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# IS BARRIER VERSION OF MERTON MODEL MORE REALISTIC? EVIDENCE FROM EUROPE

## Abstract:

A company can go bankrupt if the value of its assets drops below the debt level. This event can happen at any point in time. This is however not taken into account in the plain vanilla option framework of the Merton model. Theoretically, the barrier version of the Merton model shall therefore be more accurate since it allows the company to go bankrupt at time prior to or at maturity. This theoretical prediction is tested on European most liquid companies. The implied default probabilities are compared with observed default rates given the Standard & Poor's rating grades. We provide evidence that the Barrier version of Merton model is more realistic, i.e. provides a significantly better fit to observed default rates, based on the value of the Diebold-Mariano test statistics.

## Keywords:

structural credit risk model, barrier option pricing theory, down-and-in option, default probability

**JEL Classification:** G12, G15, C58

# 1 Introduction

Merton (1973) introduced an approach how to estimate expected loss on listed companies using the standard option pricing framework defined by Black & Scholes (1973). Based on Merton (1973) approach, company loss is identical to the price of a put option on company's equity.

The purpose of this paper is to demonstrate that the company default probability is better captured by the barrier option pricing framework, where the price of the option depends on the path of the underlying asset and not only on the final state. A company can go bankrupt at any point in time if the value of its assets drops below a pre-specified level. The default probability of an individual company can therefore be derived from the down-an-in barrier put option rather than the standard plain vanilla put option pricing model. The down-and-in put option can be expressed by a closed-form formula, first defined in Merton (1973).

The barrier is set to the exercise price of the option, which is the value of an outstanding debt of a company. Brockman & Turtle (2003) and Wong & Choi (2009) note that the value of barrier can be above or below the debt value. Nevertheless, according to the Bankruptcy Code adopted by the EU in 2002, the debtor is insolvent if he cannot meet his financial obligations. The barrier of the default event therefore has to be set equal to the debt value. If the value of company's assets drops below the debt level, it automatically triggers company's default and company encounters a loss. This event can happen at any point in time before the maturity of the option. In case of the plain vanilla option pricing Merton model, the default event can be triggered only at the time of maturity which points at the weakness of this credit risk model since it ignores the consequences of bankruptcy at all points in time except maturity, Brockman & Turtle (2003).

The hypothesis that the barrier option pricing theory is more suitable for credit risk assessment is tested on European most liquid companies. The implied default probabilities are compared with observed default rates in rating grades defined by S&P. Diebold-Mariano test is used in order to determine whether the barrier Merton model is more realistic than the plain vanilla Merton model. We find out that the Barrier Merton model dominates the plain vanilla Merton model by providing a better fit to the observed default rates.

The main findings of this paper are in line with Brockman & Turtle (2003), who present empirical evidence for a large cross-section of industrial firms from

New York Stock Exchange, American Exchange and Nasdaq and show that barriers in the structural type credit risk models are economically important and statistically significant. Moreover, they conclude that default probabilities have significant predictive abilities and dominate Z-scores in most cases. This study presents a unique analysis of default probability estimates of companies listed on European stock markets based on direct confrontation with observed default rates given firm-specific credit ratings. Anderson & Sundaresan (2000) demonstrate on UK non-financial quoted companies that barrier structural credit risk model clearly outperforms the reduced form model.

The paper is structured as follows. Section 2 presents the barrier and the plain vanilla option pricing framework that is used in this paper to derive corporate implied default probabilities. Section 3 summarizes the data used, the main empirical findings and model accuracy. Section 4 concludes and provides an insight on possible improvements of the framework.

# 2 Option pricing framework to model credit risk

In this Section, the option pricing framework used to predict corporate failure probabilities is defined. Two approaches are confronted, the barrier option pricing framework to value down-and-in put option and the plain vanilla put option on company's equity. In order to estimate default probability, the probability of the particular option ending in-the-money is determined. In the case of the down-and-in put option, it represents the probability that company's value of assets drop below the value of its debt at any point in time prior to or at maturity. In case of the plain vanilla put option, the implied default probability refers to the probability that company's value of assets is lower than its debt at one point in time at maturity. This is the main difference between the two presented frameworks, the rest of the assumptions from the option pricing theory remain the same. The risk-free rate under the risk-neutral measure is utilized to comply with the option pricing framework that assumes a complete market with no arbitrage opportunities and risk-neutral investors. This is further discussed in Section 3.

## 2.1 Barrier option pricing framework

The framework to value barrier type of option contracts was first introduced by Merton (1973). Existing literature proposing an optimal capital structure including models with barrier option features is represented by Brennan & Schwartz (1978), Leland (1994), Leland & Toft (1996), Anderson & Sundaresan (1996), Briys & De Varenne (1997) and Ericsson & Reneby (1998). These theoretical studies were focused on the valuation of corporate securities. Their solution to the barrier option pricing formula can however be utilized also for the estimation of expected loss on corporate companies. This paper contributes to the literature by implementing the barrier option pricing framework on European most liquid companies to derive their default probabilities, which is rather unique based on existing literature that focused mainly on companies quotes on US stock markets.

Brockman & Turtle (2003) proposes a framework how to empirically find the optimal level of barrier for each firm. The optimal level depends on country specific Bankruptcy Code. Differences in the Bankruptcy Codes can be incorporated by setting a barrier at any level, lower or higher than the level of debt. According to the Bankruptcy Code adopted by the EU in 2002, the debtor is insolvent if he cannot meet his financial obligations. That means that a default is triggered if firm's value of assets is lower than the value of its legal liabilities. Therefore, for the purpose of our study, the value of the barrier is set to the level of firm's debt.

Wong & Choi (2009) extend further the work by Brockman & Turtle (2003) by removing the biased estimate of market value of assets and asset volatility using the maximum likelihood estimation approach.

The barrier option pricing framework is used to derive the default probability, which is defined as the probability of company's asset dropping below the level of company's debt at any point in time before or at the maturity of a hypothetical put option on company's equity.

The default probability is derived from down-and-in closed form formula and can be written as [1]. Derivation of the formula is included in Poulsen (2006).

$$PD_B = \Phi\left(\frac{\ln\frac{S_0}{K} + (r - \sigma^2/2)T}{\sigma\sqrt{T}}\right) + \left(\frac{S_0}{B}\right)^p \times \Phi\left(\frac{\ln\frac{B^2}{S_0 K} + (r - \sigma^2/2)T}{\sigma\sqrt{T}}\right), \quad (1)$$

$$p = 1 - \frac{2r}{\sigma^2}. \quad (2)$$

[1]For the sake of simplicity, the index of individual firm is omitted. Nevertheless, the results of each PD estimation is firm specific and depend on the specific values of firm's input variables.

$S_0$ denotes the market value of company's assets at time 0, $K$ is the level of outstanding debt, $r$ is risk-free interest rate, $\sigma$ is the asset volatility, $T$ is the maturity of the hypothetical option and $B$ is the value of the barrier, which is set equal to $K$ within this study. $\Phi(x)$ denotes the standard normal cumulative distribution function. The variables of the model will be further discussed in Section 3.

## 2.2 Plain vanilla option pricing framework

The implied default probabilities from the plain vanilla type option contract, or the classical Merton model, Merton (1973), are estimated to assess whether the implied default probabilities from the barrier framework are more realistic. Implied default probability from the plain vanilla option pricing formula, or $PD_{PV}$ are defined as

$$PD_{PV} = \Phi\left(\frac{\ln\frac{S_0}{K} + (r - \sigma^2/2)T}{\sigma\sqrt{T}}\right) \tag{3}$$

The derivation of the formula is included e.g. in Poulsen (2006). Note that $PD_{PV}$ will be always lower or equal to $PD_B$, which is evident from equations (1) and (3).

## 2.3 Model specification

In order to estimate the implied default probabilities defined in equations (1) and (3), the remaining unknown input parameters need to be specified. It is namely the market value of assets $S_0$ and asset volatility $\sigma$.

By applying Ito's lemma on equity dynamics and comparing it with assets dynamics, we puzzle out the link between the asset volatility and equity process. The following equation demonstrates the equity dynamics representation using the Ito's lemma.

$$dE_t = \left(\frac{\partial E_t}{\partial t} + \frac{\partial E_t}{\partial S_t} r_t S_t + \frac{1}{2}\frac{\partial^2 E_t}{\partial S_t^2}\sigma^2 S_t^2\right) dt + \frac{\partial E_t}{\partial S_t}\sigma S_t dW_t \tag{4}$$

Asset dynamics are defined as follows.

$$dS_t = r_t S_t dt + \sigma S_t dW_t \tag{5}$$

Equations (4) and (5) can be simplified to receive the following relation.

$$\sigma_E E_t = \frac{\partial E_t}{\partial S_t} \sigma S_t \tag{6}$$

It holds that

$$\frac{\partial E_t}{\partial S_t} = \phi(d_1), d_1 = \Phi \left( \frac{\ln \frac{S_t}{K} + (r_t + \sigma^2/2)T}{\sigma \sqrt{T}} \right) \tag{7}$$

which is the formula for option delta.

However, there are still two unknown variables in equation (7). Herewith comes the famous Merton's conclusion that *"value of equity is equal to value of an European call option on a non-dividend paying stock where firm value corresponds to a stock price and K corresponds to the exercise price"*, Merton (1974).

$$E_t = S_t \Phi(d_1) - K e^{-r(T-t)} \Phi(d_2), d_2 = d_1 - \sigma \sqrt{T - t}. \tag{8}$$

Based on equation (7) and (8), the asset volatility and market value of assets is numerically solved for each company-year observation.

# 3 Data and empirical results

## 3.1 Data

The analysis is conducted on European most liquid companies in period from March 2005 to October 2010. Only the most liquid companies that appeared in the *iTraxx Europe* index (Serie 3 to Serie 13) are considered within this study. *iTraxx Europe* is credit default swap (CDS) index composed of the 125 most liquid CDS referencing European investment grade companies. *iTraxx Europe* companies are chosen for the purpose of this study since the additional risk premia are assumed to be lower for these investment grade and the most liquid companies. The implied risk-neutral probabilities are later confronted with the real-world observed default rates. In case of the most liquid and investment-grade companies, the risk-neutral probabilities are assumed to be comparable to the real-world default probabilities since with high liquidity and relatively secure markets, the investors are risk-neutral and do not require additional risk premia. This is why only the most liquid companies are analyzed on this paper since otherwise the risk-neutral option pricing framework could not be confronted with the real-world observed default rates.

A total of 708 company-years is analyzed within this study. A full list of companies is included in the Appendix. For each company, the balance sheets for years 2003 until 2010 are retrieved from DataStream. The one year implied default probabilities are recalculated on annual basis. Yield on 10 years German government bonds issued by the German Debt Agency is used as a risk free rate. German government has the highest credit rating and is commonly used as an alternative for a riskless asset in the European area. 10 years German governments bonds are chosen since they are commonly assumed to have relatively higher liquidity compared to other maturities.[2] Equity volatility is calculated on a full set of stock prices available by April 2011. Daily closing prices are obtained from DataStream Thomson Reuters. The annual standard deviation of continuously compounded return is used as equity volatility, $\sigma_E$. Asset volatility and market value of assets are estimated based on the procedure explained in Section 2.3.

Table 1 depicts the summary of the main statistics for the input variables. Average, median, standard deviation, maximum and minimum is presented for the 708 company-years observations. The risk-free interest rate ranges from 2.75% to 4.22% in years 2005-2010. In case of the interest rate, the statistics are based on six annual observations. The annual risk-free rate observations are calculated as average of monthly observations in given years. The implied values of asset volatility reach reasonable levels, which can be found in other studies, e.g. Brockman & Turtle (2003). The complete list of input variables is available upon request.

Table 1: Input variables, descriptive statistics

| in % | Leverage ratio | Asset volatility | Risk-free rate | Equity volatility |
|---|---|---|---|---|
| Avg | 29.17 | 25.27 | 3.55 | 34.94 |
| Median | 27.26 | 23.33 | 3.56 | 32.85 |
| StDev | 13.98 | 11.55 | 0.54 | 13.03 |
| Max | 79.56 | 133.82 | 4.22 | 164.72 |
| Min | 0.00 | 5.88 | 2.74 | 15.12 |

*Source:* Compustat, DataStream Thomson Reuters, ECB (2014).

[2] The analysis is conducted also on 5 years German government bonds used as a risk free and the same conclusions are received.

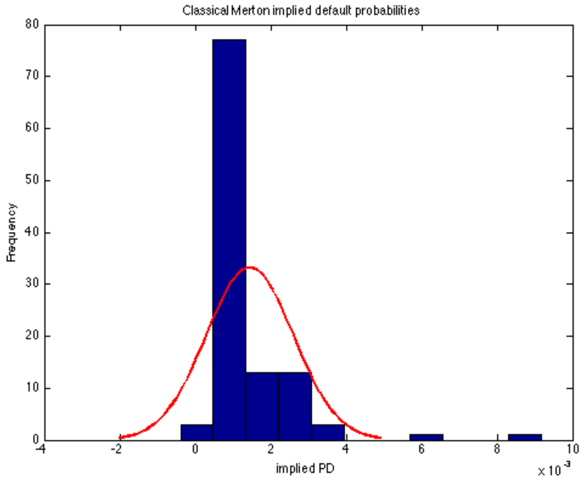


Figure 1: Classical Merton implied default probabilities

## 3.2 Empirical results

Descriptive statistics for the plain vanilla put option implied default probabilities ($PD_{PV}$) and the barrier down-and-in put option default probabilities ($PD_B$) estimated based on equations (1) and (3) are presented in Table 2.[3] The average value of the implied PDs may seem to be rather low. It is caused by the fact that only the investment grade and most liquid companies are analyzed within this study.

Table 2: Empirical results

| | Classical Merton PDs | Barrier Merton PDs |
|---|---:|---:|
| Avg | 0.00358% | 0.01908% |
| Median | 0.00002% | 0.00008% |
| StDev | 1.57E-04 | 8.84E-04 |
| Max | 0.14% | 0.81% |
| Min | 4.06E-24 | 5.00E-24 |
| Count | 708 | 708 |

*Source:* Author's estimations.

[3]The results are winsorized at 95th percentile.

ISBN 978-80-87927-05-2, IISES

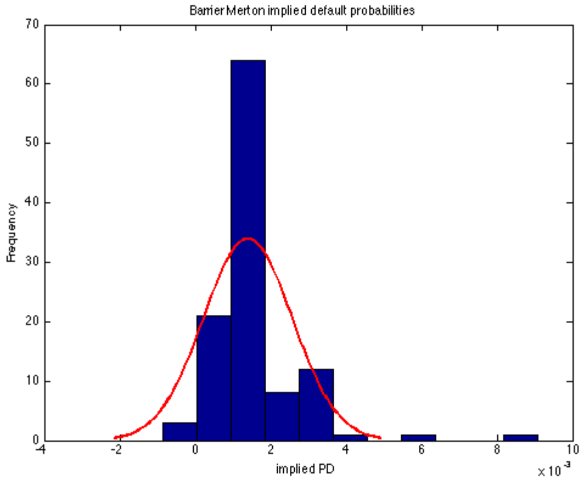


Figure 2: Barrier Merton implied default probabilities

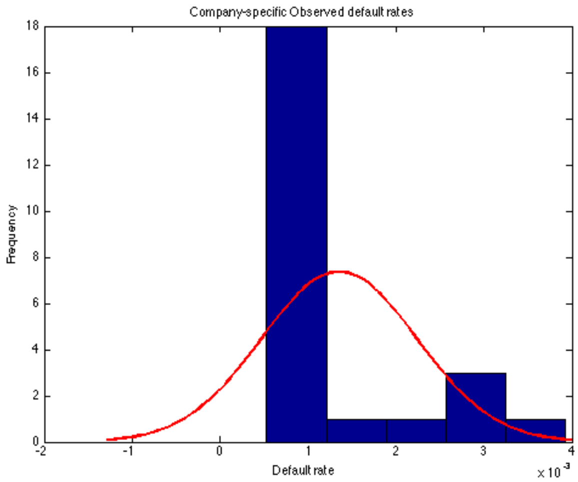


Figure 3: Company specific observed default rates

The histograms in Table 1 and Table 2 give us a first impression on how realistic the estimated PDs are. Plain vanilla Merton implied PDs are clustered around zero are generally very low. PDs implied from the Barrier Merton model are concentrated at higher values and are on average higher than the plain vanilla Merton model, which is obvious from equations (1) and (3). Nevertheless, it is not possible to determine which set of implied PDs is more realistic based on sole discussion over the results. The results are therefore confronted with the observed default rates. The accuracy of the two models is compared based on the two-sided Diebold-Mariano test and the values of the selected loss functions.

### 3.3 Model accuracy

Implied default probabilities $PD_{PV}$ and $PD_B$ are confronted with the observed default rates from Table 3. A company-year specific observed default rate is calculated based on each company's available S&P rating history. A company-year observation is taken into account only if a company has had a credit rating assigned by S&P at each day within the year. If the rating is withdrawn or does not exist yet, the observation is discarded. If a company has several different credit ratings within a year, the company-year specific observed default rate is calculated as a weighted average of observed default rates for the particular credit ratings that appeared on company's rating history within the year, where the weight is number of days a company had held the credit rating within the year. The values of the implied PDs for each company-year observation as well as the average values are available upon request.

The observed default rates presented in Table 3 are point-in-time (PiT). Nevertheless, the credit ratings are assumed or at least intended to be rather through-the-cycle (TTC). The implied default rates based on the option pricing framework are not strictly PiT or TTC since some of the input variables (leverage ratio, equity volatility) are rather TTC and other (risk-free interest rate) is PiT.

The implied default probabilities, $PD_{PV}$ and $PD_B$, in years 2005 to 2011 will be averaged for each individual company across years in order to assure that the results are TTC. Moreover, the company-specific observed default rates would be averaged across years 2005 to 2011, which will allow us to compare the PDs and default rates, both in TTC measure.

For each company $i$ from the analyzed data set:

$$PD_{PV_i}^{avg} = \frac{1}{T}\sum_{t=1}^{T} PD_{PV_i}^{t} \tag{9}$$

$$PD_{B_i}^{avg} = \frac{1}{T}\sum_{t=1}^{T} PD_{B_i}^{t}. \tag{10}$$

First of all, various loss functions for the two sets of implied PDs are calculated. It is namely the Mean Absolute Error (MAE), Mean Squared Error (MSE) and Root Mean Squared Deviation (RMSD). All the loss functions indicate that $PD_B$ are closer to the observed default rates than $PD_{PV}$, see Table 4.

Table 3: Observed default rates (%), S&P rating

| in % | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| AAA | 0 | 0 | 0 | 0 | 0 | 0 |
| AA+ | 0 | 0 | 0 | 0 | 0 | 0 |
| AA | 0 | 0 | 0 | 0.44 | 0 | 0 |
| AA- | 0 | 0 | 0 | 0.4 | 0 | 0 |
| A+ | 0 | 0 | 0 | 0.31 | 0.29 | 0 |
| A | 0 | 0 | 0 | 0.21 | 0.39 | 0 |
| A- | 0 | 0 | 0 | 0.58 | 0 | 0 |
| BBB+ | 0 | 0 | 0 | 0.19 | 0.4 | 0 |
| BBB | 0.17 | 0 | 0 | 0.59 | 0.19 | 0 |
| BBB- | 0 | 0 | 0 | 0.72 | 1.1 | 0 |
| BB+ | 0.37 | 0.37 | 0 | 1.18 | 0 | 0.8 |
| BB | 0 | 0 | 0.31 | 0.65 | 1.04 | 0.36 |
| BB- | 0.25 | 0.49 | 0.23 | 0.65 | 0.93 | 0.53 |
| B+ | 0.78 | 0.55 | 0.19 | 3.04 | 5.63 | 0 |
| B | 2.63 | 0.8 | 0 | 3.39 | 10.23 | 0.69 |
| B- | 2.98 | 1.57 | 0.9 | 7.56 | 17.63 | 2.07 |
| CCC/C | 9.02 | 12.38 | 14.95 | 26 | 48.68 | 22.07 |

*Source:* S&P (2013).

Table 4: Loss functions

| Loss function | Merton PDs | Barrier PDs New | % Difference |
|---|---|---|---|
| MAE | 1.63E-01 | 1.59E-01 | -2.201% |
| MSE | 3.82E-04 | 3.71E-04 | -2.854% |
| RMSD | 1.82E-03 | 1.80E-03 | -1.437% |

*Source:* Author's calculations.

Diebold-Mariano (DM) statistic is used to test whether $PD_B$ are significantly more accurate than $PD_{PV}$. The null hypothesis of the test statistics is that the two models have the same accuracy. We use the two-sided DM test in order to determine which model is significantly more accurate.

$$\varepsilon_{1i} = DR_i - PD_{PV_i}^{avg} \tag{11}$$

$$\varepsilon_{2i} = DR_i - PD_{B_i}^{avg} \tag{12}$$

The loss function used in the DM test is defined as follows.

$$d_i = |\varepsilon_{1i}| - |\varepsilon_{2i}| \tag{13}$$

The value of the DM test statistics is given by

$$S = \frac{\overline{d}}{\left(\widehat{avar}(\overline{d}))\right)^{1/2}} = \frac{\overline{d}}{\left(\widehat{LRV}_{\overline{d}}/T)\right)^{1/2}} \tag{14}$$

where

$$\overline{d} = \frac{1}{N}\sum_{i=1}^{N} d_i, \tag{15}$$

$$LRV_{\overline{d}} = cov\left(d_i, d_{i-j}\right). \tag{16}$$

Diebold & Mariano (2002) demonstrate that under the null hypothesis, $S \sim N(0,1)$. The null hypothesis of equal predictive accuracy at the 5% level is therefore rejected if

$$|S| > 1.96 \tag{17}$$

Moreover, if $S > 1.96$ we may conclude that the barrier option pricing framework is more accurate in predicting the default probabilities than the plain vanilla option pricing framework. The value of the DM statistic is presented in Table 5.

Table 5: Diebold-Mariano test statistic

| | |
|---|---|
| DM Statistic | 3.5718 |

*Source:* Author's calculations.

The value of the test statistic is 3.57, which implies that the barrier option pricing framework is more realistic in predicting default than the plain vanilla option pricing framework.

# 4 Conclusion

The main objective of this paper is to empirically verify the hypothesis that the barrier option pricing framework is more suitable to derive the implied default probabilities of corporate entities on companies listed on European stock markets. In reality, a company can default at any point in time if the value of its assets drops below a certain level. According to the Bankruptcy Code adopted by the EU in 2002, the debtor becomes insolvent if he cannot meet his financial obligations. The default barrier is therefore equal to the level of long-term debt for companies analyzed in this study. In general, the barrier level can be set below or above debt level and can be estimated from market information, Brockman & Turtle (2003).

If we consider the original version of the structural credit risk model, Merton (1973), which is based on the plain vanilla option pricing formula, the default event can be triggered only at maturity, which is rather an unrealistic assumption. The hypothesis that the barrier version of Merton model is more realistic is empirically tested on European most liquid companies. The implied default probabilities from the two models are confronted with the company-specific observed default rates given the S&P credit ratings history. This paper does not only prove that the barrier is significant in estimating default probabilities, but it also quantifies tha value added of the inlcusion of barrier into the model. The implied default probabilities based on the barrier option pricing theory generate a lower value of loss functions (by 1 to 3%) and provide a significantly better fit to observed default rates than the probabilities implied from the plain vanilla framework. The option pricing framework defined in this study does not take into account the dividend payout. The further step in the direction of this research would be to take into account another possible extension of the option pricing framework in order to incorporate the dividend payments in the asset pricing formula based on Hillegeist, Keating, Cram, & Lundstedt (2004). The model shall be adjusted to reflect the stream of dividends paid by a firm and accrued to equity holders.

# Bibliography


ANDERSON, R. & S. SUNDARESAN (2000): "A comparative study of structural models of corporate bond yields: An exploratory investigation." *Journal of Banking & Finance* **24(1)**: pp. 255–269.

ANDERSON, R. W. & S. SUNDARESAN (1996): "Design and valuation of debt contracts." *Review of financial studies* **9(1)**: pp. 37–68.

BLACK, F. & M. SCHOLES (1973): "The pricing of options and corporate liabilities." *The journal of political economy* pp. 637–654.

BRENNAN, M. J. & E. S. SCHWARTZ (1978): "Corporate income taxes, valuation, and the problem of optimal capital structure." *Journal of Business* **51(1)**: p. 103.

BRIYS, E. & F. DE VARENNE (1997): "Valuing risky fixed rate debt: An extension." *Journal of Financial and Quantitative Analysis* **32(02)**: pp. 239–248.

BROCKMAN, P. & H. J. TURTLE (2003): "A barrier option framework for corporate security valuation." *Journal of Financial Economics* **67(3)**: pp. 511–529.

DIEBOLD, F. X. & R. S. MARIANO (2002): "Comparing predictive accuracy." *Journal of Business & economic statistics* **20(1)**.

ECB (2014): "Germany, long-term interest rate, 10 years maturity." *ECB Statistical Data Warehouse* .

ERICSSON, J. & J. RENEBY (1998): "A framework for valuing corporate securities." *Applied Mathematical Finance* **5(3-4)**: pp. 143–163.

HILLEGEIST, S. A., E. K. KEATING, D. P. CRAM, & K. G. LUNDSTEDT (2004): "Assessing the probability of bankruptcy." *Review of Accounting Studies* **9(1)**: pp. 5–34.

Leland, H. E. (1994): "Corporate debt value, bond covenants, and optimal capital structure." *The journal of finance* **49(4)**: pp. 1213–1252.

Leland, H. E. & K. B. Toft (1996): "Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads." *The Journal of Finance* **51(3)**: pp. 987–1019.

Merton, R. C. (1973): "Theory of rational option pricing." *Bell Journal of Economics* **4(1)**: pp. 141–183.

Merton, R. C. (1974): "On the pricing of corporate debt: The risk structure of interest rates*." *The Journal of Finance* **29(2)**: pp. 449–470.

Poulsen, R. (2006): "Barrier options and their static hedges: simple derivations and extensions." *Quantitative Finance* **6(4)**: pp. 327–335.

S&P (2013): "Default, transition, and recovery: 2012 annual global corporate default study and rating transitions." Report.

Wong, H. Y. & T. W. Choi (2009): "Estimating default barriers from market information." *Quantitative Finance* **9(2)**: pp. 187–196.

# Appendix

## List of companies

AB Electrolux
AB Volvo
ABN Amro
ACCOR
Adecco
Aegon N.V.
AKZO Nobel
Allianz
ALSTOM
Aviva plc
ArcelorMittal
AXA
Barclays Bk plc
BASF AG
BASF SE
Bayer AG
Bca Monte dei Paschi
Bco SANTANDER SA
BNP Paribas
BOUYGUES
BP P.L.C.
Brit Telecom PLC
Carrefour
Casino Guichard Perrachon
Centrica plc
Cie Fin Michelin
Clariant AG
Commerzbank AG
Compass Gp PLC
Continental AG
Credit Agricole SA
Daimler AG **
DANONE
Deutsche Bk AG
Deutsche Lufthansa AG
Deutsche Post AG
Deutsche Telekom AG
Diageo PLC
EADS N V
Edison S p A
EDP Energias de Portugal SA
Electricite de France
EnBW Energie AG
Endesa S A
ENEL S p A
EXPERIAN Fin PLC
Finmeccanica S p A
Fortum Oyj
GAZ DE FRANCE
GKN Hldgs plc
Hellenic Telecom Org SA
Henkel AG & Co KGaA
Holcim Ltd
HSBC Bk Plc
Iberdrola S A
Imperial Tobacco Gp PLC
Intesa Sanpaolo SpA
ITV Plc
J Sainsbury PLC
Kingfisher PLC
Koninklijke Ahold N V
Koninklijke DSM NV
Koninklijke KPN N V
Koninklijke Philips Electrs N V
L AIR LIQUIDE
Lafarge
Lanxess
Linde AG
LVHM
Marks & Spencer p l c
METRO AG
Natl Grid Plc
Nestle S A
Next plc
Nokia Oyj
Pearson plc
Peugeot SA
Publicis Groupe SA
Renault
REPSOL YPF SA
Rentokil Initial Plc
Rolls Royce plc
RWE AG
SABMiller PLC
Siemens AG
Societe Generale
SODEXO
Solvay SA
Std Chartered Bk
Stmicroelectronics N V
Stora Enso CORP
Suedzucker AG
Svenska Cellulosa AB SCA
Swedish Match AB
Tate & Lyle PLC
TDC A/S
Technip
Telecom Italia SpA
Telefonica S A
Telekom Austria AG
Telenor ASA
TeliaSonera AB
Tesco PLC
ThyssenKrupp AG
TNT N.V.
Total SA
UBS AG
UniCredit SpA
Unilever N V
UPM Kymmene CORP
Utd BUSINESS MEDIA PLC
Veolia Environnement
Vinci
Vivendi
Vodafone Gp PLC
Wolters Kluwer N V
WPP 2005 Ltd
Xstrata Plc