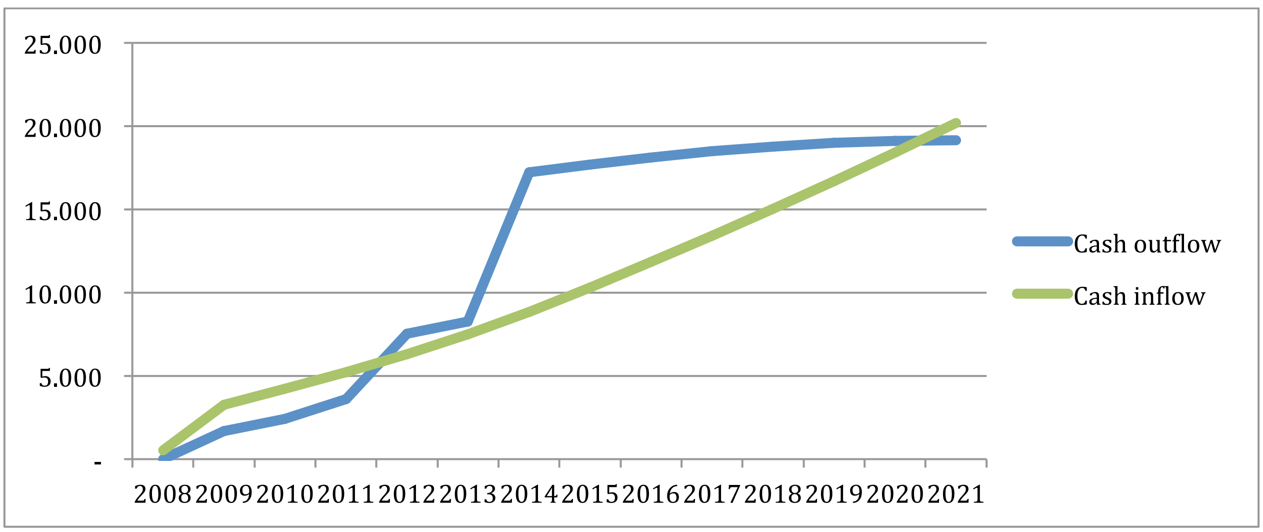
Maturity	Spread	Face value	Real value	Maturity	Spread	Face value	Real value
1	1,31%	0	-	1	0,49%	0	-
2	1,39%	0	-	2	0,73%	0	-
3	1,52%	1500	1.290	3	0,95%	500	438
4	1,62%	3300	2.688	4	1,13%	3300	2.742
5	1,71%	200	154	5	1,27%	200	158
6	1,76%	8500	6.198	6	1,37%	8500	6.345
7	1,81%	0	-	7	1,45%	0	-
8	1,84%	0	-	8	1,52%	0	-
9	1,86%	0	-	9	1,56%	0	-
10	1,87%	0	-	10	1,60%	0	-
Equity	8.843	40,19 € per share		Equity	11.089	42,89 € per share	
Debt	10.331			Debt	9.682		
ALRG	2.026			ALRG	429		

2.5 Refinancing exposure illustration

Before the refinancing operations



After the refinancing operations



3. PPR

3.1 Assumptions and data

Financial projections (in € million)

Year of study	2008						
Cash at t=0	1.215						2007 financial report
FCF forecast							
	2008	**2009**	**2010**	**2011**	**2012**		Morgan Stanley 08 report
	528	668	867	950	969		
Dividend forecast							
	2008	**2009**	**2010**	**2011**	**2012**		Morgan Stanley 08 report
	(465)	(465)	(465)	(500)	(500)		
Debt amorization							
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	
	(3.420)	(959)	(183)	(920)	(1.772)	(836)	2007 financial report

Merton model

Time to maturity	3		Average weighted maturity
Risk-free rate	4,00%		Bloomberg

CreditGrades model

Initial stock price	94,73		Bloomberg
reference stock price	100		Morgan Stanley 08 report
reference stock valatility	33%		Bloomberg
debt per share	63,203125	82,73	Own computation
global debt recovery	50%		assumption
percentage standard deviation	30%		assumption
Firm recovery rate	30%		Credit Suisse

Refinancing gap

	Before	**After**	
CDS	1,67%	1,40%	Bloomberg
number of share at t=0 (M)	128	128	Annual report
average yield	4,0%		Annual report
Credit premium	1,34%	1,13%	Own computation
FCF Growth rate	2%		assumption
Dividend growth rate	2%		assumption
debt actualization cost (kd)	4,00%		Annual report (last debt issue)
Tax rate	20%		

Refinancing operations (M€)

	2008	2009	2010	2011	2012
Asset disposals	1.200				

3.2 Projection of cash inflow / outflow

Assets	0	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Surplus cash	1.215	-	-	-	-	-																		
Operating FCF		528	668	867	950	969	988	1.008	1.028	1.049	1.070	1.091	1.113	1.135	1.158	1.181	1.205	1.229	1.254	1.279	1.304	1.330	1.357	1.384
Dividends		(465)	(465)	(465)	(500)	(500)	(510)	(520)	(531)	(541)	(552)	(563)	(574)	(586)	(598)	(609)	(622)	(634)	(647)	(660)	(660)	(660)	(660)	(673)
Liabilities																								
Interest expense		(324)	(187)	(148)	(141)	(104)	(33)																	
Debt amortization		(3.420)	(959)	(183)	(920)	(1.772)	(836)	-	-	-	-	-												

3.3 Refinancing gap computation

Refinancing gap valuation

W/o capital changes	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cumulated liabilities	-	3.744	5.002	5.494	6.720	8.797	9.940	10.244	10.539	10.825	11.102	11.367	11.620	11.860	12.086	12.297	12.491	12.668	12.825	12.962	13.077	13.168	13.232	13.268
Cumulated FCF	1.215	1.278	1.481	1.883	2.333	2.802	3.280	3.768	4.266	4.774	5.292	5.820	6.358	6.908	7.468	8.040	8.623	9.218	9.825	10.444	11.088	11.759	12.456	13.167
Annual RG	1.215	(3.681)	(1.055)	(90)	(776)	(1.608)	(665)	184	202	221	242	263	286	309	334	361	389	418	449	482	529	580	633	676
Cumulated RG	1.215	(2.466)	(3.521)	(3.611)	(4.387)	(5.995)	(6.659)	(6.475)	(6.273)	(6.052)	(5.810)	(5.547)	(5.262)	(4.952)	(4.618)	(4.257)	(3.868)	(3.450)	(3.001)	(2.519)	(1.989)	(1.410)	(777)	(101)
Cost of the RG		(33)	(47)	(49)	(59)	(81)	(90)	(87)	(84)	(81)	(78)	(75)	(71)	(67)	(62)	(57)	(52)	(46)	(40)	(34)	(27)	(19)	(10)	(1)
Actualization factor		0,85	0,89	0,92	0,96	1,00	1,04	1,08	1,12	1,17	1,22	1,27	1,32	1,37	1,42	1,48	1,54	1,60	1,67	1,73	1,80	1,87	1,95	2,03
Actualized RG value		(39)	(53)	(53)	(61)	(81)	(86)	(80)	(75)	(70)	(64)	(59)	(54)	(49)	(44)	(39)	(34)	(29)	(24)	(20)	(15)	(10)	(5)	(1)

With capital changes	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
		(2.481)	(998)	(28)	(711)																
Cumulated liabilities	-	3.744	4.944	5.374	6.535	8.542	9.609	9.831	10.043	10.242	10.427	10.598	10.754	10.893	11.014	11.116	11.198	11.257	11.294	11.305	11.305
Cumulated FCF	1.215	2.478	2.681	3.083	3.533	4.002	4.480	4.968	5.466	5.974	6.492	7.020	7.558	8.108	8.668	9.240	9.823	10.418	11.025	11.644	12.288
Annual RG	1.215	(2.481)	(998)	(28)	(711)	(1.538)	(588)	265	286	309	332	357	383	411	439	470	502	535	570	607	644
Cumulated RG	1.215	(1.266)	(2.263)	(2.291)	(3.002)	(4.540)	(5.128)	(4.863)	(4.577)	(4.268)	(3.936)	(3.579)	(3.196)	(2.785)	(2.346)	(1.876)	(1.374)	(839)	(269)	338	983
Cost of the RG		(14)	(26)	(26)	(34)	(51)	(58)	(55)	(52)	(48)	(44)	(40)	(36)	(31)	(26)	(21)	(15)	(9)	(3)	-	-
Actualization factor		0,85	0,89	0,92	0,96	1,00	1,04	1,08	1,12	1,17	1,22	1,27	1,32	1,37	1,42	1,48	1,54	1,60	1,67	1,73	1,80
Actualized RG value		(17)	(29)	(28)	(35)	(51)	(56)	(51)	(46)	(41)	(36)	(32)	(27)	(23)	(19)	(14)	(10)	(6)	(2)	-	-

	W/O	**ith (April)**
Intrisic RG value	(1.043)	(522)
Time value factor	1,09	1,09
RG value	**(1.134)**	**(568)**

3.4 Company valuation

Merton	Before refinacing		After refinancing		
Asset value	19.394	Morgan Stanley 2008 report	Asset value	19.394	
Debt Value	9.224		Debt Value	8.658	
Time to maturity	3		Time to maturity	3	
Risk-free rate	4%		Risk-free rate	4%	
Standard deviation of asset	25%		Standard deviation of ass	25%	
Equity	11.220	87,65 € per share	Equity	11.709	91,48 € per share
Debt	7.208		Debt	7.201	
ALRG	966		ALRG	484	

Creditgrades			
Initial stock price	94,73	Initial stock price	94,73
reference stock price	100	reference stock price	100
reference stock valatility	33%	reference stock valatility	33%
debt per share	72,06	debt per share	67,64
global debt recovery	50%	global debt recovery	50%
SD default barrier	30%	SD default barrier	30%
time	3	time	3
Firm recovery rate	30%	Firm recovery rate	0,3
risk-free rate	4,00%	risk-free rate	0,04
CDS Spread	0,29%	CDS Spread	0,25%

Equity	11.284	88,16 € per share	Equity	11.757	91,85 € per share
Debt	7.144		Debt	7.153	
ALRG	966		ALRG	484	

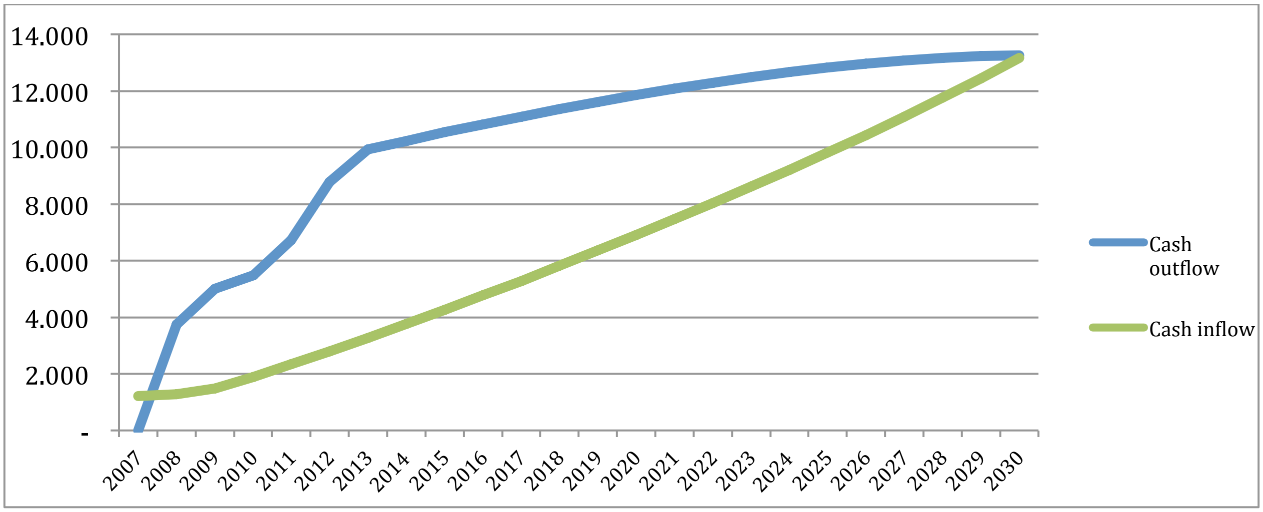
Creditgrades (spread curve)

Maturity	Spread	Face value	Real value	Maturity	Spread	Face value	Real value
1	0,04%	3420	3.284	1	0,03%	3420	3.285
2	0,15%	959	883	2	0,12%	959	883
3	0,31%	183	161	3	0,26%	183	161
4	0,48%	920	769	4	0,42%	920	771
5	0,64%	1772	1.405	5	0,58%	1772	1.409
6	0,78%	836	627	6	0,72%	836	630
7	0,91%	0	-	7	0,84%	0	-
8	1,01%	0	-	8	0,95%	0	-
9	1,10%	0	-	9	1,04%	0	-
10	1,18%	0	-	10	1,12%	0	-

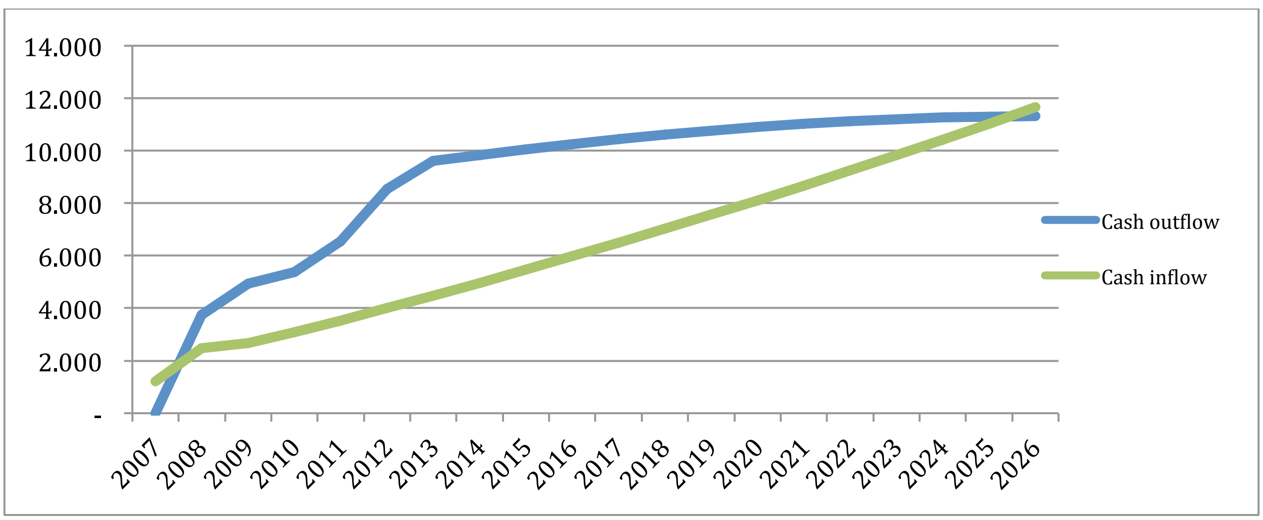
Equity	11.299	88,27 € per share	Equity	11.771	91,96 € per share
Debt	7.130		Debt	7.139	
ALRG	966		ALRG	484	

3.5 Refinancing exposure illustration

Before the refinancing operations



After the refinancing operations



4. TUI AG

4.1 Assumptions and data

Financial projections (in € million)								
Year of study	2009							
Cash at t=0	300							2008 financial report
FCF forecast								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	West LB 02/09 report
	532	620	774	2.040	834	849	906	
Dividend forecast								
	2009	**2010**	**2011**	**2012**	**2013**			West LB 02/09 report
	(124)	(125)	(175)	(201)	(213)			
Debt amorization								
	2009	**2010**	**2011**	**2012**	**2013**			
	(800)	(1.150)	(800)	(1.800)	(800)			2008 financial report

Merton model			
Time to maturity	3		Average weighted maturity
Risk-free rate	3,50%		Bloomberg

CreditGrades model			
Initial stock price	8,05		Bloomberg
reference stock price	8,05		West LB 02/09 report
reference stock valatility	0,4		Bloomberg
debt per share	21,314741	21,314741	Own computation
global debt recovery	0,5		assumption
percentage standard deviat	0,3		assumption
Firm recovery rate	0,5		Credit Suisse

Refinancing gap			
	Before	**After**	
CDS	12,00%	23,00%	Bloomberg
number of share at t=0 (M)	251	251	Annual report
average yield	4,6%		Annual report
Credit premium	8,96%	17,98%	Own computation
FCF Growth rate	2%		assumption
Dividend growth rate	2%		assumption
debt actualization cost (kd)	4,57%		Annual report (last debt issue)
Tax rate	18,00%		Annual report

Refinancing operations (M€)					
	2009	2010	2011	2012	2013
Asset disposals	1.600				

4.2 Projection of cash inflow / outflow

Assets	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Surplus cash	300	-	-	-	-	-							
Operating FCF		532	620	774	2.040	834	849	906	953	987	1.027	1.073	1.070
Dividends		(124)	(125)	(175)	(201)	(213)	(217)	(222)	(226)	(231)	(235)	(240)	(245)
Liabilities													
Interest expense		(244)	(208)	(155)	(119)	(37)	-						
Debt amortization		(800)	(1.150)	(800)	(1.800)	(800)	-	-	-	-			

4.3 Refinancing gap computation

Refinancing gap valuation

W/o capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cumulated liabilities	-	1.044	2.455	3.604	5.802	6.974	7.394	7.781	8.123	8.405	8.613	8.731	8.737	8.737	8.737	8.737
Cumulated FCF	300	708	1.203	1.802	3.641	4.262	4.894	5.578	6.305	7.062	7.853	8.686	9.512	10.364	11.245	12.155
Annual RG	300	(636)	(915)	(550)	(359)	(551)	211	297	385	475	584	715	818	853	881	910
Cumulated RG	300	(336)	(1.252)	(1.802)	(2.161)	(2.712)	(2.500)	(2.203)	(1.818)	(1.343)	(760)	(44)	774	1.627	2.507	3.417
Cost of the RG		(30)	(112)	(162)	(194)	(243)	(224)	(197)	(163)	(120)	(68)	(4)	-	-	-	-
Actualization factor		0,84	0,87	0,91	0,96	1,00	1,05	1,09	1,14	1,20	1,25	1,31	1,37	1,43	1,50	1,56
Actualized RG value		(36)	(128)	(177)	(203)	(243)	(214)	(181)	(142)	(101)	(54)	(3)	-	-	-	-

With capital changes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cumulated liabilities	-	1.644	2.375	3.330	5.320	6.243	6.401	6.418								
Cumulated FCF	300	1.976	2.451	3.064	4.993	5.646	6.339	7.054								
Annual RG	300	32	(256)	(342)	(60)	(270)	535	699								
Cumulated RG	300	332	76	(266)	(327)	(597)	(62)	637								
Cost of the RG		-	-	(48)	(59)	(107)	(11)	-								
Actualization factor		0,84	0,87	0,91	0,96	1,00	1,05	1,09								
Actualized RG value		-	-	(52)	(61)	(107)	(11)	-								

	W/O	With
Intrisic ALRG(TM) value	(1.482)	(232)
Time value factor	1,47	1,27
ALRG(TM) value	**(2.179)**	**(294)**

4.4 Company valuation

Merton	Before Refinancing		After Refinancing		
Asset value	7.850		Asset value	7.000	
Debt Value	7.529		Debt Value	5.644	
Time to maturity	3		Time to matu	3	
Risk-free rate	3,5%		Risk-free rate	3,5%	
Standard deviation of asset	20%		Standard dev	20%	
Equity	1.684	6,71 € per share	Equity	2.154	8,58 € per share
Debt	4.212		Debt	4.583	
ALRG	1.954		ALRG	263	

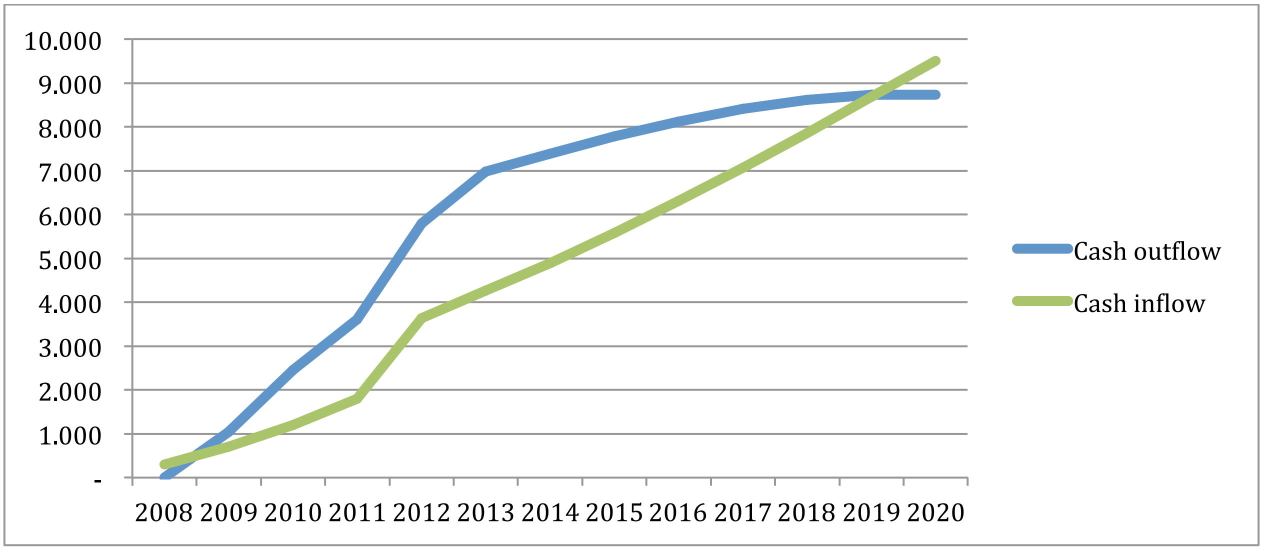
Creditgrades simplified					
Initial stock price	8,05		Initial stock p	8,05	
reference stock price	8,05		reference sto	8,05	
reference stock valatility	40%		reference sto	40%	
debt per share	29,10		debt per shar	22,36	
global debt recovery	50%		global debt re	50%	
SD default barrier	30%		SD default ba	30%	
time	3,12		time	3,12	
Firm recovery rate	50%		Firm recovery	50%	
risk-free rate	4%		risk-free rate	3,50%	
CDS Spread	4,44%		CDS Spread	3,30%	
Equity	1.721	6,86 € per share	Equity	2.410	9,6 € per share
Debt	4.175		Debt	4.326	
ALRG	1.954		ALRG	263	

Creditgrades complete

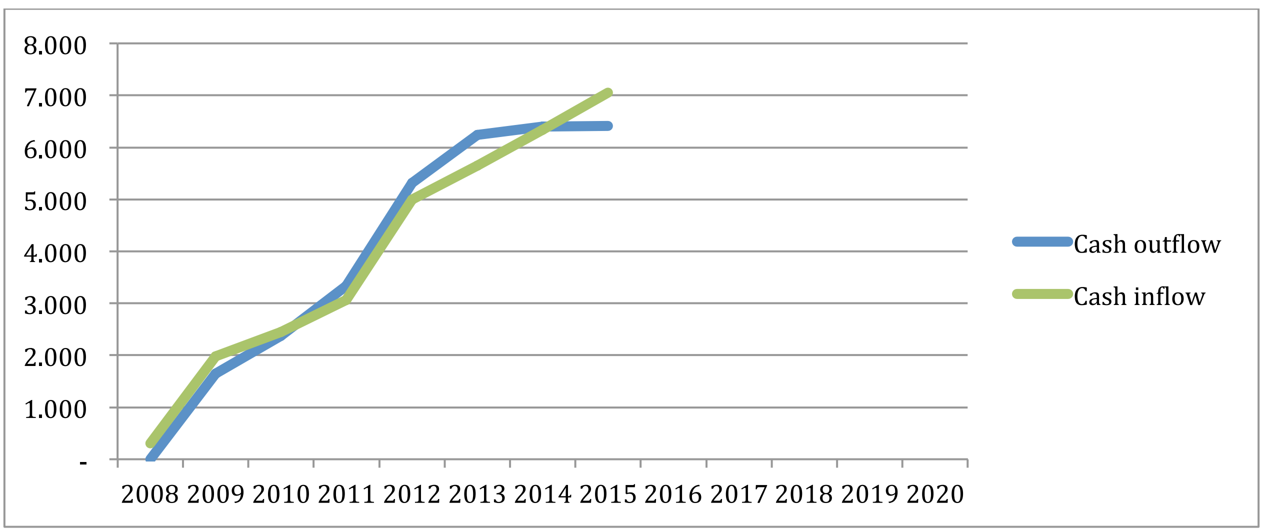
Maturity	Spread	Face value	Real value	Maturity	Spread	Face value	Real value
1	8,20%	800	712	1	4,83%	800	736
2	5,45%	1150	962	2	3,69%	1150	996
3	4,52%	800	629	3	3,33%	800	652
4	4,04%	1800	1.332	4	3,15%	1800	1.380
5	3,74%	800	557	5	3,03%	800	577
6	3,52%			6	2,94%		
7	3,36%			7	2,87%		
8	3,24%			8	2,80%		
9	3,13%			9	2,75%		
10	3,04%			10	2,70%		
Equity	1.705	6,79 € per share		Equity	2.396	9,55 € per share	
Debt	4.191			Debt	4.341		
ALRG	1.954			ALRG	263		

4.5 Refinancing exposure illustration

Before the refinancing operations



After the refinancing operations



5. KPN

5.1 Assumptions and data

Financial projections (in € million)

Year of study	2013							
Cash at t=0	947							2012 financial report
FCF forecast								
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	ING 01/13 report
	1.000	1.100	1.150	-	-	-	-	
Dividend forecast								
	2013	**2014**	**2015**					ING 01/13 report
	(300)	(300)	(300)					
Debt amorization								
	2013	**2014**	**2015**	**2016**	**2017**	**2014**		
	(1.100)	(1.400)	(1.000)	(1.300)	(1.000)	(1.300)		2012 financial report
	2016	**2017**	**2018**	**2019**	**2020**	**2014**		
	(1.000)	(1.500)	(1.300)	(800)	(500)	(3.100)		

Merton model

Time to maturity	10		Average weighted
Risk-free rate	2,50%		Bloomberg

CreditGrades model

Initial stock price	2,54		Bloomberg
reference stock price	2,54		ING 01/13 report
reference stock valatility	27%		Bloomberg
debt per share	11	4	Own computation
global debt recovery	50%		assumption
percentage standard devi	30%		assumption
Firm recovery rate	40%		Credit Suisse

Refinancing gap

	Before	**After**	
CDS	1,60%	1,60%	Bloomberg
number of share at t=0 (M	1400	4200	Annual report
average yield	5,3%		Annual report
Credit premium	-1,00%	-1,00%	Own computation
FCF Growth rate	3%		assumption
Dividend growth rate	0%		assumption
debt actualization cost (k	5%		Annual report (last debt
Tax rate	17,00%		Annual report

Refinancing operations (M€)

	2009	2010	2011	2012	2013

5.2 Projection of cash inflow / outflow

Assets	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Surplus cash	947	-	-	-	-	-															
Operating FCF		1.000	1.100	1.150	1.185	1.220	1.257	1.294	1.333	1.373	1.414	1.457	1.500	1.546	1.592	1.640	1.689	1.739	1.792	1.845	1.901
Dividends		(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)	(300)
Liabilities																					
Interest expense		(673)	(625)	(563)	(519)	(462)	(418)	(361)	(317)	(251)	(194)	(158)	(136)								
Debt amortization		(1.100)	(1.400)	(1.000)	(1.300)	(1.000)	(1.300)	(1.000)	(1.500)	(1.300)	(800)	(500)	(3.100)								

5.3 Refinancing gap computation

Refinancing gap valuation

W/o capital changes	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cumulated liabilities	-	1.773	3.803	5.422	7.328	8.919	10.793	12.348	14.382	16.191	17.472	18.426	21.949	22.331	22.678	22.986	23.251	23.471	23.641	23.756	23.813
Cumulated FCF	947	1.647	2.447	3.297	4.182	5.102	6.058	7.053	8.086	9.159	10.273	11.430	12.630	13.876	15.168	16.507	17.896	19.336	20.827	22.373	23.974
Annual RG	947	(1.073)	(1.230)	(769)	(1.022)	(671)	(918)	(561)	(1.001)	(736)	(168)	203	(2.323)	863	945	1.032	1.123	1.220	1.322	1.430	1.544
Cumulated RG	947	(126)	(1.356)	(2.125)	(3.146)	(3.817)	(4.735)	(5.295)	(6.296)	(7.032)	(7.199)	(6.996)	(9.319)	(8.455)	(7.510)	(6.478)	(5.355)	(4.135)	(2.813)	(1.383)	161
Cost of the RG		1	14	21	31	38	47	53	63	70	72	70	93	84	75	65	53	41	28	14	-
Actualization factor		0,81	0,86	0,90	0,95	1,00	1,05	1,11	1,17	1,23	1,29	1,36	1,44	1,51	1,59	1,68	1,76	1,86	1,96	2,06	2,17
Actualized RG value		2	16	23	33	38	45	48	54	57	55	51	65	56	47	38	30	22	14	7	-

With capital changes	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Cumulated liabilities	-	1.773	3.798	5.361	7.180	8.642	10.360	11.733	13.577	15.189	16.266	17.006	20.307	20.458	20.564	20.621	20.626
Cumulated FCF	947	5.647	6.447	7.297	8.182	9.102	10.058	11.053	12.086	13.159	14.273	15.430	16.630	17.876	19.168	20.507	21.896
Annual RG	947	2.927	(1.225)	(713)	(935)	(542)	(761)	(379)	(811)	(539)	38	417	(2.101)	1.095	1.186	1.282	1.384
Cumulated RG	947	3.874	2.649	1.936	1.002	460	(301)	(680)	(1.492)	(2.030)	(1.993)	(1.576)	(3.677)	(2.582)	(1.396)	(113)	1.271
Cost of the RG		-	-	-	-	-	3	7	15	20	20	16	37	26	14	1	-
Actualization factor		0,81	0,86	0,90	0,95	1,00	1,05	1,11	1,17	1,23	1,29	1,36	1,44	1,51	1,59	1,68	1,76
Actualized RG value		-	-	-	-	-	3	6	13	16	15	12	26	17	9	1	-

	W/O	**ith (April)**
Intrisic RG value	701	117
Time value factor	1,27	1,27
RG value	**887**	**148**

5.4 Company valuation

Merton	Before Refinancing		After Refinancing		
Asset value	15.979		Asset value	19.979	
Debt Value	14.413		Debt Value	15.152	
Time to maturity	10		Time to maturity	4	
Risk-free rate	3%		Risk-free rate	3%	
Standard deviation of asset	14%		Standard deviation of	14%	
Equity	5.431	3,88 € per share	Equity	6.478	1,54 € per share
Debt	11.243		Debt	13.635	
ALRG	(695)		ALRG	(134)	

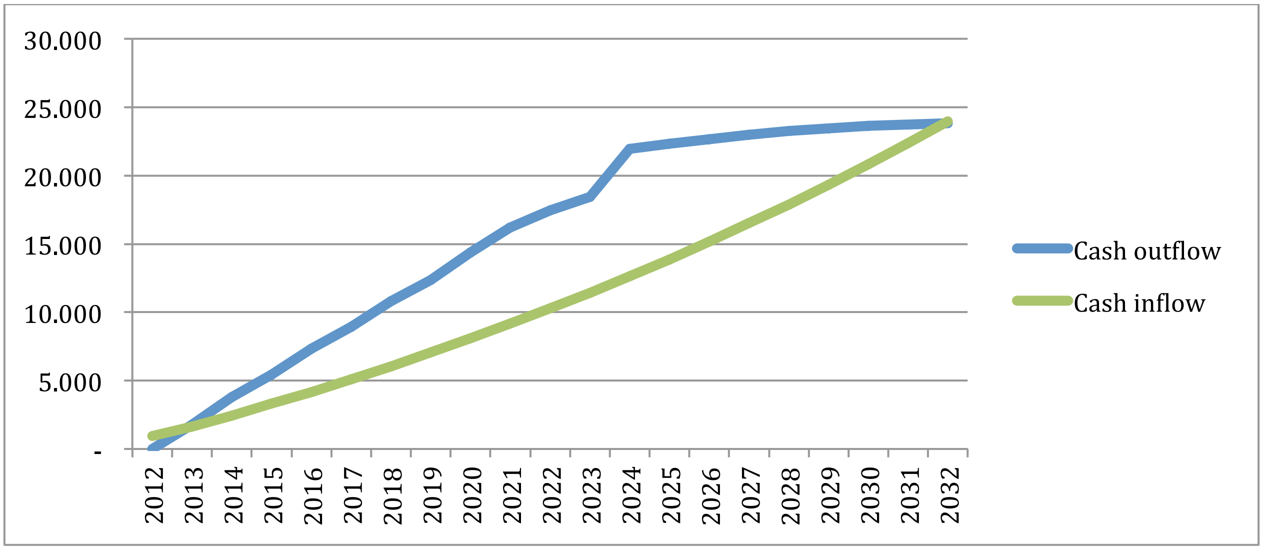
Creditgrades simplified					
Initial stock price	2,54		Initial stock price	2,54	
reference stock price	2,54		reference stock price	2,54	
reference stock valatility	27%		reference stock valati	27%	
debt per share	11,74568709		debt per share	3,69	
global debt recovery	50%		global debt recovery	50%	
SD default barrier	30%		SD default barrier	30%	
time	10		time	10	
Firm recovery rate	50%		Firm recovery rate	50%	
risk-free rate	3%		risk-free rate	3%	
CDS Spread	2,29%		CDS Spread	0,83%	
Equity	7.088	5,06 € per share	Equity	11.943	2,84 € per share
Debt	9.586		Debt	8.170	
ALRG	(695)		ALRG	(134)	

Creditgrades complete

Maturity	Spread	Face value	Real value	Maturity	Spread	Face value	Real value
1	11,32%	1100	958	1	0,39%	-2900	(2.817)
2	6,32%	1400	1.174	2	0,43%	1400	1.320
3	4,65%	1000	807	3	0,50%	1000	914
4	3,81%	1300	1.010	4	0,57%	1300	1.150
5	3,30%	1000	748	5	0,63%	1000	855
6	2,96%	1300	937	6	0,69%	1300	1.074
7	2,72%	1000	694	7	0,73%	1000	798
8	2,53%	1500	1.003	8	0,77%	1500	1154,63892
9	2,38%	1300	838	9	0,80%	1300	965,604699
10	2,27%	800	497	10	0,83%	800	573,311372
11	2,17%	500	299	11	0,86%	500	345,691091
12	2,09%	3100	1.788	12	0,87%	3100	2067,72048
Equity	5.922	4,36 € per share		Equity	11.713	2,81 € per share	
Debt	10.752			Debt	8.400		
ALRG	(695)			ALRG	(134)		

5.5 Refinancing exposure illustration

Before the refinancing operations



After the refinancing operations