Master Thesis
On the Valuation of distressed firms
A conceptual framework and case application

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August 2014
Abstract

This research study introduces a valuation model that adapts the traditional valuation models to the specific circumstances of firms that are in the declining stage of the maturity lifecycle and also find themselves in financial distress. The model is based on the traditional valuation methods and attempts to correct for the limitations by adapting the methods to account for the special characteristics of firms in this particular situation. The analysis shows that one of the main factor distorting the analysis of the traditional valuations methods is the incorrect treatment of the risk of default. In order to consider this risk, this study proposes a model that estimates the risk of default, using a probability of default estimation model based the Black and Scholes theorem, and incorporates it in the traditional valuation method. The adapted model is then applied to the case of the Eastman Kodak company in the years before its bankruptcy. It is found that the model yields accurate results that are in range with the market valuation but that it’s also highly sensitive to the input parameters.
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1 Introduction

Valuations are an integral part of the business environment and are needed for a wide range of reasons, from investment analysis to financial reporting. However, performing an accurate valuation is more an art than a science. In the search for the fundamental value of a firm, many obstacles are in the way. Although thousands of models and adaptations exist, modern asset valuation is predominated by three general approaches that are considered the Traditional Valuation techniques, namely:

- the discounted cash flow valuation (DCF)
- the relative valuation
- the option pricing valuation

These established methods have found wide application not only among academics but also among practitioners [Petersen and Plenborg, 2012]. Nevertheless, there is growing evidence that these traditional methods fail to provide an accurate picture in certain scenarios. One of these scenarios is firms that operate in volatile conditions and face future uncertainty. This is because most of the traditional methods have been designed for healthy firms with stable growth prospects and break down when these assumptions are violated [Damodaran, 2009]. Firms face uncertainty throughout their entire life cycle. However, uncertainty is greater during the start-up phase and the declining stage of the company’s industry life cycle, when the future chances of survival of the firm are not fully predictable. Yet, when it comes to firms in decline, these challenges are magnified owing to the worsening financial conditions and distress that normally accompany decline [Grant, 2010]. As a consequence, firms that are in their declining stage, and also face financial distress, are among the most difficult assets to value. Considering the poor performance of traditional valuation methods in volatile and uncertain environments, this raises the question of whether the traditional valuation methods are appropriate metrics to use for firms that are both in decline and
in financial distress.

Hence, the traditional valuation methods fail to account for the main characteristics of many of the declining and distressed firms and therefore provide very biased results. These include, among others, issues of limited applicability or biased treatment of risks. Also, the very definition of the traditional methods, in particular the DCF method, defines that the firm will never cease operations. Therefore, these methods fail to account for the risk of default, resulting in the need for a new valuation framework that specifically addresses the issue of bankruptcy risk and other characteristics of firms in decline and distress.

In order to address these issues, a model is presented that specifically addresses the various issues and risks faced by this kind of firm. The model will adapt for the identified issues and deal specifically with the risk of default in a separate variable, tailored to the firm’s characteristics. The model will be based around the following equation:

\[\text{Value} = \text{Value}_{\text{GoingConcern}} \times (1 - p_d) + \text{LiquidationValue} \times p_d\]

The main idea behind the model is that the firm’s value is given by the average of the firm’s value as a going concern, i.e. the firm will continue to exist and its liquidation value, i.e. the firm’s defaults, weighted by the firm’s probability of default. Both the going concern value and the liquidation value are adapted to the particular challenges faced by firms in decline and distress. The probability of default is carefully derived using a metric called Distance to Default which is based on the Black-Scholes-Merton Options Pricing Model. Lastly, the model is applied to a case in order to demonstrate its advantages.
1.1 Problem formulation

While the dominant valuation methods have proven to be very reliable for healthy companies with stable future growth prospects, they struggle to yield accurate results for companies that face extreme volatility and uncertainty, such as firms in decline and distress. Several research studies found major deviations in the results from traditional valuation techniques for these kind of firms. The limited applicability of the traditional methods for firms in decline and distress is caused by the fact that the characteristics of these firms violate some of the fundamental assumptions of these methods. Consequently, these methods have shown poor results for firms that operate in uncertain environments and/or violate some of the main underlying assumptions of the methods. The use of traditional valuation methods in volatile and uncertain scenarios is therefore questionable. As a consequence of the limited applicability, practitioners are ever more willing to abandon the traditional valuation approaches and rely increasingly on new paradigms based primarily on personal assessments to value distressed securities. The use of personal judgement and new paradigms instead of the traditional theoretical approach resulted in high variation in the estimates [Damodaran, 2009]. In fact, research conducted by Gilson et. al (2000) analyzed multiple valuation methods for distressed firms and obtained variations of up to 250% . Much of this variation originates from the fact that the traditional valuation methods ignore the possibility of default and assume that the firm will continue to exist into perpetuity. All in all, these factors indicate that use of the normal traditional valuation techniques is not optimal. However, an accurate valuation is particularly important for firms in decline and distress. When a firm is in this situation, many of the future strategies and courses of action they

\[\text{\textsuperscript{1}}\text{The authors analyze about 60 declining and distressed companies and value them using different valuation methods. The results they obtained were highly varied with standard deviations of up to five times from the mean, represented in this case by the market value. In their study this was the equivalent of a variation of between 20\% to 250\%. [Gilson et al., 2000]}\]
take to turn around or alleviate distress are built upon an initial valuation of the firm. Decisions about the future of the company and strategies such as refinancing, the sale of certain divisions or the whole company, raising new equity or the evaluation of liquidation are all dependent on accurate initial valuation [Houlihan and Lokey, 2011]. Furthermore, distress, once the preserve of specialists, is now attracting the mainstream. The field has benefited from growing interest as an alternative investment from actors such as hedge funds and private equity investors.

Consequently, there is a need for a more accurate valuation approach for firms in decline. In other words, an adaptation of the traditional valuation techniques is needed in order to make them applicable to uncertain and volatile scenarios. Such an adapted model would limit the use of new paradigms and personal judgements to the necessary metrics and would improve the overall valuation accuracy of hard-to-value firms.

1.2 Methodology

The aim of this study is to assess the limitations of traditional valuation techniques in a distressed-company scenario and to propose a model to correct for these distortions. Many models exist that can be used to value distressed companies. All of these methods have shown some very different results, also in the case of distressed companies [Damodaran, 2009]. This research study, however, seeks to establish a somewhat different approach which, although based on the traditional methods, specifically addresses the risk of default during the valuation process. Therefore, the objective of this thesis is twofold. The first objective is to analyze the applicability of traditional valuation techniques to firms in decline and distress and to identify the most common problems encountered in declining and distressed firms. Hence, a full analysis and review of the traditional models will be performed. The second objective is to identify possible solutions to these problems and to introduce a model that tackles the characteristics of firms in decline and dis-
tress. This adapted model will be presented in detail and applied to a real life case.

1.3 Structure

The study is structured as follows. First, a general overview of distressed and declining firms will be presented and their main characteristics highlighted.

Second, the predominant traditional valuation methods will be introduced and their major drawbacks when applied in a distressed valuation scenario will be analyzed.

Third, a valuation approach will be introduced, based on traditional valuation techniques, but will include certain adaptations to account for factors that play an important role when valuing declining firms with an uncertain future. Fourth, the proposed valuation model will be applied to the case of the Eastman Kodak company in order to perform a brief valuation. The valuation will be underlined with a brief analysis of the results obtained from the valuation model.

Finally, the research study will conclude with a presentation of the limitations of the study, recommendations for future research and a brief summary of the main findings.

2 Decline and Distress

Not all declining firms are distressed, nor are all distressed firms in decline, but in many cases distress and decline go hand in hand. In general, there are different stages in each of these conditions. The effects range from simple financial issues such as cyclical liquidity problems, to severe and close-to-bankruptcy cases [Grant, 2010]. Hence, the resulting impact on operations and ultimately on the firms’ value also vary substantially. The following section attempts to identify the major characteristics of firms in decline and firms in distress. Throughout this analysis, it also will highlight the attributes of the firms that will be analyzed in this study. Thus, first the characteristics
of a company in decline will be highlighted, followed by a short analysis of the main reasons and outcomes of decline. Then, the different types of distress will be presented, followed by an introduction of possible strategies for firms in distress and decline. Finally, the characteristics of decline and distress that will compose the scope of this study will be defined.

2.1 Decline

Throughout the maturity life cycle, companies in their growth stage constantly try to innovate to continue growing and to avoid becoming a mature company, while mature companies try to stretch their maturity as long as possible to avoid entering the declining stage. Some companies, like Coca Cola, have successfully stretched their maturity stage over decades, while others, inevitably, end up declining. The reasons for decline are numerous, and normally decline is triggered by various factors occurring at the same time. A company’s decline normally begins with changing industry conditions such as the emergence of substitutes and technological innovation. In many cases, human factors such as managerial errors are to blame for failing to innovate in new products and failing to anticipate the change in the market and in consumer behavior [Grant, 2010]. In addition, external factors such as a bearish economy and depressed capital markets can aggravate the situation. All these factors will eventually affect the company’s sales. Consequently, the drop in sales will result in both falling cash flows and poorer operating performance. In the beginning, the difference between these stages is narrow, but over time the main characteristics become more visible. There are several issues that characterize the situation of declining companies. Although not necessarily applicable to all cases, some of the main factors that accompany decline are the following [Damodaran, 2009]:

- **Stagnant or declining revenues**: One of the main signs of a declining company is its inability to increase revenues over an extended period of time, even if market conditions are generally positive.
• Shrinking or negative margins: In many cases the inability to increase revenues comes with declining profit margins. This is a result of the loss of pricing power and a reduction in the pricing level to keep revenues from falling further.

• Asset divestitures: As the debt burden of declining companies increases there is a strong pressure to divest assets to meet upcoming debt obligations. In addition, since the assets are not at their optimal use, a logical step is to sell these assets.

• Financial Leverage: With declining revenues and falling profit margins, the declining company faces great challenges to meet its liabilities. In addition, due to the higher risk involved, it is usually difficult for the company to refinance its debt because the firm’s cost of borrowing capital will usually increase, significantly limiting the possibility of raising new capital.

• Liquidity Constraints: The reduction in revenues, combined with an increase in the Net Working Capital level, will result in lower free cash flows and therefore reduce the liquidity of the firm.

As previously mentioned, there are several stages in the decline process. The first stage of decline is normally triggered by strategic issues. Since mature companies normally have a healthy cash position, in the beginning the company still has multiple options to act on the above-mentioned issues and to turn around their situation. However, as these issues become more pressing they increasingly affect the company’s ability to take action. If not acted upon, this will result in the main problems becoming more financial, for example, liquidity problems and leverage issues. In general, the response to decline is of both a strategic and financial nature. However, the longer the firm is in decline, the more financial the response will be. A firm that suffers from all of the above-mentioned issues, will normally have to secure their financial position before they can tackle their fundamental strategic
problem [IDW, 2012] [Grant, 2010]. This study focuses on firms that suffer from all of the above-mentioned issues but which are still in the position to continue operations as a going concern for a certain period of time, but the risk of bankruptcy is existent. In other words, the firms do have turnaround potential but if nothing is changed the firm may go into bankruptcy or be liquidated.

2.2 Distress: Financial and Economic

Overall, there are two different types of distress, economic distress and financial distress. While a mature company still derives a significant part of its value from growth investments, the declining company obtains almost no value from their new investments and basically lives off its existing assets. In many cases the company actually loses value from their growth investments due to investment return rates below the cost of capital of the company. In that case, the company’s net present value as a going concern is less than the total value of its assets. This means that the business is no longer viable or, as the academic literature defines it, it has become economically distressed. In this situation, the assets are not in their highest value use and it would be more beneficial for the company to close down its operations and divest its assets [Crystal and Mokal, 2006] [Damodaran, 2009].

This situation is not to be confused with financial distress. A firm that is financially distressed could be highly profitable, but the distress comes from insolvency, i.e. illiquidity. This is defined as having difficulties in meeting liabilities such as interest payments or other contractual obligations when they arise. If merely financially distressed, the company is still economically viable and its assets might be in their highest value use. Financial distress can have serious consequences, which are normally categorized as direct and indirect costs. If firms are unable to meet their debt payments they are normally forced to liquidate their assets at bargain prices and use the proceeds to pay off debt. In this scenario it is very unlikely that there is any value left for the equity holders.
However, the costs go beyond those costs associated with liquidation. The image of distress can seriously damage the firm’s operations since employees, suppliers and lenders are more cautious in their relationship with the firm. Firms that are in distress have much higher employee turnover, lose more customers and face higher restrictions from suppliers than healthy firms. A study by Andrade and Kaplan (1998) shows that these indirect costs can amount to 10% - 23% of the firm’s total value [Andrade and Kaplan, 1998]. The magnitude of the impact of these indirect costs has a severe impact on the firm’s value.

A company in economic distress will eventually, if nothing changes, end up in financial distress. Therefore, the primary scope of this study will relate to firms in a situation of financial distress, but which are still viable as a going concern. This means that there is a considerable threat of bankruptcy, but this threat is not imminent and can be avoided.

2.3 Strategies for Declining and Distressed Companies

When a firm is in a situation of decline and distress, it can usually follow several strategies. The choice of strategy depends on the economic situation of the firm, i.e. if the firm is expected to be economically viable in the future. Furthermore, the choice of possible strategies is an area of conflicting interest between the equity holders and the debt holders due to a fundamental misalignment of interest. From a certain level of distress, when debt exceeds equity, the equity holders normally do not receive any payoff in the event of liquidation. In that case they will try to engage in risky investments in order to return to profitability. Increased risk, however, is not in the interest of the debt holders, who see an increase in their recovery rate decreasing. In any case the company drafts a restructuring plan in order to analyze whether the company can return to financial health. The restructuring plan normally includes a full valuation of the firm. Based on the outcome of this analysis, the firm has, among others, the following possibilities:

• Liquidation
- Divestment
- Restructuring

**Liquidation**  If the company is expected to be no longer viable, then the conventional strategy recommended is to either liquidate all the firm’s assets (divest) or to generate the maximum cash flow from existing investments without reinvesting (harvest). Again, the choice between these two options is dependent on several factors. If the firm is able to extract any value from the assets, then it will normally harvest. On the other hand, if the industry is inherently unprofitable then the better choice will be to liquidate. However, the choice is not always in the hands of the firm. If the distress is severe, then there is the risk that the liquidation will be forced through litigation. In general, both strategies assume that the declining industries are unprofitable. If profit potential exists, then other strategies may be attractive [Grant, 2010]. If the firm is to be liquidated, the value will normally be estimated using the liquidation approach.

**Divestment**  The divestment of some, or even all, assets of the company can be a viable strategy in a distressed and decline situation. Partial divestments form a fundamental part of a company’s restructuring efforts, aimed at repositioning the firm strategically. In addition, it is a common measure to alleviate the financial condition of the firm and/or to finance the restructuring cost. Another option is the sale or a merger with a strategic investor. The goal in this situation, apart from the usual motivations for mergers and acquisitions, is to regain competitiveness through the exploitation of synergies.

**Restructuring**  If the company, or at least parts of the company, are still economically viable, then restructuring the company is a good strategy in order to return to financial health. As mentioned before, in many cases the shareholders prefer this option over liquidation. Depending on the risk
involved, this option is not in the interest of the debt holders. In general, restructuring efforts assume future improvement in both sales and margin in the beginning and then a return to the industry average. If the restructuring efforts are successful in the first five years then the firm is highly likely to continue to exist in the future. Hence, the risk of bankruptcy vanishes with the increasing success of the turnaround.

The choice among these alternatives is dependent on the financial situation of the firm. In the worst case scenario, when the firm is almost in bankruptcy, liquidation is forced by the debt holders through litigation. With an improving financial situation the firm can opt for the other alternatives. This study will focus primarily on valuation surrounding restructuring efforts. The main idea is to introduce a valuation model that accurately predicts the value of the firm so that the decision-making grounds between divestment, liquidation and restructuring can be improved.

2.4 Scope of this Study

As highlighted in the previous section, decline and distress tend to go hand in hand. What this study will not focus on, however, is on firms that are merely in low financial distress, i.e. have liquidity problems due to growth but which are otherwise profitable. The main characteristics of the companies analyzed in this study are falling revenues, i.e. negative growth and financial difficulties resulting from this negative growth. It has to be noted that the firms analyzed in this study are not bankruptcy cases. They merely face the risk of bankruptcy if the financial condition of the firm does not improve in the medium term. Therefore, throughout this study the term distress and decline will be used interchangeably to determine a company with the previously mentioned characteristics. The term distress and decline throughout this study will describe a firm in the following situation.

*The situation in which firms have fast-declining sales revenues and smaller margins and therefore face the future risk of difficulty in making their interest payments and meeting other contractual obligations*
3 Traditional Valuation Methods

The academic literature offers a wide range of studies and articles about different valuation techniques. At the same time there is considerable amount of articles dealing with declining, financial distress and the risk of bankruptcy. However, there are very few research studies that combine these two topics and explicitly deal with the valuation of declining and distressed companies. Some of the most notable works on this topic are single chapters of books on valuation or bankruptcy, by authors such as Damodaran (2009) Arzac (2008) and Scarberry (1996) [Damodaran, 2009] [Scarberry et al., 1996]. Apart from these, there is also an important research stream within the field of accounting that analyzes the difference between the book value and market value of assets for loss-making firms [Collins et al., 1999] [Hsu and Etheridge, 2009]. While there are hundreds of approaches to valuing distressed firms, this study will focus exclusively on the use of traditional valuation techniques based on the following models:

- Intrinsic Valuation
- Relative Valuation
- Option Pricing Valuation (Asset Based Valuation)

These three approaches can yield very different estimates of value for the same asset and at the same point in time. Depending on the circumstances and the characteristics of the asset, one method might be more applicable than the others but they are usually used to complement each other. All traditional valuation techniques can also be used in a distressed company setting, while they all have significant drawbacks. In general, all the traditional approaches face the same problem in a distressed scenario since they all assume that the company will continue to exist into eternity. For example, in both discounted cash flow and relative valuation, the mere assumption of the Terminal Value assumes that any financial distress is temporary and that the firm will not cease operation in the future. Nonetheless, this assumption
completely neglects the risk of bankruptcy and the possibility that the firm might liquidate and cease to exist. While there is a chance that the firm will manage to return to financial health, in a distressed scenario there is a significant risk that the expected future cash flows to the firm truncate because of bankruptcy or liquidation. Neglecting this risk in a valuation can severely overestimate the value of the firm. Moreover, including this risk in traditional valuation approaches can be very challenging.

While a full analysis of the traditional valuation methods is beyond the scope of this study, the following section will briefly analyze the problems of traditional valuation techniques in a distressed company scenario and highlight possible adaptations to account for the risk resulting from distress. Therefore, the three different approaches, namely intrinsic valuation, relative valuation and contingent claim valuation, will be presented and their applicability and limitations in valuing distressed companies in relation to the proposed model will be explained.

### 3.1 Intrinsic Valuation: DCF Method

The intrinsic value of an asset is the fundamental, theoretically-true value of an asset. It is normally estimated on the basis of its cash flows, growth potential and risk. Although multiple models to determine the intrinsic value exist, this study will focus on the most commonly used, namely the Discounted Cash Flow (DCF) method. In general, the DCF approach aims to
estimate the current company value based on the present value of the company’s projected future cash flows discounted with an appropriate rate such as the weighted average cost of capital (WACC).

"You can estimate the value of an asset as a function of cash flows generated by that asset, the life of the asset, the expected growth in cash flows and the risk associated with the cash flows. That principle remains intact for every business at every point in time, no matter how much uncertainty there is in the process.” Aswath Damodaran.

Although the DCF method is a popular and widely-used method, the problem with its application lies in the complexity of estimating the different inputs. A firm in financial distress has some or all of the following problems: negative earnings and cash flow, an inability to meet debt payments, no dividends, and a high debt/equity ratio. This makes it difficult to apply discounted cash flow methods to these firms. The solution to the problem depends, to a large extent, on how distressed the firm really is. If the distress is not expected to be fatal (in the sense of pushing the firm into liquidation), there are various potential solutions. If, on the other hand, the distress is likely to be terminal, finding a solution is much more difficult. An investor or analyst has to reliably estimate the following three aspects which are essential for any DCF analysis.

- Cash Flow Projections
- Terminal Value
- Discount Rate

Choosing appropriate inputs for the DCF analysis can be difficult. A minor change in any one of these variables can significantly affect the estimated value of a company. In the case of a company in decline this task can be particularly complex due to a number of reasons. The following section will
analyze each part of the DCF method and explain the complexities when applied in a distressed scenario.

### 3.1.1 Cash-Flow Projections

The DCF builds on a projection of the companies future cash flow for a lifespan of up to five years. For a company in decline this can be particularly difficult because one can normally not rely on the historical data to make these projections. However, if the restructuring plan makes detailed assumptions about cash flows during the transition period from distress to financial health, the discounted cash flow valuation may still be feasible. The accuracy of the value obtained from the analysis is clearly linked to the assumptions made about the probability of the transition from distress to health, the length of the transition period, and the projections during the transition period. On the other hand, many restructuring plans tend to be over-optimistic about the company’s turnaround potential and therefore overestimate future cash flows. In a normal case the discount rate adjusts for volatility in the cash flow. However, in the case of a distressed firm there is the risk that the firm will cease operation and essentially truncate the cash flows before reaching the end of the projection period. Since the DCF method is designed for healthy and growing companies, it does not take this risk into account. One possibility presented in the literature to account for this risk is to adjust the expected cash flows to reflect the likelihood of distress by lowering the expected cash flows. However, this would assume that in the event of distress the distress sale proceeds would be equal to the present value of the expected cash flows [Damodaran, 2009]. Furthermore, this would not truly reflect the actual likelihood of distress but merely reduce the value of the firm.

### 3.1.2 Discount Rate

Thus, the appropriate discount rate has to be estimated. As previously mentioned, the discount rate adapts for the volatility in the firm’s estimated future cash flows and discounts them to today’s value. This discount rate is
usually estimated using the weighted average cost of capital (WACC), which represents the return that a hypothetical investor would demand from an investment in the company, based in part on the company’s relative debt/equity ratio. In other words, it is the average of cost of debt and cost of equity weighted by the companies debt/equity ratio. There are several problems when computing the WACC for distressed firms.

When computing the WACC the main problem is that the presence of high leverage has a strong impact on both the cost of equity and the cost of debt. The cost of debt normally increases in relation to the likelihood of distress, as can be seen in the rating for the junk bonds of rated firms. On the other hand, as the debt/equity ratio increases, the cost of equity also increases, as equity investors see much more volatility in earnings. Furthermore, when estimating the WACC of declining companies for a DCF analysis, it must be taken into consideration that their debt/equity levels do not remain constant over time. Therefore, to avoid biased results from the DCF analysis, the discount rate needs to be recomputed various times to adapt for this change. This issue is normally not taken into consideration in the usual DCF method. For highly leveraged firms, the WACC method will generally result in a very high discount rate, which might undervalue the company.

In addition, there are considerable estimation issues regarding the cost of debt and equity. Many models build upon book value weights for debt and equity for computing the cost of capital. While this may be a very stable and dependable estimation metric, it may lead to meaningless results because most of the financing was raised when the company was in a healthy condition. Therefore, it does not reflect the true cost of capital in a distressed scenario, since it tends to underestimate the cost. On the other hand, when the market interest rate for debt is used, the cost will be skewed upward, since the market will demand a premium for distress. Furthermore, several academics [Damodaran, 2009] argue against the use of Yield to Maturity for distressed firms because, by definition, it is based on promised cash flows rather than on expected cash flows. They argue that to make up for the
difference, a stratospheric yield will be necessary. A possible solution is the use of Default Spread on Bond ratings. Here again, the question of which instrument truly reflects the risk-less rate is up for discussion.

The cost of equity for the WACC is normally computed by means of the Capital Asset Pricing Model. When computing the $\beta$ for the CAPM, in many cases a regression $\beta$ is used. However, regression $\beta$, particularly in distress cases, normally tend to lag behind in terms of adjusting for increased risk of higher leverage, because they are estimated over long periods of time. A possibility for adjusting for this lagging is the use of unlevered $\beta$.

### 3.1.3 Terminal Value

Finally, the terminal value, which represents the value of the cash flows after the initial projection period into perpetuity, discounted to today’s value, poses a major challenge. Making a good estimate of the terminal value is critical since it constitutes a major part of the DCF model. The impact of the terminal value in a distressed valuation is particularly important because the firm derives a major part of the total value from the fact that it will exist in the future. The terminal value is usually calculated by applying the enterprise value multiple approach, the perpetual growth rate model or the liquidation approach. Similar to the Relative Valuation, the Enterprise Value multiple approach derives the terminal value by comparing the firm’s value to the market multiples for comparable firms, such as earnings, revenue or book value multiples. The idea behind the perpetual growth model is to estimate a growth rate of the firm’s cash flows that the firm can sustain into perpetuity. The liquidation approach assumes a liquidation of all the firm’s assets in the terminal year and the terminal value is derived by estimating the market value for all the assets in the final year. Each of these methods pose some major difficulties when applied to declining firms and distressed firms. First of all, when a company has negative earnings some of the enterprise multiples, such as earnings or EBIT, cannot be used since the model requires positive multiple values. Second, some firms will never be able to reach
the stable growth stage again and will default or be liquidated before the Terminal Value period is reached. Even if the company is able to survive, there is the risk that the growth rate will be below inflation, or even negative, and therefore the firm continues to decline. Third, declining and distressed firms normally have returns that are below their cost of capital, and there is the risk that they will not be able to improve their situation. In the short run this scenario has a direct negative effect on the reinvestment rate and the Terminal Value. However, if the situation is expected to continue into perpetuity, it will increase debt levels and may consequently cause terminal values to implode. Lastly, The liquidation value approach can be used to derive the terminal value. However, when applied conservatively, this metric represents the lower end of the valuation range and will possibly result in undervaluation.

3.2 Relative Valuation

The relative valuation approach seeks to derive the enterprise value by using market-assigned prices, relative to the earning potential of comparable and publicly traded companies, as a benchmark for valuing the firm. Such a valuation can also be based on market transactions, such as financial investments or mergers and acquisitions. There are usually two steps in the relative valuation process. First, a financial performance metric, such as the EBITDA of the company to be valued, needs to be calculated. Thus, the multiple of a healthy and comparable company’s market-assigned enterprise values, relative to its corresponding EBITDA, must be determined. These two inputs are then multiplied to arrive at an enterprise valuation estimate of the company to be valued. The use of multiples to estimate the value of companies is simple and easy to relate to. In addition, they are particularly useful when there are a large number of comparable companies being traded on financial markets and the efficient market assumptions hold. The advantage of using the relative valuation method is that it is somewhat simpler than the DCF method. On the other hand, it is not as elegant and rigorous
as the DCF, and care must be taken to include only the most appropriate and relevant comparable firms, since no company is exactly the same in terms of risk and growth [Damodaran, 1998] [Koller et al., 2005].

The key is to select appropriate multiples and the most representative indications of financial performance for each particular case. In addition, for distressed companies it is important to decide which financial period the valuation should be based upon, since extraordinary levels will not yield an accurate estimate. During the selection of appropriate market multiples, the evaluation of multiples of comparable public companies and M&A transactions must take the specific risk characteristics of the subject company into consideration. In the case of a distressed company these risk factors tend to be greater and of bigger importance. Therefore, when calculating the company’s revenues, earnings and cash flows, the historical levels must often be adjusted to reflect for previous mismanagement and corrections associated to the restructuring efforts. In addition, most relative valuation approaches typically assume a normalized level of working capital, as the multiples themselves are generally derived from healthy public companies with normal working capital. The problem is that many of the factors that lead to a reliable estimate of value in the relative valuation method are very difficult to define. This is due to a number of reasons.

First, the best option for valuing distressed companies would be to only include distressed comparable firms in the analysis. However, a large pool of comparable firms are needed to make reliable relative valuation estimates. Identifying firms that are comparable, and at the same time distressed, can be very difficult. The comparable firm’s multiples for distress can be corrected. This is done by adjusting the multiple values for the default risk, by using rating models for example. In addition, a subjective discount can be applied to the comparable multiple in order to account for the risk of distress. An analyst can therefore reduce the healthy firm’s multiple by a certain percentage to adapt for decline and distress. However, particular care must be taken when choosing the magnitude of the discount, since no standard ap-
proach exists for this practice. When using this approach, it is recommended that the multiples are used on projected metrics, as it is assumed that the firm will return to an industry average, making a relative valuation easier.

Secondly, applicability of the relative valuation methods is somewhat constrained if the subject company is in decline and distress. Because multiples like Price/Earnings and Price/Book ratios only work with positive numbers, other methods have to be used, which directly limits the application base. When valuing distressed companies, depending on their situation, analysts have to move up the income statement and use the first positive metric they find. Therefore, the use of revenue and EBITDA multiples is much more frequent when valuing distressed firms. Thirdly, in some cases there is a reduced control mechanism by the capital markets because highly distressed firms trade less frequently and, in general, very little analyst coverage is given. The reduced existence of market forces makes a multiple-based valuation more complex and less precise [Damodaran, 2009] [Hotchkiss et al., 2008].

All in all, the relative valuation approach can only be used in a distressed scenario when lots of personal judgement and predictions about the comparable firms is included. This will eventually lead to biased results owing to the human factor. However, this method is very useful as a complement to other valuation methods and acts as a control mechanism.

3.3 Option Pricing Valuation

The Option Pricing Valuation approach is based on the Option Price theory introduced by Black and Scholes (1973). The concept behind the Option Pricing Valuation is based on the idea that equity has very similar characteristics to a call option on the firm; i.e. equity can be seen as a call option on the firm’s assets, with debt as a strike price. The limited liability feature of equity suggests that the equity holders have the right, but not the obligation, to pay off the debt holders and take over the firm’s remaining assets. This in turn means that the debt holders and holders of other liabilities actually own the firm until the liabilities are paid off [Black and Scholes, 1973]. The char-
acteristic of an option is that it pays off only under certain circumstances. This approach can be used to value almost any asset that has option-like features, including companies. In that sense, the equity of a company can be valued as a call option on the company’s assets, with the face value of debt representing the strike price and the term of the debt measuring the life of the option [Frey and Schmidt, 2009]. The fundamental idea behind using option pricing models is that discounted cash flow models usually tend to understate the value of assets whose payoffs are dependent on the occurrence of a certain event. Therefore, a major advantage of this method is that option pricing models make it possible to value companies that are hard to value, such as the distressed and declining companies of this research study, whose economic outlook is normally contingent on certain events.

However, the main problem with the Option Pricing theory is that, by definition, option pricing models derive their value from an underlying asset. Thus, to conduct an option pricing analysis, a valuation of the underlying assets has to be performed first. It is therefore an approach that has to be used in combination with other valuation methods, or by using market values [Damodaran, 2009]. While the use of Option Pricing theory as a main valuation tool is limited, there are several other very interesting characteristics that play a role in valuing distressed firms.

One of the most interesting insights in viewing equity as a call option on the firm’s assets comes to light when valuing highly distressed firms. In an Option Pricing Valuation the value of equity will always be positive, even if the value of the firm falls way below the face value of debt. Even if the firm is considered to be troubled, it will never be worthless. The concept behind this idea is similar to giving value to a deep-out-of-the-money option because of the possibility that the value of the underlying asset may increase above the strike price or, in this case, above the face value of the debt before it comes due [Damodaran, 1998]. Therefore, option pricing valuation allows us to take aspects such as restructuring efforts into account and to assign a value based on their probability of success. Finally, using the main idea and concept
behind this theory, not only the equity can be derived but also other variables such as the underlying value of the asset, i.e. the value of its debt and also the underlying volatility of the assets/firm. The underlying volatility can then be used to determine other factors, such as the company’s probability of default. This concept is based on the Black and Scholes Options Pricing model and will be explained in more detail when the Adapted Valuation Model is introduced later [Crosbie and Bohn, 2003].

3.4 Liquidation approach

There are differing arguments when it comes to using the liquidation approach in valuation, and its definition as a main method among the traditional valuation methods. However, due to the important role of this method in the distressed company scenario, and the model of this research study, the liquidation approach is presented in this section.

In theory, the liquidation value is determined by the difference between the book value of assets such as the real estate, fixtures, equipment and inventory owned by a company and the market value they can fetch upon sale. It must be noted that, contrary to a normal sale of the company, intangible assets are not included in a company’s liquidation value. In general, there are two possible liquidation scenarios. In the case of severe financial distress the debt holder can call for forced liquidation through litigation. In this case, operations are immediately shut down and the company’s assets are liquidated in a "fire sale". In this scenario the company is only able to fetch a distressed price due to the lack of bidders in the auction process. In the other situation the company is not in immediate distress but the liquidation value is just higher than the aggregate future income or free cash flow to the firm. In this case the company can be liquidated in an orderly fashion. Here the company has enough time to maximize the proceeds of its assets via an orderly liquidation. Additionally, the business can still generate income while its orderly liquidation is underway, and this income also needs to be taken into consideration when estimating value. Therefore, the orderly liquidation value
is generally much higher than the distressed liquidation value [Kahl, 2002] [Petersen and Plenborg, 2012].

Liquidation plays an important part in distressed companies. A company is normally liquidated when its assets would yield a higher value in a sale than the present value of its future earnings and cash flow potential. It is therefore a logical and common choice when the company is in economic distress, i.e., the company’s assets are not in the highest value use. Nevertheless, as previously mentioned, a liquidation can also be forced through litigation by the debt holders. In general, the value obtained through a liquidation represents the lowest end of a company’s value range and normally represents the most unfavorable scenario for the equity holders [Brown et al., 1994]. However, due to the possibility of being forced into liquidation by the debt holders, it has to be considered an important risk and must be included in the valuation.

Estimating the proceeds from a liquidation is very difficult because it ultimately depends on how the market values the assets. This in turn is dependent on the state of the economy and the asset specificity but also on the company’s situation and the way in which the assets are liquidated. In any case, the loss suffered by investors in the event of default is considerable. Again, both the amount at risk, or loss given default, is dependent on the type of investment and is ultimately determined by the particular contract or obligation. However, while debt investments such as loans etc. have a recovery rate of between 50% to 89%, equity investments have a much lower or, in many cases, a 0% recovery rate. Assessing the different factors affecting the liquidation value is a research field by itself and is also out of the scope of this study. There are several ways to derive a possible liquidation value. One of the most common ways to estimate the liquidation value is to use the book value of assets and to assume a discount depending on the previously-mentioned factors. However, using the book value, which represents the amount the company invested when it was in a better situation, tends to be over-optimistic. To correct for this, the discount factors have to be chosen
carefully. Another option is to derive the liquidation value, similar to the DCF approach, by discounting the cash flow generated by the assets, but with no growth prospects. Although a reasonable option, this method should not be used in the scenario of a company in decline since these firms tend to have negative growth rates and therefore the method would overvalue the assets. The discount on the book value of assets is, in this case, the better option.

### 3.5 Other Factors in Distress

The magnitude of the effects that distress can have on the firm’s operation is considerable. While a full analysis of the impact of distress on the firm’s condition is beyond the scope of this study, there are a few factors that worth mentioning. Since the effects of distress vary across industries and are, in general, influenced by the unique factors of each firm, they cannot usually be generalized and have to be considered on a case by case basis. However, there are certain issues that come up more frequently. First of all, when making estimates regarding cash-flow projections several issues must be kept in mind. In declining and distressed companies, working capital levels are often substantially distorted because of liquidity problems. When analyzing such a company, cash-flow impacts of such irregularities must be taken into account, as the return to normal NWC levels can strongly affect the cash position, which, in turn, will affect the value of the company. It is also important to note that the tax benefits of debt can only be captured when there is enough income to cover the interest expenses. Highly distressed firms that have negative earnings, therefore, can not exploit those tax benefits. This fact also has to be considered when calculating the WACC, since tax benefits are normally included in the cost of debt [Damodaran, 2009]. Second, the cost of distress is not only quantitative but also involves qualitative factors such as hidden costs. Among others, these include loss of reputation among stakeholders, unmotivated employees and depressed relationships with clients. Various studies have analyzed these hidden costs and estimated them
to be in the range of 10% to 20% of the value. Therefore, the impact of these hidden costs on the firm’s value also have an impact on the risk of default and have to be accounted for in the valuation [Almeida and Philippon, 2006] [Andrade and Kaplan, 1998].

4 The Model

The goal is to develop a model that adapts the traditional valuation techniques in order to include the risks faced by distressed companies and, most importantly, the risk of default. There are several ways to incorporate the effects of this risk into the estimated value of the company. The most widely-used methods for companies with distinct features include, among many others, the modified DCF approach, the Adjusted Present Value approach, the Simulation approach and the Relative Valuation approach. Every company has unique features that must be taken into account when making a valuation. Depending on these features and characteristics some valuation methods offer certain benefits over others. All of these methods have shown some very distinct results, also in the case of distressed companies [Damodaran, 2009]. This research study, however, seeks to establish a somewhat different approach that, although based on the traditional methods, specifically addresses the risk of default during the valuation process. This method separates the going concern assumption from the bankruptcy situation which is represented by a distressed sale. The idea is to capture all the risk associated with decline and distress in the probability a forward-looking default metric which is then used to weigh between the going concern value and the liquidation value. The following equation (1) summarizes the main idea behind the model:

\[
FirmValue = EV_{GoingConcern} \times (1 - p_d) + LV_{Distress} \times p_d
\]  

(1)

where \( EV \) is the Enterprise Value of the firm as a going concern, \( p_d \) is the probability of distress and \( LV \) is the Liquidation Value of the firm in
a distress liquidation scenario. Separating the going concern value from the probability of distress allows for the use of traditional methods such as the DCF, including its assumption that the firm will exist into eternity, while at the same time pricing in the risk of truncated cash flows due to bankruptcy or liquidation. The model will use the DCF valuation method as an illustration, but in theory it can also be used with other traditional methods. In all cases it corrects for most of the issues identified in the previous section.

The main emphasis will be on adapting the DCF valuation but a possible adaptation of the relative valuation will also be presented. The probability of default will be estimated using a model introduced by Moody’s KMV, which is based on option pricing theory [Crosbie and Bohn, 2003]. In order to explain the variables and inputs in equation (1) this section will first determine the going concern value by adjusting the normal DCF model to account for the previously highlighted attributes of distressed firms and, second, will introduce a theoretical model to estimate the probability of default during the projection period and, third, will explain how the liquidation value is derived for companies in distress.

### 4.1 Going Concern Value

The main assumption underlining the Going Concern Valuation is that the firm will survive and return to financial health in the future. The going concern value, the value of the company with no default prospects, can be estimated using various traditional models. This research study will focus mainly on the DCF Valuation method. Since the risk of default is dealt with separately in this model, it is not necessary to include this risk in the cash-flow projections or in the discount rate. However, in order to make reliable estimates, it is important to take the issues identified in the previous section into account and include them in the calculations. The Enterprise Value will then be calculated using the normal DCF method.
\[ EV = \sum_{t=0}^{N} \frac{FV_t}{(1 + r_c)^t} + \frac{TerminalValue}{r_c} \]  

(2)

4.1.1 Cash-Flow Projection

When making cash-flow projections, it is assumed that the firm will manage to turn its operations around, from decline and financial distress back to profitability. This is normally accomplished through significant restructuring measures which will affect the growth prospects of the firm. To set this path to recovery, reasonable profitability measures have to be estimated. This is done by analyzing the firm’s historical operating margins and return on capital, and comparing them to the industry average. There are three important metrics that have to be estimated for the cash-flow projection, namely Revenue Growth, Operating Margins and Tax Rate. In general, it is assumed that restructuring measures will significantly depress revenue growth in the early years but that growth will pick up substantially thereafter until reverting back to the industry average at the mid-end of the projection period. Financial distress usually has a significant impact on Operating Margins. Here it is assumed that the restructuring efforts will gradually alleviate margins and continue to improve by linear increments back to the industry average. In many cases, the high leverage of firms in distress significantly reduces the effective tax rate. The tax rate is low in the beginning but increases as the firm’s situation improves [Damodaran, 2009] [Bodie et al., 2011] [Brealey et al., 2011].

Lastly, to estimate the free cash flow, the firm’s reinvestment rate over the projection period has to be estimated. The reinvestment rate for the company is highly dependent on the situation of the firm and its characteristics. However, due to the depressed financial situation, the firm will avoid reinvestments if possible and seek higher utilization from its past investments. Again, this is highly dependent on the firm’s situation and the goal of the restructuring plan. The benefits of postponing reinvestments is that there will be certain cash inflows from depreciation charges which will improve the
4.1.2 Discount Rate Calculation

The constant change in the capital structure of the company will have a direct effect on the discount rate. On its path back to financial health, the company’s capital structure is expected to change constantly because the reduction in leverage will result in a more favorable cost of capital. Improvement in leverage, although dependent on the restructuring plan, is most likely to be gradual over time, being greater in the beginning and then smaller as the company approximates the industry average. To include this change in the capital structure and the change in the cost of capital the different variables have to be re-adjusted several times over the projection period [Damodaran, 2009]. Table 1 outlines such a projection, including the necessary inputs.

<table>
<thead>
<tr>
<th>Year</th>
<th>Beta</th>
<th>Cost Equity</th>
<th>Cost Debt</th>
<th>Debt Ratio</th>
<th>Cost Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t$</td>
<td>$\beta$</td>
<td>$r_e$</td>
<td>$r_d$</td>
<td>$D/E$</td>
<td>$r_c$</td>
</tr>
</tbody>
</table>

The Discount Rate Calculation will be based on a normal WACC estimation. Therefore, both the Cost of Equity and Cost of Debt have to be calculated.

The Cost of Equity is calculated by identifying the unlevered $\beta$ of industry peers. It is important to use the unlevered $\beta$ in a distressed company scenario because it is more up-to-date than the regression $\beta$, while at the same time correcting for the impact of leverage, which in many cases can distort the results. To derive the firm’s normal $\beta$, it has to be re-levered by the firm’s Debt/Equity Ratio. To do so, the market value of both equity and debt have to be calculated. The market value of equity can easily be derived from the market prices. The market value of debt is more difficult to obtain
directly, since firms have a lot of non-traded debt, which is normally specified in book value terms [Brealey et al., 2011]. One possibility is to convert this into market value debt, to treat the entire book value of debt as one coupon bond. The coupon is set equal to the interest expenses, with an weighted average maturity of the short and long term debt, and then the coupon bond is calculated using the current cost of debt for the company. The following equation summarizes this procedure.

\[
Debt = InterestExpense \times \left[ \frac{1 - \frac{1}{(1+r)^n}}{r} \right] + \frac{FaceValueDebt}{(1 + r)^n}
\]  

(3)

Then, to derive the levered beta, it is multiplied by the Debt/Equity ratio and adjusted for the tax shield provided by debt. The levered or normal company \( \beta \) can therefore be derived by the following formula:

\[
\beta = \beta_{\text{unlevered}} \times (1 + (1 - r_{\text{tax}})) \times (D/E)
\]

(4)

Once the \( \beta \) of the company has been derived, the CAPM formula can be used to calculate the Cost of Equity [Bodie et al., 2011].

\[
re = rf + \beta \times (rm - rf)
\]

(5)

The Cost of Debt is derived by using the Default Spread on the company’s Bond rating. The reasons for using this method have been discussed in an earlier section. Depending on whether the firm is able to exploit the full tax benefits from debt, the Cost of Debt should also be adapted for these benefits. The Cost of Debt, including the tax shield of debt, is therefore calculated by the following formula:

\[
r_d = (rf + DefaultSpread) \times (1 - r_{\text{tax}})
\]

(6)

Finally, the Discount Rate used in DCF Valuation is based on the cost of capital derived by the WACC approach.

\[\text{Converting the debt into a single class of debt with the described characteristics will be useful when predicting the probability of default using the Black and Scholes model later in this essay.}\]
\[ r_c = WACC = \left( \frac{D}{D + E} \right) * r_d + \left( \frac{E}{D + E} \right) * r_e \]  \hspace{1cm} (7)

4.1.3 Terminal Value Calculation

In order to complete the valuation, after the projection period a terminal value is estimated that reflects the value of the firm from that point onwards. Because the firm is assumed to be in a healthy condition beyond the projection period, the Terminal Value can be calculated without major adjustments. There are several ways to calculate the Terminal Value. While the multiple approach or the liquidation approach could also be used in this case, the most suitable approach in this scenario is the stable growth model. This model is explained in the following equation:

\[ V_{terminal} = \frac{NOPAT * (1 + g)(1 - ReinvestmentRate)}{(r_c - g)} \]  \hspace{1cm} (8)

Then, by putting the projected Cash Flows, the Cost of Capital and the Terminal Value together, we can derive the Going Concern Value of Operating Assets using formula (2).

4.2 Distressed Liquidation Value

As previously highlighted, two methods are available for estimating the Distressed Liquidation Value of a firm. The choice between the two methods depends on the availability of information. The most practical way to estimate the distress sale proceeds is to consider them as a percentage of book value of assets. However, it is somewhat difficult to make a good assumption of the discount on book value applied ie. which percentage of book value is used. Normally, the value is derived from the experience of other distressed liquidation within the industry. There is a significant amount of information available regarding distressed firms, but since every industry is
different and every asset has its own characteristics, such information might not be applicable [Brown et al., 1994]. Besides, in many cases the assets of the company are very industry specific and can not be used for other business areas. Therefore, another method based on the concept of the DCF approach can be used to value the company’s assets. The main idea is that the asset’s value is determined by the future cash flows they can generate. Therefore, the average EBIT of the past years is calculated in order to reflect the earning power of the assets and is then discounted by the cost of capital. The following formula can be used to calculate the value of the company’s assets:

\[
\text{ValueOfAssets} = \left( \frac{EBIT \ast (1 - r_{tax})}{\text{CostofCapital}} \right)
\]

(9)

It has to be noted that no growth is assumed. This formula then derives the value that a healthy firm would be willing to pay for the company’s assets. While this approach is more accurate than just using the book value of assets, it does not reflect the loss in value the company might suffer because of the bad bargaining position in distress and other external factors. Depending on the situation of the firm and the economy certain discounts should be applied. Since the amount of discount is dependent on the characteristics of the firm, it has to be estimated on a case by case basis.

4.3 Probability of Default

The probability of default risk, as defined earlier, is the uncertainty about a company’s ability to service its debt and other contractual obligations. In normal economic conditions, company default is a rather rare event. A normal firm in an average financial condition has a default probability of 2% in any given year. However, these probabilities vary widely and ultimately depend on the firm’s economic and financial condition. While a firm in good condition, with an AAA rating for example, exhibits an average default probability of 0.02% per year, a firm in a worse condition, for example with
an CCC rating, already has a 4% default probability per year, i.e. almost 200 times the probability of the average healthy firm. Note that the probability of default is for a single year and that its cumulative if considered over multiple years.

Before an actual default, it is not possible to unambiguously distinguish between firms that will default and those that will not. However, certain aspects and characteristics have been identified that have a direct effect on the firm’s likelihood of default. These aspects generally include the Value of the firm’s Assets, and its Asset Risk and Leverage. A firm usually defaults when the market value of its assets is insufficient to repay its liabilities. Although not necessarily in every case, this default point is close to the point when the market value of assets equals the book value of debt. The aim of this section is to determine the likelihood of this scenario.

The previous section on the Option Valuation approach briefly introduced the idea that common equity can be seen as a call option on the firm’s assets. This concept is part of the Option Pricing Theory introduced by Black and Scholes (1973) and can be used to value the firm’s equity [Black and Scholes, 1973]. The idea is an interesting one since it allows for a wider application of the Option Pricing Theory in the valuation practice of the firm’s assets but also its liabilities. In that sense, apart from assets and liabilities, this theory can also be used to determine other variables [Merton, 1974]. In a model introduced by Merton (1974) and then later successfully commercialized by Moody’s KMV, the concept of option pricing theory is used to derive the value and underlying volatility of a company’s assets in order to determine a metric called the Distance to Default. The Distance to Default (DD) is a market-based measure of corporate default risk. The main goal of the model is to estimate the probability of the market value of a firm’s assets falling below the value of its debt, i.e. the firm will default over a given time horizon. Figure 2 shows the main idea behind the concept.
In practice, we need to take account of the more complex capital structures and situations that exist in real life. For example, we need to consider the various terms and nature of debt (for example, long- and short-term debt, and convertible instruments), the perpetuity nature of equity, the time value of money, and of course, we also have to solve for the volatility of the assets at the same time. Thus, in practice, we solve the following two relationships simultaneously:

\[ \text{Asset value and volatility} \]

\[ \text{are the only unknown quantities in these relationships and thus the two equations can be solved to determine the values implied by the current equity value, volatility and capital structure.} \]

3.2 Calculate the Distance-to-default

There are six variables that determine the default probability of a firm over some horizon, from now until time \( H \) (see Figure 8):

1. The current asset value.
2. The distribution of the asset value at time \( t \).
3. The volatility of the future asset value at time \( t \).
4. The level of the default point, the book value of the liabilities.
5. The expected rate of growth in the asset value over the horizon.
6. The length of the horizon, \( H \).

**Figure 2: Distance to Default**

The default point is, for estimation purposes, set to be equal to the book value of debt. The possible asset path is normally given by the return on the asset. The possible distribution range of the asset value at time horizon \( H \) can be obtained from the implied market values using the Option Pricing Theory. The entire procedure will be presented in the next section. Lastly, the model can then be calibrated using the market value of the assets and the observed (or implied) equity price volatility in order to derive the Distance to Default. Equation (10) summarizes this idea.

\[
\text{Distance to Default} = \frac{\text{Market Value of Assets} - \text{Default Point}}{\text{Market Value of Assets} \times \text{Asset Volatility}} \tag{10}
\]

Finally, while the concept behind the Distance to Default is used in the model, this study will focus on the probability of default, which is closely associated to the Distance to Default. When assuming normal distribution, it can easily be obtained by the normal cumulative density function of a z-score, depending on the firm’s underlying value, its volatility and the face value.
The Distance to Default is a widely-used and popular method which has found successful commercial application by institutions such as Moody’s KMV, and has also been used in governmental institutions such as the Danish National Bank (2004) [DanmarksNationalbank, 2004]. Additionally, academic studies performed by [Harada et al., 2010], [Chan-Lau and Sy, 2006], and [Bharath and Shumway, 2004] widely agreed that distance to default is a useful measure for assessing the default risk of corporations.

Being a market-based measure, it also offers the advantage of being more up-to-date than periodical information from financial statements, and it also has the added advantage of using forward-looking information incorporated in security prices. In addition, assuming that financial markets are efficient, it also incorporates a substantial amount of information, and therefore aspects such as the indirect cost of distress are included in this metric. Finally, the DD method has the distinct advantage of being insensitive to the leverage ratio as it is based on the Miller and Modigliani Theorem [Modigliani and Miller, 1958] [Merton, 1974]. It is therefore a very good metric for applying to firms in distress, such as those analyzed by this study, which tend to have high leverage ratios. Although different approaches are used to derive the DD, this paper is based on a structural approach of Merton’s (1974) model and Black and Scholes’ (1973) option pricing model. The following section will present the various steps involved in the process of deriving the probability of default. The first step is to calculate Asset Value and Volatility. In the second step, the values obtained are used to derive the probability of default.

While there are doubts about whether the results of the Distance to Default model are normally distributed, analyzing the distribution would be beyond the scope of this study and thus normal distribution is assumed.
4.3.1 Asset Volatility and Value

Given that it is a market-based measure, this concept assumes that all variables are implied by the market and can therefore be derived using market values. This model in particular assumes that the value of equity, equity volatility, the firm’s debt to equity ratio and risk-free rate are known. The only variables that are not directly observable in the market, and therefore have to be derived, are Asset Value and Asset Volatility. Although related, Asset Volatility is different to Equity Volatility. Asset Volatility is a more general measure and incorporates more information than Equity Volatility. Volatility is mainly dependent on the size, leverage and nature of the firm’s business. The size of the business is, as expected, negatively correlated to volatility, while the firm’s leverage has a magnifying effect on asset volatility. Therefore, industries with low asset volatility tend to take on a higher leverage in comparison with firms in high volatility industries. As a consequence of the different debt levels, asset volatility is more differentiated by industry than equity volatility, which does not directly take leverage into account [Crosbie and Bohn, 2003].

The underlying theory of the model is based on the idea that both Debt and Equity are in fact just derivative securities on the firm’s underlying assets [Merton, 1974] [Black and Scholes, 1973]. This idea of the nature of equity is exploited in order to relate the market value of equity and the book value of debt to determine both the implied market value and the underlying volatility of the asset. This relationship is shown in the following equation, where \( V \) is the firm’s Asset Value, \( \sigma \) is the Asset Volatility, \( D/E \) is the Debt Equity ratio and \( i \) is the interest rate:

\[
\begin{align*}
\text{EquityValue} & = OptionFunction [(V_A); (\sigma_A); (D/E); (r_{\text{interest}})] \quad (11) \\
\text{EquityVolatility} & = OptionFunction [(V_A); (\sigma_A); (D/E); (r_{\text{interest}})] \quad (12)
\end{align*}
\]

As mentioned before, the only unknowns in this system of two equations are \( V_A \) and \( \sigma_A \). By solving backwards, the two equations can be solved
together in order to determine the missing values implied by the current equity value, the volatility and the debt-to-equity level. In order to proceed with the derivation, this relationship is then applied to the Black and Scholes model. In their ground-breaking model, they propose that the market value of the firm’s underlying assets is given by the following stochastic model [Merton, 1974]:

\[ dV_A = r_A V_A dt + \sigma_A V_A dz \]  \hspace{1cm} (13)

where:

\( V_A, dV_A \) are the firm’s asset value and change in asset value,

\( \sigma_A \) is the firm’s asset volatility

\( r_A \) is the expected return on the asset given by the CAPM

\( dz \) is a standard Gaussian Process.

Using this idea, the value of a call option, or in this case the value of the equity, can be derived. As mentioned before, when applying the Option Pricing Theory to firms, the strike price \((X)\) is represented by the book value of debt which is due at time \(T\). At his point it must be noted that the Black and Scholes Merton model only allows for two types of liabilities. Therefore, when applying this model only one single class of debt and one single class of equity can be used. Since most companies have different classes of equity and debt with different maturities, these have to be converted to a single type of liability. Given this input, and introducing the new variables, the market value of asset and the market value of equity are related by the following Black and Scholes expression [Crosbie and Bohn, 2003]:

\[ V_E = V_A N(d_1) - e^{-r_f T} X N(d_2) \]  \hspace{1cm} (14)
where:

\[ V_E = \text{Market Value of Equity} \]

\[ d1 = \frac{\ln(V_A^0) + (r + \sigma_A^2)T}{\sigma \sqrt{T}} \]

\[ d2 = d1 - \sigma_A \sqrt{T} \]

\[ r_f = \text{Risk-free Rate} \]

Combining this equation with the initial idea behind equations (11) and (12), a relationship between the two missing variables can be established. Consequently, the model suggests that equity and asset volatility are related by the following expression:

\[ \sigma_E = \frac{V_A}{V_E} \sigma_A \]  \hspace{1cm} (15)

Using this relationship, the implied Asset Value and Volatility are then calculated by solving for both inputs together. This is done by plugging in the observed market values and solving for the values in equations (14) and (15) simultaneously by substitution. The resulting values can then be used to derive the probability of default.

### 4.3.2 Probability of Default

In the Distance to Default model the probability of default is defined as the probability that the market value of the firm’s assets will fall below the book value of the firm’s debt by the time the debt matures. This situation is described by the following formula [Crosbie and Bohn, 2003].

\[ p_t = Pr[V_A^t \leq X_t | V_A^0 = V_a] \]  \hspace{1cm} (16)

where,

\[ p_t \] is the probability of default at time \( t \)
$V_t^A$ is the Market Value of the firm’s assets at time $t$, and $X_t$ is the Book Value of the firm’s liabilities at time $t$.

In order to predict the probability of default, the asset value path needs to be projected. The change in the value of the firm’s asset value over time is described by equation (13) [Merton, 1974]. To proceed, it is assumed that the equations also hold as a natural logarithmic equation ($ln$). Including these two ideas in the formula, and assuming that the value at $t = 0$ is $V_A$, the value of the asset, $V_t^A$, at time $t$ is given by the following Black and Scholes equation:

$$ln(V_t^A) = ln(V_A) + (r_A - \frac{\sigma_A^2}{2})t + \sigma_A \sqrt{t} \epsilon (17)$$

where, $r_A$ is the expected return on the asset $\epsilon$ is the random component of the firm’s return.

The relationship given by equation (17) describes the evolution in the asset value path shown in Figure 2. Then, combining equation (16) and (17), the probability of default is summarized in the following formula:

$$p_t = Pr \left[ ln(V_A + (r_A - \frac{\sigma_A^2}{2})t + \sigma_A \sqrt{t} \epsilon \right] (18)$$

after rearranging for the random component $\epsilon$, the equation continues as follows:

$$p_t = Pr \left[ -ln(V_t/X_t) + (r_A - \frac{\sigma_A^2}{2})t \sigma_A \sqrt{t} \leq \epsilon \right] (19)$$

The Black and Scholes model assumes that the random component ($\epsilon$) of the firm’s asset return is Normally Distributed and, as a result, we can define the probability of default in terms of the cumulative Normal Distribution [Black and Scholes, 1973] [Crosbie and Bohn, 2003]. Finally, the probability of default is given by:
\[ p_t = N \left[ -\frac{\ln \left( \frac{V_A}{X_t^2} + (r_A - \frac{\sigma_A^2}{2})t \right)}{\sigma_A \sqrt{t}} \right] \] (20)

The Moody’s KMV model then continues by defining the Distance to Default (Appendix A). This can be useful when other assumptions about the distribution of results in this model are made. However, this research study assumes normal distribution and therefore the probability of default is given by equation (20).

### 4.4 Relative Valuation

The previously introduced valuation model can also be used with the relative valuation approach. In this case, the going concern valuation is performed using a market multiple method instead of the discounted cash flow method. Again, since the model completely separates the risk of distress from the going concern valuation, a normal multiple analysis can be performed. This means that the most comparable firms’ multiple, including healthy ones, can be used during the analysis, thus increasing the number of comparable firms and compensating for the previously identified problems. The relative valuation is thus performed in the usual way, using values from operations such as revenues, EBIT, etc. and multiplying them by the comparable firms’ multiple in order to derive the firm’s value. Once the relative value is derived, it is used as the going concern value for the firm and is then weighted by the probability of default with the liquidation value.

In order to further improve the accuracy of relative valuation in the distressed company scenario, a time-series multiple can be used. This means that the relative valuation is performed using a forward-looking multiple based on a consensus estimated future figures such as revenue, which is then compared across industries. The idea behind this is that if a distressed firm is compared to an industry of primarily healthy firms, then it will appear to be undervalued. To get a more accurate picture of the company, the differences in risk, revenue growth and expected profitability need to be analyzed over a
longer period of time. However, since the risk of default is determined using a market based method it is assumed to have forward looking characteristics already.

5 The Kodak Case

The Eastman Kodak Company used to be an American Fortune 500 company and a world leader in imaging technology. It focused on functional printing, graphic communications and professional services and had operations in nearly every country in the world. Founded in 1888 it became a highly respected company known for its pioneering technology and innovative marketing. At its peak, in the late 1990s, the company had a market capitalization of nearly $30 billion, around 100,000 employees, approximately $16 billion in revenue and a profit of about $1.5 billion. After that, mainly due to its slowness to adapt and make the transition to digital photography, the company entered a long decline stage that was to last for more than a decade [Economist, 2012b]. Due to falling revenues, the company began to struggle financially and, by 2006, had started to make net losses (Appendix B). In 2011, the year before entering bankruptcy protection, the company produced estimated revenues of $5.2 billion and a net loss of approximately $0.764 billion and had about 14,500 employees (See Figure 3). The Eastman Kodak Company filed for bankruptcy protection in February 2012.
The Eastman Kodak company is a very good example of a company that entered the declining stage and later faced financial difficulties. It therefore provides an excellent case study for the valuation method introduced in this research study. Although probably influenced by other reasons, Kodak’s decline can be attributed to the company’s failure to make the transition to digital photography. This is a classical example of how changing industry conditions and the emergence of an innovative substitute product can push a company into the declining stage of the industry life cycle. Although Kodak was a pioneer in digital photography, inventing the first digital camera back in the 1970s, they failed to produce a viable business model for it and were reluctant to move away from their high-margin, but declining, core business. After their peak in the late 1990s, the company’s revenues started to stagnate and finally began a continuous decline. Although initially hesitant, the management introduced several turnaround strategies aimed at repositioning the company in order to focus on digital photography and digital printing. Although these restructuring measures were initially successful, they were not sufficient to make up for falling sales [Economist, 2012b]. As is characteristic of declining firms, Kodak’s average revenue growth stagnated after 1996 and, ultimately, from 2006 onwards it became strongly negative. The long decline and the falling revenues resulted in the company’s first net loss in
2005 and, apart from 2007, the firm was never again profitable [Kodak, 2012].

5.1 Case Study Objective and Methodology

The objective of the case study is to apply the introduced valuation model and to analyze the performance of the model in a real-life case setting. The Kodak Case has been chosen because it has the representative characteristics of a firm that progressed from entering the declining stage to facing financial distress, and ultimately entering into bankruptcy. Over the course of this development the company faced all the major risks and challenges identified in this research study as particularly difficult to perform a valuation upon.

However, since we know it culminated in bankruptcy in 2012, the case study will be performed using year 2005 as the base year. This particular base year was chosen as it was a critical year in the company’s history, when its difficulties were clearly visible, although a successful turnaround was still a possible scenario. The appointment in 2005 of a new CEO with a clear vision for the company also marked the start of a new era. Furthermore, the new capital injection by banks in the same year underlined the belief that the company, although in severe distress, was still viable per se and could return to financial health.

Applying the model to a company whose development and ultimate bankruptcy is known, offers some distinct benefits for the analysis. First of all, the results of the valuation model of this study can be compared continuously with current market data, allowing for a good analysis of the accuracy of the model. It also allows for the identification of possible discrepancies with the current data. Finally, it allows for a comparison of the value obtained by the model and the implied market value at different time stages. This means that the value and risk of bankruptcy implied by the market valuation can be compared to the results from the model at all times in the projection period.

A full valuation and analysis of the Eastman Kodak Company would be
an entire research topic in itself and is therefore beyond the scope of this study. The case valuation merely intends to apply the model with current company data in order to judge its accuracy. The analysis section is therefore very brief and only intends to provide an insight into the problems of firms in decline and distress. The inputs for the analysis and the valuation model are taken from the annual reports, restructuring plans and industry peers. It has to be noted, as identified before, that these inputs, in particular inputs from the restructuring plans, might be over-optimistic due to the management’s tendency to overestimate the value of the firm. It can be argued, however, that the discount applied through the model’s probability of default is sufficient to correct for this upward bias.

5.2 Analysis of Kodak in 2005

The progressing decline hit the company hard. In 2005, Kodak’s market capitalization was around $7 billion, down from $30 billion at its peak, and the company was in a very vulnerable situation. This represents a fall in value of 77%. Although the restructuring measures introduced in 2002-2003 led to an increase in revenues, both the company’s gross margin and its net income were still in a downward trend. See Figure 4.

![Figure 4: Kodak Financials (in mn$)]

In this situation the company’s value was extremely difficult to estimate since it was highly dependent on the success of the restructuring measures and
the repositioning of the company. At the same time, the company’s financial situation was still deteriorating at a rapid pace. The following section will provide a brief analysis of the company’s situation in 2005. It will include a brief summary of the main business challenges, as well as a brief overview of the financial situation. The analysis performed in this section will serve as a basis for the valuation of the firm and the probability of default in the base year.

5.2.1 Industry Analysis

The shock of the digital revolution impacted the entire industry. It was a time of rapid technological change for an industry based on chemistry and the large-scale production of an obsolescent good. Other factors, such as the rapid increase in the price of silver - an essential input for production - worsened the shock. Furthermore, the change affected all the product categories. Consumers and professionals ditched film first. Then healthcare services, which used film for X-rays, shifted to digital scans. The final blow came with the film industry’s switch to digital projection [Economist, 2012a]. Film industry demand fell by 60% and is expected to vanish over time. The Photo Marketing Association, an industry group, says sales of traditional film cameras fell by 15% in America in 2003 alone. Digital-camera sales were to overtake film cameras worldwide by mid 2004. Furthermore, the impact of the mobile phone camera at the time was still unclear. However, the emergence a whole new set of picture-taking opportunities was certainly expected to disrupt the entire industry again [Economist, 2004]. Of course, this change brought on by the digital revolution also impacted most of Kodak’s competitors. The industry consisted of several large players. The majority of competitors were Asian companies and other smaller companies in Europe. The most important competitors, with a comparable strategic outline to Kodak’s, were Canon, Fujifilm, and Konica Minolta. All had a similar positioning in photographic film, camera production, and health-care imaging and therefore all faced the same problems. The entire industry needed
to make the transition from traditional film to the digital era and redefine its competitive edge, i.e. they needed to restart in the industry life-cycle change in order to prevent further decline. Although all these companies faced certain difficulties at the time, these companies will be, for the sake of simplicity, considered to be healthy competitors.

5.2.2 Business Analysis

Historically, the company’s main products included photographic film, single-use cameras, and related products and services. Kodak faced decline due to the emergence of digital photography, which meant that most of their main products were substituted by digital products. Although the shock of technological change affected all its competitors, Kodak’s decline was much steeper than that of its competitors. According to InfoTrends, a research outfit, Canon, Sony, Olympus and Fuji are all estimated to have sold more digital cameras worldwide than Kodak in 2003. For example, Kodak’s sales in photographic film fell 37% for rolls, and 13% single-use cameras, compared to Fujifilm’s drop of 28% in film rolls and 5% in single-use cameras. This indicator shows that the company, despite being a leader in the market, was not only failing to develop new products but was also unable to exploit their existing products. In addition, although an initial leader in digital photography, the company was slow to adopt the new technology and to change their business model accordingly. In 2003, the management started to restructure the company and to put a strong focus on digital products [Economist, 2012b]. During this transition, Kodak also discontinued many of their traditional photography products due to poor sales and, at the same time, acquired several companies in the new digital photography segment. The new Kodak was divided into three segments, namely:

- **Digital and Film Imaging Systems (D&FIS)** which bundled the remaining traditional film business with the new digital solutions such as digital cameras
• **Health Group**: which produced imaging solutions for the healthcare sector

• **Graphic Communications**: which offered printing solutions, e.g. printers

As a result of the strong focus on digital photography products, Kodak successfully managed to enter the digital photography market in the early 2000s. By 2005 Kodak was the market leader in the U.S. in terms of digital camera sales. Revenue from its digital photography sales amounted to $5.7 billion, almost 40% of their total sales. However, this growth did not make up for the fall in traditional photography sales. Although Kodak was able to successfully penetrate the Digital Photography market, they were not able to capitalize on this success.

![Figure 5: Digital Sales](image)

The main problem was that the company was unable to change their business model from a high-margin product, up to 80% for photographic film, to a low-margin product such as digital cameras. This problem was exacerbated by stiff competition from Asian producers who were able to
produce at a much lower cost than Kodak, pushing the margins even further. As a consequence, the company was left with a very low operating margin.

Even though the main focus was on digital photography, Kodak’s other segments, particularly Graphic Communications, experienced high growth and produced an increasing share of the company’s total revenue [Kodak, 2006].

Figure 6: Sales by Segment (%)

The growing importance of the other segments was highlighted in the mid 2005 with the appointment of former Hewlett Packard veteran Antonio Perez to the position of CEO. The new CEO set up a second restructuring plan in which the company would further develop the other segment in order to balance the product portfolio between the consumer products of digital photography and the commercial products of the Graphic Communications segment and the Health Group segment. Together these three segments would represent the main pillars of the future Kodak. However, although the company managed to substantially increase sales, the operating margin in this segment was not much better than that of their digital products. As a consequence, the CEO’s proclaimed goal was to improve gross margins and operational efficiencies and to become market leaders in each of the segments. In addition, the plan included a heavy divestment of almost $2 billion of the traditional assets and the reduction of 10,000 employees up to the end of 2007.
The firm’s future and the biggest part of its value in 2005 was contingent on the success of these plans. If the firm was able to turn around and achieve these goals, Kodak would revert to financial health. If the company failed to accomplish this, the company would only be worth the liquidation value.

5.2.3 Financial Analysis

By the beginning of 2005 the company was in a relatively bad financial situation. The Corporate Rating by Moody’s and S&P was B1 and B+ respectively, both with a negative outlook [Kodak, 2005]. Revenues declined steadily from 1999 onwards and the first restructuring measures, introduced in 2003, only managed push revenues towards the 1999 level [Kodak, 2004]. Therefore, revenues from 1999 to 2004 remained stagnant while the cost of the restructuring efforts severely depressed the bottom line of the income statement. The immense cost of the turnaround efforts also strongly affected the balance sheet. While the asset value of the company remained the same in the period 1999-2004, total liabilities increased by 24% over the same period [Kodak, 2006] [Bloomberg, 2014].

Figure 7: Income Statement (in mn $)

<table>
<thead>
<tr>
<th>Field</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the period ending</td>
<td>original</td>
<td>restated</td>
<td>original</td>
<td>original</td>
<td>original</td>
<td>original</td>
</tr>
<tr>
<td>Revenue</td>
<td>13994</td>
<td>13229</td>
<td>12835</td>
<td>12809</td>
<td>13517</td>
<td>14288</td>
</tr>
<tr>
<td>Cost of Revenue</td>
<td>5971</td>
<td>6061</td>
<td>6225</td>
<td>8734</td>
<td>9645</td>
<td>10950</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>5975</td>
<td>4568</td>
<td>4610</td>
<td>4176</td>
<td>3669</td>
<td>3618</td>
</tr>
<tr>
<td>Operating Expenses</td>
<td>3761</td>
<td>3667</td>
<td>3590</td>
<td>3594</td>
<td>3841</td>
<td>3560</td>
</tr>
<tr>
<td>Operating Income</td>
<td>2214</td>
<td>1911</td>
<td>1318</td>
<td>781</td>
<td>608</td>
<td>58</td>
</tr>
<tr>
<td>Interest Expense</td>
<td>178</td>
<td>279</td>
<td>173</td>
<td>147</td>
<td>168</td>
<td>211</td>
</tr>
<tr>
<td>Foreign Exchange Losses (Gains)</td>
<td>13</td>
<td>N/A</td>
<td>N/A</td>
<td>10</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Net Non-Operating Losses (Gains)</td>
<td>-120</td>
<td>677</td>
<td>199</td>
<td>496</td>
<td>526</td>
<td>695</td>
</tr>
<tr>
<td>Pre-tax Income</td>
<td>2143</td>
<td>815</td>
<td>946</td>
<td>-128</td>
<td>-95</td>
<td>-455</td>
</tr>
<tr>
<td>Income Tax Expense</td>
<td>725</td>
<td>34</td>
<td>153</td>
<td>-85</td>
<td>-175</td>
<td>555</td>
</tr>
<tr>
<td>Income Before XD Items</td>
<td>1418</td>
<td>81</td>
<td>793</td>
<td>213</td>
<td>75</td>
<td>-1358</td>
</tr>
<tr>
<td>Extraordinary Loss Net of Tax</td>
<td>0</td>
<td>5</td>
<td>-23</td>
<td>64</td>
<td>475</td>
<td>-93</td>
</tr>
<tr>
<td>Minority Interests</td>
<td>11</td>
<td>N/A</td>
<td>N/A</td>
<td>34</td>
<td>3</td>
<td>-4</td>
</tr>
<tr>
<td>Net Income</td>
<td>1407</td>
<td>76</td>
<td>770</td>
<td>263</td>
<td>556</td>
<td>-1261</td>
</tr>
<tr>
<td>Abnormal Losses (Gains)</td>
<td>50</td>
<td>860</td>
<td>-6</td>
<td>638</td>
<td>819</td>
<td>2254</td>
</tr>
<tr>
<td>Tax Effect on Abnormal Items</td>
<td>-17</td>
<td>-266</td>
<td>0</td>
<td>-191</td>
<td>-216</td>
<td>-427.35</td>
</tr>
<tr>
<td>Normalized Income</td>
<td>1440</td>
<td>675</td>
<td>797</td>
<td>631</td>
<td>695</td>
<td>462.65</td>
</tr>
</tbody>
</table>

By the end of 2005 the restructuring efforts had resulted in a very positive growth in the new main segment of digital photography. Revenue growth from digital photography sales compared to the previous year was up by al-
most 40%, making up for the 18% decline in traditional segments and pushing overall revenues up by 5.6% [Bloomberg, 2014]. Additional cash inflows came from reductions in net working capital, divestments and aggressive patent enforcement. However, profit margins were still very low and owing to charges to the account for tax valuation allowances in the U.S. and due to the cost of accelerating the restructuring efforts, the company produced a net loss of $1.261 billion in 2005. On the other hand, the cash position of $1.665 billion, combined with a new credit line that gave the company access to $1.5 billion new borrowing capacity, ensured the short-term liquidity of the company [Kodak, 2006].

5.3 Valuation of Kodak in 2005

By the end of 2005 Kodak’s market capitalization had fallen to $6.7 billion. The main factor in the valuation of Kodak at the end of 2005 was the success of the restructuring efforts. The restructuring plan introduced in 2003 was not expected to be completed until 2007. These plans resulted in very high growth rates within certain product segments and also increased overall sales but, to date, they have failed to produce a positive net income. Due to the relatively low margin in the new segments, economies of scale had to be achieved in order for the company to be profitable.

5.3.1 Going Concern Valuation

The Going Concern value assumes that Kodak’s restructuring efforts will be successful and that the firm will return to financial health in the future. In order to project the road to recovery, an analysis of the profitability margin that the firm could achieve under healthy and normal conditions has to be performed. For the fiscal year 2005, Kodak had revenues of $14,268 million and a pre-tax operating income of $58 million resulting in a abysmal return on capital of 0.4%. Even though Kodak’s glory days were in the late 1990s, a five-year historical horizon from 2005 backwards will be used as a base for the margins and ratios in healthy conditions.
The Free Cash Flow Projection will be estimated according to the following assumptions. Looking at the historical figures, both the operating margin as well as the return on capital of fiscal year 2005 are extraordinarily low for Kodak. The average, excluding 2005, yielded an operating margin of 9% and an after-tax return on capital of 8%. However, industry figures for the operating margin ranges from 9% to 16%. The industry range for return on capital ranges from 7% to 15% [Cannon, 2006] [Fujifilm, 2006] [Konica, 2006]. Assuming that Kodak returns to profitability, an operating margin of 12% and an after-tax return on capital of 10% is assumed. The return to healthy margins is assumed to develop gradually over the projection horizon.

Overall, revenues are expected to continue their current growth of 6% until the end of the restructuring period in 2007. This moderate growth is mainly due to the decline of the traditional product lines. However, after the restructuring period, strong growth is expected in both the D&FIS and the Graphic Communications segment, originating mainly from the proceeds of the turnaround investments such as acquisitions, and from achieving critical size benefits. Therefore, from 2008 to 2010 the average growth of the divisions of 30% is assumed [Kodak, 2006]. After this period, from 2011 to the end of the projection period, revenue growth will drop to the industry average of 8% [Cannon, 2006] [Fujifilm, 2006] [Konica, 2006].
The effective tax rate in 2004 and 2003 was 18% and 15.5% respectively. The tax rate differed from the U.S. statutory tax rate because of the losses incurred and jurisdictional differences. Due to the future improvement in the firm's financial situation, the tax rate is expected to gradually revert to the normal U.S. tax rate of 35% [Kodak, 2005].

The reinvestment rate until 2007 will be half the after-tax operating income due to investments related to the restructuring efforts. However, after that, since most of the investments have already been made, it is assumed that the company will stop investing until 2010 in order to capitalize on the past investments. As a consequence, the investment rate will be negative, resulting in cash inflows from depreciation charges. After 2010, the reinvestment rate will revert to pre-restructuring levels of around 20% [Kodak, 2003].

<table>
<thead>
<tr>
<th>Year</th>
<th>Rev Growth</th>
<th>Revenue</th>
<th>Operating Margin</th>
<th>Operating Income</th>
<th>Tax Rate</th>
<th>After-Tax Income</th>
<th>Reinvestment Rate</th>
<th>Reinvestments</th>
<th>FCFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>6.0%</td>
<td>15,134</td>
<td>1.5%</td>
<td>228</td>
<td>20%</td>
<td>45</td>
<td>50%</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>2007</td>
<td>6.0%</td>
<td>16,032</td>
<td>2.6%</td>
<td>418</td>
<td>21%</td>
<td>88</td>
<td>50%</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>2008</td>
<td>30.0%</td>
<td>20,841</td>
<td>3.7%</td>
<td>772</td>
<td>23%</td>
<td>175</td>
<td>-10%</td>
<td>177</td>
<td>192</td>
</tr>
<tr>
<td>2009</td>
<td>30.0%</td>
<td>27,693</td>
<td>4.8%</td>
<td>1,302</td>
<td>24%</td>
<td>315</td>
<td>-10%</td>
<td>315</td>
<td>347</td>
</tr>
<tr>
<td>2010</td>
<td>30.0%</td>
<td>35,251</td>
<td>5.9%</td>
<td>2,680</td>
<td>26%</td>
<td>536</td>
<td>0%</td>
<td>536</td>
<td>-</td>
</tr>
<tr>
<td>2011</td>
<td>8.0%</td>
<td>36,039</td>
<td>7.0%</td>
<td>2,665</td>
<td>27%</td>
<td>738</td>
<td>5%</td>
<td>38</td>
<td>691</td>
</tr>
<tr>
<td>2012</td>
<td>8.0%</td>
<td>41,082</td>
<td>8.1%</td>
<td>3,330</td>
<td>29%</td>
<td>961</td>
<td>10%</td>
<td>96</td>
<td>865</td>
</tr>
<tr>
<td>2013</td>
<td>8.0%</td>
<td>44,369</td>
<td>9.2%</td>
<td>4,085</td>
<td>30%</td>
<td>1,242</td>
<td>15%</td>
<td>186</td>
<td>1,056</td>
</tr>
<tr>
<td>2014</td>
<td>8.0%</td>
<td>47,918</td>
<td>10.3%</td>
<td>4,939</td>
<td>32%</td>
<td>1,578</td>
<td>15%</td>
<td>237</td>
<td>1,341</td>
</tr>
<tr>
<td>2015</td>
<td>8.0%</td>
<td>51,752</td>
<td>11.4%</td>
<td>5,903</td>
<td>34%</td>
<td>1,978</td>
<td>20%</td>
<td>396</td>
<td>1,582</td>
</tr>
</tbody>
</table>

**The discount rate** has to be recomputed several times throughout the projection period in order to reflect the current financial situation of the firm and the improving cost of capital during the restructuring period. In order to calculate the current discount rate for Kodak, Equation (7) will be used.

In order to derive the debt to equity ratio necessary for the discount rate
calculation, the estimated market value of debt must first be derived by using equation (3). Given current interest expenses of $1.672 billion, a face value of debt of $8.284 billion \(^4\) an average maturity of 9.1 years \(^5\) and a cost of debt of 8.5\% \(^6\) [Kodak, 2006], the market value of debt is estimated to be equal to $14.250 billion. The market value of debt is higher than the face value because of the increased risk the firm faces now that it is in more distress. This means that the firm raised debt under more favorable terms when it was in a better situation and given the current risk the market would demand a higher return \(^7\). The market value of equity can easily be derived by the implied market values. At the time of analysis the total market value was equal to $7.095 billion, based on a share price of $25.14 and roughly 282 million shares outstanding. Given these estimates, the Debt to Equity ratio of Kodak is then 200\%. Finally, the Debt to Value ratio is 66.76\% and therefore the Equity to Value ratio is 33.24\%.

The cost of debt, based on the B+ rating by Standard & Poor’s and assuming a respective default spread of 6\% over the 3\% risk free rate, is 9\%. Assuming that the company can exploit the full tax benefit, given that the future net income will be positive, the after-tax cost of debt will be 5.5\%.

As a starting point for the calculation of the cost of equity, the unlevered industry beta is used. The benefits of this method have already been explained. The un-levered industry $\beta$ of the three main competitors at the time of the analysis is 0.86 (Appendix G). Given the debt to equity ratio of 200\% and a tax rate of 35\%, the levered $\beta$ for Kodak at the time of analysis is 2.83. Using the CAPM formula (equation 5) and assuming a total equity

---

\(^4\)The face value of debt is assumed to be equal to the total net interest bearing debt
\(^5\)The maturity is the weighted average of short term debt, assumed to be 1 year, and long term debt, assumed to be 10 years
\(^6\)The cost of debt is derived later in this section
\(^7\)There are more factors influencing the debt value such as covenants and bond indentures. A full analysis of the different classes of debt and its impact on the model is currently out of scope of this study but may provide a good ground for further research

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risk premium of 5% \(^8\) and a risk free rate of 3%, the cost of equity is given as 17.15%.

The discount rate for Kodak in 2005 is then calculated by using the WACC formula (Equation 7) and the inputs given above. Under the given assumptions, this yields a discount rate of 11.72%.

Since the company is expected to return to financial health over the restructuring period, the current relatively high debt to equity will improve and converge with the industry average of 42% (Appendix F). With falling debt levels, the cost of equity will also fall to ultimately converge at a rate of 7.4% at the end of the projection period. The cost debt is assumed to fall progressively to a rate of 5.5%, which is equivalent to the spread paid by BBB-rated companies such as Kodak’s main competitors [Damodaran, 2014] [Fujifilm, 2006] [Cannon, 2006].

The Terminal Value is calculated according to the Gordon Growth Model. In this model the revenue of the final year from the projection period is assumed to grow at a certain rate into perpetuity. The growth rate into perpetuity is assumed to be 3%, set equal to the risk-free rate cap, a common

\[^8\]The total equity risk premium is based on a calculation by Damodaran (2014) for the US Stock market [http://pages.stern.nyu.edu/]
and conservative assumption [Damodaran, 2009]. The return on capital is assumed to remain at the industry average of 10%. This yields a reinvestment rate of 30%. The Terminal Value is then computed using the after-tax operating income from Year 2016 and equation (8). This yields a Terminal Value of $30.024 billion in year 2016. Discounted to the year of the analysis, this yields a Terminal Value of $15.551 billion at the end of year 2005.

**Total Going Concern Value** is then given by the discounted free cash flows of the respective years plus the terminal value in the final year. The calculation yields a total value of $19.224 billion for the going concern valuation of the Eastman Kodak company at the end of year 2005.

![Figure 11: Kodak Going Concern Valuation (DCF)](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>FCFF</th>
<th>Terminal Value</th>
<th>Cost of Capital</th>
<th>Discount Factor</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>22</td>
<td>11.7%</td>
<td>0.90</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>2007</td>
<td>44</td>
<td>11.7%</td>
<td>0.80</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>2008</td>
<td>192</td>
<td>11.6%</td>
<td>0.72</td>
<td></td>
<td>138</td>
</tr>
<tr>
<td>2009</td>
<td>347</td>
<td>11.0%</td>
<td>0.66</td>
<td></td>
<td>228</td>
</tr>
<tr>
<td>2010</td>
<td>536</td>
<td>10.4%</td>
<td>0.61</td>
<td></td>
<td>326</td>
</tr>
<tr>
<td>2011</td>
<td>691</td>
<td>9.8%</td>
<td>0.57</td>
<td></td>
<td>394</td>
</tr>
<tr>
<td>2012</td>
<td>865</td>
<td>9.2%</td>
<td>0.54</td>
<td></td>
<td>468</td>
</tr>
<tr>
<td>2013</td>
<td>1,056</td>
<td>8.4%</td>
<td>0.52</td>
<td></td>
<td>552</td>
</tr>
<tr>
<td>2014</td>
<td>1,341</td>
<td>7.7%</td>
<td>0.51</td>
<td></td>
<td>690</td>
</tr>
<tr>
<td>2015</td>
<td>1,582</td>
<td>6.82%</td>
<td>0.52</td>
<td></td>
<td>16,272</td>
</tr>
</tbody>
</table>

Total Value of Operating Assets 19,124

### 5.3.2 Liquidation Value

The liquidation value is based on the expected proceeds in the event of a distress sale. As mentioned before the distress sale proceeds are significantly more depressed than those of an orderly sale due to the aforementioned reasons. Although there is a good possibility that in the case of default Kodak will reorganize under bankruptcy protection, this research will assume a distressed liquidation in order to better represent the risk to investors who face
a significant loss in Chapter 11. There are several ways to estimate the liq-
uidation value. The most common one is to apply a discount on the book
value of assets. However, the use of this approach is not recommendable be-
cause of the lack of comparable distress sale transactions and the difficulty in
estimating the loss in value of the assets. In the case of Kodak, the earning-
power-of-assets approach is more applicable. This is mainly due to the heavy
investments in their digital products portfolio, which could be highly interest-
ing for strategic investors. Again, the industry asset specificity increases the
bargaining power of strategic investors, which increases the distressed sale
characteristics of the liquidation. The earning power of the existing asset is
assumed to be represented by the average net operating income power over
the past five years, which in the case of Kodak amounted to roughly $1.118
billion. Using equation (9), and assuming a tax rate of 35% and a healthy
industry cost of capital of 9%, this yields expected distress sale proceeds of
$8.074 billion.

\[
\text{LiquidationValue} = \frac{1.118(1 - 35\%)}{9\%} = \$8.074\text{billion}
\]

In order to derive the liquidation value the cash balance of $1.665 has to
be added to arrive at a total liquidation value of $9.739 billion. This would
represent a discount on book value of about 35%.

5.3.3 Probability of Default

The probability of default is determined by using the Distance to Default
model and the implied market values for stock of Eastman Kodak in the year
2005. The first step in the model is to determine both the total asset value
and its volatility as implied by the other observable metrics. These inputs
will then be used in the Black and Scholes model in order to determine the
probability of default.

The Asset Value and Volatility is determined by using the observable
market value in order to derive the values as implied by these inputs. To
calculate these value, the following inputs have to be obtained from the market: market value of equity, value of debt, the return on the asset, the risk-free rate and the time horizon. As has been noted, the model only allows for two classes of liabilities. While the impact of the different classes of equity can be neglected, the different debt classes have to be converted into a single class with single coupon characteristics. This is achieved by converting the book value of debt into market value of debt using equation (3). Following the idea of the model, the time horizon $T$ is set equal to the time at which the firm’s debt matures. Since the company has different kinds of debt with differing maturities, the time horizon is set equal to the weighted average maturity of the firms debt obligations which in this case is equal to 9.1 years. Note, that the observed market values such as the volatility have a one year horizon and have to be adapted accordingly. The following table (2) summarizes the inputs used in the default prediction for the Kodak Company as observed in the market by the end of year 2005.

<table>
<thead>
<tr>
<th>Equity</th>
<th>$σ_E$</th>
<th>Debt</th>
<th>$r_A$</th>
<th>$r_f$</th>
<th>$T$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$7.095$</td>
<td>15.05%</td>
<td>$14.250$</td>
<td>-1.95%</td>
<td>3%</td>
<td>9.1</td>
</tr>
</tbody>
</table>

The relation between the asset and equity volatility is given by Equation (15). In the model the one year volatility has been adapted for the time horizon of 9.1 years ($σ * \sqrt{T}$) which results in a volatility of 45.40%. Given the observed equity value, the relationship is given by the following equation.

$$V_A = \frac{3.11}{σ_A}$$

Substituting these inputs in equation (14) will result in an implied asset value $V_A$ of $17.010$ billion and an asset volatility $σ_A$ of about 18.9%.

---

*While some of the inputs have been derived in previous sections, all other have been obtained from Datastream for FY2005 (Appendix I)*
Note that the obtained value of the asset is a valuation in itself and represents the value of the firms as estimated by the market. However, for the purpose of this study the metric will mainly be used to determine the expected probability of default. On the other hand, since in practice there is no such thing as a completely accurate valuation, this value can be used as a control metric.

**Probability of default** Finally the probability of default can be estimated using these metrics and equation (20). Assuming the previously-made assumptions and normal distribution of the results, the probability of default at the end of year 2005 is equal to 61.25%.

\[
V = $19.124(1 - 0.6125) + $9.739(0.6125) = $13.375
\]

The estimated enterprise value, as obtained by the introduced valuation model, of Eastman Kodak at the end of year 2005 was equal to $15.190 billion.
After deducting the face value debt of $8.284 billion, the firm’s equity would be valued at $6.906 billion which is in line with market capitalization.

5.3.5 Relative Valuation

The introduced model can also be used in combination with an relative valuation approach. For this method, the average enterprise value multiple of healthy industry peers is used as a proxy for the going concern valuation. The most common valuation multiples are enterprise value to sales, EBITDA and EBIT. As mentioned before, the use of the relative valuation approach is not optimal in case of distressed firms because these firms by definition tend to have a negative bottom line. This makes the use of income, EBIT and EBITDA multiples useless only leaves the sales multiple valuation as the only viable option for this approach. This problem was also the case for Kodak in 2005, as the company reported sales of $11.395 billion but negative EBITDA and net income. Therefore, in this case the application of the multiple valuation is only illustrative. The enterprise value multiples for Kodak’s peers are given in the following table.

<table>
<thead>
<tr>
<th>Multiples Kodak Peers 31.12.2005</th>
<th>in USDmn</th>
<th>Canon</th>
<th>Konica</th>
<th>Fujifilm</th>
<th>Olympus</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV/Sales</td>
<td>1.42</td>
<td>0.72</td>
<td>0.41</td>
<td>1.09</td>
<td></td>
<td>0.91</td>
</tr>
<tr>
<td>EV/EBITDA</td>
<td>9.32</td>
<td>11.68</td>
<td>46.17</td>
<td>51.4</td>
<td></td>
<td>29.6</td>
</tr>
</tbody>
</table>

Source: S&P Capital IQ

Given reported sales of $11.395 billion as of the 31.12.2005, and the average industry EV/Sales multiple of 0.91x, the going concern value of Kodak is equal to $10.860. When applying this value in the introduced valuation model, a distressed enterprise value for Kodak of $10.174 billion is obtained. After deducting the face value of debt of $8.284 billion, the firm’s equity would be valued at only $2.576 billion. The big difference to the previous valuation and the market value can be associated with poor comparables.
5.4 Discussion

Given the inputs and assumptions, the value of the Eastman Kodak Company at the end of year 2005, as implied by the introduced valuation model for companies facing distress, equals $15.190 billion. Although this value is in line with the suggested value range of other methods, a few aspects have to be noted.

Being a theoretical model, based on rigorous mathematical and statistical assumptions, the results obtained are only as good as the quality of the input. On a theoretical level, the model resulted in a value that is in line with other methods. However, during the application of the model in various scenarios, it is found to be very sensitive to several variables. Although significant for other variables, the sensitivity is found to be greatest for the return on asset metric.

Figure 15: Sensitivity Analysis

<table>
<thead>
<tr>
<th>Sensitivity Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>ra</td>
</tr>
<tr>
<td>pd</td>
</tr>
</tbody>
</table>

Source: Model Output

Minor changes in this input resulted in major deviations in the probability of default, which makes a careful estimation of this particular metric key for an accurate valuation. In addition, the different possibilities to derive this and other variables complicates the evaluation even further. Expected risk weighted returns such as the ones yielded by the CAPM are no applicable here. In the case at hand, a historical return on asset from the past financial year 2004 has been used, assuming a continuation of the current trend. However, when taking into consideration aspects such as restructuring efforts or strategic turnarounds, the input metrics can vary significantly. This observations suggest, that the determination of the inputs variables can not only be based on financial estimates but must include strategic considerations as well. However, as outlined in the beginning, the inclusion of qualitative estimates, is one of the main reasons for biased results in the financial valuation
practice. Therefore, even though the model introduced a new perspective on evaluating the risk of default in combination with traditional methods, the case at hand shows that it does not provide a solution to the lack of precision and the need of qualitative inputs variables when valuing distressed companies. Nevertheless, including the risk of default via a market based method allows for a greater precision in both the evaluation of risk and the final value. However, the model does not represent an all-round method to be used in all distressed scenarios but the method of choice should be determined by the availability and accuracy of the input data.

6 Limitations of the study

This model is an interesting application of the Black and Scholes and Merton theory on the field of bankruptcy forecasting. Furthermore, it has been continuously applied by the Moody’s KMV Corporation in a real-life setting over an extended period of time. On the other hand, several academic studies have analyzed the accuracy and predictive power of this model and its applicability and accuracy is not proven beyond doubt. A study by Bharath and Shumway (2004) finds that the KMV Model performs slightly worse than other models such as default spreads [Bharath and Shumway, 2004]. In contrast, in a study by Duffie et. al. (2004) the model exhibited results with significant predictive power over a longer period of time [Duffie et al., 2007].

Being based on an academic theory, the model relies on several assumptions implied by these models but also on other assumptions of a practical nature. The following are the most impacting ones:

First of all, the model set-up according to the Black and Scholes theory assumes that the underlying value and return of each firm follows the standard normal distribution. It would be very difficult to construct a theory without the assumption of normality of asset returns due to the amount of data needed to predict the possible returns. In addition, the probability of bankruptcy is also assumed to follow a normal distribution. In the original
Moody’s KMV model the probability of bankruptcy is calculated based on the company’s vast data of historical default and bankruptcy frequencies. Since this data is not publicly available, a normal distribution is assumed.

Second, the model only allows for one kind of debt which has to follow the characteristics of a single zero coupon bond. It therefore does not distinguish among different types of long-term bonds according to their seniority, collateral, covenants, or convertibility [Merton, 1974]. Due to these characteristic, the model requires some subjective estimation of the input parameters which could lead to biases. This fact is particularly relevant for firms with severe liquidity problems that have difficulty in meeting their short-term obligations when they come due. Because the model does not take this into account, it might underestimate the probability of default. Although the proposed model encourages the conversion of the different classes of debt into one single class, the real results might deviate as a result of this conversion.

Third, the Black and Scholes model is based on market data from the moment of analysis. Thus, the model does not capture sudden changes in market leverage. Since the market value of debt tends to constantly change, this could under- or over-estimate the probability of bankruptcy. Due to the significant difference between the going concern value and the liquidation value, a small bias could lead to a big change in the final value. Hence, careful considerations should be paid to estimate the market debt level [Crosbie and Bohn, 2003].

Fourth, it has to be noted that the model is designed for public companies, since it is built on a market-based approach. Private firms could be calculated only by using some comparability analysis based on accounting data which could distort the results. Application of the model to private firms is therefore limited.

Fifth, although the impact of violating the assumptions is relative, as shown by the commercial application by Moody’s KMV, the theory behind the model is based on the Black and Scholes theory, which is based on the following assumptions: no transaction costs, efficient markets, full access to
capital markets, and the basic assumption from the Miller and Modigliani theorems [Modigliani and Miller, 1958] [Black and Scholes, 1973].

Lastly, the purpose of the valuation is merely to illustrate the use of the proposed model in a practical setting. It therefore does not provide a complete and accurate picture of the case at hand, which would be a research study in itself. Consequently, this fact can have a major impact on the discussion of the results of the model and its accuracy.

7 Recommendations for future research

The model introduced in this research study is purely theoretical. The case application is merely to prove its applicability to a real-life case but it does not provide sufficient information regarding the accuracy of the model. It would therefore be interesting to apply the model in a bigger study, with both cross sectional as well as time series data. The findings of such a research study could be analyzed and any possible distortion identified. Then, on the basis of this information, possible adaptations to the model could be made in order to improve the accuracy of the introduced model. In addition, it would be interesting to analyze the impact of the assumptions made in the model in order to find out if it is reasonable to ignore certain facts. In particular, the impact of the use of a single type of debt in the model is worth further investigation. Finally, a sensibility analysis of the various input variables could be performed in order to assess the impact and importance of the different inputs.

8 Conclusion

The goal of this research study was to identify the limitations of the use of traditional valuation techniques on companies that are in distress and decline. The careful analysis of the three predominant valuation techniques yielded that these methods face major problems when applied to companies in such
situations. Reasons for this are that the conditions that firms in decline and distress face are very extraordinary and can not be fully captured by the traditional valuation methods. In addition, the methods completely ignore one of the major risks these firms face, i.e. the risk of default. Based on these findings, an adaptation for the traditional valuation technique is presented. The model summarizes the probability of distress in a separate probability of default metric, thus separating this risk from the rest of the valuation. Then, the value of the firm can be calculated under normal conditions. Finally, the liquidation value, in the event of the firm defaulting, i.e. in a distressed sale scenario, is calculated. The final value for the firm in distress and decline is given by the average between the value under normal conditions and the liquidation value, weighted by the probability-of-default metric. The use of this model resolves many of the major problems associated with using traditional methods in uncertainty, while at the same time provides all the benefits that these methods offers.

The application of the model to the case of the Eastman Kodak Company underlined the validity of the model by yielding results that are in line with the market valuation as well as other valuation methods. However, the application to the case also revealed the strong sensitivity of the model to the input parameters. Therefore, even though the model introduced a new perspective on evaluating the risk of default in combination with traditional methods, it does not find a solution to the lack of precision and the need of qualitative inputs variables. Nevertheless, the concept of separating the risk of default from the rest of the model and and estimate it with the BS Option pricing model, allows for a greater precision in both the evaluation of risk and the final value. Unfortunately, the model does not represent an universal method to be used in all distressed scenarios but the method of choice should be determined by the availability and accuracy of the input data.
References


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Appendices

A: Distance to Default

\[ DD = \frac{\ln(V_A X_t) + (r_A - \frac{\sigma_A^2}{2} t)}{\sigma_A \sqrt{t}} \]

B: Kodak Stock Price 1996-2011

Source: Google Finance (2014)

C: Kodak Financials 1996 - 2012

Source: Kodak Annual Reports: 2000-2005
### D: Kodak Income Statement 2000 - 2005

<table>
<thead>
<tr>
<th>Field</th>
<th>2000</th>
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<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>restated</td>
<td>original</td>
<td>restated</td>
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<tr>
<td>Revenue</td>
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<td>13229</td>
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<td>12509</td>
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<td>Cost of Revenue</td>
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<td>8661</td>
<td>5225</td>
<td>5734</td>
<td>9645</td>
<td>19650</td>
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<td>Gross Profit</td>
<td>5985</td>
<td>4565</td>
<td>4610</td>
<td>4175</td>
<td>3460</td>
<td>3018</td>
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<tr>
<td>Operating Expenses</td>
<td>3781</td>
<td>3667</td>
<td>3392</td>
<td>3394</td>
<td>3261</td>
<td>3560</td>
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<td>Operating Income</td>
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<td>1311</td>
<td>1318</td>
<td>781</td>
<td>609</td>
<td>58</td>
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<td>Interest Expense</td>
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<tr>
<td>Foreign Exchange Losses (Gains)</td>
<td>13</td>
<td>N/A</td>
<td>N/A</td>
<td>10</td>
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<tr>
<td>Net Non-Operating Losses (Gains)</td>
<td>123</td>
<td>677</td>
<td>199</td>
<td>496</td>
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<tr>
<td>Pre-tax Income</td>
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<td>Income Before XO Items</td>
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<td>Minority Interests</td>
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<td>Net income</td>
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<td>Abnormal Losses (Gains)</td>
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<td>Normalized Income</td>
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<td>675</td>
<td>787</td>
<td>631</td>
<td>690</td>
<td>462.65</td>
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Source: Kodak Annual Reports: 2000-2005

### E: Kodak Income Statement 2006 - 2011

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<th>Field</th>
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<td>7609</td>
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<td>7247</td>
<td>5838</td>
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<td>4550</td>
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<td>2409</td>
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<td>1706</td>
<td>1946</td>
<td>798</td>
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<td>Operating Expenses</td>
<td>2489</td>
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<td>2850</td>
<td>1670</td>
<td>2212</td>
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Source: Kodak Annual Reports: 2000-2005
### F: Balance Sheet 2000-2005

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Source: Kodak Annual Reports: 2000-2005

### G: Industry Debt/Equity Ratios

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<thead>
<tr>
<th>Name</th>
<th>FUJIFILM HOLDINGS</th>
<th>CANON INC</th>
<th>KONICA MINOLTA INC</th>
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<tbody>
<tr>
<td>Code</td>
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Source: Datastream
H: Industry Betas

Unlevered industry Betas

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<tr>
<th>Name</th>
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<td>Beta (2000-2005)</td>
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Source: Datastream, KPMG

I: Equity Volatility

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Source: Datastream

J: Model Parameters

Model Input Variables
### Asset Value and Volatility

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**Return asset (Datastream)**

-0.0195

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### Probability of Default

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