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The determinants of recovery rates in the Nordic high yield bond market

An empirical study of the price development and market-based recovery of defaulted high yield bonds

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Abstract

In this thesis, we analyse market-based recovery rates on 78 defaulted high yield bonds in the Nordic market, during the time-period from May 2014 to September 2016. First, we estimate market-based recovery rates, defined as the average synthetic bond price from the default event date to 90 days after the event.

Second, we analyse the bond price development in a time window of 90 days pre-default to 90 days after each individual default event. In general, our results show a decreasing price path throughout the time window with no substantial price reaction at the default event date. In contrast to bankruptcy and non-payment events, we find that distressed exchange events show an increasing price path after the default event. Additionally, we find that secured bonds trade at a stable premium compared to unsecured bonds throughout the time window.

Third, we determine the effects of a comprehensive set of variables on recovery rates. We are able to explain 55.3 per cent of the cross-sectional variation in recovery rates in our best model. These results reveal that bond characteristics such as outstanding amount and bond covenants are important determinants of the recovery rate. Furthermore, we note interesting economic effects for the net debt/EBITDA measure, a balance sheet ratio motivated by credit risk models. Macroeconomic variables play a lesser role in explaining the variation in recovery rates.

Finally, we analyse the liquidity in 42 of the 78 defaulted bonds during the same time window. In general, the average trading volume increases towards a peek at the default event day. Although the amount traded diminishes, trading remains high the following 45 days. After this point, there are virtually no trading activity.

Keywords: Nordic high yield bonds, credit risk, recovery rate, liquidity, default

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Contents

1 Introduction

The Nordic high yield bond market has shown to be an attractive marketplace for both investors seeking yield and issuers in search of financing. Over the last decade, it has transformed from being a small regional market into one of the world's largest and most important markets for corporate bonds. Although the Nordic market has delivered attractive yield to investors and easily accessible debt capital to companies, stakeholders have experienced the risks related to high yield debt securities in macroeconomic downturns. In particular, the global financial crisis and the more recent drop in oil prices have highlighted the many risks that may arise. In times of distress, issuers seek to survive as well as having to reimburse investors. Therefore, it is important to understand the credit risk in the pricing of these instruments, and especially its key determinants: the probability of default and the recovery rate in the event of default.

Traditionally, the probability of default has caught most of the focus in credit risk modelling, while the recovery rates often have been set to fixed values. However, the magnitude of the abovementioned crises and the observed increase in defaults in the Nordic high yield market, have highlighted the importance of obtaining more precise estimates of the recovery rates, as well as understanding their variation across different dimensions. Jankowitsch, Nagler and Subrahmanyam (2014) suggests that recovery rates are potentially driven by endogenous factors such as specific characteristics of each security, firm and industry, in addition to exogenous factors such as the overall macroeconomic condition. They document the determinants of these risk factors and analyse the variables' interaction effects with other dimensions of default risk on the US corporate bond market. To our knowledge, this kind of research has not been performed in the Nordic high yield bond market. Therefore, we find it highly interesting to investigate the relationship between recovery rates and factors as suggested above on this relatively young market. This will be the focus in this thesis.

The majority of bonds in the Nordic high yield bond market trades over-the-counter (OTC), making the market less transparent. In addition, bonds in the Nordic market trades less frequently compared to larger markets in the US and UK. Thus, time series of trading prices may not react to new information at the time it arrives, even though the fundamental bond value might have changed. This makes research in this area challenging. However, daily synthetic price data from May 2014 are available, provided by Nordic Bond Pricing. This permits us to examine the prices pre- and post-default events of defaulted bonds. Consequently, allowing us to estimate and analyse reliable market-based recovery rates.

We observe the price development of defaulted bonds 90 days prior the default event date to 90 days after, during the period from May 2014 to September 2016. This allows us to detect trends around the default day, not only for the sample as a whole, but also analyse differences in default event classifications, by industry and risk class. This provides key insight for estimating and further analysis of recovery rates.

In the main part of our analysis, we seek to explain the variation in market-based recovery rates. We define the recovery rate of a defaulted bond as the average daily synthetic bond price per cent of notional, from the default event date to 90 days after the default event date. Through regression models, we analyse these recovery rates along various dimensions. First, we examine them across default event type, industry and seniority. This provides understanding of the effects for the factors we believe to be the most fundamental in characterising a particular bond. Following, we add a comprehensive set of bond characteristic, firm specific and macroeconomic variables to this base. Overall, our regression analysis capture as much as 55.3 per cent of the total variation in recovery rates, with all three sets of variables contributing to the explanatory power.

Further, this thesis examine the trading activity in the Nordic high yield bond market. As this market may be characterised as illiquid, we find investigating developments and trends in trading activity of defaulted bonds intriguing. In order to analyse the liquidity, we employ a 30-days trailing average volume. We use this approach mainly due to the illiquid and lagging Nordic high yield bond market. There is a slight increase in trading moving towards the default event date, a peak close to the default event date and a slightly decreasing path thereafter.

Overall, we provide a comprehensive analysis, providing new insight on the Nordic high yield bond market. We examine the development in both prices and volumes. Through examination of an extensive set of explanatory variables, rather than only providing evidence on the effects of a single factor, we offer detailed analyses on important drivers of the recovery rates.

The structure of this thesis is as follows: Chapter 2 presents basic theoretical frameworks on credit risk, which is useful to understand the discussion and analysis of this study. Chapter 3 reviews previous literature covering credit risk and recovery rates. Chapter 4 address the research questions and states the main hypotheses tested. Chapter 5 provides a description of the Nordic high yield bond market. Chapter 6 presents the data applied in this thesis. Chapter 7 describes the methodology and explains the setup of the subsequent analysis. Chapter 8 presents descriptive statistics as well as the results from the regression models and liquidity analyses, while Chapter 9 concludes.

2 Credit risk

Although corporate bonds promise a fixed cash flow to its investors, there are risks related to whether an issuer will be able to pay the promised cash flow. Hence, corporate bond investors demand a compensation reflected in higher yields and lower prices compared to risk free bonds. The difference between the yield on a corporate bond and the risk free rate is called the yield spread and is a measure of the market premium of a risky debt security. Historically, this has been attributed solely to credit risk, hence commonly referred to as the "credit spread" (Huang and Huang, 2012). Credit risk is defined as the risk of monetary losses due to debt issuers who do not honour contractual payments (Lindset, Lund and Persson, 2014). Three main variables affect the credit risk of a financial asset: (i) the probability of default or *default rate (PD)*, (ii) the *loss given default rate (LGD),* equal to one minus the *recovery rate (RR),* and (iii) the *exposure at default* (EAD). In this way, credit risk is a function of PD, LGD/RR and EAD as shown in Equation 1.

$$\text{Credit risk} \approx \text{PD} \cdot \text{LGD} \cdot \text{EAD} = \text{PD} \cdot (1 - \text{RR}) \cdot \text{EAD} \tag{1}$$

Other factors explaining yield spreads is a debated topic and commonly referred to as the "credit spread puzzle". On one hand, Huang and Huang (2012) find that credit risk do not fully explain yield spreads, and that illiquidity, call- and conversion features, asymmetric tax treatment of corporate and government bonds and other regulatory costs are important factors. On the other hand, Feldhütter and Schaefer (2016) find that credit risk is able to explain average yield spreads. Further, Longstaff, Mithal and Neis (2005) find that the credit risk explains the largest part of yield spreads, and that the relative size of the credit risk component increase when credit rating declines. This support our focus on high yield bond recovery rates.

Recovery rates may be easy to define academically, but interpreted and calculated differently depending on investment strategy and time horizon. Overall, we distinguish between *ultimate* and *market-based* recovery rates. Ultimate recovery rates are based on the amount paid to bondholders in a redemption or a settlement, and are applicable to investors seeking to hold bonds until maturity or redemption. Market-based recovery rates are the price of bonds after the default event. We use market-based recovery because several institutional investors are directly exposed to post-default prices through mandates to sell their positions, deliver bonds through the settlement of credit default swaps (CDS) and write down the recognised value of the defaulted bonds in their balance sheets.

3 Literature review

Previous academic research on recovery rates can be divided into two categories: theoretical papers covering credit risk models, which make explicit or implicit assumptions about recovery rates at default, and empirical papers which analyse historical default events (Jankowitsch, Nagler and Subrahmanyam, 2014). Credit risk models can be further divided into three categories: first generation structural form models, second-generation structural form models and reduced-form models (Altman et al., 2003).

The most basic first generation structural model was developed by Merton (1974) using the framework of option pricing (Black and Scholes, 1973). In this framework, the process of default is modelled by the value of a firm's assets. Thus, the default risk is explicitly connected to the volatility of a firm's asset value.[1] A default occurs when the value of a firm's assets is lower than the value of its liabilities at maturity. Creditors will in a default event receive the value of the issuer's assets. In these models, all relevant credit risk elements, including recovery rate, are modelled as a function of a firm's asset volatility and leverage (Altman, Resti and Sironi, 2002). Hence, the recovery rate is treated as an endogenous variable in these first generation structural models, and the relationship between default and recovery is inversely related. It suggests that the recovery rate decreases when the default rate increases, and vice versa.

Jones, Mason and Rosenfeld (1984) found in their study that the Merton model does not price investment grade corporate bonds, issued by firms with very simple capital structures, better than simple models assuming zero default risk. Hence, second-generation structural models were developed to remove the unrealistic assumption that a default can only occur at maturity of the debt, if the value of a firm's assets are lower than the liabilities. Kim, Ramaswamy and Sundaresan (1993), Hull and White (1995) and Longstaff and Schwartz (1995), assume that default can occur any time between issue and maturity if the value of a firm's assets falls through a certain level. In these models, the recovery rate is an exogenous variable that is independent from the value of a firm's assets. The recovery rate is normally assumed to be a constant ratio of the liabilities and therefore independently related to the default rate. Although second-generation structural models represent improvements to the

[1] Other first generation structural models are for example Black and Cox (1976) and Geske (1977). Both try to remove unrealistic assumptions in the original Merton model. Black and Cox (1976) allows more complex capital structures with subordinated debt, while Geske (1977) allows interest paying debt.

original Merton model, empirical research has shown that they perform quite poorly (Eom, Helwege and Huang, 2004).

Reduced-form models were developed to overcome the shortcomings in second-generation structural models, by not conditioning default on the value of a firm (Altman, Resti and Sironi, 2002). Some of these models include Litterman and Iben (1991), Duffie and Singleton (1997) and Lando (1998). In reduced form models, it is not necessary to estimate parameters related to the value of a firm in order to implement them. Additionally, these models introduce separate, explicit assumptions to be made with respect to both default rate and recovery rate. Hence, both default- and recovery rate can be modelled independently from the structural features of the firm, volatility of the assets and leverage. Reduced-form models allow complex dependency structures, but most of these models assume the recovery rate to be exogenous and independently related to the default rate. Although reduced-form models introduce solutions to the shortcomings of structural models, empirical research (Duffee, 1999) (Longstaff, Mithal and Neis, 2005) finds that these models do not completely explain observed yield spreads. Thus, it is important and relevant to study the stochastic processes of recovery rates by analysing historical default events, which in turn can contribute to the modelling of defaults.

The first contribution of empirical research of recovery rates is Altman and Kishore (1996), who studied defaulted bonds from 1978 – 1995. They focused on recovery rates, estimated by trading prices on the default day, across industry classifications and seniority. Their main findings include that the highest recovery rate came from public utilities with 70 per cent on average. Chemical, petroleum and related products with 63 per cent on average. Further, the original rating of a bond issue had no effect when controlling for seniority. Finally, time from issuance and issue size did not affect the recovery rates.

Altman et al. (2005) examined recovery rates on corporate bond defaults primarily in the US, over the period 1982 – 2002. Their study focused on explaining aggregate recovery rates with aggregate default rates and macroeconomic variables. They find that the default rate is a substantial indicator of the recovery rate, explaining 51 per cent of the variation in recovery rates. Recovery rates and default rates were negatively correlated. On the other hand, macroeconomic variables such as GDP growth and the S&P 500 index did not explain much of the variation in recovery rates.

While Altman et al. (2005) examined the impact of aggregate default rates on recovery rates, Acharya, Bharath and Srinivasan (2007) examine the effect of distress within industries on recovery rates. By analysing defaulted US bonds over the period 1982 – 1999, they find that bonds recover significantly less, when the industry of the defaulted bond is in distress. They argue that bonds recover less if the industry is in distress and non-defaulted firms in the industry are illiquid. This is particularly evident when the industry is characterised by having assets that are hard to employ in other industries, and when the defaulted bonds are collateralised by these specific assets.

The most recent analysis on this topic is by Jankowitsch, Nagler and Subrahmanyam (2014), studying defaulted bonds in the US over the period 2002 – 2010. They analyse the trading microstructure of defaulted bonds around the default event date and perform a detailed analysis of determinants of recovery rates. They document temporary price pressure with high trading volumes on the default event date and the following 30 days, with the lowest bond price at the default event date. Further, bond covenants that set restrictions on the issuers were found to be important determinants of recovery rates. In addition, default event classifications, industry classifications, seniority classifications and balance sheet ratios were important determinants of recovery rates. Finally, they introduce liquidity variables in their analysis of the determinants of recovery rates, which were particularly important variables.

Although the majority of academic research on recovery rates examine the US market, some examine the Nordic market. Both G. Haugland and Brekke (2010) and Knappskog and Gystad Ytterdal (2015) studied the relationship between recovery rates and a set of explanatory variables. However, there are three major differences between their studies and ours. First, they use ultimate recovery rates while we use market-based recovery rates. Ultimate recovery rates reflect the eventual recovery, requiring detailed information regarding the redemption. Such information is often hard to obtain, leading to the use of rough proxies and combinations of different methods to calculate recovery rates. Consequently, they cannot rely on a consistent measurement of recovery rates, which may bias their results. In our study, we apply the same method to all default events based on reliable synthetic prices, making it possible to analyse the price development before and after the default event date. Second, we make use of far more comprehensive set of explanatory variables, particularly in the category of bond characteristics where we introduce four different covenant variables. Finally, we address the liquidity of defaulted high yield bonds, which is an unexplored area of research in the Nordics.[2]

[2] As far as we know, there has not been any academic research covering the liquidity of defaulted high yield bonds in the Nordics.

4 Research questions and hypotheses

In this chapter, we discuss the research questions and hypotheses tested in this study. First, we discuss the price development of defaulted high yield bonds both pre- and post-default event date. Second, we consider the potential effects of bond characteristics, firm fundamentals and macroeconomic indicators on the level of recovery rates on defaulted bonds. Finally, we examine the trading activity in defaulted bonds through a liquidity analysis.

Default events normally represents increased uncertainty regarding future cash flows to bondholders. Therefore, we expect to see a significant drop in prices at the default event date.

In the main part of our analysis, we explore cross-sectional variations in the recovery rates. First, we analyse default event type, industry and seniority, which are aspects we found to be of importance in previous literature. We cover the range of default event classifications provided by Stamdata, including bankruptcy, non-payment and distressed exchange. We test the hypothesis that formal legal procedures are more severe for a firm, and that bondholders are faced with higher costs in this case than more informal procedures. Hence, we expect to find lower recovery rates for bankruptcy events than for non-payments and distressed exchanges. Further, we hypothesise that industries with more tradeable and higher proportions of tangible assets will recover more. For example, we expect that shipping yield a higher recovery rate than industry, due to vessels being more tradeable than for instance paper production facilities and machines. On the other hand, shipping is a very cyclical industry and vessels may be hard to trade in downturns. Therefore, we expect that for example real estate will recover more than shipping due to real estates' nature of more stable asset values. As for the bond security, we anticipate that the greater the seniority, the higher will be the recovery.

Moving beyond these factors, we analyse the effects of bond characteristics, firm fundamentals and macroeconomic variables on recovery rates. The potential effects of bond characteristics, such as time to maturity, coupon, outstanding amount, whether or not the firm has guarantors, pledge on tangible assets and covenants (defined as investment, dividend, financial and event restrictions), on recovery rates introduce some interesting questions. In particular, we anticipate that the longer the time to maturity and the higher the amount outstanding, the lower the bond will recover. We expect the coupon rate to be positively related to the recovery rate. This is because bonds with higher coupon would be of higher value under certain outcomes of the default event (Jankowitsch, Nagler and Subrahmanyam, 2014). Regarding the guarantee, we anticipate that bonds having guarantors will obtain higher recovery rates, due to the potential help with financing in times of distress. As for the tangible pledge, we expect that bonds carrying such a pledge will recover more. This is motivated by the idea that share prices often drop as a firm default on their obligations, and a pledge in shares only, or no pledges at all, will have less value than a pledge in easily tradeable assets. Furthermore, we test whether covenants have an effect on the level of recovery rates. We hypothesise that bonds carrying covenants will yield higher recovery rates, as they might restrict firms from implementing certain policies that can expose bondholders to higher risks.

We believe that the characteristics of the firm will most definitely affect the level of recovery rates on defaulted bonds. More leveraged firms are hypothesised to have lower recovery rates. To be accurate, we especially assume that the credit metrics commonly used in credit analyses will be of importance. We expect that the higher the net debt/EBITDA, higher the default barrier and lower the interest coverage ratio (ICR), the lower will be the recovery rates. Furthermore, we expect that larger firms with more assets will obtain higher recoveries, because assets are normally tangible and have liquidation value. In addition, we test whether the firm being from the Nordics have an effect on recovery rates. We hypothesise that the effect is positive given the generally stronger economic conditions in the Nordics compared to other countries, as well as the closeness and knowledge firms from the Nordics have to the market. In addition, we investigate whether long-term debt (LTD) issuance, intangibility and receivables positively affect the recovery rates.

In general, we expect macroeconomic indicators to impact the level of recovery rates. We expect that high levels of market default rates and industry-specific default rates return lower recoveries, as they are signs of poor economic conditions. In contrast, when short-term interest rates are high, the economy will be at the higher end of the business cycle. Hence, we expect that higher 3-months NIBOR rates yield higher recovery rates. Further, we explore the impact the slope of the interest rate has on recovery rates.

We hypothesise that the total trading activity will increase from 90 days prior the default until the credit event date. Following, we assume that the trading diminishes during the 90 days after the observed default. We expect this peak due to the assumption that new information triggers trading in general. This hypothesis is extensively based on findings by Jankowitsch, Nagler and Subrahmanyam (2014) on the US market. Further, we analyse the trading activity within each default event classification. Lastly, we examine the trading activity for each risk class, secured and unsecured. We expect to observe higher trading activity for secured bonds, rather than unsecured, following default. This is based on the already stated hypothesis that secured bonds receive higher recoveries, which make them more attractive for short-term and second-hand investors.

5 The Nordic high yield bond market

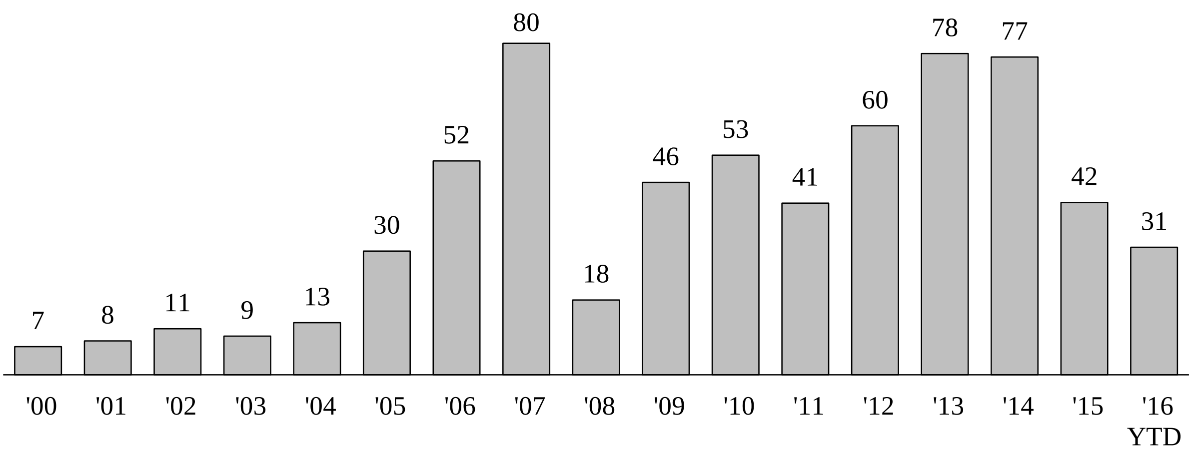
In this chapter, we introduce the Nordic high yield bond market, present general descriptive statistics, discuss trading and transparency, and present the role of Nordic Trustee.

5.1 History

The Nordic corporate bond market has transformed from a small national market with mainly domestic utility companies into a global market with large issue volumes of high yield corporate bonds (Lind, 2014). This makes the Nordic market the world's third largest market for high yield corporate bonds. In addition to being one of the largest markets in the world, it has become an international platform characterised by a large share of foreign issuers. In 2000, all high yield bond issuers were Nordic companies. Today, 58 per cent of all high yield bond issuers are foreign issuers (Nordic Trustee, 2015).

The Nordic bond market has existed for a long time, with non-credit companies starting to issue bonds in Norway in 1960 (Klovland, 2004). However, high yield bonds were not introduced until the 2000s. After the introduction of high yield bonds in the Nordics, the market experienced substantial growth until the financial crisis emerged in 2008. Global capital markets froze and banks were reluctant to provide liquidity and issue debt. The Nordic high yield bond market experienced a significant drop in the volume issued in 2008, displayed in Figure 1, after an all-time high issue volume in 2007 of NOK 80bn.

Figure 1. Nordic high yield bond issuance by year (NOKbn)



Source: Stamdata

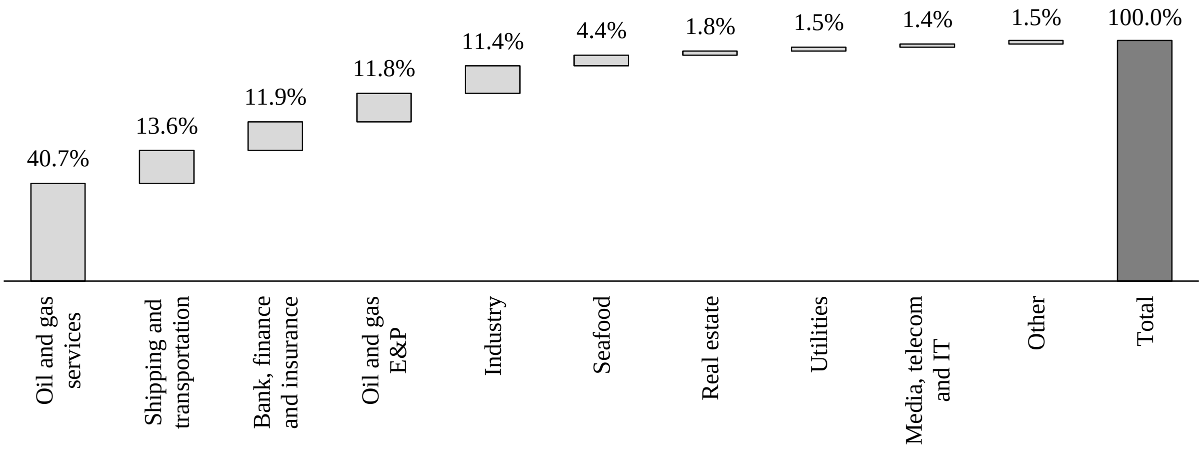
After the financial crisis, the Nordic high yield bond market recovered rapidly and experienced another high growth period from 2009 – 2014. This growth partly reflects the lending constrains that were placed on banks after the financial crisis (PwC, 2016). It allowed the bond market to become a viable alternative for companies seeking capital. This is especially true for capital-intensive industries such as oil and gas services, oil and gas exploration and production (E&P) and shipping. In addition, the global monetary policy that was introduced to face the credit crisis led to historically low interest rates on government bonds. Hence, institutional investors were forced to find other investment opportunities in their search for higher yields.

The Nordic bond has been a popular source of capital for oil and gas related companies, which account for over 45 per cent of the total outstanding amount of high yield bonds in the Nordic market. Hence, the drop in oil prices during the second half of 2014 led to another downturn in the Nordic high yield bond market. In 2015, the volume issued decreased to NOK 42bn from NOK 77bn in 2014. The focus of oil and gas related companies shifted from finding growth capital to finding restructuring solutions and refinancing capital, which in turn decreased the issue volume of high yield bonds.

5.2 Issuers

Due to the attractiveness of high yield bond financing for capital-intensive industries, and the nature of Norwegian business, the majority of high yield bonds have been issued by oil and gas related- and shipping companies. Figure 2 displays the allocation of issued high yield bonds by industry from 2000 – 2016. See Appendix 1 for annual Nordic high yield issuance volume by sector.

Figure 2. Total Nordic high yield bond volume issued 2000 – 2016 by industry



Source: Stamdata

However, the share of oil and gas related issuers has decreased in the recent years, as other industries have started to use the Nordic bond market as a source of debt financing. Industries such as media, telecom and IT, seafood and real estate has increased the share of debt financing from high yield bonds. See Appendix 2 for further detailed information regarding the outstanding volume of bonds in Nordic high yield market by industry.

5.3 Listing and trading

High yield bonds issued in the Nordic market can be listed on Oslo Stock Exchange (OSE) or the Nordic Alternative Bond Market (ABM). Listing on OSE requires the issuer to prepare a prospectus, which has to be reviewed by the Norwegian Financial Supervisory Authority (PwC, 2016). [3] Audited financial statements must be included in the prospectus and be in line with the International Financial Reporting Standard (IFRS). Additionally, a listing on OSE requires the issuer to set up an audit committee and comply with other, more technical listing requirements. In contrast, a listing on the Nordic ABM does not require audited financial statements in accordance with IFRS, a prospectus and an audit committee to be set up. As a result, Nordic ABM is a more flexible way to list a bond facilitating fast issue processes, while OSE is more regulated and transparent.

The majority share of high yield bonds trades OTC. OTC trading is done through a dealer network in contrast to a centralised exchange. It means that a broker negotiates the transaction over telephone or through a computer network. Hence, the Nordic bond market is argued to be less transparent compared to the equity market.

5.4 Standard features and characteristics

Nordic high yield bonds are normally bullet loans with floating interest rate based on the 3-months Norwegian Interbank Offering Rate (NIBOR). [4] The average tenor is 4 – 5 years and the normal issue size is between NOK 500m – 1,200m. Normal covenants mainly include financial covenants and to a smaller extent incurrence covenants.[5] Finally, Nordic high yield bonds are often redeemable through call options.

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[3] A listing prospectus is a document that contains all relevant information regarding the transaction, market, risks and issuer's financial health.

[4] Bullet loans are loans where the notional is repaid at the maturity in total.

[5] Financial covenants are restrictions regarding the issuer's financial performance and solidity, and is tested regularly. Such covenants are traditionally applied by banks. Incurrence covenants are restrictions regarding special events such as dividends, issuance of additional debt, mergers and acquisitions or related parties transactions.

5.5 Nordic Trustee

Nordic Trustee (NT) is the trustee who manages the bondholders' contractual rights towards the bond issuer. Hence, NT plays an important role both when the bond capital is raised and after the issue. NT is primarily owned by Nordic commercial banks, life assurance companies and brokerage companies. The standard documentation provided by NT has become necessary for a bond issue to be completed, hence NT is involved in almost every bond issue in the Nordic market (PwC, 2016). When NT is involved as trustee in a specific bond, NT signs the bond documents on behalf of the bondholders. Further, NT monitors whether the bond issuer comply with the bond's provisions, and has authority to pursue legal action on behalf of the bondholders and take control over collateral to secure the bondholders. In addition, NT has the authority to decide minor issues about the bond, but major issues are dependent on approval by two-thirds of the bondholders in a bondholder's meeting. Although NT primarily takes care of the bondholders, bond issuers can approach NT to discuss possible amendments regarding bonds on a confidential basis.

5.6 Unique characteristics of the Nordic high yield bond market

There are several reasons why both Nordic and international companies choose the Nordic high yield bond market when issuing bonds. First, the Nordic market is an effective venue for raising debt capital with easy access to investors. The Nordic market is often referred to as one of the three most effective high yield bond markets in the world, alongside the markets in London and New York (Oslo Børs ASA, 2015). The investment banks have strong experience and placement capacity, and new issues are often placed within a few hours. Due to the capital-intensive nature of the Norwegian economy, many companies have had to raise capital from international investors. International investors have historically found capital-intensive sectors such as maritime and energy attractive to invest in. Demand from investors in combination with extensive experience and knowledge in the investment banks have secured access to investors.

Second, the documentation process is far less extensive in the Nordic market compared to the US and UK. The documentation normally includes a term sheet (5 – 8 pages) and a standardised agreement (30 – 35 pages). In addition, there are no formal requirements regarding credit ratings from agencies such as Moody's, Fitch or Standard & Poor's in the Nordic market. The market practice has been that the investment banks' credit research department provides an independent and not formally approved "shadow rating". However, these ratings are normally provided based on international rating practices and methodologies. These ratings have provided transparency to bond investors and cost efficiency to bond issuers, as official ratings are far more complex and more expensive. However, in October 2016 the European Securities and Markets Authority (ESMA) decided that only registered rating companies like Moody's, S&P and Fitch can provide ratings. Five of the six largest banks in the Nordic region immediately chose to drop shadow ratings. This regulation is expected to put the liquidity and transparency in the Nordic high yield bond market at risk. Without shadow rating, investors have to do their own credit research on bonds issued by small companies which cannot afford an official rating. Norwegian fund managers are discussing possible solutions to maintain the transparency and liquidity in the Nordic market with the Asset Management Association.

Finally, a listing on OSE or Nordic ABM is optional and transaction costs are lower in the Nordic market compared to the market in the US and UK (Lind, 2014).

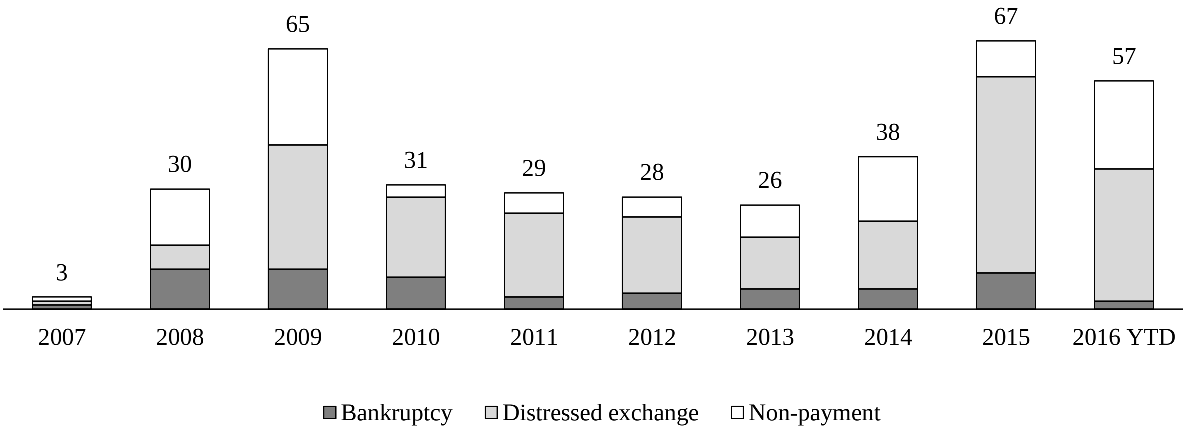
6 Data

This thesis relies on several data sources that we combine to analyse recovery rates in the Nordic high yield bond market. In this chapter, we present the data sources, explain how we filtered the data and show descriptive statistics of the final data set.

6.1 Default events

We identify default events by using Stamdata's database. This database provides detailed information about Nordic high yield bonds, covering qualitative and quantitative information from the issue date to default events and the maturity date. Stamdata is a subsidiary of Nordic Trustee and the most complex database for bonds in the Nordic region. Figure 3 and Appendix 3 display the historical development in the number of default events and amount outstanding for defaulted Nordic high yield bonds, respectively.

Figure 3. Number of default events in the Nordic high yield bond market by event classification



Source: Stamdata

We only consider straight high yield bonds and exclude other debt securities such as Capital Content Securities, CDs, Convertible Debt Instruments, Credit Linked Notes, Linked Notes, Subordinated Finance and Warrants. Trading prices of such securities with complex payoff structures at default could potentially be very different and bias our analysis. Over the period 2007 – 2016, we observe 108 firms with 374 default events. Of which 57 are bankruptcy filings, 107 are non-payments and 210 are distressed exchanges. The amount of defaults increased rapidly after the financial crisis in 2008 and during the oil price drop in the second half of 2014. This is mainly due to the high relative share of oil and gas issuers of high yield bonds in the Nordic region. 287 of the 374 default events were bonds with issuers in the oil and gas industry, including both E&P companies and services companies.

The first class of default events are bankruptcies, which are events where firms are unable to repay or service its debt. The creditor or the creditors can formally file bankruptcy proceedings through a federal court. Nordic Trustee can act as *debtor in possession*, and therefore control the business. In events where the debtor is subject to US law, it is possible to file for bankruptcy protection to a federal court under Chapter 11, which is often used to restructure debt or liquidate assets. The second class of default events are distressed exchanges. This is events where the debtor suggests to fundamentally change the contractual commitments related to debt, in order to avoid bankruptcy proceedings. Such changes of contractual commitments can be maturity extensions, reduced coupon, covenant changes, debt-to-debt swaps, debt-to-equity swaps or other fundamental changes. Hence, creditors can voluntarily agree to avoid potential costs related to formal restructurings (Jankowitsch, Nagler and Subrahmanyam, 2014). The third class of default events are non-payments, events where the debtor are unable to pay interest, amortisation or the notional at the scheduled time. The most common situations are when debtors either do not service its debt or agree with creditors to suspend or defer payments to creditors.

6.2 Trading prices and volumes

Nordic high yield bonds are traded quite unfrequently compared to Nordic common stocks and high yield bonds in larger markets like in the US and UK. Thus, trading prices contains large trading gaps in terms of time. This is undesirable because new information may have implied that the market value has changed, although no trading has taken place. As stated in in Chapter 1, we use synthetic bond prices estimated by Nordic Bond Pricing. These synthetic prices are estimated on a daily basis, hence filling the gaps in the official trading prices. In addition, the market accept these prices as fair estimates for the market values. Fund managers and other investors normally use these synthetic bond prices when writing their balance sheets. Thus, we believe these prices are reliable and sufficient. Nordic Bond Pricing is an independent pricing service company owned by the Norwegian Fund and Asset Management Association and Nordic Trustee. Nordic Bond Pricing was established in 2013 and has delivered pricing services since May 2014. Thus, we limit our dataset to high yield bonds that has defaulted in the period from May 2014 to September 2016. Although we might lose some default event observations, we value frequent observations of prices due to our focus on market-based recovery rates.

We obtain official trading volumes from three different sources depending on the status of each individual bond. For the currently traded bonds, we collect trading volumes from Oslo Stock Exchange's database or Bloomberg. For matured bonds, we use trading volumes by combining the NHH Stock Project's ("Børsprosjektet") database, Amadeus 2.0, with Bloomberg. This is due to the time limitation of Amadeus 2.0, which ends in mid-2016 and some default events occured later than this.

6.3 Bond characteristics, firm fundamentals and macroeconomic variables

We use bond characteristics such as coupon rates, outstanding amount, risk class and time to maturity provided by Stamdata's database. However, this database does not provide explicit data including which covenants each bond had at the default event day. Thus, we manually register bond covenants through the official loan documents and press releases of each particular bond, which is available on Stamdata's web page.

We obtain the firm fundamental data through FactSet, official financial statements and the web database, Proff Forvalt. All balance sheet items are last available before default event date figures, while all income statement items are last twelve months (LTM) before default event day figures. In situations where companies stopped filing official financial statements in a normal frequency, we apply the last available LTM figures. We choose last available figure to measure the current financial situation at the default event day.

For the macroeconomic variables, we gather the interest rate data from Norges Bank, the oil price data from Bloomberg and the default data from Stamdata.

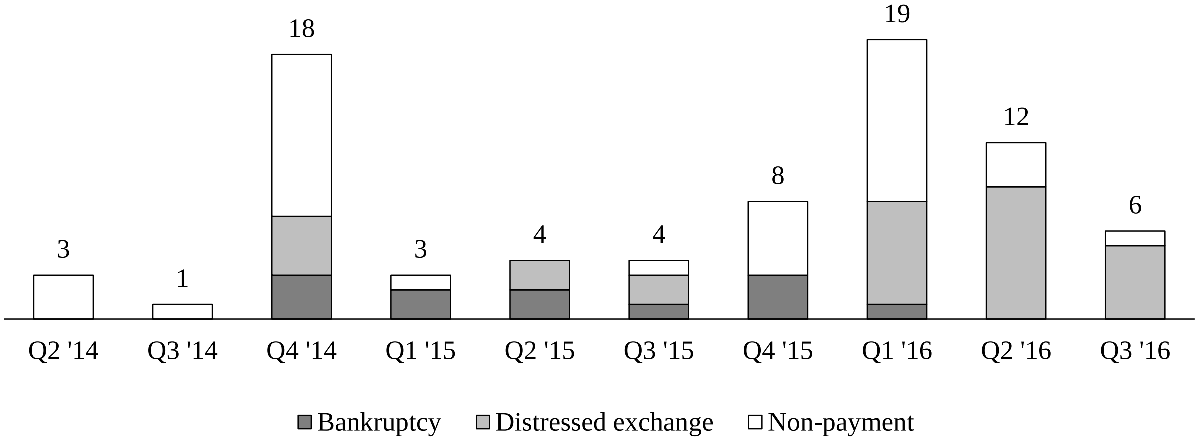
6.4 Final data set

We match default event data with all the other variables. We use prices and volumes in a range from 90 days prior the default event day to 90 days after, in order to analyse the price development both pre- and post-default event day. However, some bonds had several default events within a shorter period. We exclude default events of a particular bond if there has been another default event for the same bond within 3 months prior the event. This filtering process eliminates the issue that a particular default event may be influenced by another default event that happened before the particular default event. In total, we obtain 78 default events from 68 different bonds and 48 different firms as shown in Table 1. 12 of which are bankruptcies, 29 are distressed exchanges and 37 are non-payments. The total outstanding amount of defaulted bonds is NOK 74bn. We illustrate the development of default events in our final data set in Figure 4.

Table 1. Summary statistics for the final data set

	# of events	Outstanding amount (NOKbn)
Panel A: Total data set		
Total	74	74.10
Panel B: Credit event classification		
Bankruptcy	12	10.96
Distressed Exchange	29	18.80
Non-Payment	37	44.34
Panel C: Industry group and sub group classification		
Industry	8	9.55
Heavy industry	1	2.64
Mining and minerals	7	6.91
Oil and gas E&P	12	13.59
Oil and gas services	51	49.63
Drilling	14	30.30
Floatels	5	2.80
FPSO	2	1.52
Service and supply vessels	23	9.92
Subsea	2	2.45
Surveying	5	2.65
Real Estate	2	0.20
Shipping	5	1.12
Chemicals	4	0.77
Crude	1	0.35
Panel D: Risk class classification		
Secured	48	56.21
Unsecured	30	17.89

Figure 4. Development of default events in the final data set



7 Methodology

In this chapter, we explain the methodology we apply to measure the determinants of recovery rates in the Nordic high yield bond market. We present our definition of the recovery rate, default event characteristics, bond characteristics, firm fundamentals, macroeconomic variables and the regression model setup.

7.1 Recovery rate

The recovery rate π of bond i, issued by firm j, is calculated as the average synthetic bond price p per cent of notional, from the default day t to T=90 days after default event day.

$$\pi_{i,j} = \frac{1}{T+1}\sum_{t=0}^{T} p_{i,j,t} \tag{2}$$

Our definition of recovery rate is a market-based recovery rate rather than an ultimate recovery rate. In other words, the definition of recovery rate implies that the value of $\pi_{i,j}$ should be interpreted as what an investor would pay on average for a particular bond given that the transaction happens within a time period starting at the default event day and ends 90 days after the default. Due to the lagging and illiquid nature of the Nordic bond market compared to the US market, this time window was chosen to represent the recovery period. Jankowitsch, Nagler and Subrahmanyam (2014) apply 30 days after default event date as their recovery period, to estimate their recovery rates on the US corporate bond market. Thus, it makes sense for us to use a longer recovery period, to better capture the price effect after a default event. We do not account for any accrued interest when calculating the recovery rates, because the synthetic bond prices are *clean* rather than *dirty*. [6] In general, most bonds do not trade without any exchange of accrued interest.

7.2 Bond characteristics

We apply a variety of bond characteristics to explain differences in recovery rates. These variables are both qualitative and quantitative, that defines a particular bond. The most basic variables are outstanding amount, coupon rate and time to maturity at the time of the default

[6] A dirty price is the present value of all future cash flows, including accrued interest on the next coupon payment. A clean price does not account for accrued interest on the next coupon payment.

event for each individual bond. We measure outstanding amount in NOK and time to maturity in years, calculated by applying 252 trading days per year in accordance with Christoffersen (2012). Additionally, we use risk class classifications, as this is an important factor to account for when analysing recovery rates. Thus, we differentiate between secured and unsecured bonds. A bond can be secured by the issuer's pledge of a specific or non-specific asset, shares or through the cash flow in which the bond was originally issued to finance. We choose to add a variable that indicates if a bond is secured with a pledge in tangible assets, due to tangible assets' nature of fundamental value. In addition, a bond may be guaranteed by a parent company, indicating that the guarantor is accountable for the service of debt if the issuer cannot service. As a result, we include a variable indicating whether a particular bond is guaranteed or not.

Further, we consider the effects of having different types of covenants at the time of default. We group covenants into investment, financing, dividend and event covenants as suggested by Chava, Kumar and Warga (2010), which in turn is based on a model by Smith and Warner (1979). The background for the specific grouping relies on event situation and on the nature of restrictions each particular covenant imposes. Investment covenants are restrictions regarding mergers and acquisitions, asset transactions and investments in general. Financing covenants are restrictions regarding the issuer's balance sheet, income statement, ability to issue debt or equity, and debt hierarchy. Dividend covenants are restrictions on dividend payments to shareholders. Lastly, event covenants are restrictions regarding special events such as change in control of the issuer firm. Change in control events are often restricted by a poison put, a right to sell bonds in the event of change of control.

7.3 Firm fundamentals

Firm fundamental variables such as balance sheet ratios, income statement ratios and cash flow ratios are important measures describing firms' financial health and ability to service and repay debt. Thus, we include a set of firm fundamental variables to explain the recovery rate of high yield bonds. First, we use industry classifications separating firms operating in different industries and segments. Second, we apply certain financial statement metrics, which are commonly used in credit analysis. The following six ratios are applied:

$$\text{Net debt/EBITDA} = \frac{\text{Total debt} - \text{Cash and cash equivalents}}{\text{EBITDA}} \tag{3}$$

$$\text{Default barrier} = \frac{\text{Short} - \text{term debt} + \frac{1}{2}\text{Long} - \text{term debt}}{\text{Total assets}} \tag{4}$$

$$\text{LTD issuance} = \frac{\text{Long} - \text{term debt}}{\text{Total debt}} \tag{5}$$

$$\text{ICR} = \frac{\text{EBITDA}}{\text{Interest expense}} \tag{6}$$

$$\text{Intangibility} = \frac{\text{Intangible assets}}{\text{Total assets}} \tag{7}$$

$$\text{Receivables} = \frac{\text{Receivables}}{\text{Total assets}} \tag{8}$$

Net debt/EBITDA (3) and ICR (6) are two widely used credit metrics describing a firm's general financial health, financial leverage and debt service ability. Default barrier (4) is a metric that assess the distance to default, originally introduced by Moody's Analytics (Jankowitsch, Nagler and Subrahmanyam, 2014). Additionally, we apply LTD issuance (5) in order to describe in what extent a firm has debt maturing in the near future. LTD is generally known as a more stable source of financing while short-term debt requires liquidity in near future. Thus, a firm with a high degree of short-term debt might be more likely to default compared to an equivalent firm with less degree of short-term debt. Further, we include variables with intangible assets and receivables in the numerator and total assets in the denominator. Intangibility (7) measures the share of intangible assets, while the receivables (8) measure the share of receivables. Finally, we use total assets as a proxy for firm size. See Appendix 4 for summary statistics of firm fundamental variables.

7.4 Macroeconomic variables

We use macroeconomic variables to capture the effects of business cycles on recovery rates of high yield bonds. The 3-months NIBOR is commonly used as the reference rate of bonds denominated in NOK. Hence, we apply it in this study. Additionally, we use the slope of the term structure, defined as the yield on the Norwegian 10-years Government Bond minus 3-months NIBOR. Both the 3-months NIBOR and the slope variables are indicators of the macroeconomic health. We match each default event with the 3-months NIBOR and slope at the default event date. Further, we apply industry specific default rates in order to capture business cycles within each industry. The default rate in industry j at time t is defined as the defaulted amount outstanding of bonds in industry *j* during the period from *t* – 90 to *t*, divided by the amount of outstanding non-defaulted bonds in industry *j* at time *t* – 90.

$$\text{Default rate}_{t,j} = \frac{\text{Defaulted bonds}_{t,t-90,j}}{\text{Outstanding non} - \text{defaulted bonds}_{t-90,j}} \quad (9)$$

The equation indicates that the default rate is the 3-months trailing default rate. Rather than using a 12-months trailing default rate, we find this to be a better measure, given the relatively short time-period analysed in this study. This allows us to capture more variation in the default rates. Each default event is matched with the respective current monthly industry default rate. We use a notation of Equation 9, without the industry specification *j*, to calculate the market default rate. Appendix 5 plots the market and industry default rates from January 2007 to September 2016.

7.5 Regression models

We perform the main analysis on recovery rates of high yield bonds through cross-sectional ordinary least squares (OLS) regression models. The models incorporate all the variables we have defined in this chapter. The recovery rate of bond *i*, issued by firm *j*, is explained by default event classification, issuer's industry, risk class, bond characteristics, firm fundamentals and macroeconomic variables.

$$\begin{aligned}\pi_{i,j} = \alpha + \mu \cdot (\text{Default event classification})_{i,j} + \delta \cdot (\text{Industry})_{j} + \omega \cdot (\text{Risk class})_{i,j} \\ + \beta \cdot (\text{Bond characteristics})_{i,j} + \gamma \cdot (\text{Firm fundamentals})_{j,t} \\ + \theta \cdot (\text{Macroeconomic variables})_{t} + \varepsilon_{i,j}\end{aligned} \quad (10)$$

We define the model consisting only of the first three factors as the base model. As argued, these factors are the most fundamental variables characterising a particular bond and will be the foundation in every model tested. As a result, we are able to observe the different effects off adding various sets of other explanatory variables, using the base as a benchmark. Throughout our analysis, we focus on the explanatory power of each model. Further, while we are confident in concluding on the positive or negative effect of any significant variable, we are cautious interpreting the exact numerical effect due to the relatively small sample size. In conclusion, we determine whether any independent variable increase or decrease the recovery rate of a particular bond.

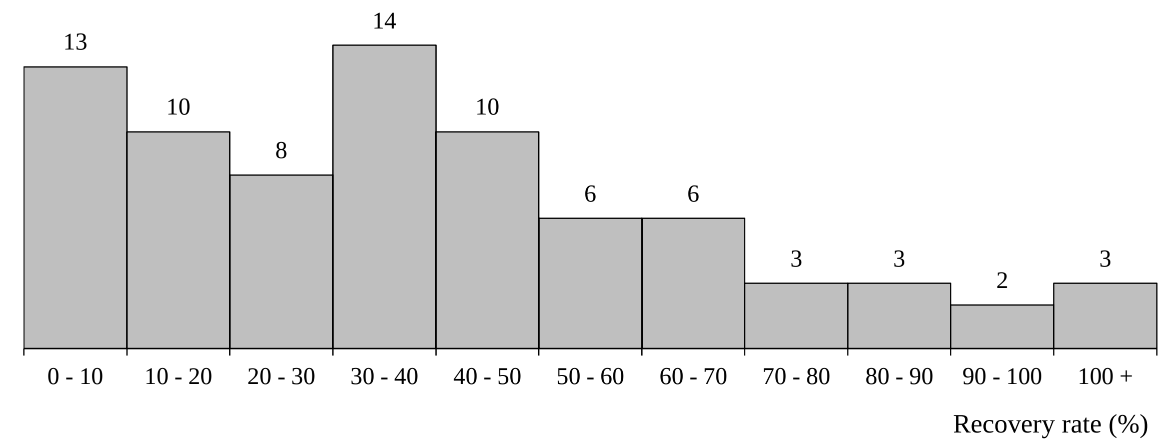
8 Results

In this chapter, we present descriptive statistics and analyse the price development of defaulted high yield bonds in the specified time window. Additionally, we analyse the results from the regression models and analyse the liquidity of a smaller sample of defaulted Nordic high yield bonds. When presenting the descriptive statistics and analysing the price development, we focus on the most fundamental variables, default event classification, industry and risk class classification. Other explanatory variables are discussed when we analyse the regression models.

8.1 Descriptive statistics

Figure 5 displays the distribution of the 78 recovery rates in the data sample.

Figure 5. Distribution of recovery rates



We observe that the majority of the sample fall in between two sections of recovery rate intervals. First, 24 out of the 78 defaults recover with 30 – 50 per cent. Second, 23 default events recover with 0 – 20 per cent. This result is in line with what Jankowitsch, Nagler and Subrahmanyam (2014) find in their study of the US market. However, they find the highest share of defaults within the two sections 0 – 20 per cent and 40 – 70 per cent. Consequently, our distribution contains relatively more observations with lower recovery rate. As previously discussed, it may be explained by the significantly lower liquidity in the Nordic high yield market compared to the US market, suggesting a liquidity discount in the Nordic market. Furthermore, our distribution of recovery rates show a long and flat right tail indicating a diminishing amount of observations as the recovery rate increases.

The average total recovery rate is 38.6 per cent with a maximum value of 100.3 per cent and a minimum value of 0.8 per cent, displayed in Panel A, Table 2. Interestingly, the average total recovery rate is equivalent to what Jankowitsch, Nagler and Subrahmanyam (2014) find in their similar analysis of the US market. This is however not what we expect considering the lower liquidity in the Nordic market. Furthermore, Altman and Kishore (1996) estimated a recovery rate of 40 per cent, which is common to apply in both academia and the industry. Thus, our average result is in line with previous research on recovery rates for defaulted high yield bonds. On the other hand, the standard deviation on the average recovery rate is 26.6 per cent, suggesting significant variation across different factors affecting recovery rates. Thus, a comprehensive analysis of the determinants of recovery rates is important. Table 2 displays minimum, average, maximum and standard deviation values of recovery rates in our data sample and across the most fundamental variables.

Table 2. Recovery rates by default event classification, industry and risk class

	# of events	Minimum	Average	Maximum	Std. dev.
Panel A: Total recovery rates					
Total	78	0.008	0.386	1.003	0.266
Panel B: Recovery rates by default event classification					
Bankruptcy	12	0.008	0.220	1.000	0.351
Distressed Exchange	29	0.039	0.426	1.000	0.224
Non-Payment	37	0.057	0.409	1.003	0.254
Panel C: Recovery rates by industry- and sub industry classification					
Industry	8	0.008	0.228	0.899	0.311
Heavy industry	1	0.057	0.057	0.057	n.a.
Mining and minerals	7	0.008	0.252	0.899	0.327
Oil and gas E&P	12	0.049	0.351	0.800	0.248
Oil and gas services	51	0.037	0.443	1.003	0.256
Drilling	14	0.089	0.438	1.000	0.243
Floatels	5	0.337	0.428	0.792	0.203
FPSO	2	0.333	0.542	0.752	0.296
Service/supply vessels	23	0.078	0.506	1.003	0.267
Subsea	2	0.354	0.492	0.630	0.196
Surveying	5	0.037	0.122	0.267	0.094
Real Estate	2	0.264	0.442	0.620	0.252
Shipping	5	0.039	0.122	0.190	0.077
Chemicals	4	0.039	0.115	0.190	0.087
Crude	1	0.150	0.150	0.150	n.a.
Panel D: Recovery rates by risk class					
Secured	48	0.008	0.437	1.003	0.288
Unsecured	30	0.037	0.305	0.800	0.207

Considering default event classifications, we find the lowest recovery rate for bankruptcy events with 22 per cent. This is in line with what we hypothesised in Chapter 4. Further, distressed exchange events return the highest recovery rate with 42.6 per cent, while non-payment events yield a recovery rate of 40.9 per cent. This is not what we would expect as distressed exchanges often originate from issuers in a more distressed condition compared to non-payment events. However, distressed exchange events may be actual solutions of the issuers' financial obligations, which in turn may leave the bondholders in a strengthen position. For example, debt-to-equity swaps are often converted with large discounts to the actual share price, giving shareholders a significant ownership in the issuers' equity.

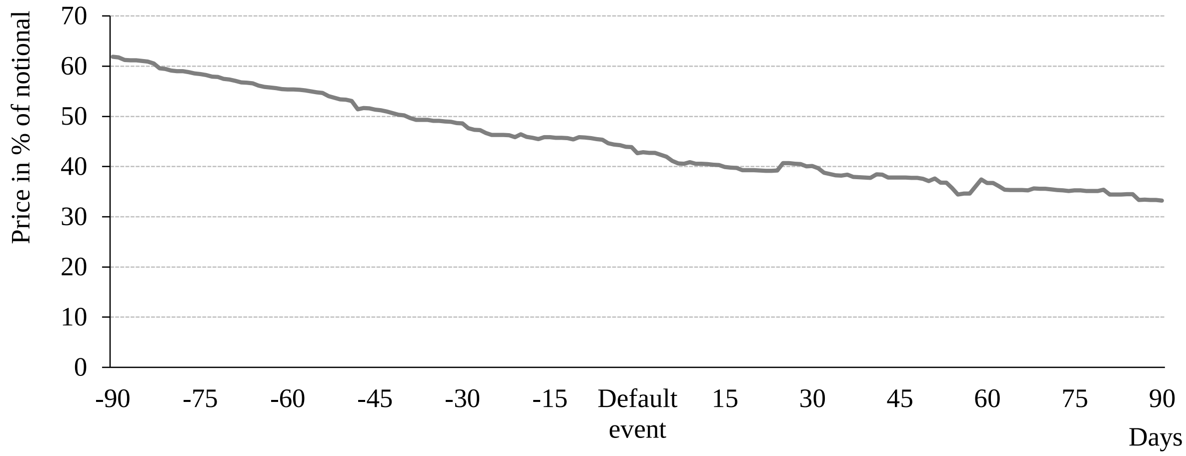
When comparing industry classifications, we find shipping to be the industry with the lowest recovery rate with 12.2 per cent, as displayed in Table 2. This is a surprising result, as we emphasised that the relatively high share of tangible assets due to the capitalisation of vessels should yield higher recovery rates. Then again, our analysis covers a time-period in which the business cycle in shipping is at its lower end, possibly resulting in lower recovery rates. It will be hard to liquidate or sell assets when there is oversupply and virtually no demand for vessels. Another explanation could be that there is relatively high leverage within this industry. Oil and gas services have the highest recovery rate with 44.3 per cent on average. Further, real estate has the second highest recovery rate of 44.2 per cent, possibly due to the relatively stable asset values over time. Oil and gas E&P and industry follows with the third and fourth highest recovery rates, 35.1 per cent and 22.8 per cent, respectively.

Secured high yield bonds have a recovery rate of 43.7 per cent, while unsecured bonds have a recovery rate of 30.5 per cent. This is line with what we hypothesised in Chapter 4. Secured bonds is less risky due to the bondholders' collateral claim in a specific asset, security or cash flow.

8.2 Price development

In this section, we analyse the price development of defaulted bonds across the most fundamental variables. We express bond price in per cent of the notional value, restricted within our time window. As shown in Figure 6, the average total price development over the time window shows a decreasing path.

Figure 6. Average total price development pre- and post-default event day

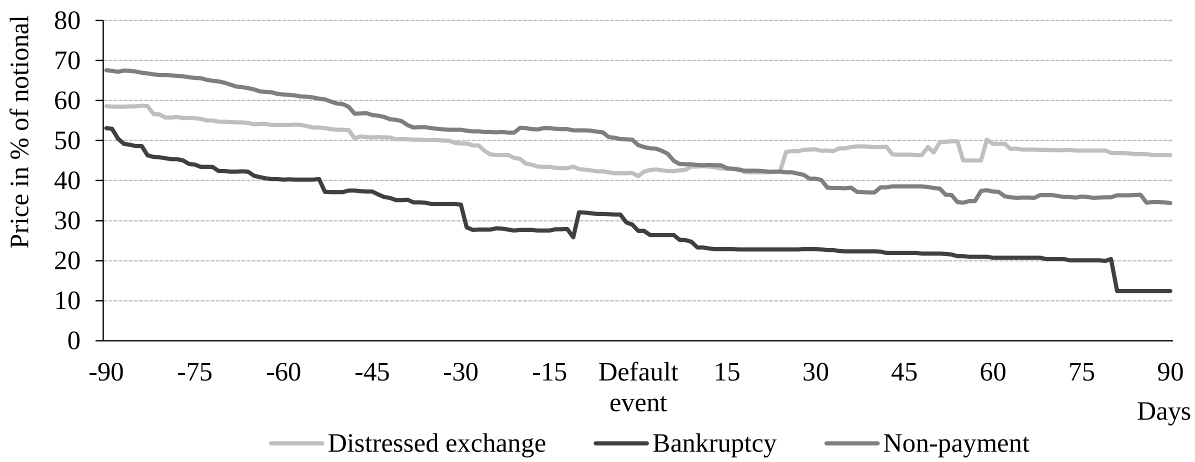


The average price level 90, 60 and 30 days prior the default event day is 61.9, 55.4 and 48.6 per cent, respectively. On the default event date, the price level decrease to 42.7 per cent on average. This indicates a decrease of 1.2 percentage points from the day prior to the default event date. Surprisingly, there is no sign of a substantial drop in the price level at the default event date, as one should expect if the market is efficient. In contrast, the stable decreasing path might imply that the market gradually receives information confirming the upcoming default event. We argue that the market is aware of the issuers' financial situation at the default event, and does not react appreciable. Moving from the default event date to 90 days after, the decreasing path continues, culminating at a price level of 33.2 per cent.

8.2.1 Price development by default event classification

When analysing the price development across default event classifications, displayed in Figure 7, we find that bankruptcy events has the lowest price throughout the entire period.

Figure 7. Average price development pre- and post-default event day by event classification



The price level of bankruptcy events 90 days pre-default is at 53.1 per cent while distressed exchanges and non-payments shows a price level of 58.7 and 67.6 per cent, respectively. All default event classifications show a quite similar decreasing path towards the default event date. However, bankruptcy events show a drop of 6 percentage points on the 29th day before the default event. It may reflect that information regarding the financial situation of the issuer normally leaks approximately 30 days prior the official default event date. On the other hand, the price level rebounds on the 10th day before the default event.

At the default event date, non-payment events show the highest price level with 48.9 per cent, followed by distressed exchanges and bankruptcies at 41.1 and 27.4 per cent, respectively. While both bankruptcy and non-payment events shows decreasing paths following the default event day, distressed exchange events show an increasing path. While non-payment and bankruptcy events decrease to 34.4 and 12.4 per cent respectively, the price level of distressed exchanges increase to 46.4 per cent 90 days after the default event date. The increasing path of distressed exchange events is surprising, but may reflect that the market expects a more dramatic outcome compared to the actual outcome. Issuers seem to propose attractive solutions in the contractual agreements to the bondholders, compared to the expectations reflected in the price level at the default event date.

8.2.2 Price development by industry

When we compare the price development across industry classifications, we find substantial different paths, as displayed in Figure 8. First, oil and gas E&P show a steep decreasing price level development. Starting at 73.0 per cent 90 days pre-default, before it flattens out about 30 days after the default event date at approximately 28 per cent. We find one substantial drop in the price level prior to the default event, a drop of 4.8 percentage points on the 48th day prior the default event date. Additionally, the price level drops by 5.4 percentage points on the 6th day after the default event day. However, approximately 30 days after the credit event date, the price level starts a slowly increasing price path ending at 34.9 per cent 90 days after the default event date.

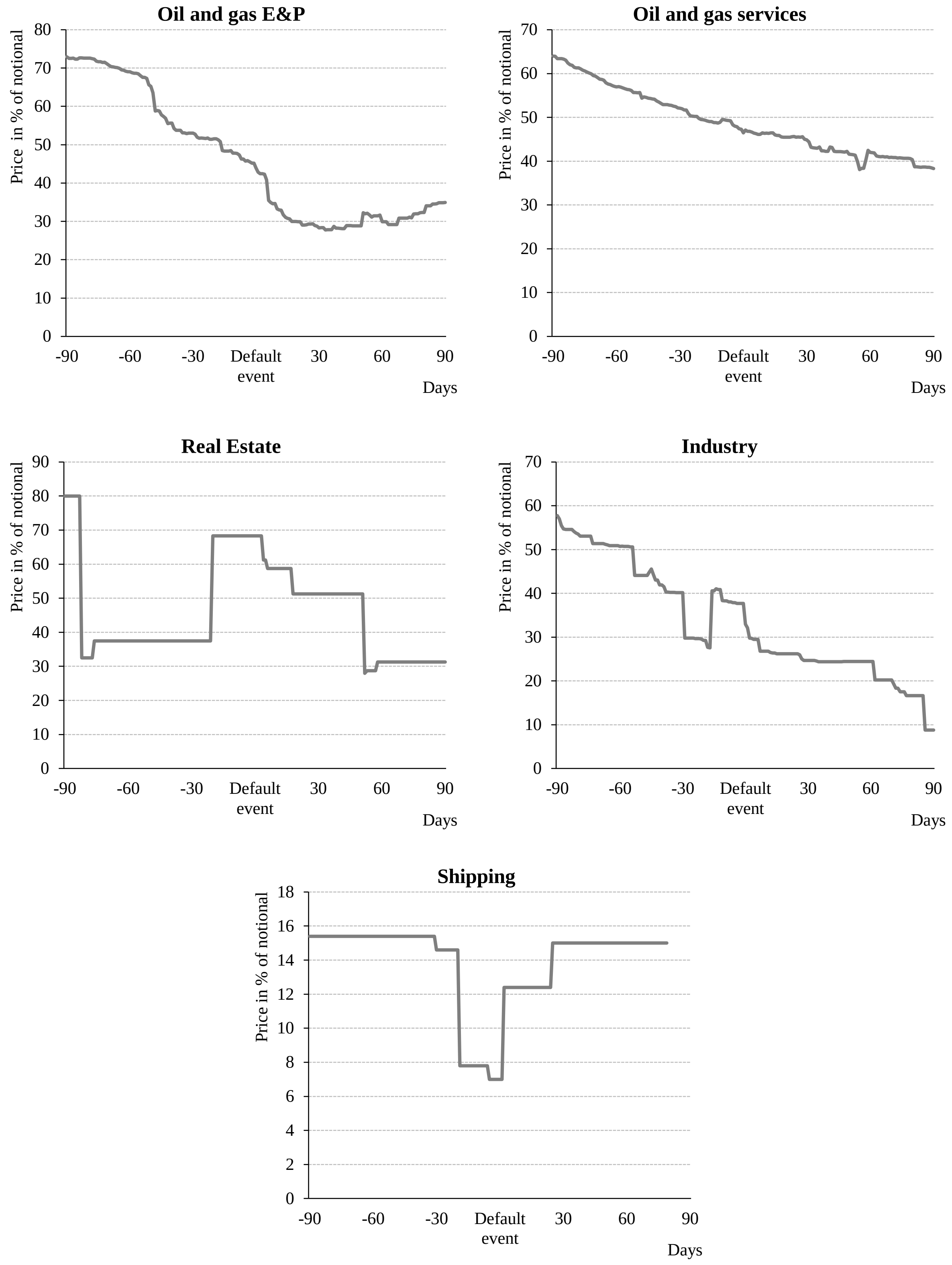
Second, oil and gas services show a decreasing path throughout the time window. Starting at 64.0 per cent 90 days prior the default event and ending at 38.3 per cent 90 days after the default event date. On the default event date, we find an average price level of 46.4 per cent.

Third, the bond prices for real estate shows a more unsystematic path during the time window analysed. This is most likely due to few observations and low liquidity. Thus, we do not emphasise that much on its price development. We apply the same argument for shipping. However, it is worth mentioning the significant drop in the price level of shipping related high yield bonds on the 19th day prior the default event date, which rebounds on the 2nd and 25th day after the default event date.

Lastly, industry show a decreasing path throughout the time window, similar to what we observe for oil and gas services. However, the price path for industry is more volatile, potentially due to fewer observations of industry default events. The price level is 57.8 per cent 90 days prior the default event and decrease to 33.0 per cent on the default event date. 90 days after the default event date, the price level for industry is 8.8 percent, which is the lowest price level on the 90th day after the default event date for all industry classifications.

In conclusion, we generally find decreasing price developments across industries throughout the time window. However, we note that some observations show a drop in prices before the default event date and an increasing price path after the default event date. Possibly indicating sell-side pressure and expectations of a more severe outcome than the actual outcome.

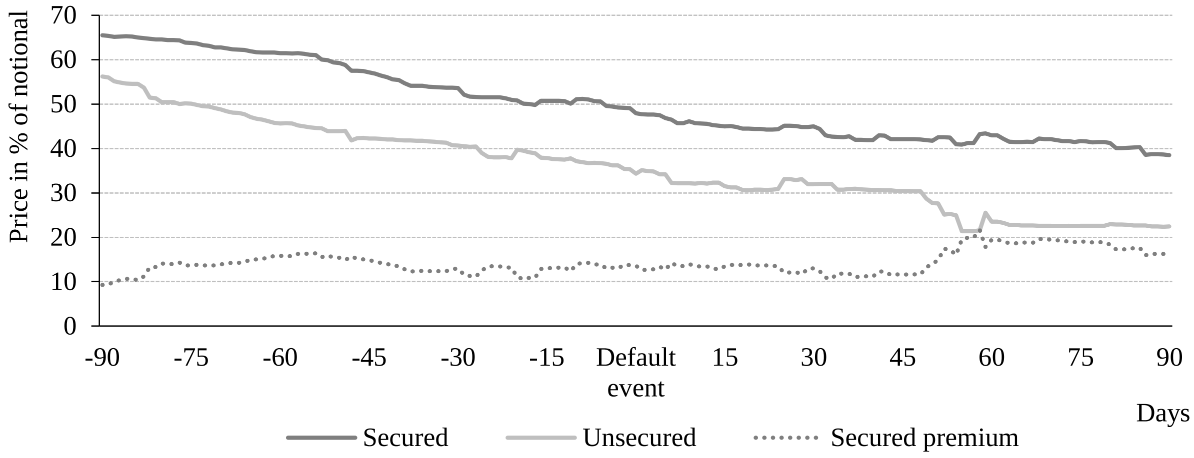
Figure 8. Average price development pre- and post-default event date by industry



8.2.3 Price development by risk class

Figure 9 illustrates the price level development of secured and unsecured high yield bonds.

Figure 9. Average price development pre- and post-default event date by risk class



Both secured and unsecured bonds show a decreasing price development throughout the time window. 90 days prior the default event date, secured and unsecured bonds trades at a price level of 65.5 and 56.2 per cent, respectively. At the default event date, the price of secured bonds have decreased to 47.9 per cent, while unsecured bonds trade at 34.4. Further, secured bonds continue to decrease during the 90 days following default, and culminates with a price of 38.5 per cent. We observe a price of 22.4 per cent of notional 90 days post-default for unsecured bonds. Interestingly, but not surprisingly, we find a quite stable price premium for secured bonds to unsecured bonds throughout the time window, displayed as the "Secured premium" in Figure 9. In theory, it should reflect the average value of having secured collateral for bondholders. The average premium over the time window is 14.3 per cent.

8.3 Regression models

In this chapter, we present and analyse the result from the regression models.

8.3.1 Base model

In this section, we present the results from Model 1, the base regression model. The model includes default event classifications, industry classifications and risk class classifications.

Model 1 explains 20.5 per cent of the total variation in recovery rates, displayed by the adjusted R^2 in Table 3.[7]

Table 3. Base determinants of recovery rates

	Model
	(1)
Intercept	0.315***
	(0.062)
Bankruptcy	-0.142*
	(0.083)
Distressed exchange	0.080
	(0.065)
Shipping	-0.304***
	(0.115)
E&P	-0.107
	(0.079)
Industry	-0.181*
	(0.098)
Real estate	0.087
	(0.175)
Secured	0.187***
	(0.060)
Observations	78
R^2	0.277
Adjusted R^2	0.205

*** $p < 0.01$ (strongly significant), ** $p < 0.05$ (significant), * $p < 0.1$ (slightly significant)*

This is a strong result considering a similar study by Knappskog and Gystad Ytterdal (2015), who obtained an adjusted R^2 of 14.9 per cent on their best model. On the other hand, Jankowitsch, Nagler and Subrahmanyam (2014) got an adjusted R^2 of 37.0 per cent using their similar base model. However, their study on the US market had more specified and a greater number of classifications for the seniority and event class dummies, mainly driven by the more complex market in the US. Furthermore, their study included 2,235 observations, covering a longer time-period. This may explain why we observe a lower explanatory power for our model. Note that the base in Model 1 and throughout is an unsecured bond issued by an oil and gas services company who defaulted through a non-payment default event.

When analysing the significance of the coefficients, we find that secured and shipping are strongly significant variables. Additionally, we find slightly significant coefficients for bankruptcy and industry.

[7] See Appendix 7 for discussion on R^2 versus adjusted R^2.

As emphasised in Section 8.1, we find that bankruptcy events have significantly lower recovery rate compared to non-payment events. We also test the same model using distressed exchange as a base and find that bankruptcy events yields significantly lower recoveries than distressed exchange events. On the other hand, we do not find any significant differences in recovery rates when comparing distressed exchanges to non-payment events.

Looking at the industry dummies, we observe that shipping yields strongly significant lower recovery than oil and gas services. This supplements the discussion in Section 8.1. Shipping also yields significantly lower recoveries compared to all the other industries, except for industry. The other industries are not significantly different from each other on a 5 per cent level. Therefore, we cannot conclude that these other industries explain different recoveries.

In Section 8.1, we observed that a bond recovers differently based on its security. Model 1 concludes this difference, as we find that secured bonds receives a significantly higher recovery than unsecured bonds.

Overall, we find that the base model has good explanatory power. It proves that important dimensions are included and confirms findings in the descriptive analysis. Further, it motivates for additional analysis, determining effects from other sets of explanatory variables against this benchmark.

8.3.2 Extended model

In this section, we add the three specifications to our base model. This allows us to control for each of the previous defined groups of variables, bond characteristics, firm fundamentals and macroeconomic variables (Model 2 – 4). We also include models consisting of all three sets of variables, with and without industry dummies, in Model 5 and 6. We display the regression outputs of these models in Table 4.

Throughout the analysis, we make sure to test for any potential breaches of the OLS assumptions, so that all conditions are satisfied and in accordance with econometric theory, as suggested in Wooldridge (2009).

Table 4. Determinants of recovery rates

	Model					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.315***	2.127***	0.455	0.338	0.457	1.222*
	(0.062)	(0.614)	(0.315)	(0.258)	(0.935)	(0.709)
Time to maturity		-0.002			-0.000	-0.000
		(0.001)			(0.001)	(0.001)
Coupon		-0.000			-0.004	-0.002
		(0.006)			(0.006)	(0.006)
Outstanding amount		-0.119***			-0.075*	-0.095***
		(0.029)			(0.039)	(0.035)
Investment covenant		0.771**			0.518**	0.446*
		(0.325)			(0.248)	(0.237)
Dividend covenant		0.108			0.158	0.192*
		(0.105)			(0.107)	(0.106)
Financing covenant		-0.113			-0.706**	-0.651**
		(0.211)			(0.274)	(0.247)
Event covenant		-0.194			0.611*	0.483*
		(0.212)			(0.307)	(0.275)
Guarantee		-0.014			-0.095	-0.129**
		(0.066)			(0.064)	(0.059)
Tangible pledge		0.047			0.128	0.147*
		(0.088)			(0.088)	(0.080)
Net debt/EBITDA			-0.008***		-0.004	-0.005**
			(0.003)		(0.003)	(0.003)
Default barrier			-0.394***		-0.182	-0.234
			(0.145)		(0.153)	(0.151)
LTD issuance			-0.133		0.034	0.015
			(0.104)		(0.111)	(0.110)
ICR			0.050		0.014	0.034
			(0.031)		(0.031)	(0.028)
Intangibility			-0.114		0.034	0.051
			(0.217)		(0.224)	(0.191)
Receivables			-0.299		-0.354	-0.132
			(0.460)		(0.490)	(0.413)
Total assets			0.003		0.077**	0.071**
			(0.032)		(0.035)	(0.033)
Nordics			0.175***		0.054	-0.003
			(0.064)		(0.078)	(0.068)
Industry default rate				-1.094**	-0.450	-0.244
				(0.520)	(0.573)	(0.553)
3-months NIBOR				0.148	0.199	0.049
				(0.169)	(0.203)	(0.172)
Slope				-0.149	-0.089	-0.138
				(0.180)	(0.181)	(0.179)
Observations	78	78	74	78	74	74
R^2	0.277	0.525	0.527	0.371	0.712	0.692
Adjusted R^2	0.205	0.401	0.404	0.277	0.553	0.550
Event dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	No
Seniority dummy	Yes	Yes	Yes	Yes	Yes	Yes

Bond characteristics

In Model 2, we add bond characteristics to our base model. We observe that adding these control variables enhances the explanatory power of recovery rates. The explanatory power increases by almost 20 percentage points to an adjusted R^2 of 40.1 per cent. This is in line with what Jankowitsch, Nagler and Subrahmanyam (2014) found when adding similar sets of variables in their study on the US market, receiving an adjusted R^2 of 43 per cent. Thus, we interpret this as a solid finding.

Looking at the individual variables, two show significant coefficients in this set of bond specific variables. We find that outstanding amount has a strongly significant negative effect on recovery rates. This does not come as a surprise as we would expect a lower servicing ability in rough times, thus making it harder to repay the outstanding amount the higher it is. Additionally, we observe that having an investment covenant has a significant positive effect. This suggests that firms having restrictions on investments and sale of assets are an effective tool by which creditors can increase their recovery rates.

Firm fundamentals

Model 3 supplements our base model with firm characteristic variables. As for Model 2, this model is able to explain a lot of the total variation in recovery rates. The model has an adjusted R^2 of 40.4 per cent, indicating that firm fundamentals is of high importance when explaining recovery rates.

We find that the variable net debt/EBITDA is strongly significant. This confirms the hypothesis that higher amounts of total debt and/or lower earnings will have a negative effect on recovery rates. We also find a significant effect for the default barrier. This is a ratio motivated by structural credit models, i.e. the lower the default barrier, the higher is the recovery rate (Jankowitsch, Nagler and Subrahmanyam, 2014). Thus, it is no surprise that we find a strongly negative relationship between this variable and recovery rates. Interestingly, the variable Nordics comes out strongly significant in a positive manner. This suggests that a firm being from Norway, Sweden or Denmark yield a higher recovery rate compared to firms located outside Scandinavia. Perhaps, this is due to the stronger economic conditions of these countries. The other firm characteristics employed are statistically insignificant, which may suggest that the industry dummies already capture the information from these characteristics.

Macroeconomic variables

Macroeconomic variables are the final set of specifications we add to our base model. Surprisingly, the adjusted R^2 only increases by approximately 7 percentage points compared to our base. The explanatory power of Model 4 is 27.7 per cent. This is not what we would expect given the relatively stronger adjusted R^2 in Model 2 and 3. This surprising result is supported by the findings by Jankowitsch, Nagler and Subrahmanyam (2014), who found that controlling for firm fundamentals and macroeconomic variables gave roughly the same explanatory power. It could be a result of this model being the one with the fewest explanatory variables, compared to Model 2 and 3. In addition, we do not include the market default rate in this model due to high correlation with other variables in our dataset. We find that the 3-months NIBOR and the industry default rate explain a lot of the same as the market default rate. While the market default rate could enhance the explanatory power, we argue that it makes sense both statistically and economically to drop this variable from our dataset. We apply the same reasoning for dropping the oil price variable as the 3-months NIBOR and the slope capture the same effects. Thus, we exclude it from the regression models. Nevertheless, we observe that the adjusted R^2 of Model 4 does enhance the explanatory power of our base model, and thus is of importance.

The industry default rate shows a significant negative coefficient. We find this intuitive, as one would expect that recoveries of firms in industries are lower when the whole industry is suffering. Findings by Acharya, Bharath and Srinivasan (2007) supports this. They argue that industries in distress experience lower recovery rates. We are not able to conclude that the other macroeconomic variables are factors that can help explaining the variation in recovery rates.

All explanatory variables

Model 5 and 6 includes all three sets of variables, i.e. bond characteristics, firm fundamentals and macroeconomic variables, in addition to our base model. We argue that these complete models are optimal in order to interpret the effects of the individual variables, since they control for every factor simultaneously.

We find that Model 5 is able to capture 55.3 per cent of the variation in recovery rates. Jankowitsch, Nagler and Subrahmanyam (2014) obtained an adjusted R^2 of 66 per cent on their best model using the same technique. This proves that the variables in our dataset are of great importance and are highly useful for indicating the outcome for recovery rates in the Nordic high yield bond market.

Before discussing the effects of the individual significant variables, it is important to address that there are some concerns regarding multicollinearity in this model.[8] We observe small signs of multicollinearity for the variables financing covenant and event covenant. As a result, we perform analysis on these variables with carefulness.

We observe that outstanding amount still is significant. However, it is only slightly significant. When controlling for all factors, the amount outstanding explains less of the variation in recovery rates than it did controlling only for bond characteristics. Further, we find that bonds having an investment covenant in their loan agreement significantly increase the recovery rate in this complete model. As discussed, the significance of the financing covenant is interpreted with caution. The same goes for the slightly significant event covenant. The finance covenant in this complete model decreases recovery rates. This is an interesting result, as we would expect restrictions on the financing policy to be an effective tool for increasing recovery rates. Breaches of this restriction indicates a very technical default, for example when a firm obtains an equity ratio of less than required in the loan agreement. Perhaps letting the firm live on as usual instead of forcing redemption would be better, as the firm could manage a period with a lower equity ratio. Potentially leading to a higher price in the future. A bond carrying an event covenant has a slightly positive effect on recovery rates, suggesting that the creditors holding a bond with this covenant have reason to expect compensation for the risk associated with a change of control during the life of the bond.

Among the firm fundamentals, all the variables we found significant in Model 3 returns insignificant in Model 5. This is a surprise as we expect to find significant effects on ratios motivated by structural credit models and highly leveraged firms, even when controlling for other factors. We are especially surprised that the net debt/EBITDA measure has no effect. This ratio should give a solid indication of a firm's ability to handle its debt burden, thus have a significant effect on recovery rates. On the other hand, total assets are of importance. The complete model suggests that having more assets increase the bond recovery. The reason for this may be that some of the assets are tangible that can be liquidated or sold and hence increase the recovery rate. Further, this confirms our hypothesis that firm size positively affects the recovery rates.

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[8] See Appendix 8 for details on multicollinearity. This section also includes discussion on why we downplay this issue.

We do not find any significant results in the third group of explanatory variables, macroeconomic characteristics, in Model 5. We observed that the industry default rate previously was of importance. However, this effect disappears in the complete model. This suggests that the state of the industry plays a lesser role in explaining the variation in recovery rates when controlling for more variables simultaneously. Considering the relatively low adjusted R^2 in Model 4 compared to Model 2 and 3, this does not come as a huge surprise. In addition, the economy has not changed a lot in the two years where we have sufficient data. We believe that since we are unable to capture the whole business cycle, the importance of this factor does not show.

Overall, we observe that bond characteristics seem to be of most importance in explaining the variation of recovery rates. This is an interesting finding, as it suggests that the bond structure itself strongly drives the variation in recovery rates, and downplays the effect of firm- and macroeconomic factors. However, we do not find as many variables of significance as we expected. Jankowitsch, Nagler and Subrahmanyam (2014) found a relatively larger number of variables to be of importance. Therefore, we explore the opportunity to generalise our model in a larger scale, in hope of finding other interesting results. Examining our data and Model 1 through 5, it seems like industry is of importance. We suspect that the variation in residuals within each industry is relatively low, but that the variation is larger looking at the market as a whole. Hence, we introduce model without industry dummies in the base but otherwise similar to Model 5, in Model 6. By doing this, the model will not lose important variables, it will only become more general.

Model 6 is also a very solid model as it is able to explain 55 per cent of the total variation in recovery rates. We observe that this is almost identical with what Model 5 were able to capture, with an adjusted R^2 of 55.3 per cent. In addition, removing the industry dummies reduce the multicollinearity issues we detected in Model 5.

The model confirms our recently stated hypothesis, with more variables displaying significant coefficients compared to Model 5. Looking at the bond characteristics, we find that bonds carrying investment and dividend covenants has a positive effect. In addition to restrictions on risky investments, as already discussed, dividend restrictions increase recovery rates. Retaining as much equity as possible seems to be an effective tool for debt investors to increase recoveries. The other covenants also show significant coefficients. However, they still need to be interpreted with caution, as there still are some indications of multicollinearity. We, observe that the amount outstanding at the time of default now has a strong negative effect. Suggesting that this is of more importance when explaining recovery rates on a more general basis than within each industry. This may be a result of that it is more common to issue bonds with similar face value within industries, but that it varies a lot from industry to industry. Having a guarantee, shows a significantly negative effect on recovery rates. This is surprising as we expect issuers with guarantors to be able to support a firm in a situation of distress. However, the negative coefficient may be explained by guarantors in often cases being tightly connected with the defaulted firm and are likely to experience rough times themselves, therefore making it hard to help the original issuer. Bonds carrying a pledge on their tangible assets yield higher recovery rates. A firm's share price is likely to drop significantly in the event of default. Therefore, having pledge on tangible assets rather than shares seems more desirable for creditors. We suspect that this becomes significant for the first time in this particular model, since there is a lot of variation between each industry in terms of assets that can be rapidly traded.

For the second group of explanatory variables, firm fundamentals, we observe that net debt/EBITDA is negatively significant. When not controlling for industries we find that this ratio actually is of importance in explaining the variation in recovery rates. Once again, this suggests that there may be little variation in this measure within each industry, but very different ratios between industries. For example, looking at shipping companies, we observe a much higher net debt/EBITDA and a lower recovery rate than for oil and gas services companies. Total assets have significantly positive effect, while the macroeconomic variables have no effect on recovery rates.

Overall, we find that bond characteristics still seem to be of most importance in explaining the variation in recovery rates in Model 6. On the other hand, firm fundamentals show to play a larger role in the more general model.

Conclusively, we find important factors to be driving the recovery rate of Nordic high yield bonds following default. Both Model 5 and 6, proves to be very solid. We document the strong economic effect bond covenants have on the recovery rate. Further, important credit metrics such as net debt/EBITDA are in general clearly linked to recovery rates. Interestingly, the state of the economy plays a less important role in explaining the variation of the recovery rate.

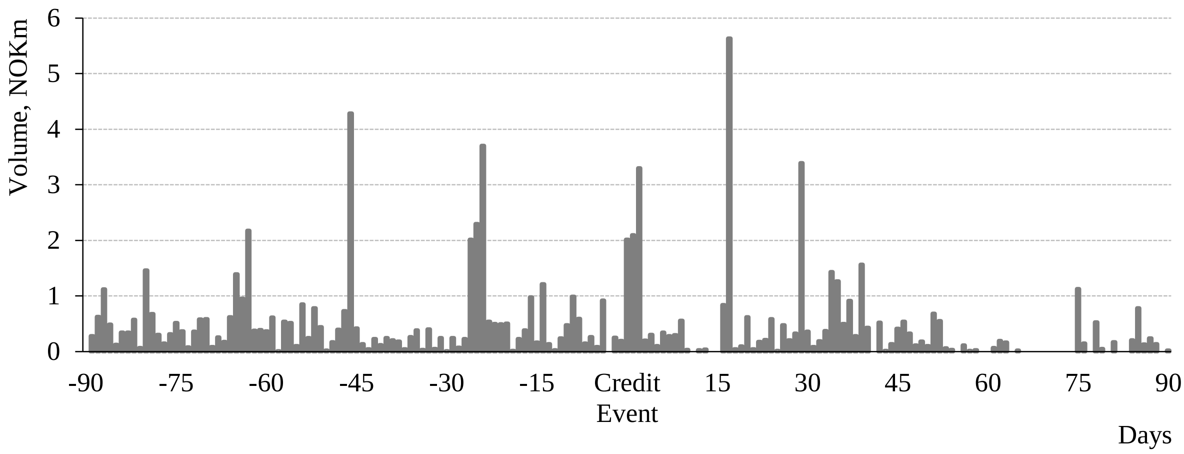
8.4 Liquidity analysis

In this chapter, we present a simple liquidity analysis of a smaller subsample. The subsample consists of 42 default events from 40 different bonds, issued by 27 different firms.

8.4.1 Total trading activity

Figure 10 displays the average daily trading volume for all the 42 default events. There is no distinct trend other than five trading peaks, two of which before the default event date, at the default event date and two after the default event date. Additionally, the trading activity seems to slow down substantially approximately 45 – 50 days after the default event date. At the default event date, we find an average volume of NOK 2.0m. This is considerably higher than the volume traded the day before of NOK 0.2m as well as the average daily volume over the 180-day period of NOK 0.5m.

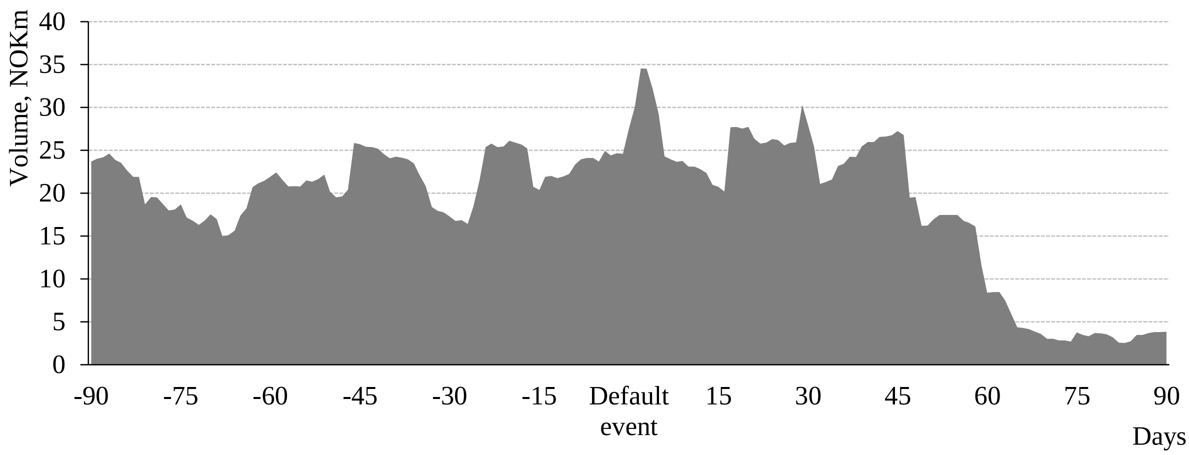
Figure 10. Average total daily trading volumes



The Nordic high yield bond market is, as argued in Chapter 5, relatively illiquid and lagging. Due to this and the relatively small sample size, we choose to analyse the liquidity using a 30-days trailing average volume from now on.

Overall, the trading activity in Figure 11 shows a slightly increasing trend when moving towards the default event date, a peak close to the default event date and a slightly decreasing path thereafter.

Figure 11. Average total 30-days trailing trading volumes



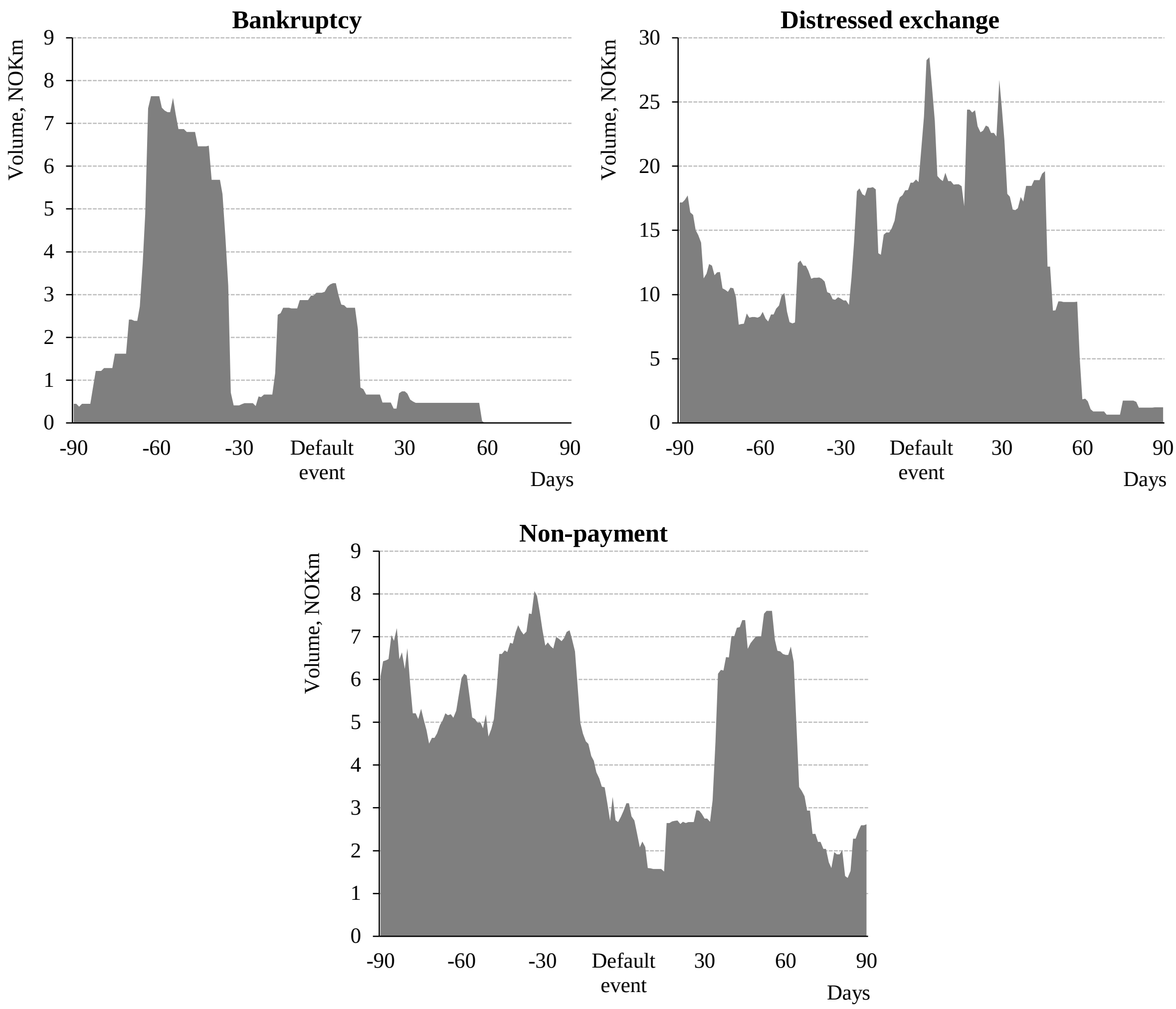
This trend is in line with what Wang and Han (2014) and Jankowitsch, Nagler and Subrahmanyam (2014) find in their analyses of defaulted corporate bonds. However, they find a more distinct peak around the default event date, indicating systematically higher trading activity. The rationale behind trading peaks close to the default event date is that new information triggers trading in general, and particularly default events triggers certain bondholders to liquidate their position. Large bond investors are often constrained by their investment mandate to liquidate positions when bonds defaults. In addition, bonds entering into a default becomes attractive to funds specialised to investing in distressed assets. Such funds have become increasingly popular in the wake of the financial crisis in 2008 (Jain, 2012).

Further, the trading volume seems to remain at a relatively high level for approximately 45 days after the default event date, which is longer when compared to the similar studies mentioned above. It implies that, as emphasised, the Nordic high yield bond market's reactions to default events is much slower than the US market.

8.4.2 Trading activity by default event classification

When analysing the trading activity across default event classifications, we find substantial different trends, as displayed in Figure 12.

Figure 12. Average 30-days trailing trading volumes by event classification

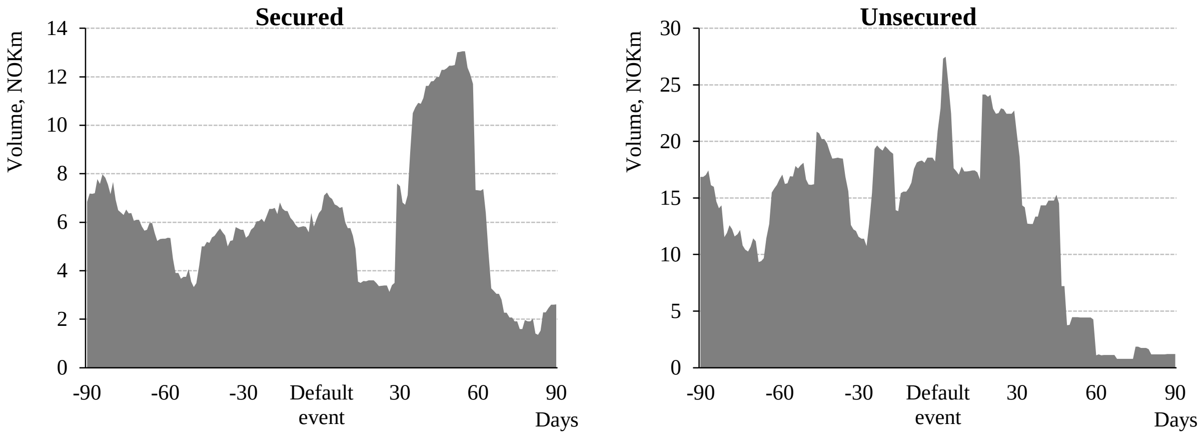


First, bankruptcy events show two distinct trading peaks, first at 65 – 35 days prior the default event date and second around the default event date. After the default event date, there is virtually no trading in bonds involved in bankruptcy proceedings. Interestingly, the first peak of trading is almost double in size compared to the second, potentially indicating that information regarding the issuer's financial health has leaked to the market. Bankruptcies are dramatic events where the issuer's financial health could potentially be very weak. Normally, such companies have struggled for a while and the market adjusts its expectations before the official bankruptcy declaration. Hence, more risk averse market participants would liquidate their position before the official bankruptcy declaration. In comparison to bankruptcies, distressed exchanges show a similar path as for the total data subsample. Therefore, the trading activity of distressed exchange events are more in line with what we emphasised in the previous section. Further, non-payment events show almost an inverse trading path compared to distressed exchanges, with peaks prior and after the default event date and a bottom close to the default event date. It seems like the investors' immediate response to the declaration of default is to wait, and potentially act after 40 – 60 days.

8.4.3 Trading activity by risk class

When analysing trading activity across risk class classifications, we find quite different trading paths, as displayed in Figure 13.

Figure 13. Average 30-days trailing trading volumes by risk class



The trading activity for secured bonds are quite stable before the default event date. Approximately 15 days after the default event date, we observe a drop in the trading activity that remains for about 10 days. After this, we observe a substantial peak in the trading activity 30 – 60 days after the default event date. Interestingly, this pattern is quite similar to what we observe for non-payment default events. One explanation could be that two-thirds of non-payment events are from secured bonds. However, secured bonds are collateralised which may help to create confidence regarding market-based recovery for the bond investors. Thus, bond investors may wait for additional information regarding the default event.

Unlike secured bonds, the trading activity for unsecured bonds follows a slightly increasing path prior the default event date. Further, it peaks close to the default event and falls quite fast after the default event date. As a result, it is quite similar to distressed exchange events. Unsecured bonds are riskier compared to secured bonds. Thus, investors seem to react more instantly to a default event when the bonds are unsecured. As for almost all types of defaulted bonds and default events, the trading activity of unsecured bonds seems to die out 45 days after the default event date.

8.5 Critical assessment

Although our results are noteworthy, there are aspects to be criticised. First, the relatively small sample size compared to the number of independent variables used in the regressions, limits the robustness of the models. In addition, the small sample size hampers drawing firm conclusions in the price development and liquidity analysis. This is mainly caused by a young market with few defaults and a short time of tracking prices.

Second, the fact that the market being illiquid in general, limits the conclusions we draw. Prices based on more frequent trading in the market, rather than using synthetic bond prices would be more reliable. Then again, when analysing such a market one have to use the best estimates available. Observing more frequent trading, may also have allowed us to include liquidity measurements in our models, possibly explaining more of the variation in recovery rates.

Third, we criticise the short time period analysed. Probably, results would be different if we could have observed complete cycles. It is especially desirable since we include macroeconomic variables in our models. In addition, some of the industries are very cyclical.

Finally, the issue with multicollinearity in our complete models are questionable, even though we argue that this issue can be downplayed.

9 Conclusion

Recovery rate is of great importance when measuring credit risk in default events, especially in the pricing of debt securities and risk management. Previous academic research find that existing credit risk models such as structural- and reduced form models does not completely explain observed yield spreads. Thus, it is important and relevant to study the stochastic processes of recovery rates and understand its determinants.

In this thesis, we examine recovery rates on 78 defaulted high yield bonds in the period from May 2014 to September 2016, in the Nordic market. First, we estimate a market based recovery rate defined as the average synthetic bond price from the default event date to 90 days after. Second, we examine the price development across default event-, industry- and risk class classifications, in a time window between 90 days pre-default to 90 days post-default. Third, we measure the effect of a comprehensive set of explanatory variables on recovery rates. The explanatory variables are divided into bond characteristics, firm fundamentals and macroeconomic variables. Finally, we examine the liquidity of defaulted high yield bonds across default event-, industry- and risk class classifications.

In general, our results from the price development analysis show that bond prices have a decreasing path throughout the time window with no substantial price reaction at the default event date. We find an average price of 61.9 per cent on the 90th day prior default events, 42.7 per cent on the default event date and 33.2 per cent on the 90th day after default events. In contrast to bankruptcy and non-payment events, we find that distressed exchanges show an increasing price path after the default event. In addition, we find that secured bonds trades at a stable premium of 14.3 per cent compared to unsecured bonds throughout the time window.

The best regression model explains 55.3 per cent of the total variation in recovery rates, applying bond characteristic- firm fundamental- and macroeconomic explanatory variables. We find that bond characteristics are particularly important in explaining the variation of recovery rates. The most important bond characteristics include outstanding amount, financing covenant and investment covenant. As expected, we find that the default event classifications are important variables. Considering other characteristics, we find that firm size, measured by total assets is important. Further, by looking at a more general model, we find that the importance of firm fundamental variables increase. This model still explains 55 per cent of the variation in recovery rates, even without industry classifications. In particular, we find that financial gearing has a significant negative effect on recovery rates, and that outstanding amount becomes increasingly important.

When analysing the liquidity of defaulted high yield bonds, we find that the trading activity increases before the default event, peaks at the default event and remains relatively high for 45 days before decreasing before it virtually dies out thereafter. When analysing trading activity across default event- and risk class classifications we find two interesting findings. First, bankruptcy events show two distinct trading sections prior the default and virtually no trading after default. Other default events show peaks in trading sections after default. Second, secured bonds displays a trading peak section after default, while unsecured bonds shows a trading peak around the default event itself.

In conclusion, we provide a detailed analysis increasing the understanding of the price development and liquidity of defaulted high yield bonds. In addition, we determine the effect of a comprehensive set of explanatory variables on recovery rates. These results will be interesting both for market participants and for researchers, seeking to understand the pricing and recovery of Nordic high yield bonds.

10 Definitions

bn – Billion

CD – Convertible debt

CDS – Credit default swaps

Credit risk – The risk of monetary losses due to debt holders not honouring debt contracts

Default – An event where an issuer violates contractual agreements related to an issued bond

EBITDA – Earnings before interest, taxes, depreciation and amortisation

ICR – Interest Coverage Ratio

Liquidity – Trading volume

LTM – Last twelve months

LTD – Long-term-debt

m – Million

Market-based recovery rate – Recovery rate measured by market prices relative to face value

NIBOR – Norwegian Interbank Offering Rate

Nordic high yield bond – Bonds issued in the Nordics with credit rating lower than BBB

Notional/Face value – The nominal/face amount that is used to calculate payments on bonds

OTC – Over-the-counter

Recovery rate – The value of a particular bond divided by outstanding amount after default

Synthetic price – Price estimates calculated by Nordic Bond Pricing

Yield – The return anticipated on a bond if the bond is held until the end of its lifetime

YTD – Year-to-date

11 References

Acharya, V., Bharath, S. and Srinivasan, A. (2007). Does industry-wide distress affect defaulted firms? Evidence from creditor recoveries. *Journal of Financial Economics*, 85(3), pp.787-821.

Allison, P. (2012). When Can You Safely Ignore Multicollinearity?. [Blog] *Statistical Horizons*. Available at: http://statisticalhorizons.com/multicollinearity [Accessed 18 Nov. 2016].

Altman, E. and Kishore, V. (1996). Almost Everything You Wanted to Know about Recoveries on Defaulted Bonds. *Financial Analysts Journal*, 52(6), pp.57-64.

Altman, E., Brady, B., Resti, A. and Sironi, A. (2003). *The Link between Default and Recovery Rates: Theory, Empirical Evidence and Implications*. Extension of a report prepared to International Swaps and Derivatives' Dealers Association. London.

Altman, E., Brady, B., Resti, A. and Sironi, A. (2005). The Link between Default and Recovery Rates: Theory, Empirical Evidence, and Implications*. *The Journal of Business*, 78(6), pp.2203-2228.

Altman, E., Resti, A. and Sironi, A. (2002). The link between default and recovery rates: effects on the procyclicality of regulatory capital ratios. *BIS Working Papers*, 113.

Arvanitis, A. and Gregory, J. (2001). *Credit: the complete guide to pricing, hedging and risk management*. 1st ed. London: Risk books.

Black, F. and Cox, J. (1976). Valuing Corporate Securities: Some Effects of Bond Indenture Provisions. *The Journal of Finance*, 31(2), pp.351-367.

Black, F. and Scholes, M. (1973). The Pricing of Options and Corporate Liabilities. *Journal of Political Economy*, 81(3), pp.637-654.

Chava, S., Kumar, P. and Warga, A. (2010). Managerial Agency and Bond Covenants. *Review of Financial Studies*, 23(3), pp.1120-1148.

Christoffersen, P. (2012). *Elements of financial risk management*. 2nd ed. Amsterdam: Academic Press.

Duffee, G. (1999). Estimating the Price of Default Risk. *Rev. Financ. Stud.*, 12(1), pp.197-226.

Duffie, D. and Singleton, K. (1997). An Econometric Model of the Term Structure of Interest-Rate Swap Yields. *The Journal of Finance*, 52(4), p.1287.

Eom, Y., Helwege, J. and Huang, J. (2004). Structural Models of Corporate Bond Pricing: An Empirical Analysis. *Rev. Financ. Stud.*, 17(2), pp.499-544.

Feldhütter, P. and Schaefer, S. (2016). The Credit Spread Puzzle - Myth or Reality?. *SSRN Electronic Journal*.

Frost, J. (2013). What Are the Effects of Multicollinearity and When Can I Ignore Them?. [Blog] *The Minitab Blog*. Available at: http://blog.minitab.com/blog/adventures-in-statistics/what-are-the-effects-of-multicollinearity-and-when-can-i-ignore-them [Accessed 18 Nov. 2016].

G. Haugland, A. and Brekke, O. (2010). *Recovery Rates in the Norwegian High Yield Bond Market: A study on default and recovery from 01.01.2005 to 30.06.2010*. Bergen: Norges Handelshøyskole.

Geske, R. (1977). The Valuation of Corporate Liabilities as Compound Options. *The Journal of Financial and Quantitative Analysis*, 12(4), pp.541-522.

Geske, R. and Delianedis, G. (2001). The Components of Corporate Credit Spreads: Default, Recovery, Taxes, Jumps, Liquidity, and Market Factors. *Working paper, UCLA*.

Hanson, S. and Schuermann, T. (2004). Estimating Probabilities of Default. *SSRN Electronic Journal*.

Huang, J. and Huang, M. (2012). How Much of the Corporate-Treasury Yield Spread Is Due to Credit Risk?. *Review of Asset Pricing Studies*, 2(2), pp.153-202.

Hull, J. and White, A. (1995). The impact of default risk on the prices of options and other derivative securities. *Journal of Banking & Finance*, 19(2), pp.299-322.

Jain, S. (2012). Investing in distressed debt. *Alternative Investment Analyst Review*, 1(2), pp.32 - 50.

Jankowitsch, R., Nagler, F. and Subrahmanyam, M. (2014). The determinants of recovery rates in the US corporate bond market. *Journal of Financial Economics*, 114(1), pp.155-177.

Jones, E., Mason, S. and Rosenfeld, E. (1984). Contingent Claims Analysis of Corporate Capital Structures: An Empirical Investigation. *The Journal of Finance*, 39(3), p.611.

Kim, I., Ramaswamy, K. and Sundaresan, S. (1993). Does Default Risk in Coupons Affect the Valuation of Corporate Bonds?: A Contingent Claims Model. *Financial Management*, 22(3), p.117.

Klovland, J. (2004). Bond markets and bond yields in Norway 1820–2003. In: J. Klovland, Ø. Eitrheim and J. Qvigstad, ed., *Historical Monetary Statistics for Norway 1819-2003*, 35th ed. Oslo: Norges Bank, pp.99-180.

Knappskog, B. and Gystad Ytterdal, A. (2015). *Predicting spreads in the Nordic High Yield bond market*. Bergen: Norwegian School of Economics (NHH).

Lando, D. (1998). On cox processes and credit risky securities. *Review of Derivatives Research*, 2(2-3), pp.99-120.

Lind, E. (2014). *A glance at the "Norwegian" HY market is and why it's such an efficient platform for raising flexible debt for foreign companies - Steenstrup News*. [online] Steenstrupnews.com. Available at: http://steenstrupnews.com/private-equity-banking-insurance-and-financial-sector/norwegian-hy-market/ [Accessed 16 Nov. 2016].

Lindset, S., Lund, A. and Persson, S. (2014). Credit risk and asymmetric information: A simplified approach. *Journal of Economic Dynamics and Control*, 39, pp.98-112.

Litterman, R. and Iben, T. (1991). Corporate bond valuation and the term structure of credit spreads. *The Journal of Portfolio Management*, 17(3), pp.52-64.

Longstaff, F. and Schwartz, E. (1995). A Simple Approach to Valuing Risky Fixed and Floating Rate Debt. *The Journal of Finance*, 50(3), p.789.

Longstaff, F., Mithal, S. and Neis, E. (2005). Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market. *The Journal of Finance*, 60(5), pp.2213-2253.

Merton, R. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *The Journal of Finance*, 29(2), pp.449-470.

Nordic Trustee, (2015). *The Norwegian HY bond market in a nutshell*. Oslo.

O'Brien, R. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity*, 41(5), pp.673-690.

Oslo Børs ASA, (2015). *Issuing corporate bonds in Oslo: an efficient, flexible and mature market for raising debt capital*. Oslo: Oslo Børs ASA.

PwC, (2016). *Issuing Corporate Bonds in the Nordic capital market*. Oslo: PwC.

Smith, C. and Warner, J. (1979). On financial contracting: An analysis of bond covenants. *Journal of Financial Economics*, [online] 56(2), pp.645-646. Available at: http://www.simon.rochester.edu/fac/warner/jerry%20papers/jfe-june%2079.pdf [Accessed 10 Nov. 2016].

Wang, K. and Han, S. (2014). Liquidity and Price Impact of Financial Distress: Evidence from the Defaulted Bond Market. *SSRN Electronic Journal*.

Wooldridge, J. (2009). *Introductory econometrics*. 4th ed. Mason, OH: South-Western Cengage Learning.

12 Appendix

Appendix 1. Annual issuance of Nordic high yield bonds by issue type

	2000	2005	2010	2011	2012	2013	2014	2015	2016*
Bonds	3,982	18,070	33,534	36,465	44,983	66,599	66,568	32,255	16,577
% of total	*58%*	*60%*	*63%*	*88%*	*75%*	*86%*	*87%*	*77%*	*54%*
Capital Content Securities	0	1,100	970	2,355	1,584	4,540	2,835	2,170	2,660
% of total	*0%*	*4%*	*2%*	*6%*	*3%*	*6%*	*4%*	*5%*	*9%*
CDs	0	2,760	353	18	30	150	26	0	0
% of total	*0%*	*9%*	*1%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
Convertibles	494	4,033	15,698	1,803	12,830	5,560	6,139	3,482	4,496
% of total	*7%*	*14%*	*30%*	*4%*	*21%*	*7%*	*8%*	*8%*	*15%*
Credit Linked Notes	0	2,161	0	0	0	177	14	0	0
% of total	*0%*	*7%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
Linked Notes	0	18	2,372	830	478	344	663	3,281	6,165
% of total	*0%*	*0%*	*4%*	*2%*	*1%*	*0%*	*1%*	*8%*	*20%*
Subordinate Finance	2,350	1,734	0	0	165	135	420	440	885
% of total	*34%*	*6%*	*0%*	*0%*	*0%*	*0%*	*1%*	*1%*	*3%*
Warrants	0	0	55	0	0	0	0	0	0
% of total	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
Grand Total	**6,826**	**29,876**	**52,983**	**41,471**	**60,069**	**77,505**	**76,665**	**41,629**	**30,783**

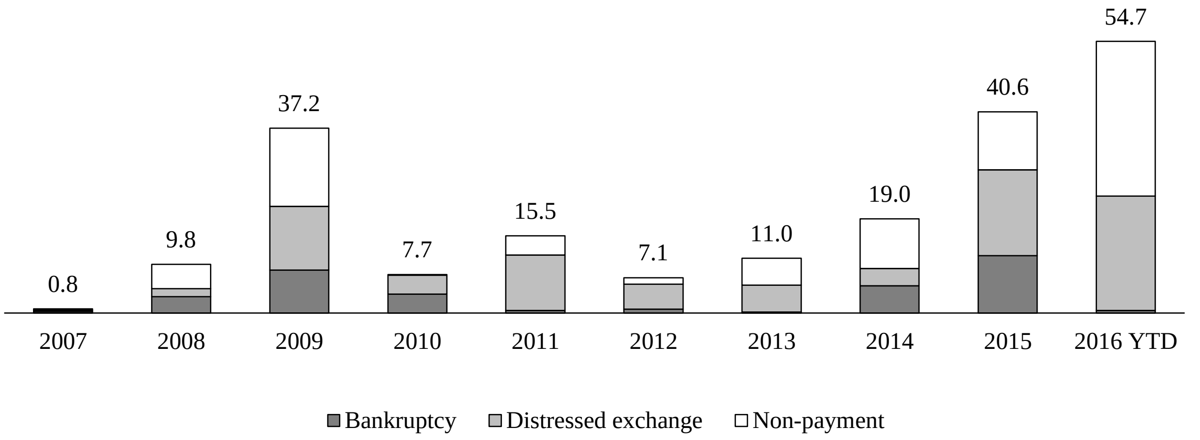
*Source: Stamdata, *YTD = Year to date*

Appendix 2. Total Nordic high yield bond volume outstanding by industry

(NOKm)	2000	2005	2010	2011	2012	2013	2014	2015	2016*
Oil and gas services	150	5,742	64,300	65,104	61,926	63,851	91,319	103,935	96,167
% of total	*1%*	*18%*	*49%*	*46%*	*42%*	*39%*	*42%*	*40%*	*36%*
Shipping and transportation	409	3,553	14,516	15,963	16,887	28,117	33,939	44,782	47,754
% of total	*4%*	*11%*	*11%*	*11%*	*12%*	*17%*	*16%*	*17%*	*18%*
Bank, finance and insurance	5,416	11,149	21,496	23,031	23,106	24,378	24,350	22,269	26,562
% of total	*48%*	*35%*	*16%*	*16%*	*16%*	*15%*	*11%*	*9%*	*10%*
Oil and gas E&P	90	766	13,059	17,914	18,135	13,756	18,388	22,228	27,328
% of total	*1%*	*2%*	*10%*	*13%*	*12%*	*8%*	*8%*	*9%*	*10%*
Industry	3,742	9,461	12,684	12,937	14,619	20,662	26,477	27,065	31,847
% of total	*33%*	*30%*	*10%*	*9%*	*10%*	*13%*	*12%*	*11%*	*12%*
Seafood	300	158	2,493	3,996	3,790	4,959	9,385	14,035	10,397
% of total	*3%*	*0%*	*2%*	*3%*	*3%*	*3%*	*4%*	*5%*	*4%*
Real estate	1,120	1,129	645	895	802	2,731	3,332	4,404	3,914
% of total	*10%*	*4%*	*0%*	*1%*	*1%*	*2%*	*2%*	*2%*	*1%*
Utilities	100	0	750	1,250	5,870	5,857	7,392	10,694	11,256
% of total	*1%*	*0%*	*1%*	*1%*	*4%*	*4%*	*3%*	*4%*	*4%*
Media, telecom and IT	0	20	574	431	526	156	1,037	4,172	6,145
% of total	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*2%*	*2%*
Other	30	30	938	944	692	388	2,941	3,737	3,206
% of total	*0%*	*0%*	*1%*	*1%*	*0%*	*0%*	*1%*	*1%*	*1%*
Total	**11,358**	**32,008**	**131,454**	**142,464**	**146,352**	**164,856**	**218,560**	**257,321**	**264,576**

*Source: Stamdata, *YTD = Year to date*

Appendix 3. Outstanding amount of defaulted high yield bonds (NOKbn)

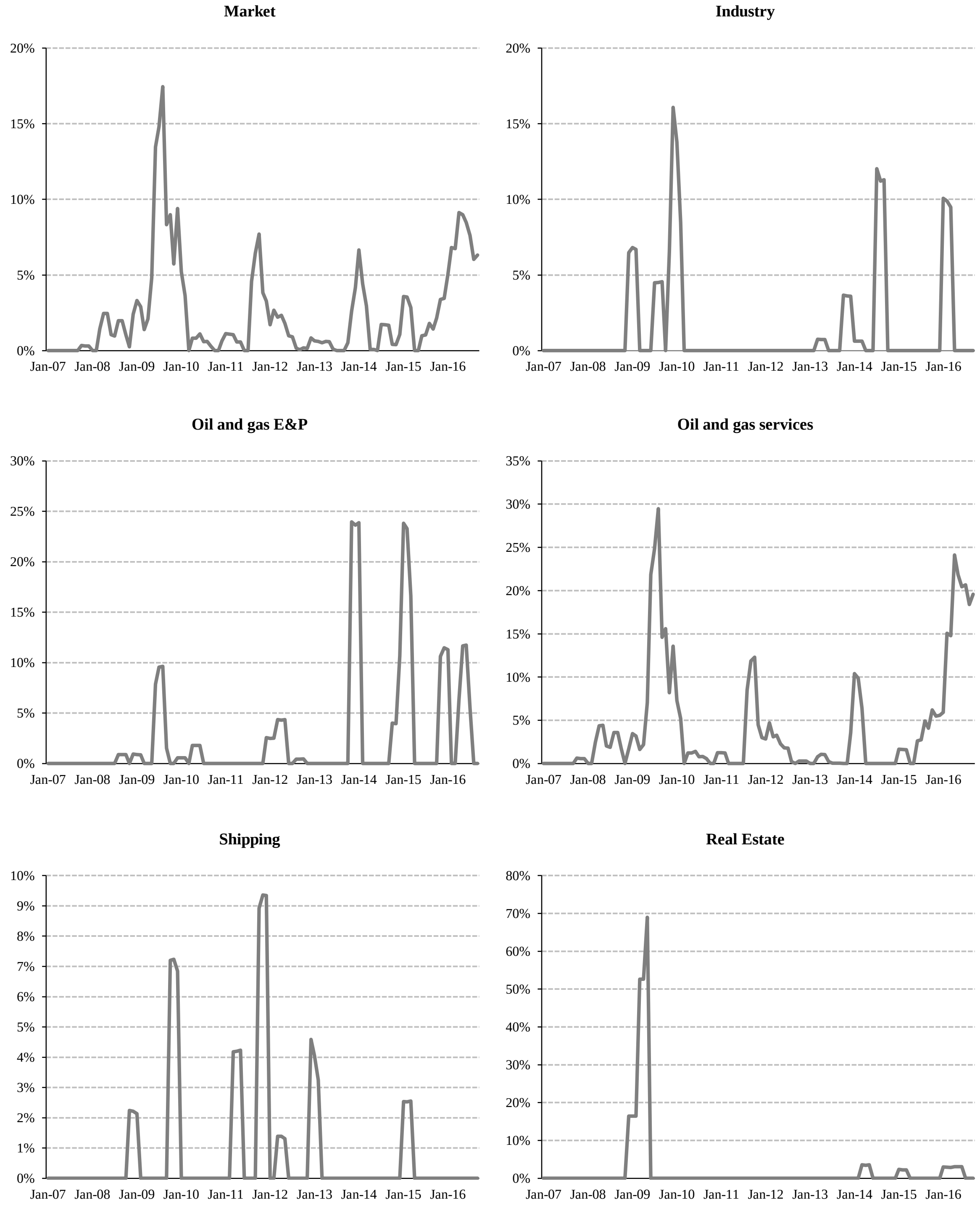


Source: Stamdata

Appendix 4. Summary statistics of the firm fundamental variables

	Observations	Minimum	Average	Maximum	Std. Dev.
Default Barrier	74	0.21	0.54	1.38	0.27
LTD Issuance	74	0.00	0.57	1.00	0.41
Intangibility	74	0.00	0.05	0.89	0.14
Receivables	74	0.00	0.07	0.33	0.06
Total assets (NOKm)	78	0	6,831	30,304	8,283
ICR	74	-6.07	-0.06	3.55	1.65
Net debt/EBITDA	74	-61.53	2.87	50.94	18.41

Appendix 5. Trailing 3-months market default rates and industry specific default rates



Source: Stamdata

Appendix 6. Specification of explanatory variables

	Variable type	Specification
Bankruptcy	Dummy	
Non-payment	Dummy	
Distressed exchange	Dummy	
Shipping	Dummy	
Oil and gas services	Dummy	
E&P	Dummy	
Industry	Dummy	
Real estate	Dummy	
Secured	Dummy	
Unsecured	Dummy	
Time to maturity	Numeric	
Coupon	Numeric	
Outstanding amount	Numeric	Natural logarithmic
Investment covenant	Dummy	
Dividend covenant	Dummy	
Financing covenant	Dummy	
Event covenant	Dummy	
Guarantee	Dummy	
Tangible pledge	Dummy	
Net debt/EBITDA	Numeric	
Default barrier	Numeric	
LTD issuance	Numeric	
ICR	Numeric	
Intangibility	Numeric	
Receivables	Numeric	
Total assets	Numeric	Natural logarithmic
Nordics	Dummy	
Industry default rate	Numeric	
NIBOR 3-months	Numeric	
Slope	Numeric	

Appendix 7. Adjusted R^2

We choose to interpret the adjusted R^2 rather than the R^2. R^2 cannot determine whether the coefficient estimates and predictions are biased. Further, R^2 does not indicate whether a regression model is satisfactory. The adjusted R^2 is a modified version of R^2 that adjust for the number of predictors in the model. The adjusted R^2 increases only if the new term improves the model more than would be expected by chance. In fact, it decreases when a predictor improves the model by less than expected by chance (Wooldridge, 2009). Therefore, we find the adjusted R^2 as optimal for explaining the variation in recovery rates in our regression models.

Appendix 8. Multicollinearity

Multicollinearity can increase the variance of the coefficient estimates and make the estimates very sensitive to minor changes in the model. The result is that the coefficient estimates are unstable and difficult to interpret (Frost, 2013). Using the variance inflation factor (VIF), we detect multicollinearity for two independent variables, financing covenant and event covenant, with a VIF of approximately 14 each. Similarly, we find multicollinearity for the same variables in Model 6, however with VIFs around 11.

It is called the variance inflation factor because it estimates how much the variance of a coefficient is "inflated" because of linear dependence with other predictors (Allison, 2012). O'Brien (2007) states that this is the most frequent technique to test for multicollinearity and that the most commonly used rule is that a VIF greater than 10 indicates problems with multicollinearity. However, he argues that this “rule of thumb” in often cases may be wrong and that higher VIFs can be accepted, due to limitations of the VIF. He states “(…) there is a sense in which the VIF has a natural metric – comparing the effects of the proportion of variance a particular independent variable shares with the other independent variables to the situation in which it shares none of its variance with the other independent variables”. When for example reviewing the effect that sample size has on the observed multicollinearity, this notation has weaknesses. There is no “natural metric” to use in describing the effects of shifts in the sample size on the variance of the regression coefficients. Therefore, comparing the sample to a “baseline” sample is necessary. Comparing our sample to a baseline sample, (i.e. our baseline sample would be larger by *n* observations) shows the effects of shifts in the sample size. O’Brien (2007) then argues that all other things being equal, decreasing the sample size increase the VIF. Thus, a larger sample size would be preferable to get rid of this problem. This is supported by the fact that unless the collinearity is perfectly correlated, which is not the case for our variables, increasing the sample size would reduce the variance of the regression coefficients. However, O’Brien’s findings imply that the variables may be of importance by themselves and that the observed VIFs may be artificially high due a small sample size.

One suggested way to solve the issue of multicollinearity is to drop the independent variables who highly correlates with other independent variables. The issue with this is that eliminating X_1 from the equation implies that the regression coefficient of X_2 no longer represents the relationship between Y and X_2 controlling for X_1 and other variables in the regression model. O’Brien (2007) argues that the model being tested has shifted, which often means that the theory being tested by the model has changed and the model not being theoretically well motivated. This is substantiated by the fact that the variables financing covenant and event covenant explains different things in economic terms.

In addition, removing one or both independent variables, reduce the adjusted R^2 in both Model 5 and 6. This proves that the factors are of importance in explaining the variation in recovery rates. Lastly, we make an integration variable between the two variables experiencing multicollinearity, financing covenant and event covenant, and substituted the two variables with this new variable in our models. This contradicts with the paragraph above, only purpose being to observe possible changes in the adjusted R^2. Doing this also reduce the adjusted R^2 in both Model 5 and 6.

Based on all the above-mentioned arguments, we keep the variables financing covenant and event covenant in our models, only interpreting them with caution. This is strongly based on that no other variables could explain the economic effect for these variables. Unlike for the oil price and the market default rate, where the industry default rate, slope and the 3-months NIBOR to large extent can replicate their significance.

To conclude this section, Frost (2013) argues that multicollinearity does not affect the goodness-of-fit statistics, meaning the adjusted R^2 is still solid and interpretable.

Appendix 9. High yield bond data sample

ISIN	Issuer	Default event date	Default event classification	Industry group	Risk class	Recovery rate
NO0010697956	Atlantic Offshore AS	3/17/2016	Non-Payment	Oil and gas services	Unsecured	0.078
NO0010699317	Axis Offshore Pte. Ltd.	7/15/2016	Distressed Exchange	Oil and gas services	Secured	0.792
NO0010684327	Bassdrill Alpha Ltd	3/29/2016	Non-Payment	Oil and gas services	Secured	0.219
NO0010604705	Cecon 1 AS and Cecon 2 AS	12/18/2014	Non-Payment	Oil and gas services	Secured	0.800
NO0010364250	Cecon 1 AS and Cecon 2 AS	12/18/2014	Non-Payment	Oil and gas services	Secured	0.620
NO0010506728	Cecon 1 AS and Cecon 2 AS	12/18/2014	Non-Payment	Oil and gas services	Secured	0.620
NO0010604697	Cecon ASA	12/18/2014	Non-Payment	Oil and gas services	Secured	0.915
NO0010604697	Cecon ASA	4/24/2015	Bankruptcy	Oil and gas services	Secured	0.915
NO0010694599	Cecon Shipping 2 AS	6/2/2015	Distressed Exchange	Oil and gas services	Secured	1.000
NO0010628860	Chloe Marine Corporation Ltd	8/13/2015	Bankruptcy	Oil and gas services	Secured	0.233
NO0010654841	Crudecorp AS	10/19/2015	Non-Payment	Oil and gas E&P	Unsecured	0.800
NO0010601198	Dannemora Mineral AB	3/18/2015	Bankruptcy	Industry	Secured	0.008
NO0010635865	DOF ASA	6/21/2016	Distressed Exchange	Oil and gas services	Unsecured	0.424
NO0010657802	DOF ASA	6/21/2016	Distressed Exchange	Oil and gas services	Unsecured	0.421
NO0010703192	DOF ASA	6/21/2016	Distressed Exchange	Oil and gas services	Unsecured	0.419
NO0010662901	Dolphin Group ASA	12/14/2015	Bankruptcy	Oil and gas services	Unsecured	0.037
NO0010697220	Dolphin Group ASA	12/14/2015	Bankruptcy	Oil and gas services	Unsecured	0.037
NO0010668601	Eitzen Chemical ASA	12/23/2014	Distressed Exchange	Shipping	Secured	0.190
NO0010668619	Eitzen Chemical ASA	12/23/2014	Distressed Exchange	Shipping	Secured	0.190
NO0010668627	Eitzen Chemical ASA	12/23/2014	Distressed Exchange	Shipping	Unsecured	0.039
NO0010668635	Eitzen Chemical ASA	12/23/2014	Distressed Exchange	Shipping	Unsecured	0.039
NO0010692882	General Exploration Partners Inc.	4/5/2016	Distressed Exchange	Oil and gas E&P	Secured	0.376
NO0010722028	Golden Close Maritime Corp Ltd	4/29/2016	Non-Payment	Oil and gas services	Secured	0.254
NO0010711732	Golden Energy Offshore Services AS	3/11/2016	Distressed Exchange	Oil and gas services	Secured	0.275
NO0010729627	Green Star Drilling Limited	2/21/2015	Bankruptcy	Oil and gas services	Secured	1.000
NO0010708209	Harkand Finance Inc.	3/21/2016	Non-Payment	Oil and gas services	Secured	0.354
NO0010714009	Havila Holding AS	3/14/2016	Non-Payment	Oil and gas services	Secured	1.003
NO0010590441	Havila Shipping ASA	2/16/2016	Non-Payment	Oil and gas services	Secured	0.454
NO0010605033	Havila Shipping ASA	2/16/2016	Non-Payment	Oil and gas services	Secured	0.426
NO0010605025	Havila Shipping ASA	2/16/2016	Non-Payment	Oil and gas services	Secured	0.424
NO0010657174	Havila Shipping ASA	2/16/2016	Non-Payment	Oil and gas services	Unsecured	0.225
NO0010584683	Interoil Exploration and Production ASA	12/15/2014	Non-Payment	Oil and gas E&P	Secured	0.334
NO0010689763	Iona Energy Company (UK) Ltd.	10/5/2015	Non-Payment	Oil and gas E&P	Secured	0.153
NO0010689763	Iona Energy Company (UK) Ltd.	12/14/2015	Bankruptcy	Oil and gas E&P	Secured	0.049
NO0010674187	Island Drilling Company ASA	4/4/2016	Non-Payment	Oil and gas services	Secured	0.106
NO0010673866	Island Offshore Shipholding LP	3/2/2016	Distressed Exchange	Oil and gas services	Unsecured	0.526
NO0010611031	Jasper Explorer PLC	11/11/2014	Non-Payment	Oil and gas E&P	Secured	0.167
NO0010683832	Latina Offshore Limited	6/30/2016	Non-Payment	Oil and gas services	Secured	0.600
NO0010703374	Metro Exploration Holding Corp.	5/13/2015	Bankruptcy	Oil and gas services	Secured	0.089
NO0010606320	Noreco Norway AS	12/9/2014	Non-Payment	Oil and gas E&P	Secured	0.503
NO0010704182	Norshore Atlantic B.V.	7/21/2015	Distressed Exchange	Oil and gas services	Secured	0.613
NO0010709199	Northland Resources AB (publ)	6/30/2014	Non-Payment	Industry	Secured	0.899
NO0010682339	Northland Resources AB (publ)	6/30/2014	Non-Payment	Industry	Secured	0.388
NO0010682321	Northland Resources AB (publ)	6/30/2014	Non-Payment	Industry	Secured	0.351
NO0010709199	Northland Resources AB (publ)	12/8/2014	Bankruptcy	Industry	Secured	0.075
NO0010682339	Northland Resources AB (publ)	12/8/2014	Bankruptcy	Industry	Secured	0.022
NO0010682321	Northland Resources AB (publ)	12/8/2014	Bankruptcy	Industry	Secured	0.021
NO0010697030	Norwegian Energy Company ASA	12/9/2014	Non-Payment	Oil and gas E&P	Secured	0.398
NO0010697048	Norwegian Energy Company ASA	12/9/2014	Non-Payment	Oil and gas E&P	Secured	0.143
NO0010700982	Oro Negro Drilling Pte. Ltd.	1/25/2016	Non-Payment	Oil and gas services	Secured	0.492
NO0010700982	Oro Negro Drilling Pte. Ltd.	7/25/2016	Non-Payment	Oil and gas services	Secured	0.435

ISIN	Issuer	Credit event date	Event classification	Industry group	Risk class	Recovery rate
NO0010724818	Oro Negro Impetus Pte. Ltd	9/30/2015	Non-Payment	Oil and gas services	Secured	0.584
NO0010724818	Oro Negro Impetus Pte. Ltd	4/11/2016	Distressed Exchange	Oil and gas services	Secured	0.470
NO0010665367	Otium AS	12/31/2014	Non-Payment	Real Estate	Unsecured	0.620
NO0010665367	Otium AS	7/17/2015	Distressed Exchange	Real Estate	Unsecured	0.264
NO0010605728	PA Resources AB	9/18/2014	Non-Payment	Oil and gas E&P	Unsecured	0.486
NO0010605728	PA Resources AB	3/24/2015	Non-Payment	Oil and gas E&P	Unsecured	0.066
NO0010714389	Polarcus Ltd (Cayman Islands)	1/6/2016	Distressed Exchange	Oil and gas services	Unsecured	0.137
NO0010680150	Polarcus Ltd (Cayman Islands)	12/7/2015	Non-Payment	Oil and gas services	Unsecured	0.132
NO0010354186	Primorsk International Shipping Ltd	1/19/2016	Bankruptcy	Shipping	Unsecured	0.150
NO0010691892	Prosafe SE	7/7/2016	Distressed Exchange	Oil and gas services	Unsecured	0.337
NO0010717473	Prosafe SE	7/7/2016	Distressed Exchange	Oil and gas services	Unsecured	0.337
NO0010635725	Prosafe SE	7/7/2016	Distressed Exchange	Oil and gas services	Unsecured	0.337
NO0010669633	Prosafe SE	7/7/2016	Distressed Exchange	Oil and gas services	Unsecured	0.337
NO0010672835	Rem Offshore ASA	6/29/2016	Distressed Exchange	Oil and gas services	Unsecured	0.371
NO0010720238	Rem Offshore ASA	6/29/2016	Distressed Exchange	Oil and gas services	Unsecured	0.347
NO0010713522	Sanjel Corporation	12/21/2015	Non-Payment	Industry	Unsecured	0.057
NO0010354632	Sea Production Ltd	5/6/2015	Distressed Exchange	Oil and gas services	Secured	0.752
NO0010354632	Sea Production Ltd	3/4/2016	Distressed Exchange	Oil and gas services	Secured	0.333
NO0010633118	Seabird Exploration PLC	12/4/2014	Non-Payment	Oil and gas services	Secured	0.267
NO0010713548	Solstad Offshore ASA	6/22/2016	Distressed Exchange	Oil and gas services	Unsecured	0.627
NO0010628753	Songa Offshore SE	3/22/2016	Distressed Exchange	Oil and gas services	Unsecured	0.530
NO0010649403	Songa Offshore SE	3/22/2016	Distressed Exchange	Oil and gas services	Unsecured	0.507
NO0010675671	Sterling Resources (UK) Ltd.	3/11/2016	Distressed Exchange	Oil and gas E&P	Secured	0.730
NO0010638158	Viking Supply Ships A/S	3/31/2016	Non-Payment	Oil and gas services	Unsecured	0.315
NO0010680069	Volstad Shipping AS	3/1/2016	Non-Payment	Oil and gas services	Unsecured	0.141
NO0010684574	Volstad Subsea AS	6/17/2016	Distressed Exchange	Oil and gas services	Secured	0.630
NO0010694565	World Wide Supply AS	11/26/2015	Non-Payment	Oil and gas services	Secured	0.295