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# **Evaluation of claims on distressed firms. A conceptual framework based on structural models**

**Master's Thesis** 



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# **Master Thesis**

# Evaluation of claims on distressed firms A conceptual framework based on structural models

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## **0** Executive summary

Within this thesis, we develop and apply a comprehensive, yet tractable framework comprising 10 sequential steps for the evaluation of claims on corporations suffering from distress.

While traditional industry approaches yield consistent and unbiased valuations for claims on a healthy firm's assets, we find encumbering evidence that results may be distorted if the valuation object experiences severe financial or economic difficulties. Standard present value, multiple, or accrual based equity valuation methods are deterministic in nature and hence, fail to properly account for the elevated idiosyncratic uncertainties surrounding distress.

Initiated by Merton (1974), on the other hand, asset pricing research has suggested structural models as a theoretically superior alternative explicitly incorporating the optionality features and asymmetric payoff-profiles of limited liability claims. However, these models have been rarely adopted by industry professionals for their proclaimed complexity, lack of transparency and stylized assumptions on the valuation object's capital structure.

Accordingly, the proposed framework aims to overcome the above shortcomings of the original Merton (1974) model and eventually allows for an intuitive, seamless pricing of multiple claims with diverse maturity and coupon profiles based on their absolute priority ranking in bankruptcy.

First, we provide a thorough characterization of both economic and financial distress and accompanying (firm) characteristics based on which a framework applicability assessment can be performed. Besides, we stress a comprehensive discussion how model input parameters can be estimated reliably.

Subsequently, we perform a holistic application of the framework to the distressed German air carrier Air Berlin. Model outputs imply a current market undervaluation of common equity by 52%. While our analysis demonstrates remarkable upsides of the framework compared to traditional valuation procedures, we conclude that a separate estimation of a going concern- and a liquidation value only partially circumvents frictions associated with the computation of a distressed firm's overall asset value.

Moreover, we find that model results are highly sensitive to changes in input factors in general and the expected asset drift rate in particular, implying a considerably low robustness to estimation errors. The latter deficiency may mitigate a broad adoption of our framework going forward.

## Acknowledgements

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Moreover, we would like to thank Björn Imbierowicz, Assistant Professor at Copenhagen Business School, for insightful explanations of the seniority and covenant profiles of claims on distressed firms observed in the cross-section. Next, we would like thank Peter Raahauge, Visiting Associate Professor at Copenhagen Business School for sharing his experiences and advice on the development and implementation of quantitative, yet intuitive financial models.

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Lastly, we appreciate assistance in the design of our title page by Hannah Marie Dean and Kasia Sznajder, Master's candidates at Copenhagen Business School.

All remaining errors are our own.

# Table of contents

0 Executive summary	ii
1 Introduction	1
1.1 Problem definition	2
1.2 Delimitations	3
1.3 Structure	6
2 Methodology	7
2.1 Research design	7
2.2 Development of the framework	9
2.3 Case study	9
3 Distress and bankruptcy	10
3.1 Definition of financial and economic distress	11
3.2 Default and bankruptcy	13
3.3 Characteristics of firms in distress or bankruptcy	15
3.4 Proceedings in financial distress and bankruptcy	17
3.5 Scope of this study	19
4 Option theory	20
4.1 Nature of an option	20
4.1.1 Generic option payoffs	21
4.1.2 Put-call-parity	21
4.1.3 Bull spread option strategy	23
4.2 Option pricing theory	24
4.2.1 Black- Scholes model in continuous time	24
5 Structural models	26
5.1 Firm value as a portfolio of options	28
5.2 Contingent claim pricing	32
5.3 Probability of default and credit risk assessment	37
5.4 Extended default-claim pricing	40
6 Framework	42
6.1 Discussion of valuation approaches	43
6.1.1 Income models	43
6.1.2 Liquidation models	46
6.2 Valuation uncertainty arising from distress	47
6.2.1 Structural uncertainty	48

6.2.2 Strategic uncertainty	
6.3 Superiority of contingent claim pricing models	
6.4 Estimation of model input variables	
6.4.1 Risk-free rate	
6.4.2 Default barrier	
6.4.3 Debt maturity	
6.4.4 Asset value	
6.4.5 Asset volatility	
6.5 Presentation	
7 Case study	
7.1 Company description	
7.2 Framework applicability assessment	
7.3 Macro and industry analysis	
7.4 Strategic company analysis	
7.5 Financial statement analysis	
7.6 Capital structure analysis	
7.7 Estimation of input variables	
7.8 Contingent claim pricing	
7.9 Probability of default	
7.10 Discussion of model outputs	
8 Limitations and future research	
9 Conclusion	
10 References	cxviii
11 List of abbreviations	cxlv
12 Appendix	cxlviii

# **1** Introduction

The accurate valuation of a firm is one of the most crucial disciplines in the field of finance. Common income models range from cash flow based to accrual based to relative valuation based procedures (Petersen and Plenborg, 2012, Imam et al., 2008). In practice, these techniques are usually used in combination when estimating the fair value of a company (Imam et al., 2008).

While these valuation techniques yield economically sound and internally consistent results for firm values when carefully implemented for healthy companies under both stable and predictable conditions (Koller et al., 2005, Petersen and Plenborg, 2012), their application to firms in financial or economic distress and bankruptcy has resulted in a very wide dispersion of valuation errors (Gilson et al., 2000). These findings can be attributed to the substantial shortcomings of traditional valuation techniques for firms in distress or bankruptcy (Damodaran, 2009). Nevertheless, these techniques have generally been used for the valuation of troubled firms by professionals in the field of distressed investing without much consideration of the special uncertainties and distortions arising from distress (Scarberry et al., 1996, Houlihan Lokey, 2011).

Indeed, already Wruck (1990) notes that "the number of investors buying and selling the securities of distressed firms and the capital available for such investments has grown spectacularly" (Wruck, 1990, p. 420). Vulture investors may have different objectives but often seek profits by identifying and investing into undervalued claims of distressed companies (Hotchkiss and Mooradian, 1997, Moyer et al., 2012). Thus, Crystal and Mokal (2006) correctly highlight the necessity of a thorough claim valuation before an investment decision is made.

In more recent years, there has been a clear trend of traditional buyout funds to acquire distressed companies with the ultimate goal of value creation (Kucher and Meitner, 2004, Roland Berger, 2017a). On top, banks currently sell their non-performing loans (NPL) in an effort to restructure their balance sheet to comply with increasing stricter regulations (Roland Berger, 2017b, Debtwire, 2017). Also Financial Times (2015) finds attractive market opportunities for distressed investors willing to move beyond standard products and valuation techniques.

Yet, financial or economic distress is a versatile and complex process characterized by increased uncertainty both of structural and strategic nature (Wruck, 1990, Gilson et al., 2000). Despite its great importance for distressed investment professionals, existing research on distress and bankruptcy has only been remotely connected to other fields in financial economics. Likewise, Hrdý and Simek (2012) chide that no directly applicable valuation model reflecting the special characteristics of real-life distressed firms has been assessed in detail so far.

Since the seminal work of Black and Scholes (1973) and Merton (1973, 1974), structural models have emerged as a prominent tool for the stylized valuation of corporate liabilities. Based on option pricing theory, these models may (i) mitigate many of the shortcomings of traditional static valuation approaches, (ii) arguably incorporate more flexibility, and (iii) overcome the bargaining problem between different claimholders inherent in the bankruptcy process, which results in the elevated strategic uncertainty named above (Damodaran, 2009, Sundaresan, 2013).

The application of structural models requires the estimation of various model input parameters, a process often described as too complicated for the model to be of practical use (Hrdý and Simek, 2012). Contrarily, Damodaran (2002, 2009) suggests to price equity in a distressed firm characterized by negative cash flows as a call option on the firm's assets and thus ultimately advocates the use of structural models to account for the value of flexibility. Yet, the original Merton model is based on a single zero-coupon debt – a setup not applicable to handle real-life firms' capital structure consisting of multiple debt instruments with different maturities and coupon features.

Consequently, this thesis develops and presents a hands-on framework for the evaluation of claims in distressed firms by consolidating state of the art research findings in the field of financial economics and corporate distress. Thereunder, a considerable part of this thesis investigates how structural models achieve the advantages introduced above. Subsequently, to prove its practical applicability, the developed framework will be applied to a real-life case company, the German network carrier Air Berlin, in a step-by-step process.

### 1.1 Problem definition

Consequently, this thesis investigates the following research question:

How should a framework for the evaluation of claims in distressed firms be designed to (i) overcome the shortcomings of traditional valuation methods, (ii) ensure a practical applicability, and (iii) be consistent with paradigms of modern scientific financial economics? How does the framework perform once applied to a real-life distressed company?

In order to answer the above research question, this thesis examines the following sub-questions:

• What are common characteristics of firms facing financial or economic distress and eventually bankruptcy? What are possible proceedings to overcome financial distress or bankruptcy?

- What is the rationale behind applying contingent claim pricing to the valuation of debt and equity in a firm? Which structural models have been proposed in academia?
- What are the shortcomings of traditional valuation techniques when applied to firms facing distress and bankruptcy and which factors contribute to the elevated uncertainty arising in a distressed environment?
- How would a framework need to be designed to implement contingent claim analysis in the valuation of distressed firms? In particular, how does the framework overcome the shortcomings of traditional valuation approaches? How can users of the framework estimate the necessary model input variables?
- For which prerequisites does the framework proposed above yield superior results in comparison to traditional valuation methods, and hence justifies its application?
- What are the fair values of the various debt and equity claims on Air Berlin using the proposed framework? What potential caveats accompany an application to a real-life company?

### **1.2 Delimitations**

Due to the complexity of this thesis, several delimitations and assumptions have been made to ensure a focused, yet comprehensive investigation of the main research question. Thus, emphasis is put on factors that impose the greatest impact and relevance in regard to both the evaluation of claims in distressed firms based on structural models and the case study implementation.

#### 1.2.1 Bankruptcy code

This thesis is based on stylized proceedings in financial distress and bankruptcy derived from the U.S. bankruptcy code Chapter 7 and Chapter 11 (see chapter 3.4). While we acknowledge that bankruptcy is a legal procedure and therefore highly dependent on country specific legislation (Pindado and Rodrigues, 2004, 2005, Brealey et al., 2010), insolvency acts across nations pursue similar overarching goals (Jones Day, 2007). Besides, the majority of structural models and academic research in the field of financial distress and bankruptcy is ultimately founded on and derived from the U.S. bankruptcy code. Finally, as the assessment of specific legal aspects is outside our area of competence, this work shall rather be seen as a contribution to the field of finance and economics.

#### **1.2.2 Option Theory**

The contingent claim pricing approach based on structural models can be implemented both in a continuous time setting using the Black-Scholes-Merton (BSM) model or in a discrete time environment employing lattices. On the one hand, lattice analysis allows for easier model-adjustments to reflect characteristics and circumstances of real life firms. In contrast, once carefully set up, the BSM closed form model significantly enhances the traceability and scalability of the outlined procedure ultimately enabling the pricing of a great number of different claims. Moreover, to ensure a fast and convenient implementation of the BSM model, we provide the necessary VBA code as part of the framework (see Appendix 6.4.4-A.1).

#### 1.2.3 Convertibility and callability feature of debt instruments

The underlying framework for the evaluation of claims in distressed firms does not take potential convertibility or callability provisions of debt instruments into account. This delimitation, however, does not imply noteworthy restrictions since such features only play a subordinated role for firms facing financial distress or bankruptcy. First, distressed firms usually experience a substantial drop in market capitalization which makes it highly unattractive to convert debt into equity claims (see Crosbie and Bohn, 2003). Second, companies in distress commonly face cash constraints, and hence do not often have the financial resources for an earlier repayment of their debt instruments. Further, given the severe situation it is unlikely that a distressed firm will be able to refinance itself with better terms.

In addition, the framework refrains from directly considering potential put provisions, which are sometimes part of bond indentures. These features permit investors to request the repayment of the outstanding face value prior to maturity. However, if the framework user finds the exercise of the early redemption option to be optimal, we heuristically suggest to replace the contractual maturity of the respective instrument with the period length until the exercise date when calculating the firm's aggregated debt maturity (see chapter 6.4.3).

A number of authors has developed various complex extensions to the original structural Merton model to account for the debt instrument features mentioned above. Yet, Hull et al. (2004a) note that "none [of these] has emerged as clearly superior" (Hull, 2004a, p. 4). Accordingly, the framework builds on the initial structural model by Merton (1974).

4

#### **1.2.4 Absolute priority rule**

Fixed bankruptcy proceedings and compliancy with the absolute priority rule form the basis of contingent claim pricing. Therefore, in line with existing academic literature, this thesis does not model deviations from the absolute priority rule in case of bankruptcy or liquidation. However, various empirical studies (e.g. Warner, 1977, Baldwin and Mason, 1983, Franks and Torous, 1989) have shown that the absolute priority rule in bankruptcy is seldom honored fully in real life.

#### 1.2.5 Case study: case company

The practical application of the developed framework and the concluding discussion of results are exclusively based on the case of the German airline Air Berlin PLC. Therefore, this allows for a detailed and holistic analysis of the firm but is not yet generalizable to the cross-section of distressed firms.

#### 1.2.6 Case study: time frame

This work undertakes the evaluation of various claims on Air Berlin's assets as of December 31, 2016. Consequently, major subsequent events are not taken into account for the strategy assessment and financial valuation performed within the case study.

#### 1.2.7 Case study: publication of the annual report 2016

According to Air Berlin's financial calendar, the company publishes its annual report 2016 on April 27, 2017 (Air Berlin, 2017). Given the short time left the official thesis submission deadline set by CBS, we base our calculations partly on Q3 2016 and otherwise carefully estimated figures.

Further, the company's restructuring of its operating model together with the effects of economic and financial distress impede an ordinary forecast of Air Berlin's income statement and balance sheet. While relevant future income statement items are modelled based on a comprehensive peer group benchmarking study, a forecast of the balance sheet is omitted. Yet, this approach shall not significantly influence the overall valuation results obtained.

#### **1.3 Structure**

Exhibit 1.3-1 illustrates the structure of the underlying work. The current introduction is followed by a methodology section. Subsequently, chapter 3 is dedicated to a formal characterization of distress and bankruptcy. Along with chapter 4 on option theory, these parts form the basis for the understanding of structural models and the contingent claim pricing approach outlined in section 5. The main part of this thesis motivates, develops, and outlines a framework for the evaluation of claims in distressed firms using the structural Merton model. Section 7 applies the outlined framework to a case company. Finally, the work closes with a discussion of model outputs and limitations, recommendations for future research and lastly a concluding remarks and limitations

#### Exhibit 1.3-1: Structure of the thesis



Source: Own production

# 2 Methodology

Bryman et al. (2011) stress a clear understanding of the research design is crucial for any academic endeavor. In particular, a thorough assessment of the underlying assumptions about the philosophy of science and resulting paradigms guiding the research is considered pivotal to apprehend how results can be achieved, which inferences can be drawn based upon it and, more generally, which research gaps can/ cannot be closed by the chosen research method. Accordingly, the following sections will outline the research philosophy, approach and strategy selected for this thesis. Moreover, we cast light on how the framework for the evaluation of claims on distressed firms has been developed and how the case study has been implemented.

To ensure that the analysis conducted within this thesis can also be understood and applied by a general audience without experience in financial economics and business administration, the major theoretical financial and strategic concepts underling our work have been summarized in Appendix 2-A.1 and Appendix 2-A.2, respectively.

## 2.1 Research design

For Gupta and Lincoln (1994), the evaluation of appropriate *paradigms*, i.e. "basic belief system[s] or world view[s] that guide[s] the investigation" (Gupta and Lincoln, 1994, p. 105), ranks the highest within the research process. Saunders et al. (2009) point out that different paradigms or research priorities can be characterized based on their ontological, epistemological and axiological positioning.<sup>1</sup>

Within this thesis, a *positivistic paradigm* is chosen: Remenyi et al. (1998) and Saunders et al. (2009) clarify that reality is perceived as objective (with regard to ontology) and observable (with regard to epistemology) so that research findings often culminate into "law-like generalizations" (Saunders et al., 2009, p. 113). Accordingly, Bryman et al. (2011) remark that scientific knowledge is developed through a logical processing of theorems or empirical data. With regard to axiology, Saunders et al. (2009) point out that research ought to be carried out as value-free as possible way.

We follow Schophuus and Stefanac (2008) and exclusively rely on one single paradigm to ensure that all assumptions, methods and inferences part of this thesis are mutually aligned. On top, building on

<sup>&</sup>lt;sup>1</sup> Following Saunders et al. (2011), the philosophical term ontology characterizes how the nature of reality/ being is perceived while epistemology relates to the question what composes acceptable knowledge and how such knowledge is created. Lastly, axiology is concerned about the role (personal) values should assume in the research process.

the idea that knowledge is objective, most theories used in this thesis are considered factually valid across their specific contexts.

According to Saunders et al. (2009), a *positivistic research philosophy* is typically accompanied by a *deductive research approach*. Snieder and Larner (2009) conclude that deductive reasoning tracks the standard path of logic most closely, while Wilson (2014) clarifies that existing theories are often used or combined to first craft a research question or hypothesis that is assessed subsequently. The *inductive approach*, on the other hand, typically starts with (specific) observations and aims to identify generalizable patterns within them (Babbie, 2007).

Since the individual academic fields relevant for the development of our framework (see section 2.2 for a more detailed discussion) have generally been broadly covered on a stand-alone basis, we mostly *deduce* insights from existing research. While we abstain from articulating formal hypotheses, the research question is addressed by the consolidation of various connected research strands, finally leading to a framework tailored to distressed firms.



#### Exhibit 2.1-1: The research onion

Source: Saunders et al. (2009), own production

Subsequently, a case study has been chosen as the most appropriate research strategy to demonstrate both the validity and applicability of the step-by-step process outlined in the framework (see section 2.3). Since Saunders et al. (2009) point out that case study research is necessarily context-specific, the interferences drawn from this section involve inductive elements as well.

#### 2.2 Development of the framework

The framework developed in this thesis builds on a broad review of existing literature and solely relies on secondary data such as peer-reviewed academic publications or, if not possible otherwise, so far unpublished working papers. This is in line with a positivistic philosophy and the deductive approach outlined in section 2.1. More concretely, our analysis consolidates previous academic work devoted to both theoretical and empirical research within asset pricing, corporate finance as well as the investigation of financial/ economic distress and bankruptcy.

Whenever possible, rigorous quality-filters have been applied to ensure high validity and relevance of the research forming the base for this thesis. Hence, predominantly research printed in leading academic journals or well recognized publishing houses has been considered. Moreover, we broadly follow the generic requirements articulated by Schophuus and Stefanac (2008) how to identify theories and empirical results relevant for the compilation of our framework: first, the research has to focus on one of the academic fields listed above. In addition, the results obtained need to be generalizable beyond the specific context of their genesis. Eventually, research contributions considered for our framework ought to represent the contemporary state of knowledge and should be considered valid. Again, the last requirement is ensured through a stringent focus on journals or publishing houses with a strict editorial process and a generally high impact factor.

#### 2.3 Case study

Damodaran (2002) and Damodaran (2009) argue that the valuation of (claims of distressed) firms is inevitably dependent on the idiosyncratic characteristics of the valuation object. Likewise, Yin (2003) and Saunders et al. (2009) correctly remark that *case-studies*, i.e. "empirical investigation[s] of a particular contemporary phenomenon within its real-life context" (Robson, 2002, p. 178), are domain-dependent and typically yield detailed insights into the specific scenario considered. On the other hand, broader quantitative studies seem inappropriate for our research question since claim (e)valuation typically involves a detailed investigation of a single company and requires a considerable degree of model adjustments to reflect idiosyncratic circumstances.

In view of the space requirements set by CBS and for the sake of a (i) profound application of our framework and (ii) rigorous discussion of the model outputs, the examination of a single case study was chosen. Nonetheless, Flyvbjerg (2006) argues that despite the context dependent nature, careful analysis may actually allow to extrapolate selected case study findings to a broader population.

Our case study exclusively builds on secondary data and hence, includes company disclosures, press articles and market research studies complied by broker analysts or independent industry experts as well as security and claim prices provided by leading financial database providers. By abstaining from sourcing primary data, we ensure that the framework is applied in a setting similar to the outside-in perspective on the valuation object often faced by industry professionals.

Finally, we consider the financial data used for the application of our framework to be of high quality: financial statements have been audited and should thus comply with the applicable accounting standards. On the other hand, figures obtained from database providers were often provided by organized exchanges subject to strict regulations of security law.

## **3** Distress and bankruptcy

The development of a tailored framework for the evaluation of claims in distressed companies undeniably requires a holistic understanding of the special environment such firms operate in. Given the remark of Hamoto and Correia (2012) that analogous notions and theories used in academia are often overlapping but ultimately lack coherence, we will carefully derive a differentiation between economic and financial distress. On top, default and bankruptcy, two common outcomes of distress with pivotal importance for contingent claim pricing models, will be conceptualized.





Source: Own production

Next, we portray common characteristics of firms in financial distress or bankruptcy and provide an overview on measures to overcome distress or handle bankruptcy processes. The chapter closes with a delimitation of concepts and assumptions we will incorporate in our own model and thus sets the boundaries for further analysis.

## **3.1 Definition of financial and economic distress**

A clear and precise definition and conceptual distinction between economic and financial distress is the key for understanding the various contingent claim pricing models and their underlying default trigger. While some authors note that economic and financial distress might be mutually dependent,<sup>2</sup> the great majority of literature separates both concepts.

The definition of financial distress can effectively be reduced to a firm's inability to honor its debt obligations, most commonly related to an ultimate cash flow insolvency (Wruck, 1990, Shobhana and Deepa, 2012). In other words, Davydenko (2007, p. 1) summarizes more precisely:

"The firm is financially distressed when it has difficulties honoring its financial obligations. Even when the business is fundamentally sound, temporary declines in cash flows may result in the inability of highly-levered firms to make promised debt payments."

Following Outecheva (2007), financial distress is a complex and broad economic concept, whose definitions can be clustered into three different categories.

Definition of financial distress				
Event-oriented	Process-oriented	Technical definitions		
• Beaver (1966)	• Gordon(1971)	• Altman (1968, 1984)		
• Baldwin and Mason (1983)	• Turetsky and MacEwen (2001)	• Ohlson (1980)		
• Brown et al. (1992)	• Kahl (2002)	• Asquith et al. (1994)		
• Andrade and Kaplan (1998)	• Van Gestel et al. (2006)	• Whitaker (1999)		
• Kahl (2001)	• Purnanandam (2008)	• etc.		
• etc.	• etc.			

#### Exhibit 3.1-1: Definitions of financial distress

Source: Outecheva (2007), own production

The first group of event-oriented delimitations relates financial distress to failure, default or bankruptcy. Accordingly, financial distress can be defined as "the inability of a firm to pay its financial obligations as they mature" (Beaver, 1966, p. 71). Further on, the following events may

 $<sup>^2</sup>$  Both Wruck (1990) and Davydenko (2007) find financial distress to follow from (persistent) economic distress. Similarly, Kahl (2002) postulates that financial distress is an imperfect indicator of economic viability. Further on, Asquith et al. (1994) note the difficulty of studying financial distress in isolation since firms may be in economic distress simultaneously.

trigger a firm's failure: "bankruptcy, bond default, an overdrawn bank account, or nonpayment of a preferred stock dividend" (Beaver, 1966, p. 71). Congruent definitions of financial distress are made by Baldwin and Mason (1983), Brown et al. (1993), Dennis and Dennis (1995), Andrade and Kaplan (1998), and Kahl (2001). These authors define financial distress as an event separating the time of financial health from the period of financial difficulties and ultimately triggering measures of restructuring and reorganization (Outecheva, 2007).

Secondly, early contributions to define the term financial distress as a process have been made by Gordon (1971) who characterizes financial distress to precede failure and reorganization. Under his definition, financial distress is triggered by the deterioration of a firm's earnings trajectory resulting in a higher probability to default on upcoming interest payments and hence, a higher bond yield. Similarly, Van Gestel et al. (2006) characterize financial distress and failure as a result of recurring substantial losses essentially leading to insolvency as the firm's liabilities exceed its assets. Moreover, Turetsky and McEwen (2001) explicitly postulate "financial distress as a series of financial events that reflect varied stages of corporate adversity" (Turetsky and McEwen, 2001, p.323). Purnanandam (2008) characterizes financial distress as an intermediate low-cash flow state between solvency an insolvency.<sup>3</sup> Similar to the original Merton model, "insolvency occurs on the maturity date if [the] terminal firm value is below the face value of debt" (Purnanandam, 2008, p. 707).<sup>4</sup>

Thirdly, a large group of academics has defined financial distress in technical terms through the deployment of financial ratios as the main indicator. Most popular within this category are contributions by Altman (1968) and Ohlson (1980) who use a combination of different financial ratios to predict financial distress. More specifically, Asquith et al. (1994) characterize a firm in financial distress using solely the interest coverage ratio, whereupon a firm is declared distressed if its EBITDA is less than 80% of its interest expenses in two consecutive years. Whitaker (1999) combines accounting based and market based determinants to classify financial distress. According to his definition, a firm is financially distressed if, first, its cash flow is less than the due amount of outstanding debt and, second, the firm suffers from a substantial drop in market value.

<sup>&</sup>lt;sup>3</sup> A similar definition of distress has been deployed by Titman (1984).

<sup>&</sup>lt;sup>4</sup> The definition of insolvency based on assets and liabilities by Purnanandam (2008) is equivalent to the stock based classification of insolvency by Wruck (1990). On the other hand, a firm is insolvent on a flow basis if it is unable to meet current cash obligations.

Finally, financial distress may be caused by a broad variety of factors comprising but not limited to economic distress, poor management, operating difficulties and firm performance relative to the industry, decline of firm's industry, technological or social change or regulatory restrictions (Bibeault, 1982, Wruck, 1990, Denis and Denis, 1990, Whitaker, 1999, Hrdý and Simek, 2012, Van Gestel et al., 2006). In addition, Opler and Titman (1994) as well as Andrade and Kaplan (1998) find that the higher the firm's level of debt, the higher is the probability of financial distress.

While there are various different approaches to the definition of financial distress, economic distress is rather homogenously characterized and consistently used in existing literature. Its diagnosis is independent of the presence of debt or pending interest payments but, on the contrary, builds on the economic viability of the firm's business activity (Davydenko, 2007). Further, as the company's future ability to generate positive cash flows worsens, its business model is no longer viable, economic distress prevails, and ultimately the firm value expressed as the market value of its productive assets will decrease (Davydenko, 2007). In other words, "economically distressed firms can be identified by declining asset values, even though [the firm] may have no immediate difficulty making ongoing debt payments" (Davydenko, 2007, p. 2).

In addition, Crystal and Mokal (2006) argue that a business is economically distressed, if "the net present worth of the business as a going concern is less that the total value of its assets" (Crystal and Mokal, 2006, p. 1). Thus, the firm's assets would be more valuable in the hand of another owner and hence, should be sold to avoid further deterioration to the firm's claimants (Crystal and Mokal, 2006).

#### 3.2 Default and bankruptcy

Both economic and financial distress can eventually lead the company into default. Generally speaking, a firm is considered to be in default if it fails to honor one of its debt payments as they come due (Meckling, 1977, Pastena and Ruland, 1986, Hamoto and Correia, 2012). For 2015, the credit rating agency Moody's found that 29.4% of all corporate defaults are related to payment defaults (Moody's, 2016). Additionally, a firm is in technical default if it violates any of the contractually specified debt covenants not related to principal and interest payments, e.g. minimum-net-worth requirements or working capital constraints (Wruck, 1990).<sup>5</sup> In the case of a violation of minimum-

<sup>&</sup>lt;sup>5</sup> Note that default may also be triggered by cross-default provisions, i.e. "default on one debt security is a condition for technical default in another" (Wruck, 1990, p. 421).

net-worth requirements, technical default is essentially caused by economic distress. Finally, according to Moody's delimitation, a firm is also found to be in default if it files for "bankruptcy, administration, legal receivership, or other legal blocks" (Moody's, 2007, p. 1).

Systematically, triggers of default can be clustered based on whether they are related to financial (liquidity shortage) or economic distress (low market value of assets, Davydenko, 2007). However, empirically analyzing reasons for firms to default, Davydenko (2007) reports that most firms in default are insolvent both economically and financially.<sup>6</sup>

The vast majority of theoretical structural models specifies firm default to be driven by economic distress, i.e. in terms of the market value of the firm's assets  $V_t$  and liabilities D. The default boundary can both be specified exogenously or defined endogenously by stakeholders (Davydenko, 2007).

#### Exhibit 3.2-1: Exogenous and endogenous default trigger

Economic distress	Exogenous default trigger	<ul> <li>Default is exogenously imposed by positive net-worth condition (e.g. in bank covenant or loan indenture) or cash-flow shortage to cover debt services (assumes financial and credit constraints)</li> <li>Commonly, firm defaults if market value of assets is below value of liabilities, V<sub>t</sub> ≤ D</li> </ul>
	Endogenous default trigger	<ul> <li>Firm derives critical asset value for bankruptcy, i.e. shareholders choose default boundary endogenously</li> <li>Default can occur prior to debt maturity if equity option value falls below required debt payment</li> <li>Essentially, equity holders have an option to default</li> </ul>

Source: Own production

Even if market value ranks among the best univariate default predictors, "there is no pronounced boundary separating defaulting and non-defaulting firms" (Davydenko, 2007, p. 4). First, some firms continue to operate and service their debt although their asset value reaches the book value of total liabilities. Those firms might potentially default at a later point in time (Crosbie and Bohn, 2003, Davydenko, 2007). Secondly, given the long-term nature of some debt instruments, Crosbie and Bohn (2003) note that generally the default barrier, the asset value at or below which the firm will default, lays between the firm's short-term and total liabilities. Likewise, Davydenko (2007) finds that a default boundary of 68% of the face value of the firm's debt has the highest discriminatory power to differentiate between failing and surviving firms. These findings confirm similar results derived by Leland (2004).

<sup>&</sup>lt;sup>6</sup> In his sample Davydenko (2007) finds that "the average market value of assets at default is only 60% of the face value of debt, and liquidity ratios are below the industry median for 80% of defaulting firms" (Davydenko, 2007, p. 2).

Although most often used, the market value of assets is not the only default trigger deployed in academic literature. Other authors have developed structural models reflecting the nature of financial distress whereupon the firm defaults due to a shortage in instantaneous cash flow to cover its current debt obligations (Davydenko, 2007). The most prominent contributions in this field have been made by Kim et al. (1993), Anderson and Sundaresan (1996) and Ross (2005). Since these models usually prevent external financing and assume the absence of cash reserves, Davydenko (2007) notes "in most such models the market value of assets is always proportional to the current cash flow. As a result, the default trigger specified in terms of a threshold cash flow [i.e. financial distress] is equivalent to one that uses the boundary market value of assets [i.e. economic distress]" (Davydenko, 2007, p. 6). More information will be provided in section 3.5 and 5.4 of this work.

While Meckling (1977) states that default and bankruptcy should be considered alternative outcomes, Hamoto and Correia (2012) note that in most cases they are sequential events with bankruptcy following from default. Likewise, Brealey et al. (2010) note that bankruptcy commonly can be viewed as a result of default triggered from declining asset values.

Bankruptcy has very different characteristics than has financial distress (Gilbert et al., 1990) and should essentially be understood as only one possible outcome of financial distress (Giroux and Wiggins, 1984, Ward and Foster, 1997, Pindado and Rodrigues, 2005). In particular, different from financial distress, bankruptcy is merely a legal mechanism with no economic significance and hence, depends of the legal procedure of the relevant country (Pindado and Rodrigues, 2004, 2005, Brealey et al., 2010). It essentially provides the institutional platform to organize a potential "transfer of ownership from one security holder to another" (Haugen and Senbet, 1988, p.32) and thereby to resolve the problem of insolvency (Meckling, 1977, Berkovitch et al., 1998).

#### 3.3 Characteristics of firms in distress or bankruptcy

Hrdý and Simek (2012) point out that firms in distress or bankruptcy differ from healthy, stable firms along a broad array of dimensions. Hence, an understanding of their special and distinguishable characteristics contributes to an applicability assessment of the framework (step 1) developed in chapter 6 of this thesis.

While Platt and Platt (2002) recall the absence of a single measure valid in isolation to identify when a company can be considered distressed, academic research has often used the candidate's past earnings trajectory as a main indicator (see Exhibit 3.3-1 for an overview on this and alternative metrics). Davydenko (2007) finds that more than 90% of all failing firms have a negative accounting income (with a median profit margin below -20%) in the year of default, almost 60% of these firms exhibit a negative book equity (compared to less than 15% in the non-defaulting control sample).

Exhibit 3.3-1:	Characteristics	of firms in	distress o	r bankruptcy

Negative (cumulative) earnings	Negative operating cash flows	Increasing leverage	Decreasing market value	Negative equity returns
• Gilbert et al. (1990)	• Asquith et al. (1994)	• Asquith et al. (1994)	• Whitaker (1999)	• Gilson et al. (1990)
• John et al. (1992)	Platt and Platt (2002)	• Damodaran (2002)	• Davydenko (2007)	• Whitaker (1999)
• Davydenko (2007)	• Davydenko (2007)	• Davydenko (2007)	Shobhana and Deepa (2012)	• Davydenko (2007)
• etc.	• etc.	• etc.	• etc.	• etc.

Source: Own production

An additional phenomenon common among distressed firms is a decline of asset values. This may either indicate industry-wide decline or recessions (Shleifer and Vishny, 1992) or reflect that alternative users could employ the firm's resources more effectively (Crystal and Mokal, 2006). Moreover, the balance sheet total may also decline since distressed firms often conduct asset sales to ensure short-term liquidity despite low operational profitability (see section 3.4 for a more detailed discussion).

As a direct consequence, firms in financial distress often experience a significantly negative equity return momentum. For example, Davydenko (2007) observes that a firm's share price typically starts to decline about 3.5 years before default, while debt yields tend to widen approximately two years in advance. Since equity absorbs most of the decline in asset value, increasing leverage ratios can be observed for almost all firms in distress. This effect is exacerbated by the tendency of distressed firms to issue additional debt to fund operations or to meet existing short-term obligations. This move is often required since cash flows from operations are negative and interest coverage ratios insufficient to honor interest or principal repayments with the money generated by the firm itself (see e.g. Asquith et al., 1994).

Further, common characteristics among firms in distress or bankruptcy include the cut or overall suspension of dividends (DeAngelo and DeAngelo, 1990, Platt and Platt, 2002, Franks and Sanzhar, 2003), the reduction of capital expenditures (Asquith et al., 1994), a declining workforce, most likely