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Mergers and Acquisitions and Default Risk:

Evidence from the Western European Financial Sector

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Keywords:	M&A; Mergers; Acquisitions; Default Risk; Merton model; Probability of Default; Distance-to-Default; European; Financial Sector
Purpose:	The purpose of this paper is to examine how the Western European financial sector acquirers' default risk changes when carrying out M&A transactions. Further to determine, which independent transaction, acquirer, and target characteristics have explanatory power over the change in default risk.
Theoretical Framework:	This paper is based on prior research and literature on default risk changes in M&A deals, as well as general performance and value effects in M&A deals.
Sample:	The sample data consists of 276 M&A transactions, which have been announced earliest in August 2010 and completed latest in August 2018. The sample consists of 147 unique acquirers operating in the financial sector in Western Europe. All data is acquired from Bloomberg Terminal and Thomson Reuters Eikon.
Methodology:	Besides using Merton Distance-to-Default framework to determine the probability of default pre- and post-merger, univariate analysis, and multiple regressions are used to test whether the aforementioned characteristics have significance in explaining the change in default risk.
Conclusions:	This research provides evidence indicating that mergers and acquisitions performed in Western Europe by financial sector bidders, on average, were rather risk neutral. The changes in default risk can be explained by different statistically significant transaction, acquirer, and target specific characteristics introduced later in this research.

Abstract

The purpose of this paper is to examine the impact of mergers and acquisitions on the default risk of acquiring companies. The sample consists of 276 transactions carried out between 2010 and 2018 by acquirers from Western European financial sector. We estimate the acquirer's default risk using Merton Distance-to-Default model and further regress a set of independent variables with the changes in default risk in order to find out what contributes to these changes. On average, we find these transactions to be rather risk-neutral. Breaking down the whole sample to smaller sub-samples reveals that acquirers who have high default risk before the deal experience significant decreases in their default risk. Results from the regression analysis indicate the Merton model being more sensitive to, newly introduced variable, change in idiosyncratic risk than to change in leverage. We found no significant results indicating cross-industry diversification effects, whereas cross-border deals were decreasing the default risk. Outside the main discoveries of our study, our findings indicate prior idiosyncratic risk, prior leverage, and relative transaction size to be increasing the default risk. Another risk-reducing factor beside cross-border characteristic was cash payment. The found evidence casts yet another doubt upon M&A deals from acquirers' standpoint, questioning their role as reasonable investments.

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List of Abbreviations

DD – Distance-to-default

IMAA – Institution for Mergers, Acquisitions, and Alliances

M&A – Merger and Acquisition

PD – Probability of Default

Introduction

As the number of M&A transactions has grown globally from 2,676 in 1985 to 50,874 in 2018, so has the interests of researchers (Institution for Mergers, Acquisitions, and Alliances, n.d., a). Existing M&A studies have been mainly concentrating on the stock returns and whether shareholder value is created in these transactions. Findings in related studies examining changes in the aforementioned variables around acquisitions have followed a distinctive pattern. Bruner (2001) conducted a meta-analysis taking into account 130 studies of M&A payoffs. Summarized findings from these studies suggested that in M&A transactions most of the value, created through cost and revenue synergies, is gained by the shareholders of the target company, and buyers were on average earning zero adjusted returns. If acquisitions favor only one of the related parties, target companies, why the number of M&A deals has continued increasing over the years. After all, there must be something beneficial on the table for the acquirer companies as well. One of the hypothesized benefits suggested by existing literature is the risk reduction through diversification effects. In this research, we examine the changes in acquirer default risk related to M&A transactions by observing the pre- and the post-transaction default risk and try to determine what are the underlying factors contributing to possible risk changes. Our sample consists of acquirers from Western European financial sector.

The primary purpose of this paper is to answer the following research questions:

How is the acquirer's probability of default affected by mergers and acquisitions in the Western European financial sector?

What can explain the changes in default risk?

The financial sector is a substantive industry when it comes to the number of acquisitions. Since 1985, the financial sector has carried out third most M&A deals within all industries, while carrying the most substantial total transaction value. According to IMAA (Institute for Mergers, Acquisitions, and Alliances, n.d., b), 12.2% (111,468) of all deals since 1985 have been executed by financial institutions, total transaction value carrying 16.3% of all transactions. The geographical focus of M&A studies has been mainly in the US, and the European markets have

received less interest from the researchers, especially when it comes to default risk. This factor justifies the examination of European region furthermore.

Previous literature researching the risk changes related to M&A transactions exists, whereas studies using the probability of default as a risk measure is niche. A large proportion of papers measure risk relying solely on accounting-based (e.g., z-scores) or equity-based indicators of risk (e.g., beta). Both of these estimation approaches have their flaws, because of considering only one or the other. Only a few studies have chosen Merton's Distance-to-Default framework to examine the default risk, and further the changes in risk. This approach can be considered superior to accounting-based or equity-based measures because it has the capability to create risk measure using both accounting and market data. As a result, DD scores can be considered as a viable measure of bank fragility, outperforming simple market-based risk measures such as subordinated bond spreads over most time horizons (Gropp et al., 2006). Vallascas and Hagendorff (2011) were the first ones to apply the Merton model in estimating the impact of European bank mergers on bidder's default risk. This was followed by a handful of papers with a similar methodological framework with a focus in North America. Even though some of the latest studies have been conducted in a similar manner, providing evidence from multiple sectors and industries, the inconclusive nature of the findings, after all things considered, gives justification for further research. These studies will be further described in the literature section.

On average, papers researching risk in M&A context, have studied the explanatory variables affecting the changes in risk, the dependent variable, giving us a foundation in the selection process of suitable independent variables. Bringing in new, previously unconsidered determinants[1] to the multiple regression will add to existing literature and might help to discover important individual factors contributing to changes in default risk. We are further contributing to the European study by examining new time-period with new transactions and taking into account cross-industry deals, them representing a significant part of the sample. All things considered, this paper can provide useful information to the Western European finance sector in making calculated and informed decisions regarding future mergers and acquisitions, not to

[1] New variables to all M&A and default risk studies: change in idiosyncratic risk (ΔVOL). New variables to European M&A and default risk studies: change in leverage (ΔLEV), change in idiosyncratic risk (ΔVOL), pre-announcement idiosyncratic risk (PRE_VOL), cross-industry deals (CROSS_IND), cross-continental deals (OUT_EUROPE) and equity payment (EQUITY).

mention private investors and analysts who are attempting to control for their portfolio risk exposure regarding these kinds of corporations.

Despite the theoretical asset-diversification potential offered by M&A deals, we observe these transactions to be rather risk-neutral on average. We observed only slight and insignificant increases in default risk, which indicates not only mergers between European banks being rather risk-neutral (Vallascas and Hagendorff, 2011), but the M&A transactions carried out by the whole Western European financial sector. Our findings, in both univariate and multivariate analysis, suggest that companies, which have been carrying relatively high default risk prior to M&A, face a significant decrease in their default risk. The opposite finding was also made, for companies carrying lower default risk, in multivariate analysis. We find the change in default risk being driven, to a large extent, by market-based factors (change in idiosyncratic risk) rather than accounting-based information (change in leverage). In fact, the previously unconsidered variable, change in idiosyncratic risk has the most explanatory power of all variables considered. This finding ultimately contributes to all the existing literature. We confirmed findings from North America (Furfine and Rosen, 2010; Koerniadi et al., 2015), which indicated the cross-industry variable being insignificant in explaining the changes in default risk. Other factors contributing to an increase in default risk were prior idiosyncratic risk, prior leverage, relative transaction size, and equity financing, whereas cash payment and cross-border deals were decreasing the post-acquisition default risk. The contrast between previous literature and these findings will be further discussed in results.

There are some limitations in this study, which restrict the statistical inference that could be drawn from this paper. First and foremost, our sample of acquirers consists of companies operating in the Western European financial sector. This restricts the results to a particular geographical region, and the conclusions might not be the same for financial sectors in other parts of the world. However, previous studies related to different variables around M&A events have been indicating similar research findings at least in the US, making this study possibly applicable to other continents as well, whereas limitation regarding the sector is more severe since our sample companies have most likely particularly good accessibility to financing compared to the other business sectors. The second limitation is related to the nature of the sample companies, all of them being publicly traded, which leaves the Western European private financial sector out of the sample (e.g., private equity).

The paper will proceed in the following manner. The introduction chapter is followed by a chapter including a literature review; pointing out the main discoveries and limitations; and a more detailed review of the explanatory factors. The second chapter presents the sample data. The third chapter, empirical approach, includes the Merton model, default risk estimation process, and the regression variables. The fourth chapter is divided into two parts. In the first part, we perform a univariate analysis where we break the sample into subsamples by different deal- and acquirer-specific characteristics. We examine whether these characteristics alone have significance in changes in distance-to-default. Then, we will run the OLS regression testing, whether the chosen independent variables have explanatory power over the changes found in the default risk. Finally, we present the results of the research and give recommendations for further research on the subject.

1 Literature Review

1.1 Default Risk and Main Findings

The previous empirical evidence is somewhat unsettled regarding the outcome of default risk after M&A transactions. There is evidence of increasing and decreasing default risk post-M&A as well as indications of risk-neutrality. Appendix A includes a summarized representation of the past studies; it distinguishes the main approaches, study outlines, and key findings.

Vallascas and Hagendorff (2011), being the pioneers of using Merton DD framework in measuring risks related to M&A transactions, studied 134 European bank mergers between 1992 and 2007. They found these bank mergers to be, at best, risk neutral for the acquirer, yet offering substantial scope for risk increasing driven by cross-border and activity-diversifying deals. Another significant explanatory factor in risk increasing in their study was relative deal size, questioning mega-mergers' capability to reduce the overall risk of the banking sector in Europe. Especially, banks with previously relatively low probability for default experienced risk increases after completion of the transaction.

Furfine and Rosen (2011), concentrating in 3 604 domestic M&A deals in North America, found that default risk increases as a result of these transactions. Therefore, rejecting the idea of asset diversification effects and their potential to decrease the default probability. Their paper highlighted three factors associated with acquiring firms experiencing default risk increases: high pre-acquisition idiosyncratic risk, a larger option-based compensation for CEOs and poor pre-acquisition stock performance. They applied expected default frequencies (EDF) provided by Moody's KMV, which differentiates their study methodology from all of the previous studies and on the other enabled their large sample size, since estimating default risk using the Merton DD framework can be considered as time-consuming and complicated.

Bruyland and Maeseneire (2014) studied 987 distressed M&A transactions, comparing those to 187 non-distressed transactions in the United States, finding that both distressed and non-distressed M&A deals increase default risk bidders default risk. This study and its findings were reinforced by Pelov and Nguyen (2018), researching 101 distressed and 281 non-distressed

M&A deals in the United States. Whereas Bruyland and Maeseneire (2014) treated distressed targets equally, Pelov and Nguyen (2018) differentiated themselves by making a distinction between permanently and temporarily distressed targets. They also examined different financing methods and their influence on the post-acquisition default risk, finding equity financing to be risk increasing.

Perhaps the biggest contradictory findings in relation to the rest of the studies were observed by Koerniadi et al. (2015); and Jóhannsson and Kopitz (2012). Koerniadi et al. (2015) found US firms (sample of 376 cross-border M&A transactions) taking over foreign targets in related industries to be associated with a significant reduction in their default risk. However, they established that acquirers with low default risk before acquisition experienced higher post-transaction default risk, and vice versa, which is consistent with Vallascas and Hagendorff (2011). Jóhannsson and Kopitz (2012) studied 69 transactions made by Swedish companies listed in OMX Stockholm. Their findings are consistent with Koerniadi et al. (2015), indicating that M&A deals on average decreased the acquirer's probability of default.

A possible reason for the variety in the results could be the differentiation in estimation/examination methodologies. For example, Vallascas and Hagendorff (2011) implemented a PD estimation which leaves out the industry's own default probability – Industry-adjusted distance to default; Furfine and Rosen (2011) applied expected default frequencies (EDF) provided by Moody's KMV; Koerniadi et al. (2015) in PD estimation process applied past year's stock performance as the expected return of equity. The implementations of methodological frameworks have differences which could have an impact in results as well. However, since all of the aforementioned methodologies seek to estimate the same thing, default risk, and the determining variable being the change in these parameters during the transaction process, methodological differences are unlikely to cause this much variety in results.

On the other hand, the differences in these findings could be explained by the different study setups and samples; differences in time, geographical, industrial dimensions. However, the lack of quantity in previous studies, make it hard to establish any clear patterns in these dimensions altogether.

When it comes to closely related studies, it could be expected that they would end up in similar findings. This was not the case with the two studies which were examining distressed M&A

transactions. For example, findings concerning the change in default risk regarding whether the M&A is distressed or non-distressed was contradictory. Bruyland and Maeseneire (2014) found that distressed M&A transactions increase more PD than non-distressed. Pelov and Nguyen (2018) made the opposite finding.

As mentioned previously, Europe as a region has received less attention from the researchers when it comes to M&A deals, especially in context with default risk. Studies concerning the European M&A transactions, examining other variables than default risk, have generally been consistent with the US studies, yielding similar findings, but this stylized fact is hard to make regarding M&A deals and probability of default since only one study has considered the European region. As Vallascas and Hagendorff (2011) mention, Europe as a region provides a particularly suitable setting for this kind of research since European banks have been in a position to consolidate, e.g., insurance and securities companies, which has only been possible for US banks following the passing of the Gramm-Leach-Bliley Act in 1999. Not to mention the unsynchronized business cycles in European countries, which could yield substantial diversification possibilities.

Similar to Vallascas and Hagendorff (2011), who studied the whole European region, our geographical area will cover acquirers from Western Europe. In contrast, our study will not restrict the target nor acquirer companies solely to banks. We will examine the whole financial sector in Western Europe, and our sample will include both cross-industry as well as cross-border deals. Most of the studies related to default risk and M&A transactions, mentioned earlier in this chapter, have studied period starting pre-financial crisis –from the early 1990s until post-financial crisis around 2011. Only one of the studies (Pelov and Nguyen, 2018) considered a similar time period as is our objective, but it focused on distressed M&A deals in the US, making our research layout very different. Timewise, our study will contribute to the existing literature by examining these transactions for the post-financial crisis period, and therefore providing a more accurate representation of current conditions. Further we will introduce new, previously unexamined explanatory variables[2] detailed in the third chapter.

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[2] New variables to all M&A and default risk studies: change in idiosyncratic risk (ΔVOL). New variables to European M&A and default risk studies: change in leverage (ΔLEV), change in idiosyncratic risk (ΔVOL), pre-announcement idiosyncratic risk (PRE_VOL), cross-industry deals (CROSS_IND), cross-continental deals (OUT_EUROPE) and equity payment (EQUITY).

1.2 Detailed Review of Explanatory Factors

Previous literature has investigated many factors, which could explain the changes in acquirer's default risk. However, the empirical results point to different directions, and therefore, an additional examination of these variables is justified. The following sub-chapters will address the key variables examined by the existing literature.

1.2.1 Financing- and Payment Method

The payment method of the acquisition can be broadly divided into two main categories: equity and cash. It should be noted that the funding for cash payment can arise from internal sources (e.g., Retained earnings), but often it is a mixture of cash and debt, the latter being drawn from external sources. According to Martynova and Renneborg (2009), one-third of all cash paid acquisitions have actually been financed at least partially with external funds, namely debt. This dilemma is further discussed in the third paragraph.

Previous studies, considering the payment method as an independent variable, have yielded contradictory results. According to Furfine and Rosen (2011), equity financing has had decreasing influence over the default risk of the acquirer. Considering the capital structure, these findings are intuitive, since transaction being fully equity-financed means relatively decreasing leverage through increased firm size, caused by increased equity. Lower leverage leads to lower default risk by construction since the amount owed to lenders in relation to the assets owned is taken into account in the Merton model. On the other hand, Pelov and Nguyen (2018) discovered equity financed acquisitions to be followed by increasing probability of default. This could be due to information asymmetry problems, where shareholders might assume acquirer's stock to be overvalued, and therefore used as the payment method in the transaction. This often leads to poor stock performance and negative abnormal returns (Andrade et al., 2001), which could result in increased acquirer's stock price volatility as well as diminishing shareholders equity. Asset volatility being one of the inputs in the Merton model, this could, in theory, offset the benefits of decreased leverage.

Another payment method used in mergers and acquisitions is cash. Like noted in the first paragraph, the financing method of cash payment may differ between internal cash and external debt. Considering the acquirer value effect and post-M&A returns, overwhelming empirical

evidence suggests (Amihud et al., 1990; Brown and Ryngaert, 1991; Faccio et al., 2006; Fuller et al., 2002; Servaes, 1991; Travlos, 1987) cash payment, regardless it being internal cash or debt, to outperform equity as a method of payment from the acquirer's shareholders point of view. However, many of these studies have been oversimplified, not taking into account the origin of the cash payment and using the form of payment as a proxy or substitute for the source of financing (Schlingeman, 2004). Since companies usually hold a limited amount of cash, unless saving free cash flow for long before the actual acquisition, issuing debt may be required in order to pay in cash (Fisher, 2017). Taking into account the Merton model framework, the difference between cash and debt financing could be expected to make a difference. Koerniadi et al. (2015) found that cash payment (underlying finance method, including both debt and internal cash) to reduce the default risk.

According to the pecking order theory, shareholders prefer both cash and debt financing over equity financing. In theory, this could lead to less volatility, which in turn could lead to lower default risk. Limited by the availability of disclosed transaction details, this paper can only compare equity to cash as a payment method, but we are aware of the fact that the cash payments may include external financing.

1.2.2 Capital Structure

Previous studies have examined how the capital structure and the changes in the capital structure might explain movements of the default risk. This paper will examine how the pre-merger capital structure and the change in capital structure affect the default risk post-merger.

Capital structure before M&A transaction has been considered in many of the related studies (Vallascas and Hagendorff, 2011; Koerniadi et al., 2015; Pelov and Nguyen, 2018). The intuition that results in examining this variable is driven by the expectation that managers in companies with different leverage levels, might be more or less willing to engage in risky M&A transactions. Companies with high leverage might be less willing to carry out risk increasing investments, whereas managers of low leverage firms might be looking for these risky investment opportunities in order to extract benefits from their high debt capacity. Vallascas and Hagendorff (2011) found a positive correlation between pre-transaction leverage and distance-to-default, indicating higher leverage firms carrying default risk decreasing M&A deals whereas Koerniadi (2015) and Pelov and Nguyen (2018) found this variable to be insignificant. Pre-M&A measured leverage levels could result in different payment methods as

well. Pelov and Nguyen (2018) found a link between pre-merger leverage and payment method. In their sample, companies with high levels of leverage were financing their transactions with equity, and low leverage firms used cash more frequently.

The change in the leverage is another element related to capital structure, which, being one of the critical inputs to the Merton model, could be expected to affect the change in default risk. Empirical evidence related to this particular variable is again pointing to different directions, whereas Furfine and Rosen (2011) found the change in leverage being far from crucial explanatory factor. Two studies (Jóhannsson and Kopitz, 2012; Bruyland and Maeseneire, 2014) used a similar approach, finding a change in leverage to be correlating positively with the change in default risk. Ceteris paribus, this is reasonable considering the construction of the Merton model.

1.2.3 Idiosyncratic Risk and Information Asymmetries

Acquirers' idiosyncratic risk, measured pre-acquisition, is one of the factors that has been found to be significant according to previous empirical studies examining M&As and default risk (Furfine and Rosen, 2010; Koerniadi et al.,2015). Used as a proxy for possible information asymmetries, it reflects the information gap between the management and shareholders. Outside M&A literature, Moeller et al. (2007) found that idiosyncratic volatility, as a proxy for asymmetric information, can also be useful in predicting stock returns.

Furfine and Rosen (2010) found a strong link between idiosyncratic volatility and increases in acquirers default risk, consistent with asymmetric information allowing firm management to hide these risk-increasing actions from the shareholders. Koerniadi et al. (2015) confirmed similar empirical findings, observing increased default risks in companies with high pre-acquisition idiosyncratic risk.

1.2.4 Transaction Size

The relative size of the transaction and transaction value are potential explanatory variables regarding the default risk post-merger. They are also widely accounted for in the previous studies.

Furfine and Rosen (2011) found the relative deal size to be positively correlated with changes in acquirer's default risk post-merger. The same finding was later supported by Jóhannsson and Kopitz (2012). Whereas Vallascas and Hagendorff (2011) found transaction value to be linked with increases in default risk. The results are intuitive, ceteris paribus, the bigger the acquisition compared to the size of the acquirer, the more default risk can be affected. Larger deal can accommodate more risk increasing elements (e.g., debt). However, the underlying reasons for these empirical findings can depend on many factors. The diversification effect could be more substantial in relatively larger deals, but from an organizational perspective, Ingham et al. (1992) suggest a major problem being the effective post-merger asset integration, which becomes increasingly difficult in case of large acquisitions relative to pre-merger size. Fuller et al. (2002) were studying the returns related to acquisitions, finding larger transactions yielding larger returns regardless of whether negative or positive.

1.2.5 Initial Stake

In the outline of this paper, M&A transaction does not necessarily mean the acquisition of all target company's shares, nor exclude deals where initial ownership stake is substantial. Some of the previous studies (Bruyland and Maeseneire, 2014; Furfine and Rosen, 2011) have excluded acquisitions where pre-merger ownership stake is more than 50%, and the final stake is less than 50%. However, these aforementioned studies have not been studying the financial sector, where acquisitions of smaller stakes are more likely. Vallascas and Hagendorff (2011), who studied the European banking sector did not pose limitations in this regarding pre- and post-ownership stakes. This paper is following similar restrictions relating to pre- and post-ownership stakes.

Bruyland and Maeseneire (2014) were studying distressed and non-distressed M&A deals and found the initial stake of a target to be associated with lower default risk post-transaction, especially in distressed acquisitions. These results make intuitive sense since companies owning the target at least partially could be more enlightened of the target financial situation and in a position to be able to adjust their financial risk exposure accordingly already before the transaction. Additionally, part of the assets might already be integrated, making the merger process faster and more efficient.

1.2.6 Target Country and Industry

According to economic intuition, cross-border and -industry acquisitions could yield diversification possibilities, reducing the overall risk of the firm in question. In theory, by introducing a new market region or activity to their asset portfolio, the acquirer could reduce the volatility of their cash flows through asset diversification effect. Lewellen (1971) suggested that the combination of two unrelated businesses whose cash flows are imperfectly correlated can reduce the risk of default of the enterprise.

In practice, multiple factors are affecting the success of a cross-border and -industry acquisitions. Vallascas and Hagendorff (2011) found no risk reduction related to cross-border, nor activity diversifying deals; however, it is worth mentioning that they were studying horizontal bank mergers and therefore real industry diversification could not be observed. Conglomerate acquisitions, where acquirer and target are operating in unrelated business sectors, could provide yet more diversification possibilities and risk reduction. However, empirical evidence by Koerniadi et al. (2015) suggested no significant difference between focused and activity diversifying acquisitions. Instead, they observed lower default risk to be associated with culturally and geographically different, but closely related countries. They showed that cross-border deals where the target was operating in a related industry were associated with lower default risk. The findings produced by Jóhannsson and Kopitz (2012) studying M&A transactions carried out by Swedish acquirers indicated both country and activity diversification to produce even higher default risk post-transaction. The implementation of new corporate policies to an entirely new country and industry can often be difficult, resulting in sub-optimal performance, which could at least partly explain their findings. Kumar (2019) suggests that the value creation exists due to coinsurance effect, where the risk reduction potentially lowers the cost of capital, which could, in turn, lead to lower default risk indicating possible differentiation between horizontal and conglomerate mergers in this relation.

1.2.7 Target Public Status

Private companies are generally considered to be riskier than publicly traded companies, and therefore, making this separation between target companies can provide evidence of the risk transfer effects. Acquiring public target may also be safer in the sense that historical information

regarding key performance indicators and solvency ratios are widely, frequently, and reliably available.

Previous studies have made a distinction regarding the public status of the target companies (Vallascas and Hagendorff, 2011; Furfine and Rosen, 2011; Johansson and Kopitz, 2012; Koerniadi et al., 2015) mainly, as a proxy to test the existence of risk transfer effects. However, all of the findings have proven that there is a rather weak link between target's public status and change in default risk. Thus, there is only weak empirical evidence pointing towards the existence of the prementioned risk transfer effect.

1.2.8 Prior Stock Performance

Acquirer's pre-transaction stock performance and returns have also been a point of interest in the previous literature. Furfine and Rosen (2011) found significant evidence indicating poor stock performance to be followed by risk increasing M&A deals. According to the research, it could be a sign of low-quality management pursuing their personal agenda rather than maximizing shareholder value. On the contrary, Jóhannsson and Kopitz (2012) found companies outperforming the markets to be associated with risk increasing acquisitions. They proposed managerial overconfidence, rising from strong past performance, to be one of the key reasons behind the results. Similar findings were established by Koerniadi et al. (2015), summarizing that companies with poor (good) past stock performance are more likely to undertake low (high) risk M&A transactions.

2 Data

2.1 Data Collection Process

The studied sample of this paper consists of completed M&A deals, which have been announced earliest in August 2010 and completed latest in August 2018. This time period is expected to be less affected by the Global Financial Crisis in 2008, and therefore, a more accurate representation of the current market conditions. The data used in this study is primarily acquired from Bloomberg Terminal, and in case of incomplete data, Thomson Reuters Eikon was utilized. The sample consists of transactions where the acquirer is operating in Western European[3] financial sector. To end up with the final sample of 276 deals, the data gathering, and processing phase included some filters.

Firstly, the acquirer company needed to be publicly traded because the Merton's default risk model requires stock price data. This filtering excluded, e.g., all private equity companies performing a relatively substantial amount of M&A transactions in the Western European financial sector. Secondly, debt-free companies were excluded, since, by the assumption of Merton's credit risk model, a company needs to have debt for it to default. Thirdly, we excluded all real estate investment companies from the sample as their purchasing generally was related to real estate and its classification as a merger or acquisition type of deal is debatable. Fourth applied filter was such that minimum deal value was set to be 1 million USD[4]. Considering the fact that we placed no limitation regarding how large part of the target company's shares was acquired, we made this limitation to exclude smaller, less significant acquisitions. Fifthly, only single-buyer deals were considered. This criterion was set to simplify the sample data, leaving us with one buyer per transaction, whose changes of default risks needed to be observed/studied.

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[3] Western Europe was defined by Bloomberg Terminal's data categorizing. List of countries provided in Appendix B

[4] The values in this paper are presented in United States Dollars, as the currency in Bloomberg Terminal is by default US Dollars.

Additionally, to end up with a meaningful and reliable sample, deals with specific characteristics were left out. Purchases of PPE (Property, Plant, and Equipment) we excluded, since they, naturally do not fulfill the criteria of M&A. In addition, deals, which were reported to have completion date before the announcement, were excluded. Lastly, as the time period between announcement and completion extends, the more external factors might affect the acquirer's financial status, resulting in incorrect conclusions in changes in default risk. Thus, M&A deals which had time span longer than one year, between announcement and completion were excluded.

2.2 Data Description

The final sample consists of 276 M&A deals. These 276 deals had a total value of 112,435.20 Million USD. Thus, the average value of a deal was 407.37 M USD. Table 2.1 presents the time-distribution of the deals. The most active years in the sample were 2013 - 2016, where the most deals (48) were announced in 2014. The least number of deals were announced in 2012[5] with 24 announcements. The most prominent deals were announced in 2014 and 2016, with the total value of the deals being 20.81% and 21,38% of all deals in the sample, respectively. In 2018, the deals had the highest average value.

Table 2.1 Time-Distribution of the Sample Deals

	Number of M&A Deals	%	Total Deal Values (M US$)	%	Average Deal Value (M US$)
2010	29	10.51%	8 464.41	7.53%	291.88
2011	26	9.42%	7 145.04	6.35%	274.81
2012	24	8.70%	7 311.44	6.50%	304.64
2013	34	12.32%	11 130.20	9.90%	327.36
2014	48	17.39%	23 394.21	20.81%	487.38
2015	34	12.32%	8 495.19	7.56%	249.86
2016	44	15.94%	24 044.87	21.39%	546.47
2017	28	10.14%	4 492.38	4.00%	160.44
2018	9	3.26%	17 957.46	15.97%	1 995.27
Total	276	100%	112 435.20	100%	407.37

[5] Excluding 2018, as the whole year is not included in our sample

Appendix B presents the list of countries where the acquirers and targets are located. There were 21 unique acquirer countries in the sample and 50 unique target countries. The location of countries was presented in Bloomberg with ISO country codes; thus, the sample includes also autonomous areas like Guernsey (GG).

Table 2.2 presents the country distribution between acquirers and targets. The countries in the table are selected by their deal numbers – countries with a higher number of deals are presented separately in the table, whereas the countries with a smaller count of deals are included under 'Other' labels. From Table 2.2, it can be seen that domestic deals are naturally occurring more frequently than cross-border deals. In the studied sample, British companies made the most acquisitions totaling 54, followed by Swedish (19), French (18), Italian (17) and Spanish (17) companies. The most usual target countries in the sample were Great Britain (54), Italy (21), France (18) and the United States (17).

Table 2.2 Acquirer - Target Country Distribution

Acquirer	Target Country Code[6]																
Country[6]	AT	CH	DE	DK	ES	FI	FR	GB	GG	GR	IT	NL	NO	SE	US	Other[7]	Total
AT	1						1								1		3
CH		7					1	2			3				1		14
DE			5		1		1	1							1		9
DK				8													8
ES					10			3			1			1	2		17
FI				2		6								1			9
FR			2				10				2	1			3		18
GB		2						40	2			3			7		54
GG								2									2
GR										5							5
IT			2								15						17
NL			1				1	1				2					5
NO				1									3				4
SE			1	2		2	2						3	8	1		19
Other[8]					2		2	5							1	82	92
Total	1	9	11	13	13	8	18	54	2	5	21	6	6	10	17	82	276

[6] Country names (ISO-code): Austria (AT), Switzerland (CH), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Great Britain (GB), Guernsey (GG), Greece (GR), Italy (IT), Netherlands (NL), Norway (NO), Sweden (SE), United States (US)

[7] Other target countries can be found in Appendix B.

[8] Other acquirer countries can be found in Appendix B.

Figure 2.1 represents the target industry distribution. From 276 M&A deals, 195 (70.7%) were horizontal mergers, where the target company was operating in the same sector as the acquirer. Whereas 81 (29.3%) M&A deals were conglomerate. Figure 2.1 represents the distribution of these industries outside the financial sector, the most popular targets being in consumer- and industrial sectors.

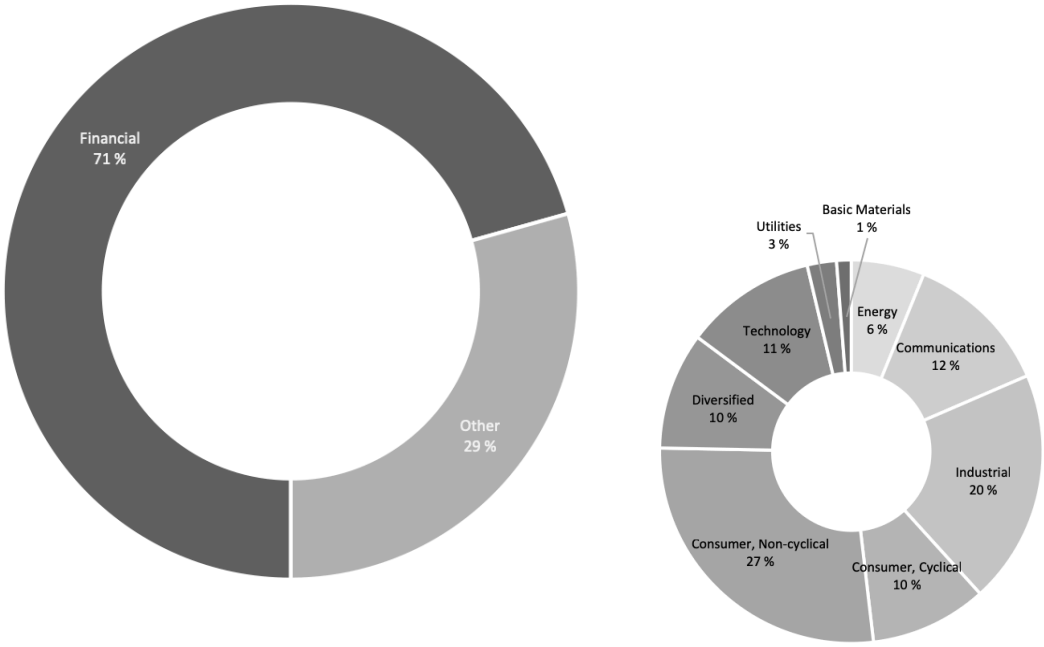

Figure 2.1 Target Industry Distribution

The 276 M&A transactions in the sample were made by 147 unique companies from the financial sector. The most usual method of payment was cash with 195 observations. The payment methods analyzed in this study are 'Equity only' and 'Cash only'. In the sample, cash financing was not further divided into internal financing and debt financing. The deal sample included 155 (56% of all) deals in which target country was different from acquirer; 93 (26%) of these transactions were targeted outside Europe.

On average, the acquirer had 13% ownership before the deal. However, the median of 0.00% implies that the weight is firmly on companies which have no initial stake. Out of all deals, in 58 the acquirer had ownership before the deal. In the vast majority of the deals, the acquiring company has sought a majority stake, as the average equal to 72%, and median being 100%. The acquiring companies have paid an average premium of 39.3% to the target companies' shareholders, the most substantial premium totaling over four times the enterprise value. Within the sample, there has been discount-deals as well; the minimum announced premium being negative 8.3%.

On average, the deal size has been 9% of the acquiring company's total assets. The highest relative deal value equaled over two times the acquiring company's total assets. We can also observe that these deals have been primarily small in relative scale as the median converges to zero by two decimals as it can be seen from Table 2.3.

Table 2.3 Deal-Specific Descriptive Statistics

	Mean	Median	Standard Deviation	Minimum	Maximum	Sum
General Deal Statistics						
Bidder Total Assets (M$)	385 281.61	47 572.81	636 154.80	4.05	2794700	106337725
Announced TV (M$)	407.37	84.11	1 230.15	1.05	15201	112435
Relative Size of Deal	0.093	0.002	0.328	0.000	2.25	25.57
Announced Premium	0.393	0.226	0.670	-0.083	4.46	19.26
Percent Owned	0.125	0	0.270	0.000	0.986	34.58
Acquired Stake	0.723	1	0.357	0.014	1.000	199.61
Final Stake	0.849	1	0.275	0.014	1.000	234.19

Number of Companies	147	Number of Additional Stake Purchase Deals	58
Number of Cross-Border M&A	155	Deal Financed with Equity only	25
Number of Outside Europe M&A	73	Deal Financed with Cash only	195
Number of Financial to Non-Financial Deals	195	Deal Financed with Cash and Equity	22

3 Empirical Approach

3.1 Merton Model

In this sub-chapter, we will introduce the Merton Distance-to-Default model and how the default risk estimate is constructed.

There are two different categories of default risk models, structural models, and reduced-form models. Structural models are sometimes called asset-value models. They are referred to as asset-value models for their properties. In these models, the default probability is modeled being dependent on the relationship between the company's assets and liabilities. The general framework of the Merton model constructs around a number of theoretical assumptions like the option-like behavior of the equity.

The option-like behavior of equity constitutes from the datum that there are only two securities: Debt and Equity. The debt of a company is treated as a zero-coupon bond that has a maturity at time *T*. The default for the observed company can only actualize at time *T*. This observation gives the option-like form for the equity. (Lütkebohmert, 2007)

Merton model assumes frictionless markets. In frictionless markets, the company value (asset value) at time *T* is determined by the sum of debt (B) and equity (S_T):

$$V_T = B + S_T \tag{1}$$

There are two scenarios for the company value at maturity (T):

1) $V_T > B$
2) $V_T < B$

In the first scenario, the value of a company's assets exceeds its face value of debt. This scenario would result in debtholders being paid in full, and shareholders would receive the residual part. In the second scenario, the total value of a firm's assets is less than the face value of debt. This would result in the firm being unable to meet its financial obligations. The shareholders would not be paid because of the superior claim of debtholders. Moreover, as a rule, since the value

of assets is smaller than debt, the equity value is negative. In this situation, rationally shareholders would exercise the "walk-away" option and leave the company for creditors. Because if one has something that has a negative value, and this individual could give that away with no cost, one would be very willing to do so (Löffler & Posch, 2007).

Using this framework, the payoffs for both claimholders can be presented followingly:

$$\text{For shareholders: } S_T = Max(V_T - B, 0) \; ; \tag{2}$$

$$\text{for debtholders: } B_T = Min(V_T, B) \tag{3}$$

This presentation of the shareholders' payoff displays how the firm's equity possesses the characteristics of a European call option on the company's assets with a strike price of the face value of debt. This makes it possible to apply option-pricing theory in the Merton model.

Another important assumption in Merton's distance-to-default framework is that the firm's total assets follow a stochastic process, more specifically, it follows a geometric Brownian motion:

$$dV_t = \mu_V V_t dt + \sigma_V V_t dW_t, 0 \leq t \leq T \tag{4}$$

Where dV_t is the change in firm value, V is the firm value, μ_V is the expected continuously compounded return on V (drift term), σ_V is the volatility of the total assets, and dW_t is a standard Wiener process. (Lütkebohmert, 2007; Hull, 2012)

The firm's asset value is also assumed to follow a log-normal distribution. In other words, it is expected that the logged value of total assets follows a normal distribution. Thus, the firm value V follows a normal distribution:

$$ln\, V_t \sim N(ln\, V_t + \left(\mu - \frac{\sigma^2}{2}\right)(T - t), \sigma^2(T - t)) \tag{5}$$

By using elementary statistics, the probability of default is the probability that a normally distributed variable x falls below a certain threshold z. This is generally expressed by $\varphi[z - E[x]/\sigma(x)]$, where φ indicates a cumulative standard normal distribution. In our case, it is the probability that asset value falls below a default point (Löffler & Posch, 2007):

$$P_{def,T} = N\left[\frac{ln\ B - ln\ V - (\mu - \sigma_V^2/2)(T-t)}{\sigma_V\sqrt{T-t}}\right]$$

$$= N\left[\frac{ln(^B/_V) - (\mu - \sigma_V^2/2)(T-t)}{\sigma_V\sqrt{T-t}}\right] \quad (6)$$

A common way to represent the probability of default is to express it via the term distance-to-default (*DD*). Essentially, the distance-to-default is the number of standard deviations the firm is away from default point (ibid.):

$$DD = \frac{\ln(B/V) + (\mu - \sigma_V^2/2) * T}{\sigma_V * \sqrt{T}} \quad (7)$$

$$PD = N(-DD) \quad (8)$$

In theory, determining the probability of default is quite straightforward. In practice, there is one substantial issue: The firm value, expressed by the value of the total assets, is employed by market value. The market value of assets is unobservable, and so is the volatility of the asset returns as well. For this reason, the option pricing theory is utilized. The option pricing theory can adduce the relationship between unobservable variables (V, σ_V) and equity (ibid.).

Given the shareholders' payoff formula (2), which equals a European call option's payoff, it is possible to apply Merton's option-theoretic model, which implements the Black Scholes (1973) option pricing formula followingly

$$S = VN(d1) - e^{-rT} * BN(d2) \quad (9)$$

Where S is the market value of firm's equity, V is the market value of the firm, B is the face value of the debt, r is the risk-free interest rate, N is the cumulative normal distribution and

$$d_1 = \frac{\ln(V_o/B) + (r + \sigma_V^2/2) * T}{\sigma_V * \sqrt{T}} \quad (10)$$

$$d_2 = d_1 - \sigma_V\sqrt{T} \quad (11)$$

As mentioned, the calculation is not completely straightforward as the market value of the firm (V), and the asset volatility (σ_V) are not directly observable. In the option-theoretic model, the firm's equity value is expressed as a function of the firm value and time. In order, to define the

market value of assets and the volatility of assets, another formula needs to be represented; to end up with two formulas and two unknown variables. Here it is possible to derive the asset volatility from Ito's lemma:

$$\sigma_E = \left(\frac{V}{E}\right)\frac{\partial E}{\partial V}\sigma_V \tag{12}$$

Bharath and Shumway (2008) impart that under the Merton model's assumptions, it can also be expressed that $\frac{\partial E}{\partial V}$ in the Black Scholes formula equals $N(d1)$. Thus, the volatilities of the firm are related to the firm's equity

$$\sigma_E = \left(\frac{V}{E}\right)N(d1)\sigma_V \tag{13}$$

With the formulas (3) and (7) it is possible to solve for the two unobservable, unknown variables (Bharath & Shumway, 2008). Once the V and σ_V have been solved, the distance-to-default (DD) and the probability of default can be calculated.

In this paper, we use Distance-to-Default as our risk measure. In order to practically implement the model and calculate the estimate the risk measure, the following inputs are needed (following the framework implemented in Bruyland and Maeseneire, 2014):

1) S_t – Market value of equity; which is from the daily stock prices and number of shares outstanding
2) F – Default barrier; which consists of 100% of the firm's short-term liabilities and 50% of long-term liabilities.
3) T – Time horizon; one year
4) R_f – Risk-free rate.
5) σ_V – Asset volatility, and V – Market value of the firm. These variables are solved using the MS Excel Solver, by following the Löffler and Posch (2007) approach by using equity values and equity volatilities.

3.2 Default Risk Estimation

The essential component for the final regression is the dependent variable ΔDD. Distance-to-Default is chosen to be the key input instead of the probability of default. This is because the

changes in *DD*-measure are more comparable to our set of independent variables, whereas the changes *PD*-measure are in percentages, thus much smaller in magnitude. In the previous sub-chapter, we presented the theoretical framework of the Merton Model and how to calculate the distance-to-default. The *DD* is calculated for each acquirer pre- and post M&A. Pre and post-M&A estimation windows are determined in a manner which follows best practices from previous literature (Vallascas and Hagendorff, 2011; Furfine and Rosen, 2011; Koerniadi et al., 2015)

1) Pre-period: 180 days until one month prior to the announcement
2) Post-period: one month after completion to 180 days after completion

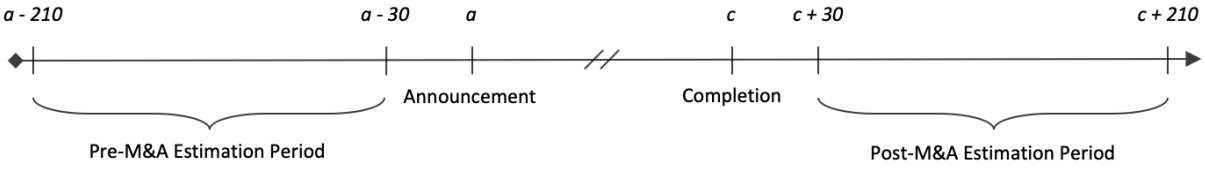

Figure 3.1 Distance-to-Default Estimation Intervals

The pre-period ends one month before the announcement to minimize biases, which could be caused by possible information leakages. Similar estimation period is selected in the post-period, minimizing the effect of stock price volatility caused by completion of the transaction. It is also more likely that the new accounting-based information (e.g., quarterly report) will be released and accounted for in our estimation, during this post-period.

For each of the observation period, average distance-to-default will be estimated. The change in *DD* (ΔDD) is then calculated according to

$$\Delta DD = \overline{DD}_{ac} - \overline{DD}_{pa} \tag{14}$$

where $\overline{DD}_{ac}$ is the average distance-to-default for the post-M&A period, and $\overline{DD}_{pa}$ is the average distance-to-default – pre-M&A announcement period.

3.3 Multiple Regression

3.3.1 Variable description

The default risk varies as a result of changes in the Merton model input variables reviewed in the second chapter. In order to determine which of the underlying factors have explanatory power over the change in default risk, we run multiple regressions. In our study, the selection of these particular variables is based on existing literature related to default risk changes in M&A transactions, with new variables picked based on their significance in other M&A literature and our intuition.

Table 3.1 represents the final group of variables included in the multiple regressions. ΔDD is set as the dependent variable, a number of the deal- and acquirer-specific characteristics as independent variables. Our independent variables are of two types; continuous variables, which have an infinite amount of possible numerical values; and dummy variables which are binary, meaning that they will receive a value of one in case the underlying characteristic is true and zero in case it does not apply to that particular observation.

The calculation of the idiosyncratic risk was carried out by using the CAPM framework

$$r_{t,n} = \alpha + \beta r_{mkt} + e \tag{15}$$

Where, the $r_{t,n}$ represents stock returns at time t for company n, and r_{mkt} are the market returns.

We used the *MSCI Financial Sector Index* as the market returns since it represents the European financial sector. Further, we obtained the idiosyncratic component of volatility by regressing our sample companies' returns with market return according to the formula above and taking the standard deviation of the residuals.

Table 3.1 List of Variables

Dependent variables	
ΔDD	*Change in Distance-to-Default*
Continuous variables	
PRE_STAKE	*Percentage of target company's shares owned prior to the transaction*
LN_TV	*Logarithmic transaction value*
LN_PRE_TA	*Logarithmic value of total assets observed one month prior to the announcement*
PRE_LEV	*Total debt (short- and long-term debt) to assets ratio, observed one month prior to the announcement*
ΔLEV	*Change in total debt (short- and long-term debt) to assets ratio, the difference between observation one month prior to the announcement and one month after completion*
PRE_VOL	*Acquirers idiosyncratic risk, measured as average from pre-M&A estimation period*
ΔVOL	*Acquirers idiosyncratic risk, the difference between averages from pre-M&A estimation period and post-M&A estimation period*
REL_SIZE	*Transaction value to Book Value of Assets, total assets observed one month prior to the announcement*
PRE_PERF	*Acquirers cumulative stock returns from the pre-M&A estimation period subtracted with market returns (MSCI Financial Sector Index)*
Dummy variables	
CROSS_B	*Dummy variable that equals one if acquirer and target are located in different countries*
OUT_EUROPE	*Dummy variable that equals one if the target is located outside of Europe*
CROSS_IND	*Dummy variable that equals one if acquirer and target are operating in different business sectors*
CASH	*Dummy variable that equals one if the acquisition is paid in cash (internal cash and/or debt)*
EQUITY	*Dummy variable that equals one if the acquisition is paid in equity/stocks of the acquirer*
T_PUBLIC	*Dummy variable that equals one if the target company is publicly traded*
H_PRE_DD	*Dummy variable that equals one if acquirer's Distance-to-Default prior to the deal is among the highest sample quartile (low default risk)*
L_PRE_DD	*Dummy variable that equals one if acquirer's Distance-to-Default to the deal is among the lowest sample quartile (high default risk)*
H_PRE_VOL	*Dummy variable that equals one if acquirer's idiosyncratic risk prior to the deal is among the highest sample quartile*
L_PRE_VOL	*Dummy variable that equals one if acquirer's idiosyncratic risk prior to the deal is among the lowest sample quartile*

3.3.2 Descriptive statistics (regression variables)

This sub-chapter presents the essential statistics of the regression variables. These inputs provide a general description of the nature of the sample of regression variables. The non-binary

variables are winsorized mainly on 0.5% level[9], except PRE_LEV, which was winsorized on 1% level based on its multiple outliers, detected with the help of boxplot-graph.

Table 3.2 presents that there have been prominent changes in the Distance-to-default; ranging from -14.04 to 14.88 standard deviations to default. As the mean is bigger than the median, the distribution of *DD* is positively skewed. The average change in *DD* was a decrease of 0.262. This implies that on average, the companies' *DD* decreased in consequence of M&A. In univariate analysis chapter (4.1), we will test whether this change is statistically significant.

Table 3.2 Descriptive Statistics - Regression Variables

	Mean	Median	Standard Deviation	Minimum	Maximum	Sum
Regression Variables						
Dependent Variable						
ΔDD	-0.262	-0.298	3.921	-14.042	14.875	-72.230
Independent Variables						
LN_TV	4.392	4.432	1.911	0.049	9.629	1 212.198
LN_PRE_TA	10.289	10.770	3.297	1.399	14.843	2 839.736
ΔLEV	-0.002	-0.002	0.060	-0.221	0.277	-0.687
PRE_LEV	0.189	0.130	0.181	0.001	0.886	52.143
ΔVOL	0.000	0.000	0.011	-0.090	0.045	-0.069
PRE_VOL	0.016	0.013	0.013	0.005	0.106	4.399
REL_SIZE	0.093	0.002	0.328	0.000	2.247	25.575
PRE_PERF	-0.003	0.015	0.197	-0.996	0.680	-0.907
PRE_STAKE	0.125	0.000	0.270	0.000	0.986	34.581
CASH	0.707	1	0.456	0	1	195
EQUITY	0.091	0	0.288	0	1	25
CROSS_B	0.562	1	0.497	0	1	155
OUT_EUROPE	0.264	0	0.442	0	1	73
CROSS_IND	0.293	0	0.456	0	1	81
H_PRE_DD	0.250	0	0.434	0	1	69
L_PRE_DD	0.250	0	0.434	0	1	69
H_PRE_VOL	0.250	0	0.434	0	1	69
L_PRE_VOL	0.250	0	0.434	0	1	69
T_PUBLIC	0.268	0	0.444	0	1	74

The sample consists of companies that possess very different kind's capital structures. Within the sample, some companies have practically no debt, and those who are highly leveraged since the maximum value is 0.89. The sample of companies also has different levels of changes in leverage between pre-M&A and post-M&A period. The highest decrease in leverage was -0.22, whereas the highest increase was 0.28. Decreases in leverage could be explained by the

[9] LN_TV, LN_PRE_TA, and PRE_STAKE were not winsorized.

involvement of equity-financing in the deal, and increase indicating the possible involvement of debt-financing. On average, these companies' capital structures before acquisitions have consisted of 19% of debt.

Idiosyncratic volatility or the standard deviation of the idiosyncratic component[10] of companies' returns in the pre-M&A period averaged 1.6%. In the sample, there are also companies that have high idiosyncratic volatility, as the maximum value is 10.6%, which indicates high asymmetric information. Yet, there are also considerable changes observed between pre- and post-M&A period volatilities. At highest, the volatility between pre- and post-periods has decreased by -9.0%; and the biggest increase in volatility was 4.5%.

On average, the sample companies have been underperforming the benchmark index, during the pre-M&A period by 0.03%, while the median is 1.5%. This implies negative skewness in excess of the return of the index. In the sample, there have been strong underperformers as well as strong outperformers. The highest outperformance equals 68% over the *MSCI Financial Sector*, whereas the biggest underperformance equals to -99.6%.

The transaction value (*LN_TV*), bidder's total assets (*LN_PRE_TA*), pre-owned stake (*PRE_STAKE*), and relative size of the deal (*REL_SIZE*) were already introduced in Chapter 2.2. Thus, we are not going to re-present the statistical features regarding these variables. The sum of the dummy variables implies the number of observations they had.

[10] Also known as the standard deviation of residuals

4 Results and Analysis

4.1 Univariate Analysis

In this sub-chapter, we analyze different sub-samples and their observed changes in default risk. The sub-samples are determined by certain deal-related categories. We present the average pre-M&A distance-to-default measures, average changes in *DD* as well as the *p*-values. Probability-values are calculated with *t*-test. This test measures whether the change in distance-to-default is significantly different from zero. Categories with prefixes, high- and low- are determined by belonging to the highest or lowest quartile of the category. The findings of the univariate analysis are presented in Table 4.1.

In the pre-M&A period, the sample average of Distance-to-default was 8.011. On average it decreased by 0.262. Even though the sample observed this change, it is not statistically significant. In other words, the change in distance-to-default is not significantly different from zero. This finding is in line with Vallascas and Hagendorff (2011), indicating not only the mergers between banks in Europe being risk-neutral but the M&A deals conducted by the whole financial sector.

When it comes to the geographical dimension, the findings do imply that on average, domestic transactions increase the default risk more than cross-border deals. In this study, we bring contribution to European literature by also presenting sub-sample of cross-continent (Outside Europe) deals. Cross-border and cross-continent deals do not differ much in risk-changes; both are having a similar decrease in *DD*. Despite these observed average changes, they, as well, are not statistically significant.

Vallascas and Hagendorff (2011) considered conglomerate setup, but in the sense that the deals were either product diversifying or focusing. All of their deals, in any case, were between banks. In our study, by conglomerate setup, we treat it as an unrelated industry deal. On average, both product diversification as well as product concentration increase default risk; conglomerate deals having a bigger decrease in *DD*. However, neither of these categories have statistical significance. The same finding is observed in ‘target ownership' category.

Table 4.1 Categorical Decomposition of Distance-to-Default Changes

	Observations	Pre DD	ΔDD	Prob.
Whole sample	276	8.011	-0.262	0.756
Geographic				
Domestic	121	7.289	-0.611	0.424
Cross-Border	155	7.602	-0.231	0.871
Outside Europe	73	7.421	-0.233	0.683
Industry				
Financial to Financial	195	7.421	-0.233	0.639
Cross-Industry	81	9.431	-0.330	0.968
Targets Ownership				
Public	74	6.665	-0.089	0.921
Private	202	8.504	-0.325	0.767
Prior Default Risk				
High Risk	69	2.390	0.927	0.002
Low Risk	69	16.423	-2.561	0.202
Leverage				
High Leverage	69	9.272	-0.266	0.576
Low Leverage	69	6.492	0.027	0.656
Increases	115	10.139	-0.805	0.629
Decreases	161	6.491	0.127	0.820
Idiosyncratic Volatility				
High Volatility (prior)	69	5.239	0.871	0.266
Low Volatility (prior)	69	12.307	-1.843	0.403
Increases	136	8.654	-2.421	0.000
Decreases	140	7.386	1.835	0.064
Prior Stock Performance				
High Return	69	7.473	0.104	0.949
Low Return	69	7.173	0.232	0.836
Financing Method				
Cash only	195	7.852	0.208	0.707
Equity only	25	5.301	-0.448	0.653
Cash and Equity	22	8.786	-0.062	0.963
Bidders Size				
Large Firm	69	6.192	-0.429	0.550
Small Firm	69	11.385	-0.189	0.965
Relative Deal Size				
Over 5%	50	11.716	-0.649	0.709
Over 10%	37	11.832	-0.525	0.790

The pre-M&A default risk is one of the few sub-sample categories in which statistically significant change in default risk is observed. The companies, which belong to the highest default risk quartile in the pre-M&A face a significant decrease in default risk. This implies that in high-risk companies, M&A deals are carried out as possible risk management or mitigating measure. Companies carrying low pre-M&A default risk faced an average decrease of 2.6 in *DD*, yet the finding is not statistically significant. Vallascas and Hagendorff (2011) in their

univariate setup observed the same nature of changes, yet their findings were significant for the low-risk category.

On average, companies, which faced an increase (decrease) in leverage and/or had high (low) leverage before the M&A also faced an increase (decrease) in default risk. Once again, these changes were not statistically significant. An interesting finding of these sub-samples regarding leverage is that on average high-leverage companies had smaller default risk than small-leverage companies.

The idiosyncratic component of acquirer's stock returns plays a significant role in default risk changes. When considering sub-samples alone, this role is not tied to the level of volatility in the pre-M&A period, but rather how the volatility changes through the M&A process. Our findings do present that the risk changes go to different directions regarding companies, which have high idiosyncratic volatility and low idiosyncratic volatility during the pre-M&A period. However, neither of the changes are statistically significant. Statistical significance is found when we are distinguishing whether the volatility increases or decreases as a result of M&A. It can be observed that companies whose idiosyncratic volatility increases (decreases) after M&A also experience an increase (decrease) in default risk. These findings provide strong indications that the ΔVOL variable will also be significant in multiple regression setup. Also, when considering market-based indicators and balance sheet data as the inputs of the Merton model, there are indications that the contribution to the output of the Merton model is more weighted towards the market-based indicators. We can observe a higher change in *DD* for the volatility changes than capital structure changes.

Findings regarding methods of payment imply that deals with cash-only (internal cash, debt, or both) payments decrease a company's default risk on average, whereas equity-only and cash-equity combinations increase default risk. Conclusions drawn from the findings of the two latter options are limited since these sub-samples include only 25 and 22 observations, respectively. Nevertheless, none of these sub-samples has a change in default risk that would be significantly different from zero.

Companies that belong to the highest or lowest quartile in the sample regarding their size, both face an increase in default, larger firms facing a bigger change in *DD* on average. Interesting about these sub-samples is also the fact that the small companies have bigger distance-to-default

than bigger companies do. The mean changes in default risk for both sub-samples are not significantly different from zero.

Final studied sub-sample is the M&A deals where the acquired company is relatively large compared to the acquirer. We find a negative impact of relatively large transactions to default risk, yet statistically insignificant. The univariate tests were run on subsamples of companies, which acquire targets that are bigger than 5% and 10% of acquirer's total assets. These transactions are large in magnitude from the acquirer's perspective. In our sample, we observe 50 deals where the transaction value is more than 5% of acquirer's total assets; and 37 where it is more than 10%. It can be noted that the majority of the sample of deals consist of relatively small deals.

Considering only one variable, we find three characteristics that ultimately have a significant relationship with default risk change. These were related to pre-M&A risk and idiosyncratic volatility. These findings imply that; high default risk companies benefit from M&A transactions and give protection against default, and change in idiosyncratic risk plays a vital role in default risk changes. None of the other categories alone has a significant effect on change in distance-to-default. In the next sub-chapter, we will take the analysis into multivariate setup.

4.2 Multivariate analysis

In earlier sub-chapter, we provided sub-sample analysis on default risk changes. Three of the subsamples alone showed a significant relationship with the change in default risk. By introducing a multivariate setup, we can observe the relationships and their magnitude of several independent variables simultaneously and their "actual contribution" to the dependent variable. As earlier mentioned, distance-to-default is our dependent variable, which is run in regression with certain deal-, bidder- and target-specific variables. In this chapter, we analyze the determinants of default risk changes with multivariate setup.

We run several multivariable regressions. In total, we estimate 11 regressions. By running several regressions, we aim to establish robust results and distinguish variables with clear explanatory power. Regression inputs are determined in such a way that no independent variable has a correlation bigger than 0.5 or smaller than -0.5. This procedure is exercised in regard to study from Dormann et al. (2012) who reported that pairwise collinearity is considered

to be high for thresholds: 0.5-0.7; referring to absolute values of correlation. As we take multicollinearity into consideration, some pairs of independent variables will not be included in models simultaneously. Example of these pairs is the change in volatility (ΔVOL) and pre-period volatility (*PRE_VOL*). These pairs can be observed in the correlation table provided in Appendix C. All of the regressions are also tested for heteroscedasticity, normality of residuals as well as functional misspecification. Based on heteroscedasticity test findings, the regressions are run with heteroscedasticity-consistent standard errors. Specimen of the tests is presented in Appendices D, E, and F.

The regression outputs are presented in Table 4.2. In our regression analysis, we find empirical support for specific variables having a significant relationship with the change in default risk. The most significant finding, statistically and economically, is the change in idiosyncratic volatility (Δ*VOL*). This variable is significant on one percent level in every regression where it is present. Already in the univariate analysis, we showed that M&A deals are related to significant changes in idiosyncratic volatility, which in turn is significantly affecting the output of the Merton model. This finding brings contribution to the related literature as it has never been considered before according to our best knowledge. The economic significance exceeds clearly the next highest ones, which are *PRE_VOL*, Δ*LEV*, and *PRE_LEV*. Since Δ*VOL* has such high economic significance, acquirers' management should be transparent regarding the on-going acquisition process in order to diminish existing shareholders' uncertainty.

Another volatility-based independent variable, average pre-period idiosyncratic volatility (*PRE_VOL*), is closely related to change in distance-to-default. In each regression, the variable is significant on a five percent level and shows a high negative relation. Thus, idiosyncratic volatility, which proxies asymmetric information, is a strong factor affecting default risk in M&A transactions. In other words, companies that have high information asymmetries tend to carry out deals, which increase their default risk. This finding is in line with Furfine and Rosen (2011), and Koerniadi et al. (2015). The high and low quartile-dummies for idiosyncratic volatility had no statistical significance.

When it comes to acquirer-specific variables, leverage is also a significant contributor to default risk changes. Both pre-M&A leverage and change in leverage, have statistical and economic significance. On average, acquirers who have high leverage prior to M&A tend to face an increase in default risk. A similar finding was made by Vallascas and Hagendorff (2011). Δ*LEV* has also negative and significant effect on default risk changes. Thus, an increase in leverage

between pre- and post-period tends also to increase the default risk. Same discovery was made by Furfine and Rosen (2011). This finding was also highly anticipated because leverage is one of the inputs in Merton's credit risk model; thus, by mechanical connection, ΔLEV has explanatory power over ΔDD. The increase in leverage could indicate debt-financing as a part of cash payment or certain amounts of debt transferred from the target company in the consolidation process. This, although, is speculation since there might be other reasons for the increase in leverage for the sample companies.

Table 4.2 Regression Outputs

Model # Coefficient (T-stat)	1	2	3	4	5	6	7	8	9	10	11
LN_TV		**0.245****	**0.221***	**0.222***	0.201	**0.278****	**0.268****			-0.069	**0.27****
		(2.02)	**(1.77)**	**(1.86)**	(1.49)	**(2.19)**	**(2.04)**			(-0.56)	**(2.12)**
LN_PRE_TA		**-0.296****	**-0.276****	**-0.309*****	**-0.262****	**-0.429*****	**-0.424*****	**-0.255*****	**-0.234****		**-0.432*****
		(-2.38)	**(-2.2)**	**(-3.89)**	**(-2.11)**	**(-4.66)**	**(-4.5)**	**(-2.96)**	**(-2.68)**		**(-4.69)**
ΔLEV	**-10.577****	**-11.28****	**-12.061****	**-12.684*****	**-12.697*****	**-8.852****	**-9.63****	**-7.801***	**-8.795****	-5.711	**-8.773****
	(-2.22)	**(-2.59)**	**(-2.77)**	**(-2.76)**	**(-2.95)**	**(-2.15)**	**(-2.36)**	**(-1.85)**	**(-2.04)**	(-1.37)	**(-2.11)**
PRE_LEV		**-2.389***	-2.03	**-2.978*****	**-2.474***	**-5.731*****	**-5.633*****	**-5.968*****	**-5.946*****	**-4.997*****	**-5.691*****
		(-1.82)	(-1.59)	**(-2.60)**	**(-1.96)**	**(-3.82)**	**(-3.7)**	**(-4.27)**	**(-4.18)**	**(-3.4)**	**(-3.78)**
ΔVOL	**-178.406*****	**-153.864*****	**-161.735*****	**-151.875*****	**-161.396*****						
	(-7.02)	**(-5.88)**	**(-6.16)**	**(-5.86)**	**(-6)**						
PRE_VOL						**-30.851****	**-33.761****	**-33.271****	**-36.804****	**-32.525****	
						(-2.41)	**(-2.3)**	**(-2.75)**	**(-2.63)**	**(-2.56)**	
REL_SIZE		**-2.369****	**-2.576*****	**-2.360****	**-2.465****	-1.782	**-2.09***			0.065	-1.825
		(-2.58)	**(-2.91)**	**(-2.58)**	**(-2.64)**	(-1.46)	**(-1.68)**			(0.06)	(-1.48)
PRE_PERF		-0.822	-0.869	-0.982	-1.043	-0.653	-0.606	-0.612	-0.523	-0.55	-0.217
		(-0.94)	(-0.95)	(-1.11)	(-1.09)	(-0.73)	(-0.64)	(-0.67)	(-0.54)	(-0.6)	(-0.21)
PRE_STAKE		0.048	0.097	0.059	0.147	0.039	0.091	-0.2	-0.144	-0.738	0.137
		(0.07)	(0.15)	(0.09)	(0.23)	(0.05)	(0.13)	(-0.26)	(-0.19)	(-0.91)	(0.19)
CASH		**1.068****		**1.168*****		**1.741*****		**1.825*****		**1.523*****	**1.725*****
		(2.56)		**(2.68)**		**(3.43)**		**(3.91)**		**(2.96)**	**(3.39)**
EQUITY			-0.067		-0.312		**-1.537****		**-1.605****		
			(-0.14)		(-0.63)		**(-2.37)**		**(-2.62)**		
CROSS_B		**0.845****	**0.915****			0.732	0.71			0.357	0.831
		(2.02)	**(2.15)**			(1.44)	(1.37)			(0.71)	(1.65)
OUT_EUROPE					0.085			0.18	0.057		
					(0.17)			(0.32)	(0.1)		
CROSS_IND		-0.062	-0.049		-0.165	0.371	0.418	0.186	0.21	0.612	0.313
		(-0.13)	(-0.1)		(-0.32)	(0.64)	(0.7)	(0.32)	(0.35)	(0.98)	(0.54)
H_PRE_DD		**-2.666*****	**-2.622*****	**-3.000*****	**-2.768*****	**-3.579*****	**-3.7*****	**-3.56*****	**-3.692*****	**-3.27*****	**-3.613*****
		(-4.57)	**(-4.34)**	**(-5.16)**	**(-4.56)**	**(-5.5)**	**(-5.53)**	**(-5.48)**	**(-5.56)**	**(-4.82)**	**(-5.59)**
L_PRE_DD		0.8	0.709	**0.882****	0.601	**2.144*****	**2.138*****	**1.885*****	**1.836*****	**1.547*****	**2.161*****
		(1.34)	(1.2)	**(2.33)**	(1.05)	**(4.07)**	**(3.94)**	**(3.59)**	**(3.43)**	**(3.05)**	**(4)**
H_PRE_VOL		-0.154	-0.259		-0.294						
		(-0.26)	(-0.44)		(-0.49)						
L_PRE_VOL		-0.883	-0.936		-0.79						
		(-1.25)	(-1.29)		(-1.04)						
T_PUBLIC		0.116	0.166	-0.015	0.101	-0.034	0.247	0.137	0.43	0.108	-0.028
		(0.3)	(0.42)	(-0.04)	(0.25)	(-0.08)	(0.55)	(0.31)	(0.93)	(0.23)	(-0.06)
C	-0.333	1.789	2.382	**2.351****	**2.989***	**3.255*****	**4.62*****	**3.014****	**4.273*****	0.521	**2.798****
	(-1.61)	(1.28)	(1.62)	**(2.58)**	**(1.95)**	**(3)**	**(4.04)**	**(2.7)**	**(3.53)**	(0.59)	**(2.66)**
R-squared	0.253	0.407	0.393	0.392	0.382	0.259	0.231	0.235	0.204	0.203	0.249
Adjusted R-squared	0.248	0.37	0.355	0.364	0.344	0.219	0.19	0.2	0.168	0.164	0.212
Obs.	276	276	276	276	276	276	276	276	276	276	276
F-statistic	46.226	11.091	10.48	14.132	10.008	6.501	5.607	6.736	5.619	5.14	6.697

The findings regarding the two earlier variable categories, idiosyncratic volatility, and leverage, provide a strong indication that the equity-based component in Merton model is having a more substantial effect on the output of Merton Model than the accounting-based data. There is one possible explanation, which could be affecting the weighting of these two, which is, that our default risk model has an emphasis on short-term debt as the default barriers is constructed of 100% short-term debt and 50% of long-term debt, which as a consequence is diminishing the total debt involved in these calculations. This, although is purely speculative.

The studied acquirers tended to face adverse effects in default risk the bigger they were. This is implied by the negative coefficient of the variable *LN_PRE_TA*, which indicates acquirers' total asset value before the transaction. This finding is in line with our univariate analysis as well as with Furfine and Rosen (2011), who implied that the biggest companies in the sample faced an increase in default risk after M&A. The variable *LN_TV*, or the total transaction value, is affecting positively to default risk. Bigger companies in absolute terms tended to be better targets, on average, considering default risk change. This finding is in contradictory with Vallascas and Hagendorff (2011), who found the opposite. The transaction value has a positive effect, but when the transaction value is set relative to the acquirer's total assets, it receives a negative sign. This is captured by *REL_SIZE*. The negative coefficient implies that the bigger the deal value is, relative to the acquirer's total assets, the more the default risk of the acquirer will increase. This finding is in line with Furfine and Rosen (2011).

When it comes to acquirer's default risk before M&A, both companies, belonging to the highest[11] and lowest quartile[12], have a significant change in default risk. Companies, which belonged to the lowest quartile in terms of pre-M&A Distance-to-Default, thus having the biggest default risk, experienced a decrease in default risk in consequence of M&A. This finding was already observed in univariate analysis and now confirmed with multiple regression. On the contrary, the companies which had low default risk prior to M&A faced an increase in default risk.

In order to capture possible geographical diversification effects, two independent variables measuring the location of the target country, in more detail, *CROSS_B* and *OUT_EUROPE* were created. Our regressions provide empirical evidence indicating cross-border deals being

[11] Captured by dummy H_PRE_DD

[12] Captured by dummy L_PRE_DD

risk decreasing at five percent level. However, the robustness of this finding could be argued since four out of six regressions indicated insignificance. *OUT_EUROPE*, dummy variable capturing deals were target country is located out of Europe, was found to be insignificant.

Our results suggest that there is a difference regarding the payment method of the transaction. Whereas cash payment is correlating with default risk reduction at the significance level of ten percent in most regressions, evidence regarding equity payment is limited, but pointing towards risk increasing. As mentioned earlier, it should be noted that cash payment may be financed with internal cash and/or external debt. In this sense, results are contradictory, considering the mechanics of the Merton model. However, as realized earlier, our empirical findings indicate the model being mainly driven by changes in market data (idiosyncratic risk) rather than accounting data (leverage). According to pecking order theory, equity financing being the worst option for existing shareholders, these results could be explained by negative shareholder reaction in case of equity payment.

Vallascas and Hagendorff (2011) made limited findings that public status of the target company has significance with *DD*. The findings were limited in the sense that they were not particularly robust. Our regression analysis was yielding with insignificant results. In addition, finding made by Furfine and Rosen (2011) about the acquirer company's pre-M&A returns being negative and significant; was not confirmed by our results, which were opposite, however, insignificant.

5 Conclusion

Mergers and acquisitions have been successfully drawn researchers' attention. An extensive amount of papers related to relative apparent aspects like value creation and performance surrounding these corporate events have been published. On the other hand, risk as a consequence has been a somewhat less popular topic among these papers. Especially default risk changes in the context of M&A deals has been disregarded among empirical literature until 2010 and like in many economic topics; the attention has been mainly pointed towards the United States.

Our research concentrates on the changes in default risk as a reaction to M&A deals, measured using the Merton Distance-to-Default framework. Our empirical findings indicate M&A's in the European financial sector being, on average, risk-neutral. Univariate analysis reveals that companies having high (low) default risk before the deal, were involved in risk decreasing (increasing) transactions. In order to further understand where the contributions to this model evolve, we run multiple regressions with appropriate independents. Our study ultimately contributes to existing literature by introducing a new variable, change in idiosyncratic risk (ΔVOL). Out of all included independent variables, ΔVOL consistently has the highest explanatory power; relationship with the dependent variable (change in distance-to-default) being highly negative and statistically significant. This finding provides indications that Merton's distance-to-default model is much more sensitive to the changes in idiosyncratic volatility than changes in leverage. Thus, market-based indicators seem to affect the output of the model, more than accounting-based inputs. As predicted, based on the mechanical connection to the Merton model, both of these variables were significant and able to explain the changes in default risk consistently.

In addition, we measured the idiosyncratic volatility and leverage before the announcement, finding them to be linked with risk-increasing deals. As in existing literature, prior idiosyncratic volatility (asymmetric information) having more economic significance than prior leverage. When it comes to payment methods, cash payment is associated with risk-reducing, whereas equity-financed deals are found to be risk increasing. The findings regarding presumed industry- and geographic-diversification are indicating insignificance in a majority of the

regressions. However, limited evidence is pointing towards at least some cross-border diversification effect.

Regarding the change in default risk, our findings are in harmony with a significant part of the previous literature. Vallascas and Hagendorff (2011) reported relatively risk-neutral, though slightly towards risk increasing leaning results. This evidence is confirmed by our findings accounting the cross-industry deals as well. A possible reason for differentiation to studies regarding M&A transactions as risk increasing (Furfine and Rosen, 2011; Bruyland and Maeseneire, 2014; Pelov and Nguyen, 2018) might be due to the financial sector, where the transaction values are smaller relative to the sizes of the acquirers on average. The sample in studies produced by Bruyland and Maeseneire (2014); and Pelov and Nguyen (2018) consisted partly of distressed targets, which could further cause the differentiation. Our study is in slight contrast with Koerniadi et al. (2015), who found cross-border deals to be risk decreasing on average. Even tough cross-border deals, also according to our research, diminishes the risk increasing, our univariate analysis regards cross-border deals as rather risk neutral. Jóhannsson and Kopitz (2012) were investigating a rather small sample of Swedish acquirer, which could in itself be the reason for the inconsistency in their study.

Our research is contributing to the literature studying slightly disregarded aspect of M&A deals, especially in the European continent. Widening the target sample and further introducing a variety of new explanatory factors have brought forward essential information. Recommended future research could consider similar study setup as Furfine and Rosen (2011) obtaining the default risk measures (EDFs) from Moody's KMV and therefore allowing larger sample size. Europe and Asia as big world economies could be viable region candidates. However, implementation of their study setup would require access to credit rating agencies' data on companies' default risk, which for an external person could be difficult. Additionally, cross-border M&A deals could be further expanded to account more explanatory elements explaining why they might reduce the acquirer's default risk.

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Databases

Bloomberg Terminal

Thomson Reuters Eikon

Appendix A - Literature summary

Authors	Vallascas and Hagendorff (2011)	Furfine and Rosen (2011)	Jóhannsson and Kopitz (2012)	Bruyland & Maeseneire (2014)	Koerniadi et al. (2015)	Pelov & Nguyen (2018)
Study description	1) Analysis of default risk effects of M&As for European bank mergers 2) Determinants of default risk changes	1) M&A's impact on default risk 2) Determinants of default risk changes	1) Determinants of changes in default risk	1) Default risk changes when acquiring a non-distressed or distressed target 2) Determinants of changes in default risk	1) Default risk changes in cross-border M&A 2) Determinants of default risk changes following cross-border M&A	1) Default risk changes in M&As, controlling distress level and deal financing
Studied Period	1992-2007	1993-2006	2002 - 2011	1990-2011	1997-2011	2011 - 08/2017
Sample description	134 European bank mergers	3,604 M&A transactions in North America	69 M&A transactions of firms listed in OMX Stockholm Stock Exchange	987 non-distressed and 187 distressed M&A transactions for US-based bidders	376 cross-border M&A transactions by US-based acquirers	281 non-distressed and 101 distressed M&A's for US-based bidders
Findings concerning changes in default risk	Bank Mergers are *Risk Neutral*	On average acquisitions *increase* acquirers default risk	Mergers on average *decrease* default risk	Distressed as well as Non-distressed M&As *increase* bidder default risk; *Distressed* M&A increase more	On average cross-border M&As *decrease* acquirers' default risk	Distressed as well as Non-distressed M&As *increase* bidder default risk; *Non-distressed* M&A increase more
Determinants which increase default risk (Statistically significant)	Log of deal value; Acquirer's operating costs to total assets; Low-risk pre-M&A dummy	Idiosyncratic volatility; Deal value to acquirer's market value; Poor Pre-M&A stock performance	Cross-border M&A; Deal size; Change (increase) in leverage	Change (increase) in leverage	Matching target industry; Idiosyncratic volatility	Equity financing
Determinants which decrease default risk (Statistically significant)	GDP growth rate	At least partly equity financed deal; Market value of the acquirer	Pre-M&A stock performance; Acquisition in different industry	Acquirer size	Strong pre-M&A stock performance; High bidder default risk Pre-M&A	

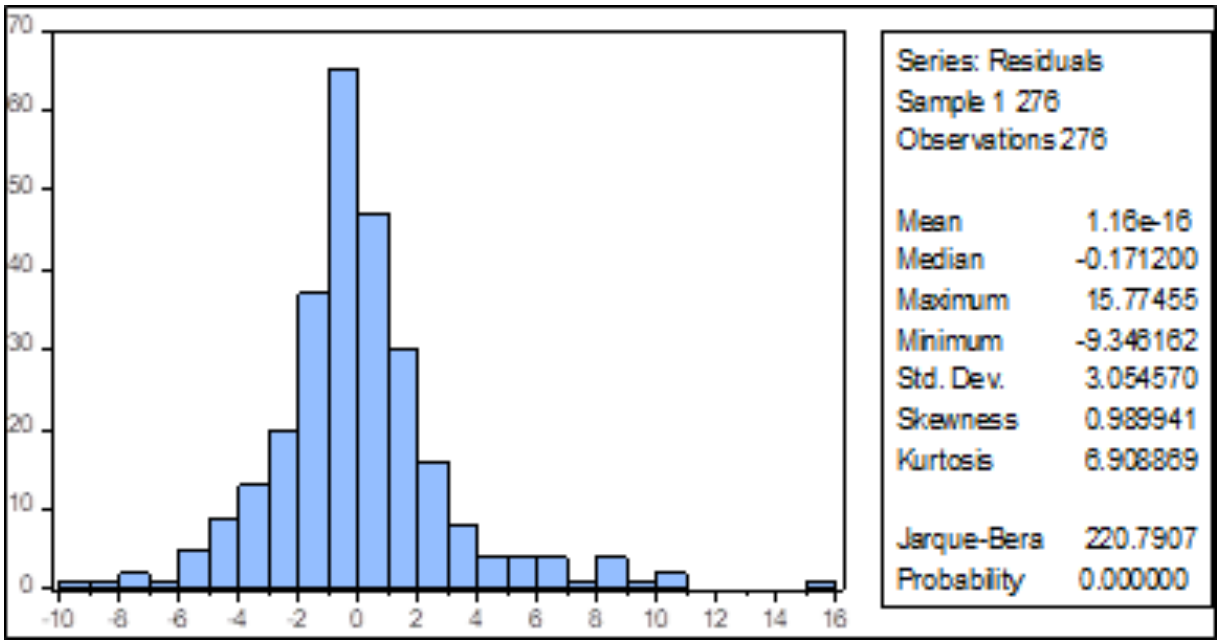
Appendix B - List of Acquirer – Target countries

List of Countries					
Acquirer countries		Target Countries			
Country Name	*ISO Code*	Country Name	*ISO Code*	Country Name	*ISO Code*
Austria	*AT*	Australia	*AU*	Korea (Republic of Korea)	*KR*
Belgium	*BE*	Austria	*AT*	Lithuania	*LT*
Denmark	*DK*	Belgium	*BE*	Luxembourg	*LU*
Finland	*FI*	Bermuda	*BM*	Malaysia	*MY*
France	*FR*	Brazil	*BR*	Mexico	*MX*
Germany	*DE*	Bulgaria	*BG*	Morocco	*MA*
Gibraltar	*GI*	Canada	*CA*	Mozambique	*MZ*
Great Britain	*GB*	Chile	*CL*	Netherlands	*NL*
Greece	*GR*	China	*CN*	Norway	*NO*
Guernsey	*GG*	Colombia	*CO*	Philippines	*PH*
Ireland	*IE*	Denmark	*DK*	Poland	*PL*
Italy	*IT*	Estonia	*EE*	Portugal	*PT*
Jersey	*JE*	Finland	*FI*	Romania	*RO*
Luxembourg	*LU*	France	*FR*	Saudi Arabia	*SA*
Malta	*MT*	Germany	*DE*	Singapore	*SG*
Netherlands	*NL*	Great Britain	*GB*	South Africa	*ZA*
Norway	*NO*	Greece	*GR*	Spain	*ES*
Portugal	*PT*	Guernsey	*GG*	Sweden	*SE*
Spain	*ES*	Hong Kong	*HK*	Switzerland	*CH*
Sweden	*SE*	India	*IN*	Thailand	*TH*
Switzerland	*CH*	Ireland	*IE*	The Isle of Man	*IM*
		Italy	*IT*	The United Republic of Tanzania	*TZ*
		Japan	*JP*	Turkey	*TR*
		Jersey	*JE*	United States	*US*
		Kenya	*KE*	Virgin Island	*VG*

Appendix C - Correlation Table

	ΔDD	LN_TV	LN_PRE_TA	ΔD/A	PRE_D/A	ΔVOL	PRE_VOL	REL_SIZE	PRE_PERF	PRE_STAKE	CASH	EQUITY	CROSS_B	OUT_EUROPE	CROSS_IND	H_PRE_DD	L_PRE_DD	H_PRE_VOL	L_PRE_VOL	T_PUBLIC
ΔDD	1																			
LN_TV	-0.029	1																		
LN_PRE_TA	-0.044	0.458	1																	
ΔD/A	-0.074	0.160	-0.066	1																
PRE_D/A	0.021	-0.064	-0.026	-0.350	1															
ΔVOL	-0.477	0.014	0.116	-0.174	0.139	1														
PRE_VOL	0.277	-0.196	-0.397	0.064	0.104	-0.556	1													
REL_SIZE	-0.064	0.014	-0.491	0.030	0.107	-0.145	0.345	1												
PRE_PERF	-0.057	0.078	0.042	0.076	-0.021	-0.042	-0.228	0.107	1											
PRE_STAKE	0.014	-0.046	0.186	0.005	0.160	0.000	-0.071	-0.098	0.068	1										
CASH	0.186	-0.053	0.167	-0.139	0.075	-0.084	-0.116	-0.191	0.076	0.084	1									
EQUITY	-0.015	0.092	-0.113	0.111	-0.002	0.082	0.214	0.063	-0.176	0.018	-0.490	1								
CROSS_B	0.079	-0.013	0.159	-0.065	-0.195	0.008	-0.180	-0.054	0.014	-0.026	0.104	-0.230	1							
OUT_EUROPE	-0.013	-0.038	0.191	-0.028	-0.247	-0.041	-0.127	-0.110	0.086	-0.149	0.026	-0.161	0.530	1						
CROSS_IND	-0.011	-0.164	-0.301	-0.055	0.187	-0.058	0.078	0.237	-0.037	0.041	-0.004	-0.009	-0.136	-0.152	1					
H_PRE_DD	-0.339	-0.031	-0.176	0.066	-0.378	0.108	-0.237	0.045	0.023	-0.107	-0.032	-0.124	0.021	0.052	0.032	1				
L_PRE_DD	0.175	0.080	0.241	-0.036	0.411	-0.144	0.356	-0.030	-0.118	0.202	0.005	0.109	-0.181	-0.251	-0.133	-0.333	1			
H_PRE_VOL	0.167	-0.259	-0.448	-0.049	0.120	-0.167	0.634	0.225	-0.184	-0.021	-0.142	0.284	-0.164	-0.119	0.051	-0.198	0.246	1		
L_PRE_VOL	-0.233	0.214	0.337	-0.021	-0.194	0.091	-0.365	-0.118	0.036	-0.002	0.041	-0.124	0.223	0.299	-0.041	0.324	-0.275	-0.333	1	
T_PUBLIC	0.027	0.192	0.150	0.018	0.056	0.022	0.074	-0.106	-0.091	0.281	0.031	0.265	-0.125	-0.103	-0.031	-0.066	0.161	0.066	0.009	1

Appendix D - Non-normality test



Appendix E - Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	2.230073	Prob. F(16,259)	0.0049
Obs*R-squared	33.41918	Prob. Chi-Square(16)	0.0065
Scaled explained SS	86.94639	Prob. Chi-Square(16)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/24/19 Time: 15:25
Sample: 1 276
Included observations: 276

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.70703	8.177891	3.632603	0.0003
LN_TV	-0.002336	0.886644	-0.002634	0.9979
LN_PRE_TA	-1.722822	0.735125	-2.343578	0.0199
DELTA_D_A_W	-9.827131	25.19533	-0.390038	0.6968
PRE_D_A_W	-23.92334	10.15099	-2.356749	0.0192
DELTA_VOL_W	-36.21590	132.4671	-0.273395	0.7848
REL_SIZE_W	-1.246510	5.077038	-0.245519	0.8062
W_PRE_PERF	-6.142052	6.952658	-0.883411	0.3778
PRE_STAKE	-1.092350	5.386585	-0.202791	0.8395
EQUITY	-0.940065	5.253148	-0.178953	0.8581
CROSS_B	0.362657	2.935423	0.123545	0.9018
CROSS_IND	-0.479471	3.264811	-0.146860	0.8834
H_PRE_DD	5.702154	3.867407	1.474413	0.1416
L_PRE_DD	4.656165	4.247451	1.096226	0.2740
H_PRE_VOL	-5.171028	4.029349	-1.283341	0.2005
L_PRE_VOL	5.490317	3.807705	1.441897	0.1505
T_PUBLIC	-2.249556	3.341112	-0.673296	0.5014

R-squared	0.121084	Mean dependent var	9.296594
Adjusted R-squared	0.066788	S.D. dependent var	22.63936
S.E. of regression	21.87028	Akaike info criterion	9.067750
Sum squared resid	123882.1	Schwarz criterion	9.290746
Log likelihood	-1234.350	Hannan-Quinn criter.	9.157235
F-statistic	2.230073	Durbin-Watson stat	1.473419
Prob(F-statistic)	0.004923		

Appendix F - Ramsey RESET test

Ramsey RESET Test
Equation: FINAL_REG3
Specification: DELTADD_W LN_TV LN_PRE_TA DELTA_D_A_W PRE_D_A_W DELTA_VOL_W REL_SIZE_W W_PRE_PERF PRE_STAKE EQUITY CROSS_B CROSS_IND H_PRE_DD L_PRE_DD H_PRE_VOL L_PRE_VOL T_PUBLIC C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.892676	258	0.0595
F-statistic	3.582221	(1, 258)	0.0595
Likelihood ratio	3.805783	1	0.0511

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	35.13800	1	35.13800
Restricted SSR	2565.860	259	9.906795
Unrestricted SSR	2530.722	258	9.808999

LR test summary:

	Value
Restricted LogL	-699.3185
Unrestricted LogL	-697.4156

Unrestricted Test Equation:
Dependent Variable: DELTADD_W
Method: Least Squares
Date: 05/24/19 Time: 15:27
Sample: 1 276
Included observations: 276

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_TV	0.223308	0.126979	1.758622	0.0798
LN_PRE_TA	-0.247304	0.106347	-2.325448	0.0208
DELTA_D_A_W	-10.98489	3.652623	-3.007399	0.0029
PRE_D_A_W	-1.870640	1.456111	-1.284682	0.2001
DELTA_VOL_W	-181.8743	21.75046	-8.361858	0.0000
REL_SIZE_W	-2.024147	0.783400	-2.583796	0.0103
W_PRE_PERF	-0.930778	0.996186	-0.934342	0.3510
PRE_STAKE	-0.049289	0.775223	-0.063580	0.9494
EQUITY	-0.088576	0.752363	-0.117730	0.9064
CROSS_B	0.886048	0.420650	2.106376	0.0361
CROSS_IND	-0.007982	0.468051	-0.017053	0.9864
H_PRE_DD	-2.396054	0.566505	-4.229537	0.0000
L_PRE_DD	0.774722	0.609246	1.271607	0.2047
H_PRE_VOL	-0.043273	0.588138	-0.073577	0.9414
L_PRE_VOL	-0.883763	0.545977	-1.618680	0.1067
T_PUBLIC	0.214949	0.479176	0.448581	0.6541
C	2.025638	1.186195	1.707677	0.0889
FITTED^2	-0.026346	0.013920	-1.892676	0.0595

R-squared	0.401293	Mean dependent var	-0.261705
Adjusted R-squared	0.361843	S.D. dependent var	3.920565
S.E. of regression	3.131932	Akaike info criterion	5.184171
Sum squared resid	2530.722	Schwarz criterion	5.420284
Log likelihood	-697.4156	Hannan-Quinn criter.	5.278919
F-statistic	10.17227	Durbin-Watson stat	1.534400
Prob(F-statistic)	0.000000		