

University of St. Gallen (HSG) Graduate School of Business, Economics, Law and Social Sciences



**MASTER'S THESIS**

**A Valuation Framework for Pricing Hybrid Bonds**

*submitted to*

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## 1 Introduction

Hybrid capital financing is known since 1988, when the Basel Committee on banking supervision published the first Basel Capital Accord (Basel I), including an agreement to apply common minimum capital standards. Initially issued by financial institutions in order to meet the minimum capital requirements, hybrid capital financing started to gain popularity among non-financial issuers, when the rating agencies in 2005 first granted equity credit to tax deductible trust preferred securities. In recent years, hybrid bonds have become an established asset class among institutional investors. Hybrid bonds combine features of both debt and equity by offering the advantage of being tax-deductible (debt-like cost of capital) while containing equity-like features owing to which credit rating agencies assign partial equity credit.

### 1.1 Idea and Contribution

At present, there exists no closed-form valuation framework for pricing hybrid bonds. Although during the accelerated hybrid issuance activity between 2005 and 2007 various models for pricing hybrid bonds were tested, none has ever managed to become industry standard, not least because of the complexity and uncertainty involved in determining the fair value of hybrid bonds. The main objective of this thesis is the replication and practical implementation (Excel VBA based)<sup>1</sup> of an integrated valuation framework for pricing hybrid bonds, first introduced and applied by JPMorgan in a 2005 published investment research paper. The framework is based on a valuation methodology known as “rock-bottom spread approach”, which only draws on credit fundamentals data, such as default and recovery rates, the future discounted cash flows of the security (credit returns), and the risk tolerance of the investor. The replicated and extended valuation framework should finally be able to objectively quantify credit fundamentals data and translate these input parameters into a fair value price and thus allow for a transparent assessment of various current corporate hybrid bonds (i.e. non-financial issues). Although fundamentally possible, an in-depth analysis of financial hybrids would go beyond the scope of this thesis, especially with regard to the implications of Basel III. Under the proposed bank capital reform, certain financial hybrid capital instruments considered to be inadequately loss-absorbing will be eliminated from the capital base. Therefore, the main focus will be laid on the analysis of corporate hybrid bonds.

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<sup>1</sup> A significant part of the work was devoted to the development of a comprehensive valuation framework for pricing hybrid bonds. All presented results can be reproduced (see enclosed CD). Instructions for applying the model are to be found in the appendix.

## 1.2 Outline

Hybrid bonds have not yet found attention in academic literature. Thus, the theoretical part of this thesis will mainly rely on investment research papers and rating agency reports. After elaborating a conclusive definition of hybrid bonds, the first chapter provides a detailed introduction to the key structural features and characteristics. Afterwards, the rationale for issuance from an issuer's as well as from an investor's perspective will be discussed. A special focus will be laid on the rating agencies' perspective.<sup>2</sup>

The second part of the work consists of the replication, implementation and extension of the rock-bottom spread valuation framework. Prerequisite for the calculation of rock-bottom spreads is a quantitative description of the underlying credit fundamentals, credit returns and the risk tolerance of the investor. A basic modeling framework will be built and consequently extended in order to account for the key structural features of hybrid bonds. The last chapter analyzes the results from the valuation framework.

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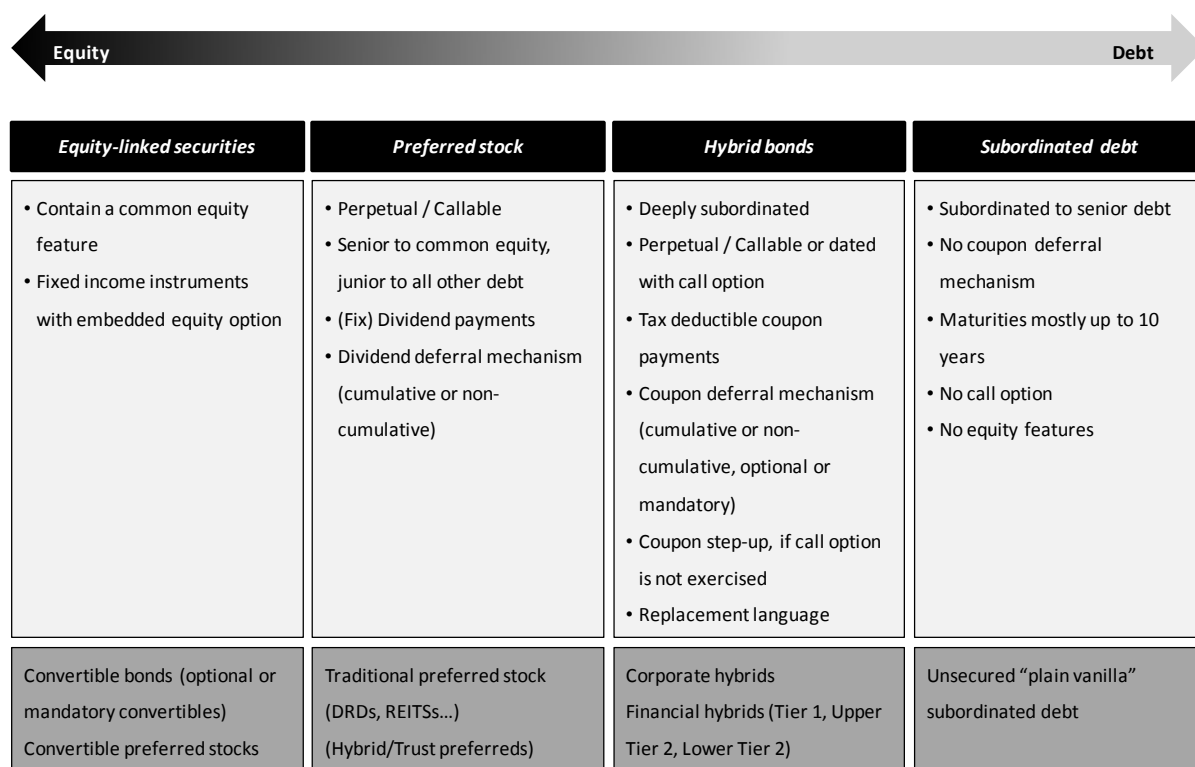
<sup>2</sup> The outlined structure of this thesis partly follows von Allmen (2007).

## 2 Overview

The following chapter is aimed at framing a conclusive definition of corporate and financial hybrid bonds and delimiting them from other hybrid securities, followed by a brief historical review intended to provide basic knowledge required for the understanding of recent market development.

### 2.1 Definition

The term hybrid capital is more a label rather than an asset class with stringent characteristics, combining features of both debt and equity.<sup>3</sup> It covers a broad range of different financial instruments which have in common that their characteristics place them, from a legal or financial perspective, somewhere between senior unsecured debt and equity in the capital structure.<sup>4</sup> In general, hybrid capital is structured so that it is junior to senior unsecured debt, but senior to common equity.



**Figure 1: Debt-equity continuum<sup>5</sup>**

**Equity-linked securities:** Convertible bonds are equity-linked instruments (entitled to receive coupons and principal payments) with an embedded stock option, which gives the holder the right to convert the bond into common equity at a predetermined ratio. This conversion ratio implies an implicit exercise price on the stock option.<sup>6</sup> A convertible bond can thus be decomposed into a straight

<sup>3</sup> Kreitmair/Kleindienst (2010), p. 14.

<sup>4</sup> Larsen/Magnussen (2010), p. 1.

<sup>5</sup> Von Allmen (2007), p. 7.

<sup>6</sup> Arak/Martin (2005), p. 44.

bond and a stock option. If the conversion is required, that is the holder must convert the bond into the underlying common stock on a pre-specified date, the instrument is called mandatory convertible. In the debt-equity continuum, mandatory convertibles are the most equity-like. Another equity-linked security is the convertible preferred stock which allows the holder to convert preferred stock into the underlying common stock.

**Preferred stock:** Preferred stocks are equity securities issued with a fixed par value and fixed dividend payments. They are perpetual instruments with no stated maturity and mostly callable five or ten years after issuance. Traditional preferreds pay dividends, usually quarterly, out of earnings and rank only above common equity.<sup>7</sup> Dividends on traditional preferreds can be deferred without invoking default (either cumulative or non-cumulative). DRDs (Dividends Received Deduction) are the most common form of traditional preferreds. They are eligible for U.S. tax-advantage and corporations can deduct part of the income received on DRD preferreds from federal taxable income.<sup>8</sup> DRD preferreds appear on the issuer's balance sheet as preferred stock. Real Estate Investment Trust (REIT) preferred securities are issued by financial institutions. A REIT is corporation or trust specializing on income-generating commercial real estate and is therefore eligible to avoid corporate income taxes.<sup>9</sup> Newer hybrid preferreds, first introduced in 2005, differ from traditional preferreds mainly in terms of maturity, seniority and nature of payment. While traditional preferreds pay fixed dividends (equity-like), hybrid preferreds and trust preferreds pay interest (debt-like). Hybrid preferreds have long-term maturities (usually 60 years or longer) and are senior to preferred and common equity and junior to all other debt. Provided that certain conditions are met, the issuer is entitled to defer the coupon payments for up to 10 years. Hybrid preferreds appear as liability on the issuer's balance sheet. Trust preferred securities (usually with maturities of 30 years) are issued by a trust or partnership (established by a parent company), which invests in parent debenture and passes on interest payments to the investor.<sup>10</sup> The issuer of trust preferreds can defer or skip payments up to five years. The parent company's payments are tax deductible to the issuer. Like hybrid preferreds, trust preferreds are accounted for as liability on the issuer's balance sheet.

**Hybrid bonds:** Looking at the current outstanding issues it can be noticed that at present no single conclusive definition of hybrid bonds exists. The hybrid bond market is no asset class with homogeneous bond structures and each new issue adds to the already rich diversity of existing structures. Corporate and financial hybrids are bonds issued by non-financial corporations or banks (and insurance companies), which have features of both debt and equity capital.<sup>11</sup> Most hybrid bonds share in com-

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<sup>7</sup> Von Allmen (2007), p. 11ff.

<sup>8</sup> Mauro (2010), p. 14.

<sup>9</sup> Mauro (2010), p. 26.

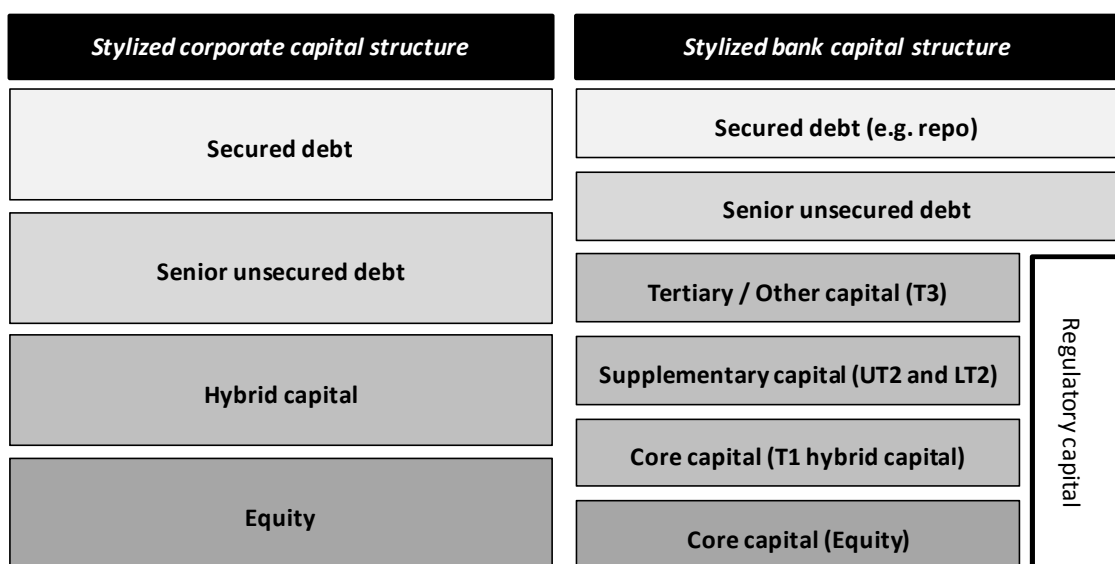
<sup>10</sup> Mauro (2010), p. 44.

<sup>11</sup> Keenan/Goulden (2006), p. 4; Ryll (2010), p. 3.



mon that their coupon payments are tax-deductible (debt-like) and from a balance sheet point of view, they are – at least to some extent – treated as equity capital (equity-like). There exist mainly three key structural features that drive the level of debt or equity designation:

- Subordination:** Hybrid bonds are subordinated to senior debt and they usually rank senior only to common shares. This feature clearly distinguishes corporate and financial hybrids from regular senior debt. In the case of default, the recovery rate of subordinated debt will be significantly lower than that of senior debt because senior debt is serviced first in the event of issuer insolvency.<sup>12</sup> Until the claims of higher-ranking creditors have been satisfied, no payments will be made to the subordinated bondholder. Bank capital is further tiered into Tier 1, Tier 2 and Tier 3 capital. Although both LT2 and UT2 bonds rank after senior debt, they are – in case of insolvency – serviced ahead of T1 capital.<sup>13</sup>



**Figure 2: Stylized capital structure**<sup>14</sup>

- Deferral:** A further equity-like structural element of hybrids bonds is the right of the issuer to defer coupon payments under certain circumstances. Two different variations of the right to coupon deferral can be distinguished: optional and mandatory deferral. If an issuer opts for optional deferral he can, under certain circumstances, typically in the case where no equity dividends have been paid, decide to suspend regular coupon payments without triggering a default. The equity-like characteristic of interest deferral can be enhanced by linking deferral to mandatory triggers, e.g. the breach of certain financial covenants, which leads to an automatic suspension of coupon payments. Another important distinction is whether deferral

<sup>12</sup> Ryll (2010), p. 5.

<sup>13</sup> Regulatory and rating agency requirements with regard to hybrid capital for financial institutions and corporates will be discussed in chapters 3.2 and 3.3.

<sup>14</sup> Larsen/Magnussen (2010), p. 1; Arnt/Hovard (2010), p. 1; Schäffer (2007), p. 1.

of interest is cumulative (i.e. accrues) or non-cumulative and therefore lost. Cumulative deferral accrues and all accrued interest is paid up if payments on equity or other subordinated capital are resumed (optional coupon deferral) or the issuer reaches certain relevant financial ratios again (mandatory coupon deferral). If the interest rate deferral is non-cumulative, the issuer has no obligation to compensate deferred coupon payments at a later date.<sup>15</sup>

- **Extension:** Most hybrid bonds are perpetuals, or in certain cases have very long dated maturities, and can usually be called 5 to 10 years after issuance by the issuer.<sup>16</sup> Because the equity-like characteristic of hybrid bonds is intended to be retained, the investor has no such termination right. Like straight bonds, hybrid bonds initially pay a fixed annual coupon until the first call date. If the issuer does not exercise the call option at the end of the fixed income phase, the coupon changes from fix to floating (usually 3-month Euribor + original credit spread at issuance + step-up of 100 bps to 250 bps) due to a step-up clause.<sup>17</sup> The coupon step-up clause is designed to incentivize the issuer to redeem the hybrid bond on the first call date. Calling the bond commits the issuer to replace the hybrid capital with pari passu or subordinate securities. The replacement language usually contains an intent-based or legally binding declaration by the issuer to refinance the hybrid bond when it is called.<sup>18</sup> Tight replacement clauses (mostly required by the rating agencies) are intended to retain the equity-like character of the hybrid bond. Some hybrid bonds also contain protective change-of-control (CoC) clauses, which in the event of an acquisition provide for a coupon step-up if the ownership changes. Change-of-control clauses are designed to provide investor protection in the event of a leveraged buyout.

**Subordinated debt:** Subordinated or “plain vanilla” subordinated debt shows no structural equity-like features. It has no coupon deferral mechanism and is ranked junior only to senior secured and unsecured debt. Subordinated debt therefore generally only absorbs losses in the case of liquidation.<sup>19</sup> At default, subordinated debt like hybrid bonds has lower recovery rates than senior bonds.

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<sup>15</sup> Kreitmair/Kleindienst (2010), p. 15.

<sup>16</sup> Sparrow et al. (2007), p. 30.

<sup>17</sup> Ryll (2010), p. 4.

<sup>18</sup> Kreitmair/Kleindienst (2010), p. 17.

<sup>19</sup> Havlicek/Ogg (2009), p. 5.

## 2.2 History and Market Development

In 1988, the Basel Committee on banking supervision published the first Basel Capital Accord (Basel I), which set the course for identical rules of competition for banks, including an agreement to apply common minimum capital standards. The terms Tier 1 core capital and Tier 2 supplementary capital were introduced. Since Basel I only accounted equity capital and disclosed reserves as core capital (Tier 1), all other sources of capital, especially hybrid debt capital instruments and subordinated debt, had to be included in supplementary (Tier 2) capital.<sup>20</sup> Hybrid capital achieved its breakthrough in the U.S., when the Federal Reserve in 1996 approved the inclusion of certain cumulative preferred stock instruments (subject to a 25% limit) in Tier 1 capital. In order to be eligible as Tier 1, the Federal Reserve required these instruments to provide for a minimum five year consecutive dividend deferral period and to be subordinated to all other subordinated debt.<sup>21</sup> Consequently, a number of large banking holding companies started issuing trust preferred securities to satisfy Tier 1 capital requirements. In 1998, the definition of Tier 1 capital was amended by the Basel Committee. The Committee decided the inclusion of a range of innovative capital instruments (characterized mainly by step-ups and call options) in Tier 1 capital, subject to certain conditions and limited to a maximum of 15% of Tier 1 capital.<sup>22</sup> The rating agencies for many years qualified trust preferreds as an expensive form of debt and therefore corporate issuers did not make use of hybrid capital, since non-financial corporations – other than banks – are not subject to regulatory capitalization requirements. In 2005, when Moody's followed S&P in granting equity credit to tax deductible trust preferreds, for the first time transparent criteria for the treatment of hybrid capital were at hand. It was now possible to construct a tax-deductible hybrid security that gained equity credit from the rating agencies. Moody's new methodology increased the maximum equity credit assigned to hybrid instruments to 75% and opened the way for a significant number of non-financial institutions to tap the hybrid market for the first time. Soon after, other agencies followed with revised methodologies.

**Hybrid market:** Although hybrid issuance by financial institutions (i.e. banks and insurance companies) is common, corporate hybrid bonds are still rare by comparison. The outstanding corporate hybrid volume amounted only to about half of the outstanding volume of Tier 1 bank capital in the eurozone in 2010.<sup>23</sup> After the introduction of Moody's new rating methodology in 2005, issue activity peaked and then stayed relatively high until 2007. At the outbreak of the financial crisis, new issue

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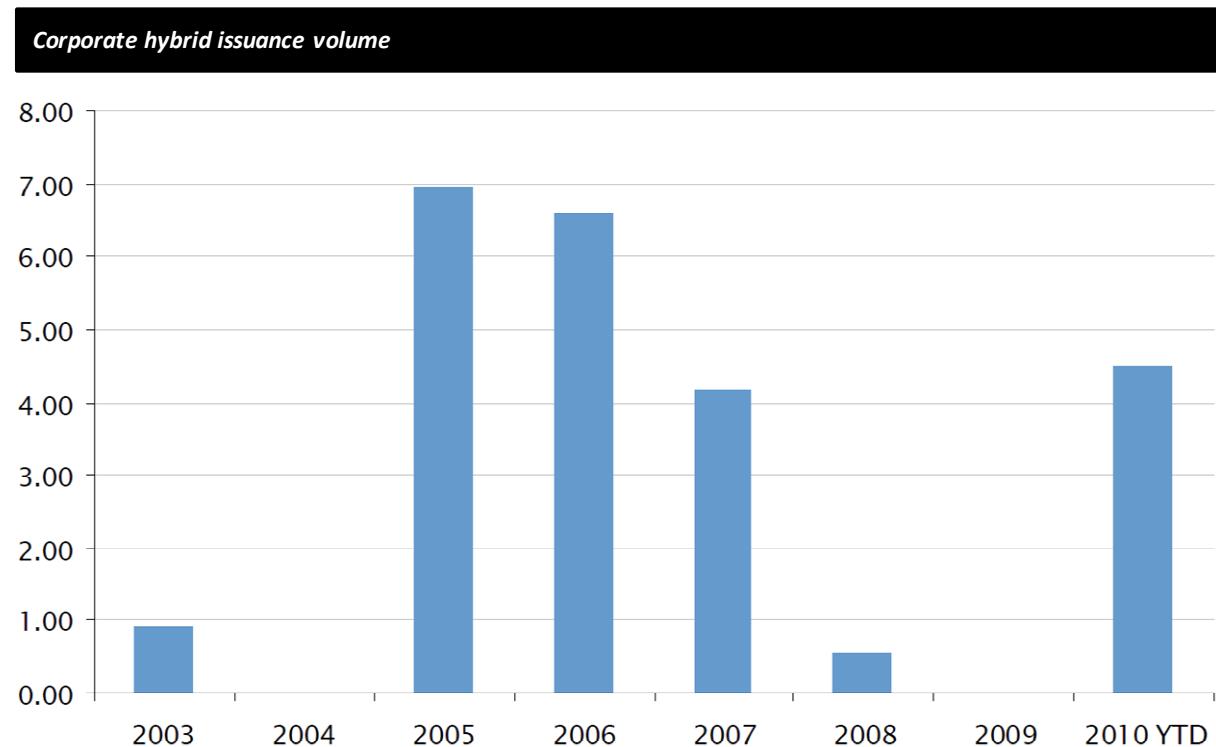
<sup>20</sup> Basel Committee on Banking Supervision (1988).

<sup>21</sup> Federal Reserve Release (1996).

<sup>22</sup> Basel Committee on Banking Supervision (1998).

<sup>23</sup> Ryll (2010b), p. 3ff.

activity halted after the last issue of Deutsche Boerse and a small Austrian industrial company in June 2008.<sup>24</sup>



**Figure 3:** Corporate hybrid issuance volume in the eurozone as of October 2010 (€ bn)<sup>25</sup>

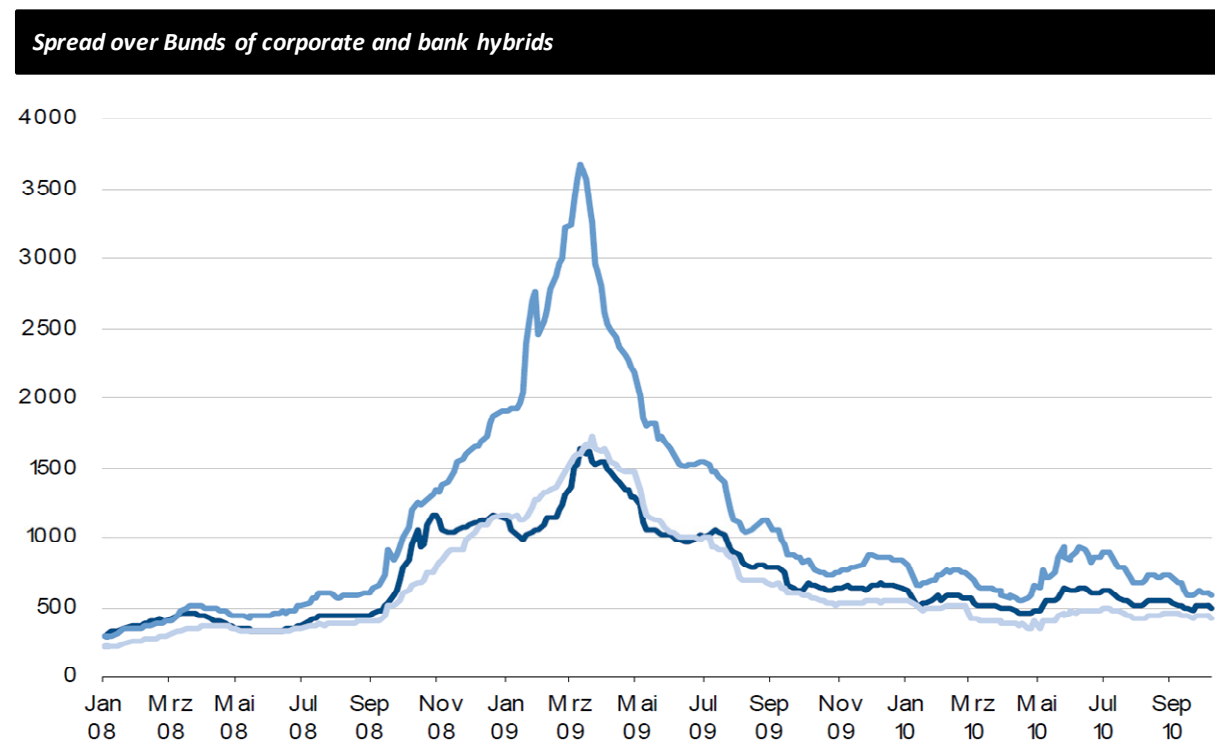
As illustrated in Figure 3, the primary market for corporate hybrid bonds was shut throughout the year 2009 until Dutch utility Tennet used the positive momentum in February 2010 to issue a € 500mln investment grade rated hybrid bond, followed by the utilities Scottish & Southern Energy, Suez Environment, Santos (oil and gas) and RWE in September 2010 (total issuance in September only: € 4bn). The market reopening was mainly triggered by Moody's final publication of its revised rating methodology in July 2010 (see chapter 3.3 *Rating Agencies' Perspective*), supported by the current low-rate yield and a normalized credit spread<sup>26</sup> environment. Owing to the downward shift of the yield curve, companies are able to get long-term financing at very attractive levels in absolute terms. From an investor's perspective, hybrid securities (especially in the current low-rate yield environment) at a first view offer an attractive compensation in relation to the incurred underlying credit risk. This holds true in particular for the recently issued utilities, which operate in a very stable and non-cyclical industry. Compared to the height of the crisis in March 2009, the spread over Bunds of

<sup>24</sup> Ryll (2010), p. 2ff.

<sup>25</sup> Ryll (2010b), p. 2.

<sup>26</sup> The credit spread measures the investor's compensation for bearing the credit risk associated with holding risky securities (like bonds or loans) compared to some risk free investment, e.g. a respective government bond. See Felsenheimer et al. (2006), p. 171ff.

corporate and financial hybrids has tightened significantly, reflecting the overall healthier state of credit markets (see Figure 4).



**Figure 4:** Comparison of spread (bps) over Bunds of corporate and bank hybrids<sup>27</sup>

During the crisis, corporate and financial hybrids were not only under pressure because of the general deterioration in economic conditions and the difficult capital market situation, but also because of a paradigm shift in relation to coupon payment and call date. Market participants had in part become accustomed to treating hybrid bonds as straight bonds, ignoring some of the inherent structural risks of the asset class, that is deferral and extension risk.<sup>28</sup> It was implicitly taken for granted that issues would be called on the first possible call date and investors were taken by surprise when a number of (financial) issuers exercised their coupon deferral rights and others failed to call the bonds on the first call date. In December 2008, Deutsche Bank's move not to call a LT2 bond on the first scheduled call date, cast shadow over the hybrid market as a whole. The reasoning for doing so was that it was still cheaper for Deutsche Bank to pay the contractually agreed penalty (step-up) rather than to replace the issue at sharply risen refinancing costs. Although this example from the financial hybrid market sent negative signals and reduced investor confidence to some extent, in the corporate hybrid market, only few negative cases in terms of risk with respect to subordination, deferral or extension became reality during the crisis.

<sup>27</sup> Ryll (2010b), p. 7.

<sup>28</sup> Ryll (2009), p. 2.

### 3 Hybrid Bonds

The following chapter is intended to provide an in-depth overview of the three key structural features of hybrid bonds, i.e. subordination, deferral and extension. Further, the rationale for issuance shall be examined, both from an issuer as well as from an investor perspective. Last, the rating agencies' treatment of hybrid bonds is outlined.

#### 3.1 Key Structural Features

##### 3.1.1 Subordination

The term subordination refers to the order of priorities of claims among the holders of different corporate liabilities. In the event of a bankruptcy or default, for example, holders of debt have priority of claims over holders of equity. The priority of claims among holders of debt depends upon the specific terms of each contract, which contains provisions specifying the priority of the claim with the occurrence of the event.<sup>29</sup> Following the so-called waterfall principle, first the claims of secured debt holders with claims on the pledged assets are satisfied. The next most senior debt holders, i.e. senior unsecured debt holders, are paid only after secured debt holders are paid in full.<sup>30</sup> Senior unsecured debt holders are only backed by the general credit quality of the issuer and its capacity to make interest payments and repay the principal. Subordinated debt is ranked junior to senior unsecured debt and holders of subordinated debt usually only rank senior to preferred and common equity holders. No payments will be made to debt holders ranking subordinated in the capital structure until the claims of more senior debt holders are paid in full. If the remaining sum of the proceeds is not sufficient, then all more subordinated debt holders are left with nothing. The following listing provides an overview of the priority of claims of debt and equity holders in the event of bankruptcy or default:<sup>31</sup>

1. Senior secured debt holders – Debt holders have the first claim on the pledged asset, for example, issuer's specific asset such as real estate.
2. Senior unsecured debt holders – Debt holders are backed by the issuer's general credit quality and its capacity to repay interest and principal.
3. Senior subordinated debt holders – Subordinated debt holders are paid only after senior debt holders are paid in full.
4. Junior subordinated debt holders – for example, trust preferreds.

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<sup>29</sup> Barclay/Smith (1995), p. 901.

<sup>30</sup> Felsenheimer et al. (2006), p. 220.

<sup>31</sup> Mauro/Chesnicka (2010), p. 2.

- 5. Junior to junior subordinated debt holders – for example, newer hybrid preferred structures.
- 6. True preferred stockholders – Including only the traditional perpetual preferreds that pay a fixed dividend out of earnings, for example, DRDs and REIT preferreds.
- 7. Common stockholders – Common and preferred stockholders’ claims have lower priority than that of debt holders.

Subordination is a key structural feature, which clearly distinguishes corporate and financial hybrids from senior debt. As noted above, holders of hybrid bonds are subordinated in the event of insolvency or liquidation, ranking just ahead of common equity in the capital structure. Subordination negatively affects the recovery prospects of subordinated obligation holders given an event of default and the subordinate feature of hybrid bonds consequently implies that the recovery rate of subordinated instruments is significantly lower than that of senior debt. The issue of expected default probability by seniority and severity of default, based on default recoveries has been widely analyzed and documented in studies by the various rating agencies as well as in the academic literature.<sup>32</sup> Altman and Karlin (2010) report in 2009, based on a comprehensive sample issue of over 2,500 defaults from 1978-2009, a weighted average recovery rate for senior secured debt of 43.7% (historical average: 57.8%), 37.2% (historical average: 37.7%) for senior unsecured debt, 24.1% (historical average: 30.6%) for senior subordinated debt and 12.6% (historical average: 30.9%) for subordinated issues.<sup>33</sup> Due to the waterfall principle, the recovery rate is significantly impacted by the seniority of the claim. The recoveries on all seniorities were notably lower than the historical average, a finding also stated by Moody’s, which differentiates the recovery rates into seniority classes (see Table 1). As the table shows, the subordinated classes differ appreciably from senior unsecured debt. While senior secured debt (apart from bank loans) shows the highest recovery rates, the junior subordinated class offers the smallest recovery potential given a default. The agency documents long term (1982-2009) issuer-weighted average corporate debt recovery rates of 49.8% for senior secured debt, 36.6% for senior unsecured debt, 30.7% for senior subordinated debt, 31.3% for subordinated debt and 24.7% for junior subordinated debt.

Lien Position	Issuer-Weighted			Value Weighted		
	2009	2008	1982-2009	2009	2008	1982-2009
<i>1st Lien Bank Loan</i>	54.0%	61.7%	65.6%	56.6%	46.9%	59.1%
<i>2nd Lien Bank Loan</i>	16.0%	40.4%	32.8%	20.5%	36.6%	31.9%

<sup>32</sup> Altman et al. (2005), p. 2207.  
<sup>33</sup> Altman/Karlin (2010), p. 16f.

<i>Sr. Unsecured Bank Loan</i>	34.5%	31.6%	48.7%	38.1%	22.8%	40.0%
<i>Sr. Secured Bond</i>	37.5%	54.9%	49.8%	29.5%	40.3%	48.5%
<i>Sr. Unsecured Bond</i>	37.7%	33.8%	36.6%	35.5%	26.2%	32.6%
<i>Sr. Subordinated Bond</i>	22.4%	23.7%	30.7%	17.9%	10.4%	25.0%
<i>Subordinated Bond</i>	46.8%	23.6%	31.3%	24.7%	7.3%	23.5%
<i>Jr. Subordinated Bond</i>	n.a.	n.a.	24.7%	n.a.	n.a.	17.1%

**Table 1:** Moody's Average Corporate Debt Recovery Rates<sup>34</sup>

S&P also emphasizes that the empirical evidence has shown that, in case of bankruptcy, recoveries for subordinated instruments tend to be similarly poor and therefore the agency does not distinguish between subordination and deep subordination in general.<sup>35</sup>

The significantly lower recovery rate of subordinated instruments compared to senior debt implies that the yield spread<sup>36</sup> (i.e. the difference between the yield on a risky debt instrument and the yield on a comparable risk-free investment) on subordinated debt must compensate the investor for the higher expected loss relative to senior debt.

$$S = Y_{\text{risk}} - Y_{\text{no risk}}$$

The higher yield spread on subordinated debt can thus be interpreted as the premium paid to the holder of the instrument for the higher loss incurred given a default event. Bichler (2003) found that the equilibrium yield spread of subordinated debt instruments not only contains a risk premium, but also an incentive premium to compete with senior debt.<sup>37</sup>

### 3.1.2 Deferral

Another key structural feature of hybrid bonds is the issuer's option to defer the contractually agreed coupon providing the issuer with the ability and flexibility to preserve liquidity in case of financial stress. As this is a structural feature of common equity, where dividends can be cancelled at the discretion of the company at any time, plain vanilla debt instruments in general do not have a deferral mechanism. Hybrid debt instruments, however, in almost all cases contain deferral provisions forcing (mandatory) or allowing (optional) the issuer to defer coupon payments.

<sup>34</sup> Emery/Ou (2010), p. 6.

<sup>35</sup> Sprinzen et al. (2008), p. 49.

<sup>36</sup> Felsenheimer et al. (2006), p. 173.

<sup>37</sup> Bichler/Hancock (2003), p. 3.



**Mandatory deferral mechanisms:** Mandatory coupon deferral triggers are usually linked to some financial ratio relevant for Moody's or S&P (mostly interest coverage ratios or cash conversion ratios, e.g. FFO/interest expense or Cash flow/interest expenses). If the company does not meet the critical value in a certain financial ratio, the coupon payments are automatically suspended.<sup>38</sup> The mandatory coupon deferral mechanism therewith represents a financial covenant, which is breached if the publication of the annual report unveils that a certain financial ratio is undershot. Whereas the existence of a mandatory deferral clause protects senior debt holders, investors of hybrid debt instruments are exposed to coupon deferral.<sup>39</sup>

**Optional deferral mechanisms:** The vast majority of coupon deferral mechanisms, however, are optional. Optional coupon deferral mechanisms are subject to management's discretion and usually linked to dividend restrictions, i.e. by linking the coupon on the hybrid instrument to the dividend on common equity.<sup>40</sup> If the issuer decides to cancel the dividend on common equity, it is at his discretion whether or not to defer the coupon on the hybrid instrument. However, if a dividend is paid out, the issuer is forced to pay the coupon on the hybrid instrument (dividend "pushers"). This usually applies for a certain look-back period, e.g. if a dividend has been paid during the last 12 months then the payment of the coupon on the hybrid instrument is compulsory. In contrast, the so called capital payment "stoppers" forced the issuer to cancel dividend payments on common equity while any hybrid coupons are outstanding. The optional coupon deferral clause ensures that hybrid investors are not worse off than common shareholders.

**Cumulative and non-cumulative deferral mechanisms:** Deferred coupon payments are either cumulative or non-cumulative. Cumulative deferral means that the deferred coupon payments accrue cumulatively and the issuer has the obligation compensate for the suspended payments.<sup>41</sup> As soon as dividend payments on equity, preferred stock or other subordinated instruments are resumed (optional coupon deferral) or the relevant financial ratios met again (mandatory coupon deferral), cumulatively accrued coupon payments must be paid in full. Non-cumulative deferral implies that the issuer has no obligation to make up for the suspended coupon payments, i.e. the coupon is cancelled. Whereas in the case of coupon deferral on a cumulative basis the suspended payments remain a liability of the issuer and the investor does not lose his coupon claim, the deferred coupon is effectively lost in a non-cumulative structure from an investor's point of view.<sup>42</sup>

**Cash-cumulative and non-cash cumulative deferral mechanisms:** Cash-cumulative deferral mechanisms require the deferred coupons to be settled in cash, i.e. from the issuer's cash flow. The concept

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<sup>38</sup> Kreitmair/Kleindienst (2010), p. 15.

<sup>39</sup> Kreitmair/Kleindienst (2010), p. 21.

<sup>40</sup> Keenan/Staszewski (2010), p. 17f.

<sup>41</sup> Ryll (2010), p. 4.

<sup>42</sup> Kreitmair/Kleindienst (2010), p. 15f.

of alternative coupon settlement mechanisms (ACSM) allows for settlement by proceeds from alternative means such as issuing new equity or further hybrid instruments. As non-cash cumulative deferral mechanisms comprise a cash conserving aspect, they are considered to be more equity-like than the cash cumulative format.<sup>43</sup> However, alternative coupon settlement mechanisms pose additional risk to investors, e.g. if the issuer fails to raise sufficient means for the settlement of the outstanding deferred coupon payments. Further, the length of deferral is often limited. While an unlimited length of time for which coupon payments can be deferred would be most credit supportive in the view of the issuer, in practice, coupons can often be deferred for five years. Table 2 provides an overview of different mandatory and optional coupon deferral mechanisms of selected outstanding corporate hybrid bonds.

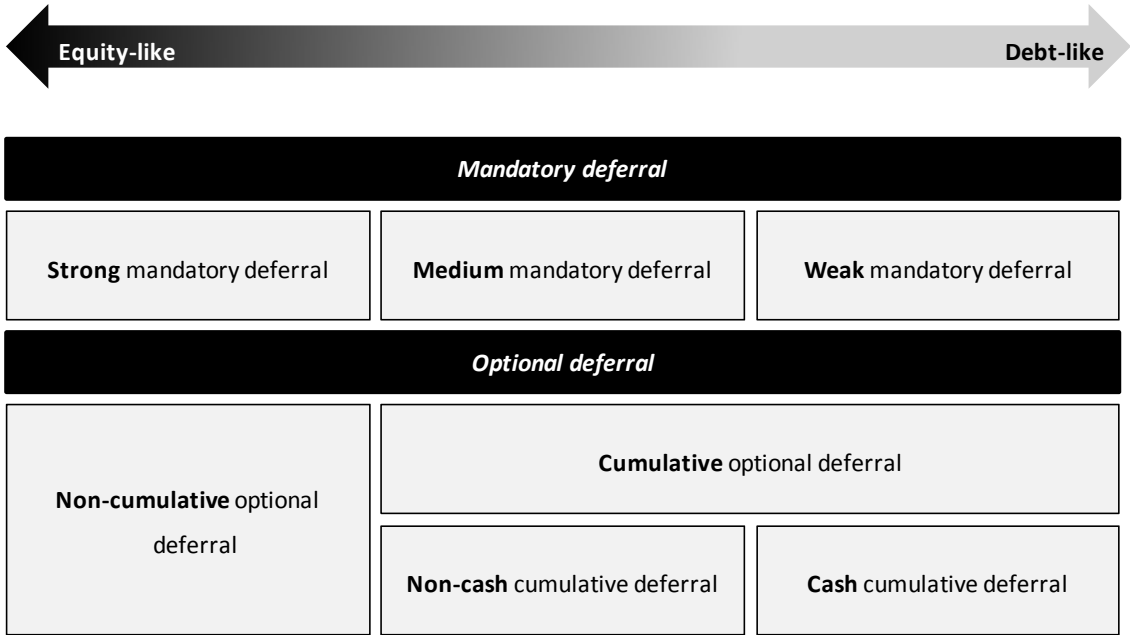
	Mandatory deferral mechanism	Optional deferral mechanism
<b>Bayer</b>	CF from operations < 7% of revenues	Yes, cumulative up to 10 years, to be settled in cash
<b>Dong</b>	None	Yes, non-cash cumulative, to be settled only in common shares or other junior securities
<b>Henkel</b>	CF/pension adjusted net debt ratio <15%	Yes, Operating cash flow / Adj. net debt < 20%
<b>Linde</b>	None	Yes, cumulative, no interest paid on deferred payments
<b>Rexam</b>	Adj. net debt/Adj. EBITDA > 5.5 or 4.5 in the last 4 years	Yes, cumulative up to 5 years
<b>RWE</b>	None	Yes, cumulative, no interest paid on deferred payments
<b>Scottish &amp; Southern</b>	None	Yes, cumulative, interest is paid on deferred payments
<b>Siemens</b>	(Operating CF + gross interest)/gross interest < 3.0x	Yes, cumulative for up to 5 years, no interest paid on deferred payments
<b>Solvay</b>	None	Yes, cumulative, only ACSM
<b>Suedzucker</b>	FFO < 5% of revenues	Yes, cumulative, no interest paid on deferred payments
<b>Suez Environnement</b>	None	Yes, cumulative, interest is paid on deferred payments
<b>Vattenfall</b>	(FFO + interest costs)/interest expense: 2.5x	Yes, cumulative, no interest paid on deferred payments

<sup>43</sup> Sparrow et al. (2007), p. 29.

<b>Vinci</b>	None	Yes, non-cumulative
<b>Wienerberg</b>	None	Yes, cumulative, may be settled through common equity or other hybrid securities

**Table 2:** *Coupon deferral mechanisms of selected corporate hybrids*<sup>44</sup>

Compared to optional deferral mechanisms, mandatory deferral triggers automatically forcing the deferral of coupon payments after a deterioration of credit quality are more credit supportive as management may be reluctant, e.g. from a reputation point of view, to optionally cancel dividend or coupon payments. Because of this cash conserving function, mandatory deferral triggers are considered to be more equity-like than optional deferral mechanism. Hybrid instruments with a non-cumulative coupon deferral mechanism are more equity-like because the feature allows for more flexibility with regard to the reduction or elimination of coupon payments to investors in the event of financial stress (see Figure 5).<sup>45</sup>



**Figure 5:** *Equity and debt-like characteristics of coupon deferrals*<sup>46</sup>

**3.1.3 Extension**

**Maturities and call provisions:** Apart from subordination and coupon deferral, hybrid bonds are characterized by very long maturities (from at least 30 years up to perpetual) combined with an issuer call option usually after five to ten years, which allows for the redemption of the instrument after expiration of the call period. While S&P has no explicit requirement with regard to the original ma-

<sup>44</sup> Bloomberg, Prospectus, modified from Kreitmair/Kleindienst (2010), p. 37ff.  
<sup>45</sup> Keenan/Staszewski (2010), p. 17ff.  
<sup>46</sup> Kreitmair/Kleindienst (2010), p. 16.

turity, Moody's requires an initial maturity of at least 30 years to qualify for equity treatment at all. In terms of maturity structure, most outstanding corporate hybrid bonds are very similar to bank Tier 1 bonds, which are perpetuals and have no legal final maturity. The others are dated instruments, which feature maturities well beyond the regular investor horizon (30 years up to 1000 years).<sup>47</sup> In order to preserve the equity-like characteristics of the hybrid instrument, the issuer has a call option, not the investor. If hybrid bonds contained investor puts, the credit quality at the senior level would be impaired because the investor put would be very likely to be exercised in a financial stress scenario.<sup>48</sup> In order to incentivize the issuer to redeem the instrument at the first call date, a fixed-to-floating coupon mechanism (usually 3-month Euribor + original credit spread at issuance + step-up of 100 bps to 250 bps) ensures that the post-call spread exceeds the original issue spread. Currently, a step-up of 100 bps is the regulatory limit for banks and as well the norm for most corporate hybrid issuers. The call feature must be carefully structured, because it should neither have too much of a punitive character to the issuer nor be too lax. In order to retain the desired managerial flexibility, credit rating agencies limited the step-up after call spread to 100 bps above the spread at the time of issue. The call feature provides the issuer with a valuable option to retire the debt in the face of changed market conditions, e.g. a lower interest rate level.<sup>49</sup> If interest rates decline, the issuer can exercise the call and refinance at a lower interest rate level. In addition, the credit spread environment also significantly influences the decision of whether to redeem an outstanding hybrid instrument or not. If at the first call date, for example, credit spreads are materially wider (in general or for idiosyncratic reasons, like a decline in the issuer's credit quality) compared with the spread-to-call of the outstanding issue, the issuer is most likely going to leave the issue outstanding. In contrast to common equity, which is not designed to be redeemed at any particular date in the future, hybrid bond investors in general expect the issuer to redeem the instrument at the first call date. Consequently, not calling is associated with substantial reputational risk.

**Replacement Capital Covenants (RCC):** Of course, the issuer's ability to call the hybrid instrument raises the question whether it will remain outstanding beyond the initial call date. Rating agencies consider the permanence of the hybrid instrument an essential and enduring criterion for granting equity credit. Especially S&P started to question the permanence of issues incorporating material step-ups (26 bps-100 bps in the case of investment-grade issuers), which are specifically designed to incentivize redeeming the issue at the first call date. As hybrid investors strongly expect redemption at the first call date, the issuer could be pressured to exercise the call at the initial call date, even if economically not worthwhile.<sup>50</sup> Therefore, issuer's commit themselves to replacement clauses which

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<sup>47</sup> Ryll (2009), p. 4.

<sup>48</sup> Keenan/Staszewski (2010), p. 13ff.

<sup>49</sup> Kish/Livingston (1992), p. 689.

<sup>50</sup> Sprinzen et al. (2008), p. 38f.

are designed to retain the hybrid instrument as a permanent part in the capital structure. Replacement Capital Covenants (RCCs) legally oblige the issuer to replace the redeemed instrument with common equity or other hybrid capital with the same amount of equity credit.

*“An RCC is a legally enforceable commitment by the issuer to replace a hybrid capital issue upon its call, redemption, or repurchase with an instrument having specified characteristics. To be effective in helping to preserve credit quality, the RCC must commit the issuer to replace a hybrid security, if it is called, redeemed, or repurchased, with an instrument having similar equity-like characteristics in terms of payment flexibility, degree of subordination, and permanence.”<sup>51</sup>*

At present, most outstanding corporate hybrid bonds issued before 2010 involve a non-legally binding declaration of intent.

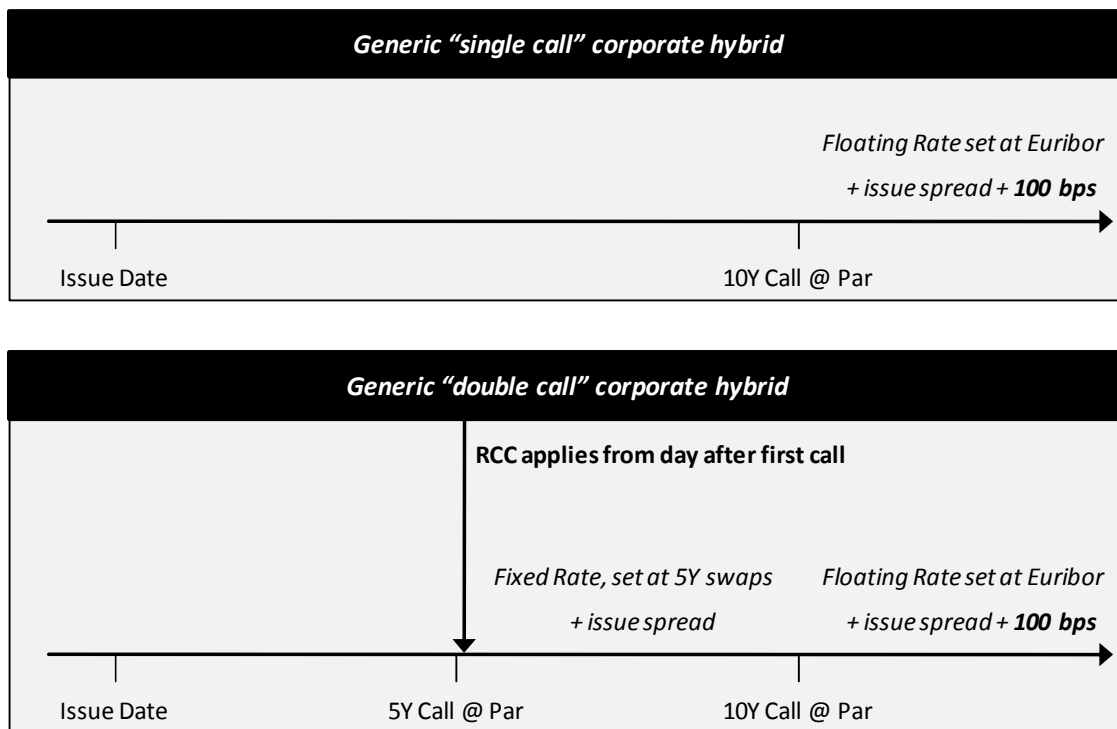
**“Double call” structure:** Since the publication of its revised methodology in 2007, S&P quit assigning equity credit to hybrid instruments that had call provisions combined with material step-ups, unless the issuer had entered into a legally-binding RCC.<sup>52</sup> According to S&P, an RCC must apply from the day after the first call day and must come into effect no later than five years before the step-up clause sets in. The call option with the step-up should be a minimum of ten years after the issue date. Accordingly, since the reopening of the corporate hybrid bond market in September 2010, the “double call” structure has emerged. The structure makes a compromise between the reluctance of issuer to enter into a legally binding RCC and investor’s preference for a material step-up clause incentivizing a call of the hybrid instrument. Hybrid bonds issued in the “double call” structure format pay a fixed coupon for at least five years before they become callable in year five. The coupon will be reset at a new fix coupon rate for the next five years if the call is not exercised. The fix coupon rate is reset at the five year mid-swap rate plus the original issue spread, i.e. there is no step-up at year five. Additionally, the RCC sets in and applies from the first day after the first call date (see Figure 6).<sup>53</sup> The effective step-up actually takes effect after a further five years, when the coupon is reset to floating plus issue spread and plus 100 bps and the bond becomes callable on each coupon date going forward. Accordingly, the utilities Scottish & Southern Energy, Suez Environnement and RWE issued hybrid bonds structured in the “double call” format in September 2010.

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<sup>51</sup> Sprinzen et al. (2008), p. 42.

<sup>52</sup> Ryll (2010b), p. 4.

<sup>53</sup> Keenan/Staszewski (2010), p. 15.



**Figure 6:** Time line of a generic "single call" and "double call" corporate hybrid<sup>54</sup>

Although the introduction of legally binding replacement capital covenants was aimed at preserving credit quality by ensuring that a redeemed hybrid instrument is being replaced by an instrument having similar equity-like characteristics, JP Morgan points out that issuer's reluctance to enter a legally binding RCC poses a very strong incentive to call the issue in year five. By exercising the call at the initial call date, the entering of the RCC (which only applies from the first call date on) can be avoided by the issuer.

### 3.2 The Rationale for Issuance

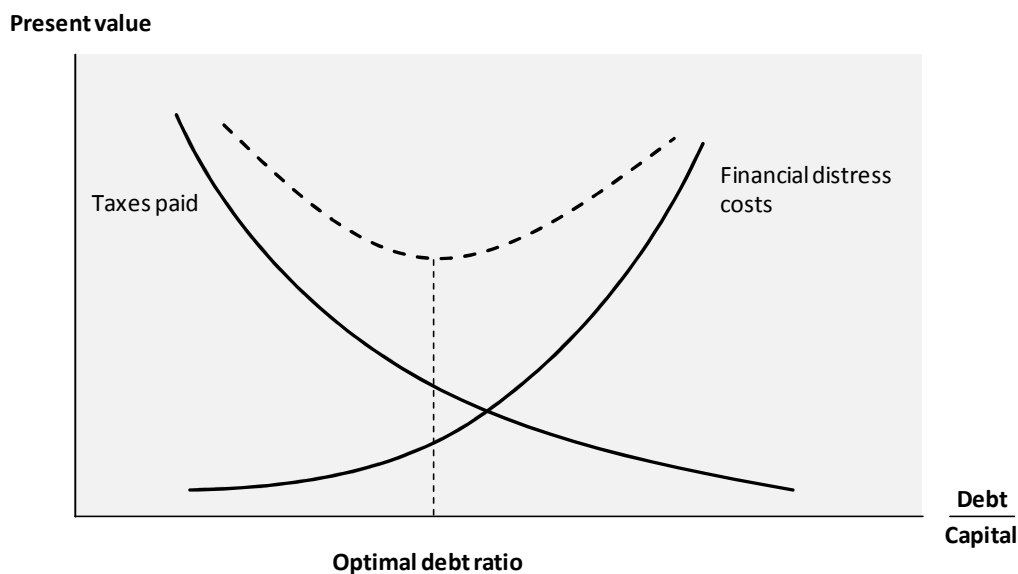
#### 3.2.1 Issuer's Perspective

Due to the debt and equity-like characteristics of hybrid bonds, from the issuer's perspective, the issuance of hybrids can help to enhance a company's credit profile as it offers flexible alternatives with regard to the composition of the capital structure and funding strategies (diversification).<sup>55</sup> Hybrid bonds, broadly put, offer the advantage of being tax-deductible (debt-like cost of capital) while containing equity-like features owing to which credit rating agencies grant them partial equity credit. The obtained equity credit by rating agencies is the most important motivating factor for non-financial corporations to issue hybrid bonds. The partial recognition as equity positively affects the is-

<sup>54</sup> Following Keenan/Staszewski (2010), p. 15.

<sup>55</sup> Larsen/Magnussen (2010), p. 3.

suer's overall rating and has therefore a crucial impact on the future refinancing costs.<sup>56</sup> Hybrid bonds not only allow an issuer to improve or stabilize the capital structure but also tend to reduce the company's weighted average cost of capital (WACC). In a seminal paper published in 1958, Modigliani and Miller point out that, under the assumption of a perfect capital market, the value of a company is independent of the capital structure, i.e. independent of how debt and equity are partitioned. They show that consequently the average cost of capital is entirely independent of the company's capital structure.<sup>57</sup> In practice, however, the perfect capital market assumption does not hold (financial frictions, bankruptcy costs, personal taxes etc.) and the value of a company therefore does depend on its capital structure. In 1996, Leland and Toft extended an earlier article by Leland (1994), based on Modigliani and Miller. The authors modeled the value of a company taking into account the optimal leverage ratio, equity risk, credit spreads, bankruptcy probabilities, and writedowns in bankruptcy. The results describe the company's value as a function of leverage, concluding that the optimal debt ratio can be described as a trade-off between tax advantages, bankruptcy costs, and agency costs.<sup>58</sup>



**Figure 7:** Optimal capital structure as a trade-off between tax advantages and insolvency costs<sup>59</sup>

Debt is tax-deductible and therefore offers tax advantages compared to equity. As a company increases the amount of debt held, the present value of the tax shield (tax advantages) decreases as a function of debt to total capital ratio. At the same time, the present value of the insolvency costs increases, i.e. the risk of insolvency increases due to leverage. Figure 7 illustrates the optimal capital structure result from the Leland approach as a trade-off between tax advantages and insolvency

<sup>56</sup> Ryll (2010b), p. 14.

<sup>57</sup> Modigliani/Miller (1958), p. 268f.

<sup>58</sup> Leland/Toft (1996), p. 1014f.

<sup>59</sup> Copeland et al. (2005), p. 592.

costs. The optimal debt to capital ratio is reached when the company's weighted average cost of capital is minimized. In general, the weighted average cost of capital is calculated by weighting the after-tax cost of debt ( $r_d$ ) by the relative amount of debt in the company's capital structure and by adding the cost of equity ( $r_e$ ) multiplied by the relative amount of equity ( $\tau_c$  = corporate tax rate).<sup>60</sup>

$$WACC = (1 - \tau_c) \cdot r_d \cdot \frac{\text{debt}}{\text{total capital}} + r_e \cdot \frac{\text{equity}}{\text{total capital}}$$

Unlike equity dividends, as mentioned before, coupon payments on hybrid bonds are tax-deductible. Hybrid bonds consequently offer a lower-cost equity-like financing option than traditional equity, because although the after-tax interest paid on hybrid bonds ( $r_h$ ) may be higher than the after-tax cost of debt, it is certainly lower than the current cost of equity. This implies that by adding hybrid bonds to the capital structure, a company can directly reduce its weighted average cost of capital without weakening its credit profile.<sup>61</sup>

$$WACC = (1 - \tau_c) \cdot r_d \cdot \frac{\text{debt}}{\text{total capital}} + (1 - \tau_c) \cdot r_h \cdot \frac{\text{hybrid}}{\text{total capital}} + r_e \cdot \frac{\text{equity}}{\text{total capital}}$$

If an issuer chooses to maintain or even lower his risk profile, he can realize the pointed out cost of capital reduction by buying back common equity and/or replacing traditional debt with hybrid bonds. The theoretical benefits of the modified WACC formula including hybrid capital is illustrated by the following numerical example.<sup>62</sup> A company with a total capital of 200 and a target capital structure of 50% debt-to-total capital (100 debt and 100 equity) currently pays 6.00% on its debt and 10.00% on its equity (corporate tax rate: 35%).

$$6.95\% = (1 - 35\%) \cdot 6\% \cdot \frac{100}{200} + 10\% \cdot \frac{100}{200}$$

Hence, a WACC of 6.95% results. Assuming the company has the option of issuing a hybrid bond at 7.00% (100 bps premium to its senior debt), it could perform the following credit ratings-neutral transaction (i.e. target capital structure of 50% debt-to-total capital is kept): Issuing a 50 hybrid (with 50% equity recognition by the rating agencies) and replacing 25 equity and 25 debt would reduce the WACC by 0.60% to 6.35%.

$$6.35\% = (1 - 35\%) \cdot 6\% \cdot \frac{75}{200} + (1 - 35\%) \cdot 7\% \cdot \frac{50}{200} + 10\% \cdot \frac{75}{200}$$

Even if the company had to pay a higher premium on its hybrid bond, the transaction would still make good economic sense ( $r_h$ : 8.00% -> WACC = 6.51% and  $r_h$ : 9.00% -> WACC = 6.68% and even  $r_h$ : 10.00% -> WACC = 6.84%), due to the tax deductibility of coupons paid on the hybrid instrument. As

<sup>60</sup> Copeland et al. (2005), p. 569.

<sup>61</sup> Kreitmair/Kleindienst (2010), p. 13.

<sup>62</sup> Ryan et al. (2007), p. 59.



Table 3 illustrates, the relation  $r_d < r_h < r_e$  also holds in practice. The cost of equity of selected corporate hybrid issuers exceeds the cost of debt and hybrid financing without exception. Thus, the proposed realization of economic benefits, i.e. cost of capital reduction, is feasible.

	Cost of Debt <sup>63</sup>		Cost of Hybrid		Cost of Equity <sup>64</sup>	
			CPN	Yield to Call		
<b>Bayer</b>	2.78%	<	5.00%	5.37%	<	13.30%
<b>Henkel</b>	2.51%	<	5.38%	5.67%	<	11.81%
<b>Linde</b>	2.76%	<	7.38%	5.61%	<	12.32%
<b>Lottomatica</b>	2.01%	<	8.25%	8.23%	<	9.01%
<b>Rexam</b>	3.88%	<	6.75%	8.37%	<	15.56%
<b>RWE</b>	2.26%	<	4.63%	6.13%	<	12.29%
<b>Scottish &amp; Southern</b>	3.49%	<	5.03%	6.06%	<	10.18%
<b>Siemens</b>	2.41%	<	5.25%	5.30%	<	16.01%
<b>Solvay</b>	3.31%	<	6.38%	6.47%	<	13.15%
<b>Südzucker</b>	2.88%	<	5.25%	6.95%	<	10.62%
<b>Suez Environnement</b>	2.56%	<	4.82%	6.37%	<	12.22%
<b>TUI</b>	3.57%	<	8.63%	9.40%	<	19.83%
<b>Vinci</b>	2.68%	<	6.25%	6.31%	<	14.39%
<b>Wienerberg</b>	5.54%	<	6.50%	9.59%	<	14.23%

**Table 3:** Cost of capital of selected corporate hybrid issuers<sup>65</sup>

By behaving more equity-like in times of financial stress (e.g. coupon deferral), hybrid bonds offer the advantage of reducing the risk of insolvency associated with traditional debt while preserving the advantage of being tax-deductible.<sup>66</sup> As the issuance of hybrid bonds has similar effects as a capital increase in the form of ordinary stock, a company creates an additional risk cushion and therewith re-

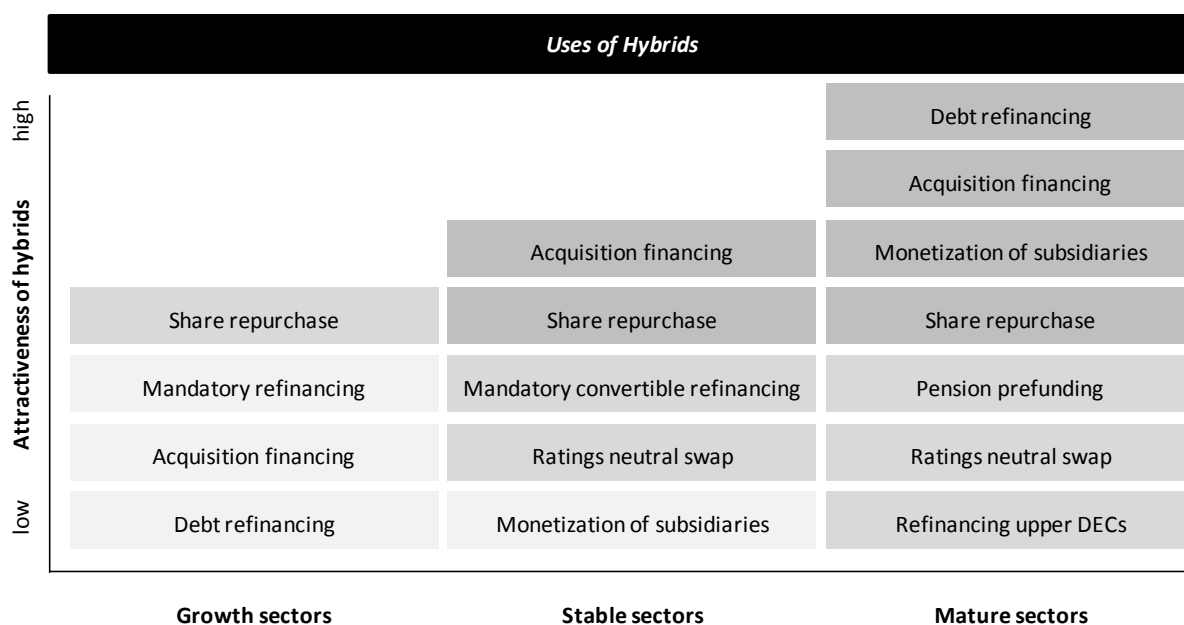
<sup>63</sup> Bloomberg, WACC Cost of Debt Weighted average cost of debt for the security calculated using government bond rates, a debt adjustment factor, and the proportions of short and long term debt to total debt, as of 11/29/2010.

<sup>64</sup> Bloomberg, WACC Cost of Equity derived by the Capital Asset Pricing Model (CAPM), as of 11/29/2010.

<sup>65</sup> Bloomberg, as of 11/29/2010.

<sup>66</sup> Ryan et al. (2007), p. 58.

duces the overall risk profile. Some issuers are also constrained from issuing equity, because they are state-owned. Additionally, unlike a capital increase, there is no dilution of voting rights associated with the issuance of hybrid bonds. Figure 8 depicts potential uses of hybrid bonds with regard to the relative attractiveness to companies operating in growth, stable or mature sectors. The figure also exhibits that not all companies benefit equally from issuing hybrid debt.<sup>67</sup> While a typical growth sector company with limited free cash flow and high capital investment needs is more reliant on equity financing, companies operating in mature sectors (for example utilities) benefit more from hybrid financing. Although generating stable cash flows, these companies are often confronted with declining growth figures and pressure on credit ratings. Debt refinancing or full debt acquisition financing usually leads to a deterioration of the issuer's credit quality and consequently pressure on the credit rating, whereas hybrid financing tends to ease the negative effects.<sup>68</sup>



**Figure 8:** *Uses of hybrids*<sup>69</sup>

The recently issued hybrid bonds by the utilities Tennet, Scottish & Southern Energy, Suez Environnement and RWE validate the statement above. The Dutch utility company Tennet used the proceeds from the hybrid issuance to finance the acquisition of E.ON's German electricity grid. Although Scottish & Southern Energy experienced no immediate rating pressure before the issuance, an ambitious capital expenditure plan may have caused emerging rating pressure in 2011. Suez Envi-

<sup>67</sup> Zenner et al. (2006), p. 11.

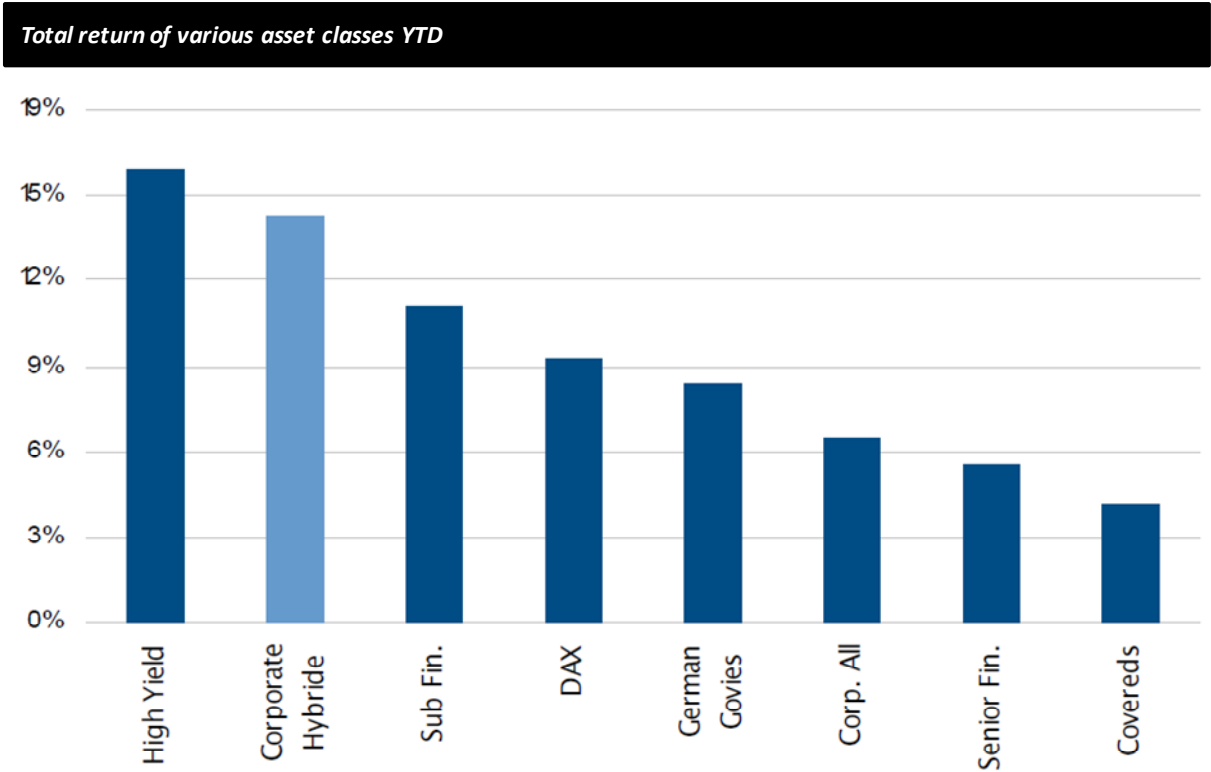
<sup>68</sup> Kleindienst (2007), p. 8.

<sup>69</sup> Zenner et al. (2006), p. 11.

ronnement’s rating was put on negative outlook in October 2009 by Moody’s, as the company announced to increase its stake in a Spanish water company, leading to an increase in net debt.<sup>70</sup>

**3.2.2 Investor’s Perspective**

In recent years, hybrid bonds have become an established asset class among institutional investors.<sup>71</sup> Especially in a low yield environment, from an investor’s point of view, corporate hybrid bonds offer an attractive risk and return profile compared to senior debt. As commonly known from capital market theory, higher returns are always associated with higher levels of risk. Investing in hybrid bonds, an investor incurs the risks implied by the key structural features of hybrid bonds: subordination, deferral and extension (see chapter 3.1 *Key Structural Features*). As illustrated in Figure 9, corporate hybrid bond investors were compensated accordingly from a year-to-date perspective.



**Figure 9:** Total return of various asset classes YTD<sup>72</sup>

Thus, the main incentive for investing in hybrid bonds results from the yield pick-up (compared to senior debt) due to the incurred structural risk.<sup>73</sup> The higher risk associated with subordination etc.

<sup>70</sup> Kleindienst (2010), p. 4ff.

<sup>71</sup> Kreitmair/Kleindienst (2010), p. 20f.

<sup>72</sup> Ryll (2010b), p. 7.

<sup>73</sup> Ryll (2010), p. 9.

requires the investor to very precisely analyze the underlying credit quality and business profile of a hybrid bond issuer in order to minimize the risk of default.

*“The Theory of Buying the Highest-Yielding Obligation of a Sound Company – It follows also that if any obligation of an enterprise deserves to qualify as a fixed-value investment, then all its obligations must do so. Stated conversely, if a company’s junior bonds are not safe, its first-mortgage bonds are not a desirable fixed-income investment. For if the second-mortgage is unsafe the company itself is weak, and generally speaking there can be no high-grade obligations of a weak enterprise. The theoretically correct procedure, therefore, is first to select a company meeting every test of strength and soundness, and then to purchase its highest yielding obligation, which would usually mean its junior rather than its first-lien bonds.”*<sup>74</sup>

This quote from the famous *Securities Analysis* by Benjamin Graham and David Dodd (1940) illustrates the importance of a thorough risk evaluation process on an issuer level, when investing in hybrid bonds.

### **3.3 Rating Agencies’ Perspective**

As outlined before (see chapter 3.2 *The Rationale for Issuance*), the combination of debt and equity-like characteristics of hybrid instruments contributes significantly to the attractiveness of the asset class from an issuer perspective. While providing debt-like cost of capital (tax deductibility of coupon payments), hybrid bonds are also granted equity credit by the rating agencies. The rating agency treatment of hybrid capital has become a core issue in structuring hybrids. Ideally, the issue qualifies for tax deductibility by containing debt-like characteristics while at the same time exhibiting enough equity-like features that merit at least partial equity credit, too.<sup>75</sup> In general, both Moody’s and S&P use an analytical framework for evaluating hybrids and take a holistic approach in assessing equity content by considering the overall effect of hybrid capital on an issuer’s credit profile. At the same time, the rating agencies also pay close attention to individual instrument features.<sup>76</sup> Both agencies have formed centralized committees in order to ensure consistent and transparent criteria for assessing the relative debt and equity characteristics and awarding equity credit.

#### **3.3.1 Moody’s**

After considering and incorporating the severe impact of the financial crisis on hybrid securities, Moody’s published its updated “Revisions to Moody’s Hybrid Tool Kit” in July 2010. The revision was

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<sup>74</sup> Graham/Dodd (2008), p. 148 and Hjort et al. (2010), p. 2.

<sup>75</sup> Larsen/Magnussen (2010), p. 3ff and Ryan et al. (2007), p. 60.

<sup>76</sup> Sprinzen et al. (2008), p. 4ff.

mainly aimed at simplifying the methodology towards a principles-based rather than a rules-based approach.<sup>77</sup> Moody's equity credit process is based on classifying hybrids into a "debt-equity continuum" represented by five baskets labeled A to E, with A closest to debt (0% equity credit) and E closest to equity (100% equity credit). Intermediate baskets are categorized as B (25% equity credit), C (50% equity credit) and D (75% equity credit). While the baskets remained the same as before the revision, the process according to which the instruments are assigned changed quite significantly. The previous mechanistic, rule-based classification process was replaced by an interrogative assessment, aimed at determining the degree to which an instrument offers credit support to a "going" concern and a "gone" concern. In the "going" concern, losses are absorbed well before a default occurs (no imminent danger of default) whereas in the "gone" concern losses are only absorbed when default is imminent.<sup>78</sup> The revised hybrid classification framework is thus built around the following three questions:

1. *Does the hybrid absorb losses for a "going" concern?*
2. *Does the hybrid absorb losses for a "gone" concern?*
3. *Is the loss absorbing hybrid there when needed?*

Focusing on the benefits that a hybrid offers for a "going" concern versus a "gone" concern, the revised methodology prioritizes the cash conserving ability (e.g. coupon deferral) in order to avoid a potential default over the ability to absorb losses for a "gone" concern.<sup>79</sup> The financial crisis has shown that at times of financial distress, many hybrid characteristics previously considered to be loss absorbing well in advance of a default actually proved not to be loss absorbing for the "going" concern.<sup>80</sup> Therefore, Moody's only considers non-cumulative preferred securities<sup>81</sup> as eligible for basket D (75% equity credit). This minimum standard for a "going" concern tends to provide better loss absorption compared to cumulative preferred securities (or ACSM-settled), which are at maximum eligible for basket C (50% equity credit). Under the assumption, for example, that corporate issuers do not defer coupon payments optionally until default is imminent, the presence of an optional deferral coupon skip mechanism qualifies a hybrid security for basket C treatment, at best, irrespective of whether the deferral is cumulative or non-cumulative (due to regulatory oversight, this does

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<sup>77</sup> Havlicek/Ogg (2010), p. 1ff.

<sup>78</sup> Havlicek/Ogg (2010b), p. 1ff.

<sup>79</sup> Keenan/Staszewski (2010), p. 6.

<sup>80</sup> Havlicek/Ogg (2010), p. 1.

<sup>81</sup> According to Moody's defined as very deeply subordinated securities, which cannot default or cross default other than at maturity and that have only limited ability to influence the outcome of a bankruptcy proceeding. Havlicek/Ogg (2010), p. 2.

not apply securities issued by banks). Figure 10 provides some generic hybrid examples to illustrate the application of Moody’s revised classification framework.

<b>Revised Basketing Guidance</b>															
<b>Coupon skip</b>	Mandatory Weak		X												
	Restricted Optional			X						X					
	Mandatory Moderate										X				
	Optional	X			X	X		X	X				X		
	Optional & Mand. strong						X			X				X	
<b>Settle- ment</b>	Cumulative	X	X	X	X	X	X		X						
	Non-cumulative							X		X	X	X	X	X	
<b>Ranking</b>	Subordinated	X	X	X	X	X	X								
	Preferred							X	X	X	X	X	X		
	Equity													X	
<b>Maturity</b>	< 30 years	X													
	30 – 59 years				X				X						
	>= 60 years		X	X		X	X	X		X	X	X	X		
	Irredeemable													X	
	Basket for Banks	<b>A</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>D</b>	<b>D</b>	<b>E</b>
	Basket for Non-Banks	<b>A</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>D</b>	<b>E</b>

**Figure 10: Generic hybrid examples<sup>82</sup>**

While, for example, a 30-year subordinated hybrid instrument with a cumulative coupon deferral mechanism is eligible for basket B treatment, it gets placed in basket A if the original maturity is less than 30 years. Dated hybrids with a maturity greater than 60 years are treated as perpetuals. In contrast to S&P, the replacement language is no longer a key consideration in Moody’s analysis.<sup>83</sup> Within the revision of the hybrid rating methodology also the alignment of basketing with notching was revised. As a consequence, instruments (Bayer, Suedzucker and Vattenfall) with a mandatory non-cumulative coupon deferral mechanism (eligible for basket D treatment) were downgraded to three notches below the senior unsecured rating.<sup>84</sup>

<sup>82</sup> Havlicek/Ogg (2010), p. 5.

<sup>83</sup> Havlicek/Ogg (2010b), p. 2.

<sup>84</sup> Keenan/Staszewski (2010), p. 12.

**3.3.2 Standard & Poor’s**

Compared to Moody’s basket classification, S&P’s approach can essentially be considered to be similar, despite few differences with regard to some characteristics of equity-like instruments.<sup>85</sup> Even though some changes have been made with regard to the replacement provision in 2007 (strengthened view on built-in call incentives and replacement language), S&P’s methodology has been in place for the most part unchanged since 2003. The rating agency assigns different hybrid instruments to the following three categories: "High" equity content (treated entirely as debt), "intermediate" equity content (50% debt and 50% equity) and "minimal" equity content (treated entirely as debt).<sup>86</sup> While Moody’s revised approach is more interrogative rather than classificative, S&P focuses primarily on several defining characteristics that need to be satisfied in order for an instrument to achieve certain equity content. "High" equity content hybrids exhibit very strong equity-like features, which help to protect the credit quality, including mandatory convertibility, linkage to common shares and mandatory deferrability with high thresholds, no loopholes and no ACSM settlement. The “intermediate” equity content category includes the widest range of instrument types and makes up the vast majority of issued hybrid securities. Hybrids in this equity content category feature substantial equity-like characteristics while also being debt-like in some respects. As outlined before, S&P requires a legally-binding replacement capital covenant (RCC) in order to qualify for the “intermediate” equity content category. Irrespective of the RCC, S&P no longer grants “intermediate” equity credit to issues with an initial call date less than five years after issuance due to doubtful permanence. If a hybrid instrument falls short of the “intermediate” category it is only eligible for “minimal” equity content (e.g. having less than 20 years to maturity). This category mainly comprises subordinated issues with little permanence, i.e. for example, the ability to defer coupon payments is limited to fewer than five years. S&P’s methodology to notching is quite similar to Moody’s notching approach (after the revision). Both agencies assign one notch for subordination and one for optional coupon deferral. As Moody’s revised methodology allows for an additional notch for mandatory non-cumulative deferral, S&P’s framework also has an additional notch for mandatory deferral available. Table 4 summarizes the criteria of the rating agencies’ main hybrid categories.

	<b>Moody’s – Basket C</b>	<b>Moody’s – Basket D</b>	<b>S&amp;P - Intermediate</b>
<b>Minimum original maturity</b>	60 years. Moody's requires 30 years for equity credit to be assigned at all, and 60 years to be treated as perpetual, and therefore eligible for higher equity treat-	60 years. Moody's requires 30 years for equity credit to be assigned at all, and 60 years to be treated as perpetual and therefore eligible for higher equity treatment	No specific requirement but effectively 25 years due to criteria on remaining maturity and minimum period to first call.

<sup>85</sup> Keenan/Staszewski (2010), p. 7f.

<sup>86</sup> Sprinzen et al. (2008), p. 12ff.

	ment than basket B.	than basket B.	
<b>Minimum remaining term</b>	10 years	10 years	20 years
<b>Minimum period to first call</b>	10 years to call and step	10 years to call and step	5 years
<b>Step up</b>	100 bps	100 bps	25 bps, or 100 bps with RCC in place.
<b>Discrete calls</b>	No specific requirement	No specific requirement	After any call date, it must be no more than 5 years to the next call unless there is an RCC in place.
<b>Replacement Language</b>	No specific requirement	No specific requirement	RCC in place for at least 5 years prior to a 100 bps step-up. RCC should be in a separate document covenanted with a significant amount of senior debt that the hybrid will be redeemed only with an equivalent amount of hybrid or 50% of the equivalent amount in common equity. However, the RCC need not apply if all covered debt has been redeemed, there is a change of control, tax laws change, credit quality improves or equity credit is lost.
<b>Coupon Deferral trigger</b>	Optional	Optional and a strong mandatory trigger. A strong trigger causes deferral when the issuer is rated Ba1/Ba2.	Optional
<b>Link to dividend</b>	Can be a capital payments stopper, or a dividend pusher with no more than six month look back period.	Can be a capital payments stopper, or a dividend pusher with no more than six month look back period.	Can be a capital payments stopper, or a dividend pusher with no more than a twelve month look back period.
<b>Settlement of arrears</b>	Cash cumulative with all ACSM settled-coupons regarded as cumulative.	Optionally deferred coupons may be cash cumulative with all ACSM settled-coupons regarded as cumulative. Mandatorily deferred coupons must be non-cumulative, but the issuer may have an option (but not the obligation) to settle coupon arrears via the issuance of common equity after the trigger is cured.	Cash cumulative



<b>Maximum deferral period</b>	Must be unlimited, although permissible to state an intention to clear after 5 years.	Must be unlimited, although permissible to state an intention to clear after 5 years.	5 years
<b>Status of the issue</b>	Preferred. Senior only to common equity, with no default or cross-default provisions and a limited ability to alter the outcome of a restructuring.	Preferred. Senior only to common equity, with no default or cross-default provisions and a limited ability to alter the outcome of a restructuring.	Subordinate to senior debt
<b>Maximum hybrid in capital structure</b>	Less than 25% of equity credit (common equity + equity credit from hybrids).	Less than 25% of equity credit (common equity + equity credit from hybrids).	Less than 15% of capitalization (adjusted debt + hybrids + book equity).
<b>Notching</b>	1 notch for subordination 1 notch for optional coupon deferral	1 notch for subordination 1 notch for optional coupon deferral 1 notch for non-cumulative mandatory coupon deferral	1 notch for subordination 1 notch for optional coupon deferral (+1 additional notch for mandatory coupon deferral)

**Table 4:** *Criteria for different basket / equity content treatment*<sup>87</sup>

<sup>87</sup> Keenan/Staszewski (2010), p. 22.

#### 4 Valuation Framework

Building an appropriate valuation framework for the determination of the fair value of hybrid bonds is an intricate task, because at present there exists no closed-form model explaining the fair spread of hybrid bonds.<sup>88</sup> While a plain vanilla senior bond can be priced quite easily, the pricing of corporate and financial hybrid bonds depends on various parameters and distinguishing features that allow no clear-cut valuation (e.g. subordination, coupon deferral and extension). During the accelerated activity of hybrid issuance between 2005 and 2007, several hybrid pricing methodologies were tested and ultimately rejected. Among the considered methodologies were multiples of senior spread approaches or sum-of-parts valuations. To this day, no valuation framework has managed to become common standard for the pricing of hybrid bonds, underlining the complexity of determining the fair value of hybrid bonds.<sup>89</sup> Therefore, market participants frequently apply a straight forward comparables approach, i.e. by simply referring to secondary market prices of similar outstanding paper.

This thesis aims at replicating and implementing an integrated valuation framework for pricing hybrid bonds first introduced and applied by JPMorgan in a 2005 published research paper "*A Framework for Pricing Corporate Hybrids*".<sup>90</sup> The valuation methodology is based on JPMorgan's "*Rock-bottom spread framework*", a 2001 developed valuation framework drawing only on credit fundamentals data, such as default and recovery rates (credit fundamentals), the future cash flows of the security (credit returns), and the risk/return target (risk tolerance) of the investor.<sup>91</sup> Rock-bottom spreads are entirely independent from market spreads, making them most suitable to fundamentally determine the fair value of hybrid bonds. Market spreads are, to a great extent, driven by investor sentiment and general risk aversion. A valuation framework based on rock-bottom spreads therefore allows for a transparent and market independent assessment of the fair level of hybrid bonds. The rock-bottom spread represents the lowest spread (reservation spread) at which an investor should be willing to bear the fundamental credit risk associated with holding credit instruments. The methodology is built around the assumption that investors require a risk premium (extra return above a risk-free government rate), which compensates them for the risk of default. Accordingly, the difference between the market spread and the rock-bottom spread of a bond is the maximum being offered for the credit instrument's lower liquidity compared to government bonds.<sup>92</sup> If the market spread falls short of the rock-bottom spread, this indicates that an investor is not properly compensated for bearing the underlying credit risk. If the market spread exceeds the rock-bottom spread, however, the bond is fairly valued if the excess spread also properly compensates for illiquidity (positive liquidity spread). Thus,

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<sup>88</sup> Felsenheimer et al. (2006), p. 51 and Keenan/Staszewski (2010), p. 23ff.

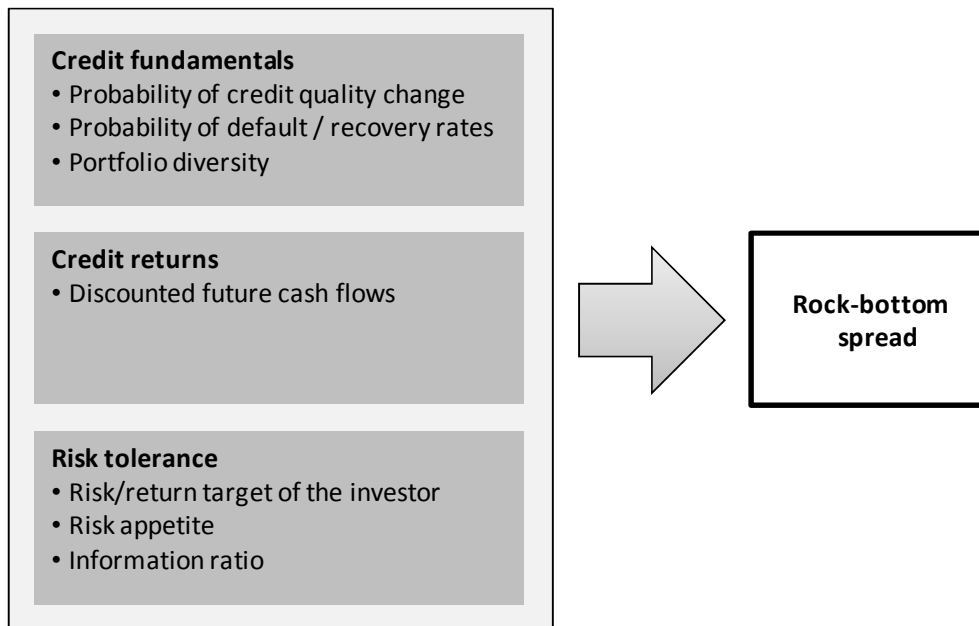
<sup>89</sup> Kreitmair/Kleindienst (2010), p. 25 and Goulden/Keenan (2005), p. 4.

<sup>90</sup> Goulden/Keenan (2005), p. 1ff.

<sup>91</sup> Rappoport (2001), p. 1ff.

<sup>92</sup> Rappoport (1999), p. 1ff.

comparing market spreads to rock-bottom spreads offers a way to judge whether a bond is – based on credit fundamentals data – fairly valued or not.



**Figure 11:** *Rock-bottom spread methodology: the basic recipe*<sup>93</sup>

The 2005 developed JPMorgan framework for pricing corporate hybrids is an extension of the original rock-bottom spread valuation methodology. It has been adapted for various hybrid specific features (subordination, coupon deferral, extension risk), allowing it to transparently price hybrid securities. Due to the additional complexity of the 2010 issued hybrid bonds (e.g. “double call” structure) substantial alterations to the model are necessary – an issue the replicated model developed in this thesis will incorporate.<sup>94</sup> The following chapter is aimed at giving a thorough insight into the mechanics of the rock-bottom spread approach and the replicated valuation frameworks in particular (Excel/VBA based).<sup>95</sup> In a first step, the aim of the basic model (see Rock-Bottom Spread Calculator\_Basic) was to be able to replicate the calculated rock-bottom spreads in JPMorgan’s 2001 portfolio research paper “*Rock-bottom spread mechanics*”.<sup>96</sup> The developed extension of the model (see Rock-Bottom Spread Calculator\_Hybrid) requires a stable and flawless basis framework and only by being able to correctly replicate basic rock-bottom spreads, the accuracy of the extended model can be guaranteed. Therefore, to begin with, the input parameters for the basic model correspond to the baseline inputs for the rock-bottom spread calculation used in JPMorgan’s 2001 research paper. Af-

<sup>93</sup> Modified from Rappoport (2001), p. 1.

<sup>94</sup> Keenan/Staszewski (2010), p. 23.

<sup>95</sup> All presented results can be reproduced (see enclosed CD). Instructions for applying the model are to be found in the appendix.

<sup>96</sup> See Rappoport (2001b), p. 1ff.

ter having laid the foundation, baseline inputs will be altered and configured to match actual market data in order to be able to price current hybrid bonds.

#### 4.1 Rock-Bottom Spread Mechanics

In order to be able to calculate the rock-bottom spread, a quantitative description of the underlying credit fundamentals, credit returns and the risk tolerance of the investor is required. The most important assumption of the rock-bottom spread methodology is that the underlying financial state of a company can be represented by the assigned credit rating.<sup>97</sup> With the probability of receiving future cash flows being directly linked to the financial state of the company, the future probability distribution of values is implied by the respective rating migration matrix published by the rating agencies.<sup>98</sup> Moody's and S&P, for example, publish rating migration matrices which summarize the likelihood of credit quality migration, including default likelihood, over a certain period of time, e.g. the start and end of one year.<sup>99</sup> Using the rating categories and the probabilities of migrations between these categories as key input factor, the rock-bottom spread methodology then makes future cash flows dependent on the rating states.

##### 4.1.1 Credit Fundamentals

The credit fundamentals serve as input parameters for the calculation of the underlying credit exposure of a risky debt instrument. While the likelihood of default and the probability of a credit quality change are directly implied by the rating migration matrix, the extent of diversification in the portfolio is measured by a variant of the "diversity score", an approach created by Moody's to estimate the correlation of movements in issuer's credit quality.<sup>100</sup> The approach is based on the assumption that issuers in the same industry are highly correlated and that there is little to zero correlation across industries. The total score sums up the diversity scores of the bonds held in each industry group to capture the diversity of the portfolio. This corresponds to translating a portfolio of correlated exposures into segregated, smaller numbers of uncorrelated exposures. The more diversified a portfolio, the greater is the risk taking capacity with regard to credit fundamentals. Measuring portfolio diversity will become relevant when calculating the rock-bottom spread, because less-diversified investors require a greater rock-bottom spread than fully diversified investors.

Rating migration matrices summarize, based on empirical evidence, the likelihood of credit quality migration over a certain period of time, e.g. over the period of one year (see Figure 12). A BBB rated

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<sup>97</sup> Goulden/Keenan (2005), p. 6ff.

<sup>98</sup> This method is theoretically based in the *CreditMetrics™* framework. See Gupton/Finger (1997).

<sup>99</sup> Emery/Ou (2010), p. 74.

<sup>100</sup> Rappoport (2001), p. 15.

bond, for example, has a 0.18% probability of default over one year. The bond's chance of staying within the same rating category over one year amounts to 86.96% and with a probability of 6.24% the bond is upgraded to the A bucket. For comparison, AAAs have zero probability of default over one year and CCCs exhibit a 29.21% chance of defaulting within one year. In case of a default, the likely net residual value is approximated by the historical recovery rate. As pointed out before, the recovery rate is directly linked to the seniority class of the debt.

	AAA	AA	A	BBB	BB	B	CCC	D
AAA	89.20%	9.69%	1.08%	0.00%	0.03%	0.00%	0.00%	0.00%
AA	1.03%	89.31%	9.14%	0.37%	0.09%	0.02%	0.00%	0.03%
A	0.04%	2.48%	90.97%	5.57%	0.72%	0.21%	0.01%	0.00%
BBB	0.04%	0.29%	6.24%	86.96%	5.15%	1.09%	0.05%	0.18%
BB	0.03%	0.03%	0.60%	5.59%	82.94%	8.67%	0.62%	1.52%
B	0.01%	0.06%	0.25%	0.58%	6.43%	82.06%	3.14%	7.46%
CCC	0.00%	0.00%	0.00%	1.12%	2.87%	6.77%	60.03%	29.21%

**Figure 12:** Exemplary 8-state, one-year rating migration matrix<sup>101</sup>

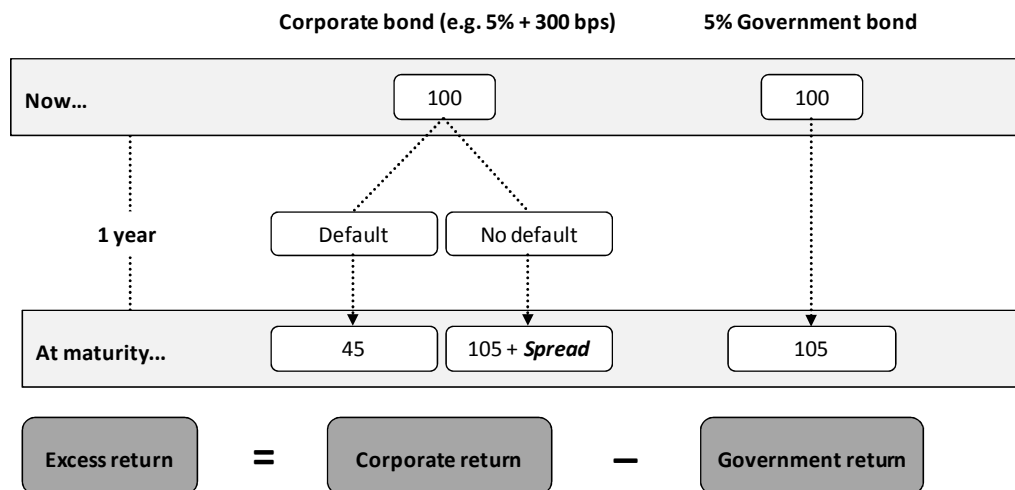
The idea behind looking at the probabilities of credit quality changes is that each rating state represents the financial state of the company over time. By making future cash flows dependent on rating states, a probability distribution of future asset value states can be created.<sup>102</sup> Either the historically observed patterns of rating changes and default can be accepted as being the best predictor of future behavior of credit quality changes, or a modified rating migration matrix can be used as baseline input in order to express differing views about the future.

#### 4.1.2 Credit Returns

Besides credit fundamentals, the actual cash flow is the second key building block of the rock-bottom spread methodology, illustrated by a very simple example of a one-year corporate bond (see Figure 13). For a one-year bullet corporate bond, only two future price scenarios have to be considered: If the bond does not default, the investor receives the promised cash flow (105 + spread) at maturity. In the event of default, the payout amounts to the recovery value (e.g. 45 per 100 of principal). The value of the bond today then only depends on the probability of the bond being in the state "default" or "no default" after one year (average price across scenarios). Subtracting the government return, resulting from the risk free cash flow of the 5% government bond, yields the excess return. As a compensation for the uncertainty (the possibility of a default), the corporate bond pays a spread (credit component: 300 bps) over the risk-free interest rate (interest component: 5%).

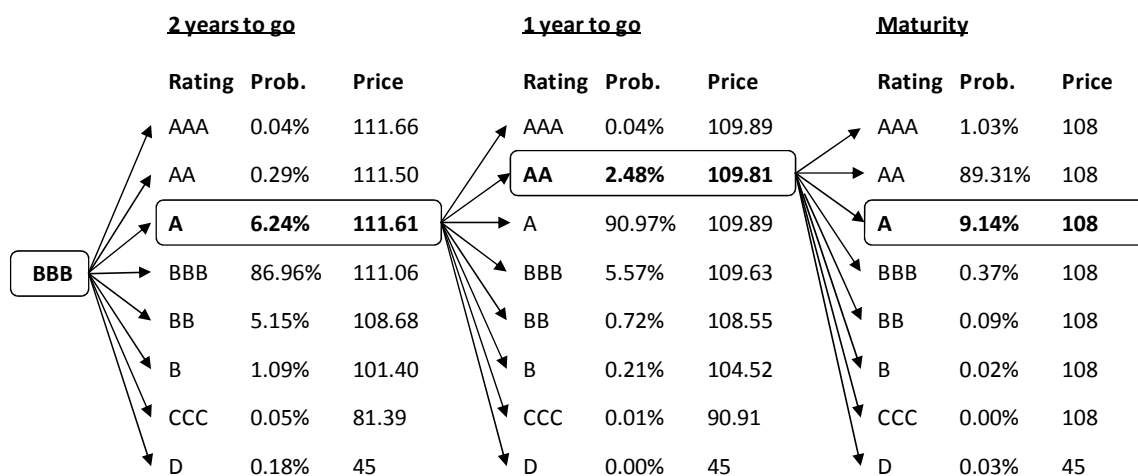
<sup>101</sup> Rappoport (2001b), p. 6.

<sup>102</sup> Goulden/Keenan (2005), p. 8.



**Figure 13:** Price scenarios for a one-year corporate bond<sup>103</sup>

The illustrated one-year bullet bond example is the easiest case, because there are only two possible price scenarios and a price “anchor” at maturity.<sup>104</sup> As soon as longer-maturity bonds are considered, the respective probabilities of rating changes over time have to be taken into account in order to be able to calculate the average credit return. A BBB rated 3-year bullet bond, for example, could end up the year as 2-year AAA, AA, A, BBB, BB, B or CCC rated bond.



**Figure 14:** Exemplary price scenario for a 3-year corporate bond<sup>105</sup>

These simple examples illustrate, on a conceptual basis, how average prices across various credit scenarios can be created, based only on credit fundamentals implied by rating migration matrices (without actually calculating the prices yet). In order to be able to calculate the risk premium (excess return above government return) required by the investor as a compensation for the risk of default, some quantitative measure of the investor’s risk tolerance is needed.

<sup>103</sup> Modified from Rappoport (2001), p. 8.

<sup>104</sup> Rappoport (2001b), p. 2.

<sup>105</sup> Own illustration, following Rappoport (2001b), p. 5 and Gupton/Finger (1997), p. 24.

### 4.1.3 Risk Tolerance

The third important building block of the rock-bottom spread methodology is the investor's risk aversion, expressed by the information ratio (commonly referred to as Sharpe ratio), which was first expounded by Jack Treynor and Fischer Black in 1973 as a measure of volatility-adjusted excess return.<sup>106</sup> The information ratio describes the relationship between excess return (asset return minus benchmark return) and the volatility of this return and determines the premium the investor requires as a compensation for holding a corporate bond (or any other risky asset). Mathematically, the one-year information ratio is given by equation.<sup>107</sup>

$$I_1 = \frac{E(r_{i,1} - r_{f,1})}{\sqrt{\text{Var}(r_{i,1} - r_{f,1})}}$$

where  $r_{i,1}$  is the one-year credit return on the bond and  $r_{f,1}$  is the risk-free rate. The term  $\sqrt{\text{Var}(r_{i,1} - r_{f,1})}$  is the standard deviation of the difference between the credit return on the bond and the risk-free rate (also known as tracking error), expressing the volatility of that return. The information ratio over T years is given by:

$$I_T = \frac{T[E(r_{i,1} - r_{f,1})]}{\sqrt{T}\sqrt{\text{Var}(r_{i,1} - r_{f,1})}} = \sqrt{T}I_1 = \frac{E(r_{i,T} - r_{f,T})}{\sqrt{\text{Var}(r_{i,T} - r_{f,T})}}$$

The higher the information ratio, the better is the excess average return per unit of excess return volatility compared to other investment opportunities, e.g. the risk-free government return.<sup>108</sup> Empirically, the average Sharpe ratio (relative to the risk-free rate) tends to be close to 0.5 across several asset classes. By requiring an investment to attain a certain target information ratio, an investor can quantify his risk tolerance with regard to the preference of holding a bond over a risk-free government bond. Moving from a single bond to a portfolio or index of assets, the information ratio needs to be adjusted by the diversity score ( $d$ ) for the reduced volatility.<sup>109</sup>

$$I_T = \frac{T[E(r_{i,1} - r_{f,1})]}{\sqrt{T}\frac{\sqrt{\text{Var}(r_{i,1} - r_{f,1})}}{\sqrt{d}}} = \sqrt{T}I_1 = \frac{E(r_{i,T} - r_{f,T})}{\frac{\sqrt{\text{Var}(r_{i,T} - r_{f,T})}}{\sqrt{d}}}$$

<sup>106</sup> The Sharpe ratio was introduced by William Sharpe in 1966. Whereas the information ratio defines excess return as the return above a relevant benchmark, the Sharpe ratio refers to the return above the risk free rate. Here: Information ratio = Sharpe ratio. Israelsen (2004), p. 423. See also Chincarini (2007), p. 284ff.

<sup>107</sup> Shah et al. (2008), p. 12ff.

<sup>108</sup> Rappoport (2001b), p. 2 and Rappoport (2001), p. 8.

<sup>109</sup> Shah et al. (2008), p. 13f.

#### 4.1.4 Calculating Rock-Bottom Spreads

As conceptually illustrated in Figure 13, the rock-bottom spread represents the lowest spread (reservation spread delivering the investor's target information ratio) at which the investor is willing to bear the fundamental credit risk associated with holding a corporate bond, i.e. the spread he requires to be adequately compensated for the possibility of a default. In order to be able to calculate rock-bottom spreads, in a first step, the bond's expected excess return and the volatility of the expected excess return need to be determined.<sup>110</sup> Starting off with the binary "default/no-default" scenario, the expected excess return is:

$$\begin{aligned} E(r_{i,T} - r_{f,T}) &= (1 - p) \left( \frac{100 + x - 100}{100} - r_{f,T} \right) + p \left( \frac{R - 100}{100} - r_{f,T} \right) \\ &= (1 - p) \frac{100 + x}{100} + p \frac{R}{100} - (1 + r_{f,T}) \end{aligned}$$

where  $x$  is the interest plus credit return an investor requires over  $T$  years and  $R$  the recovery value.  $\left( \frac{100+x-100}{100} - r_{f,T} \right)$  is the  $T$  year excess return in the case of no default, with probability  $(1 - p)$ , and  $\left( \frac{R-100}{100} - r_{f,T} \right)$  the excess return in the event of a default, with probability  $p$ .

The volatility of the expected excess return can be calculated as:

$$\begin{aligned} \text{Var}(r_{i,T} - r_{f,T}) &= (1 - p) \left( \frac{100 + x - 100}{100} - r_{f,T} - E(r_{i,T} - r_{f,T}) \right)^2 \\ &\quad + p \left( \frac{R - 100}{100} - r_{f,T} - E(r_{i,T} - r_{f,T}) \right)^2 \end{aligned}$$

which can be simplified to:

$$\text{Var}(r_{i,T} - r_{f,T}) = \frac{p(1-p)}{100^2} (100 + x - R)^2 = \sqrt{\text{Var}(r_{i,T} - r_{f,T})} = \frac{\sqrt{p(1-p)}}{100} (100 + x - R)$$

Since the rock-bottom price of a bond corresponds to the price that delivers the investor's target information ratio, the expected excess return and the volatility of the expected excess return can be substituted into the information ratio:

$$I_T = \sqrt{T} I_1 = \frac{T[E(r_{i,1} - r_{f,1})]}{\sqrt{\frac{T}{d}} \sqrt{\text{Var}(r_{i,1} - r_{f,1})}} = \frac{E(r_{i,T} - r_{f,T})}{\frac{\sqrt{\text{Var}(r_{i,T} - r_{f,T})}}{\sqrt{d}}} = \sqrt{\frac{T}{d}} I_1 \sqrt{\text{Var}(r_{i,T} - r_{f,T})} = E(r_{i,T} - r_{f,T})$$

<sup>110</sup> The following mathematical derivation is based on Shah et al. (2008), p. 15ff, Rappoport (2001b), p. 1ff and Gupton/Finger (1997), p. 28ff.



$$= \sqrt{\frac{T I_1 \sqrt{p(1-p)}}{d}} (100 + x - R) = (1-p) \frac{100+x}{100} + p \frac{R}{100} - (1+r_{f,T})$$

Solving for  $x$  yields the total rate of return of the bond over the lifetime  $T$ :

$$x = \frac{pR - 100(1+r_{f,T}) + RI_1 \sqrt{\frac{Tp(1-p)}{d}}}{I_1 \sqrt{\frac{Tp(1-p)}{d}} - (1-p)} - 100$$

Subtracting the risk-free rate compounded over  $T$  years from  $x$  returns the  $T$ -year credit return. Divided over  $T$  years finally yields the rock-bottom spread.

For modeling reasons, it is more convenient to restate the just derived rock-bottom spread equation as a definition of the rock-bottom price, from which the rock-bottom spread can be deduced on an annual basis via a conventional price-to-yield calculation.<sup>111</sup> At first, the input parameters for the basic model (see Rock-Bottom Spread Calculator\_Basic) are set equal to the baseline inputs used by JPMorgan for the rock-bottom spread calculations.

**Baseline inputs:**

Default/Downgrade view:	<i>Historical (see Figure 12)</i>
Recovery rate average:	<i>0.45</i>
Recovery rate volatility:	<i>0</i>
Information ratio:	<i>0.5</i>
Diversity score:	<i>70</i>
Government curve:	<i>flat 6%</i>
Coupon:	<i>8%</i>

Working backwards, i.e. starting off in the final year before maturity, the model computes the average price across all scenarios  $\mu_M$  (here: either “default” or “no default”):<sup>112</sup>

$$AAA \text{ rated: } \mu_M = \sum_{i=1}^s p_i \mu_i = \begin{pmatrix} 100.00\% \cdot 108 + \\ 0.00\% \cdot 45 + \end{pmatrix} = 108.00$$

$$AA \text{ rated: } \mu_M = \sum_{i=1}^s p_i \mu_i = \begin{pmatrix} 99.97\% \cdot 108 + \\ 0.03\% \cdot 45 + \end{pmatrix} = 107.98$$

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<sup>111</sup> Rappoport (2001b), p. 2ff.

<sup>112</sup> See also Gupton/Finger (1997), p. 29ff.

$$CCC \text{ rated: } \mu_M = \sum_{i=1}^s p_i \mu_i = \left( \begin{array}{cc} 70.79\% \cdot 108 & + \\ 29.21\% \cdot 45 & + \end{array} \right) = 89.60$$

The price volatility across the scenarios for the final year is calculated as

$$AAA \text{ rated: } \sigma_M = \sqrt{\sum_{i=1}^s p_i \mu_i^2 - \mu_M^2} = \sqrt{\left( \begin{array}{cc} 100.00\% \cdot 108^2 & + \\ 0.00\% \cdot 45^2 & + \end{array} \right) - 108.00^2} = 0.00$$

$$AA \text{ rated: } \sigma_M = \sqrt{\sum_{i=1}^s p_i \mu_i^2 - \mu_M^2} = \sqrt{\left( \begin{array}{cc} 99.97\% \cdot 108^2 & + \\ 0.03\% \cdot 45^2 & + \end{array} \right) - 107.98^2} = 1.09$$

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$$CCC \text{ rated: } \sigma_M = \sqrt{\sum_{i=1}^s p_i \mu_i^2 - \mu_M^2} = \sqrt{\left( \begin{array}{cc} 70.79\% \cdot 108^2 & + \\ 29.21\% \cdot 45^2 & + \end{array} \right) - 89.60^2} = 28.65$$

As before, the two components can be substituted into the information ratio, i.e. dividing the average credit return by the corresponding volatility:<sup>113</sup>

$$I_M = \frac{\frac{\mu_M}{x_M} - (1 + r_{f,M})}{\frac{\sigma_M}{x_M}}$$

where  $x$  is the current price of the bond. Solving for  $x$ :

$$x_M = \frac{\mu_M - I_M \cdot \sigma_M}{(1 + r_{f,M})}$$

Now, the rock-bottom price ( $rbp$ ) is equal to the price that yields the investors target information ratio  $I_M$ . Adjusting for diversity by dividing the price volatility of the single bond by the square root of the diversity score ( $d$ ) returns:

$$rbp_M = \frac{\mu_M - I_M \cdot \frac{\sigma_M}{\sqrt{d}}}{(1 + r_{f,M})}$$

$$AAA \text{ rated: } rbp_M = \frac{\mu_M - I_M \cdot \frac{\sigma_M}{\sqrt{d}}}{(1 + r_{f,M})} = \frac{108.00 - 0.5 \cdot \frac{0.00}{\sqrt{70}}}{(1 + 6\%)} = 101.89$$

<sup>113</sup> Since the level of the term  $(1 + r_{f,1})$  has the same effect in each scenario, it does not influence the credit return volatility. See Rappoport (2001b), p. 3.

$$AA \text{ rated: } rbp_M = \frac{\mu_M - I_M \cdot \frac{\sigma_M}{\sqrt{d}}}{(1 + r_{f,M})} = \frac{107.98 - 0.5 \cdot \frac{1.09}{\sqrt{70}}}{(1 + 6\%)} = 101.81$$

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$$CCC \text{ rated: } rbp_M = \frac{\mu_M - I_M \cdot \frac{\sigma_M}{\sqrt{d}}}{(1 + r_{f,M})} = \frac{89.60 - 0.5 \cdot \frac{28.65}{\sqrt{70}}}{(1 + 6\%)} = 82.91$$

The (annual) rock-bottom spread ( $rbs$ ) can hence be calculated via a conventional price-to-yield calculation:<sup>114</sup>

$$yield = \frac{\left( \frac{redemption}{100} + \frac{rate}{frequency} \right) - \left( \frac{par}{100} + \left( \frac{A}{E} \cdot \frac{rate}{frequency} \right) \right)}{\frac{par}{100} + \left( \frac{A}{E} \cdot \frac{rate}{frequency} \right)} \cdot \frac{frequency \cdot E}{DSR}$$

where  $A$  is the number of days from the beginning of the coupon period to the settlement date (accrued days),  $E$  the number of days in the coupon period and  $DSR$  the number of days from the settlement date to the redemption date. Subtracting the  $yield_{rbp}$  from the  $yield_{r_{f,M}}$  equals the one-year to maturity rock-bottom spread:

$$AAA \text{ rated: } rbs_M = yield_{rbp} - yield_{r_{f,M}} = 6.00\% - 6.00\% = 0 \text{ bps}$$

$$AA \text{ rated: } rbs_M = yield_{rbp} - yield_{r_{f,M}} = 6.08\% - 6.00\% = 8 \text{ bps}$$

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$$CCC \text{ rated: } rbs_M = yield_{rbp} - yield_{r_{f,M}} = 30.26\% - 6.00\% = 2426 \text{ bps}$$

The model can be extended to longer-maturity bonds by simply repeating the inductive backwards calculation, whereby the final one-year rock-bottom prices  $rbp_M$  serve as input prices for the two-year calculation (adjusted for the annual coupon payment). Now, all possible credit quality changes have to be taken into account, according to the 8-state one-year rating migration matrix. Therefore, the average price across all scenarios two years to maturity  $\mu_{M-1}$  is calculated as follows:<sup>115</sup>

$$AAA \text{ rated: } \mu_{M-1} = \sum_{i=1}^s p_i \mu_i = \begin{pmatrix} 89.20\% \cdot (101.89 + 8.00) \\ 9.69\% \cdot (101.81 + 8.00) \\ \cdot \\ \cdot \\ 0.00\% \cdot (82.91 + 8.00) \\ 0.00\% \cdot (45) \end{pmatrix} = 109.88$$

<sup>114</sup> Standard Excel calculation.

<sup>115</sup> See also Gupton/Finger (1997), p. 29ff.

$$AA \text{ rated: } \mu_{M-1} = \sum_{i=1}^s p_i \mu_i = \begin{pmatrix} 1.03\% \cdot (101.89 + 8.00) \\ 89.31\% \cdot (101.81 + 8.00) \\ \vdots \\ 0.00\% \cdot (82.91 + 8.00) \\ 0.03\% \cdot (45) \end{pmatrix} = 109.78$$

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The price volatility across all the scenarios two years to maturity is calculated as:

$$AAA \text{ rated: } \sigma_{M-1} = \sqrt{\sum_{i=1}^s p_i \mu_i^2 - \mu_{M-1}^2} = \sqrt{\begin{pmatrix} 89.20\% \cdot (101.89 + 8.00)^2 + \\ 9.69\% \cdot (101.81 + 8.00)^2 + \\ \vdots \\ 0.00\% \cdot (82.91 + 8.00) \\ 0.00\% \cdot (45) \end{pmatrix} - 109.88^2} = 0.03$$

$$AA \text{ rated: } \sigma_{M-1} = \sqrt{\sum_{i=1}^s p_i \mu_i^2 - \mu_{M-1}^2} = \sqrt{\begin{pmatrix} 1.03\% \cdot (101.89 + 8.00)^2 + \\ 89.31\% \cdot (101.81 + 8.00)^2 + \\ \vdots \\ 0.00\% \cdot (82.91 + 8.00) \\ 0.03\% \cdot (45) \end{pmatrix} - 109.78^2} = 1.13$$

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Inserting the results into the rock-bottom price equation (1) return the two-year to maturity rock-bottom prices ( $rbp_{M-1}$ ), which then, as demonstrated, can be transformed into the respective rock-bottom spreads ( $rbs_{M-1}$ ):

$$AAA \text{ rated: } rbs_{M-1} = yield_{rbp-1} - yield_{r_f, M-1} = 6.01\% - 6.00\% = 1 \text{ bps}$$

$$AA \text{ rated: } rbs_{M-1} = yield_{rbp-1} - yield_{r_f, M-1} = 6.09\% - 6.00\% = 9 \text{ bps}$$

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$$CCC \text{ rated: } rbs_{M-1} = yield_{rbp-1} - yield_{r_f, M-1} = 26.88\% - 6.00\% = 2088 \text{ bps}$$

This basic valuation approach can now be repeated in order to work out the entire rock-bottom spread term structure of the exemplary 8%, 10-year bond (flat 6% government yield curve).

	1	2	3	4	5	6	7	8	9	10
AAA	0	1	1	2	2	3	3	4	4	5
AA	8	9	9	9	9	10	11	11	12	13
A	0	3	6	9	11	14	17	19	22	24
BBB	27	33	38	44	50	55	60	64	68	72
BB	141	162	179	193	204	212	219	224	228	230
B	589	590	584	575	563	551	539	528	517	507
CCC	2426	2088	1821	1613	1452	1326	1228	1150	1087	1037

**Figure 15:** Rock-bottom spread (bps) by rating and maturity<sup>116</sup>

Interpreting the results in Figure 15 with respect to the shape of the rock-bottom spread term structure exhibits the typical upward sloping character of the high-grade (AAA,AA,A,BBB) credit curve, i.e. the longer the maturity, the higher the rock-bottom spread, because investors require a risk premium, which compensates them for the risk of default. While BB-rated rock-bottom spreads (first non-investment grade rating category) still is upward sloping, with diminishing marginal increases, B- and CCC-rated rock-bottom spread term structures are clearly inverted, i.e. exhibit falling rock-bottom spreads with longer maturities.<sup>117</sup> This phenomenon can be explained by examining the cumulative default probabilities for the different rating categories. The cumulative default probabilities of high-grade bonds rise at an increasing rate over time, whereas the cumulative default probabilities of low-grade bonds rise at a decreasing rate.<sup>118</sup> This phenomenon is primarily attributable to the fact that the credit quality of the non-defaulting low-grade bonds tends to increase over time.

As pointed out before, the rock-bottom spread consists of two components: the breakeven spread (risk-neutral spread), which on average yields the risk-free rate earned on government bonds plus the risk premium (credit component) required by risk averse investors for being exposed to default risk. By setting the information ratio equal to zero in the basic valuation framework, the breakeven spreads result:

	Breakeven spread	Risk premium	Rock-bottom spread
AAA	2	3	5
AA	5	8	13
A	13	11	24
BBB	46	26	72
BB	176	55	230
B	427	80	507
CCC	953	84	1037

<sup>116</sup> Own calculations (see Rock-Bottom Spread Calculator\_Basic), following Rappoport (2001b), p. 6. Note: Running the basic model on current rating migration matrices yields significantly higher rock-bottom spreads, because current rating migration matrices incorporate the 2008 and 2009 credit crisis (reflected by higher default rates).

<sup>117</sup> Rappoport (2001b), p. 6.

<sup>118</sup> See Moody's average cumulative issuer-weighted global default rates, 1920-2009. Emery/Ou (2010), p. 46.

**Figure 16:** *Decomposed rock-bottom spread (bps) of the exemplary 8%, 10-year bond*<sup>119</sup>

One of the advantages of the valuation framework is its great flexibility and transparency. Being able to change all baseline inputs, allows to work out different sensitivity analyses, which exhibit how single features (e.g. coupon, government or recovery rate) contribute to the spread of a bond.<sup>120</sup> Figure 17, for example, shows how the rock-bottom spread of the exemplary 8%, 10-year bond is affected by altering the flat government yield curve. The sensitivity analysis shows that the underlying government yield curve only has a limited effect on rock-bottom spreads. For example, a BB-rated 8%, 10-year bond tightens only 33 bps if the government rate is changed from 1% to 10% and the spread of a B-rated 8%, 10-year bond lowers 95 bps from 553 bps to 458 bps. This is explained by the fact that the entire rock-bottom valuation framework is built around discounted future cash flows, i.e. cash flows from the government bond as well as cash flows from the bond with credit risk are discounted with the same government rate. The higher the discount rate, the lower the discounted future cash flows (rock bottom price) and the lower also the rock-bottom spread.

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
AAA	5	5	5	5	5	5	5	5	5	4
AA	14	14	14	13	13	13	13	13	13	12
A	26	25	25	25	25	24	24	24	23	23
BBB	76	75	75	74	73	72	71	70	69	68
BB	246	244	241	238	234	230	227	222	218	213
B	553	545	537	527	517	507	495	484	471	458
CCC	1186	1159	1130	1100	1069	1037	1003	968	932	895

**Figure 17:** *Sensitivity analysis for different government rate assumptions (rock-bottom spread, bps)*<sup>121</sup>

Against it, Figure 18 shows the effect of different coupon rates on the exemplary 10-year bond (under the assumption of a flat 6% government yield curve). While rising government rates lead to lower rock-bottom spreads, higher coupon rates lead to wider spread levels. This effect is particularly noticeable for low-grade bonds and is attributable to a different reason than the effect of a rising discount rate, i.e. government yield curve. In the event of default, the capital loss on low-coupon bonds is considerably smaller than on high-coupon bonds, because low-coupon bonds have lower cash prices than high-coupon bonds. Therefore, spreads for low-coupon bonds are lower than for high-coupon bonds, i.e. they are more expensive.

<sup>119</sup> Own calculations, following Rappoport (2001b), p. 5.

<sup>120</sup> Goulden/Keenan (2005), p. 21ff.

<sup>121</sup> Own calculations, following Rappoport (2001b), p. 7.

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
AAA	4	5	5	5	5	5	5	5	5	5
AA	11	12	12	12	12	13	13	13	13	14
A	22	23	23	23	24	24	24	24	25	25
BBB	60	62	64	66	68	69	71	72	73	74
BB	170	181	191	201	209	217	224	230	236	242
B	306	342	376	407	435	461	485	507	527	546
CCC	437	534	628	717	803	885	962	1037	1107	1175

**Figure 18:** Sensitivity analysis for different coupon rate assumptions (rock-bottom spread, bps)<sup>122</sup>

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
AAA	62.9	70.3	77.6	85.0	92.3	99.7	107.0	114.3	121.7	129.0
AA	62.6	69.9	77.2	84.5	91.8	99.1	106.4	113.7	121.0	128.3
A	62.0	69.2	76.5	83.7	91.0	98.3	105.5	112.8	120.0	127.3
BBB	59.9	66.9	74.0	81.0	88.0	95.1	102.1	109.1	116.1	123.1
BB	54.4	60.7	66.9	73.1	79.3	85.6	91.8	98.0	104.2	110.4
B	48.4	53.2	58.0	62.8	67.6	72.4	77.2	82.0	86.8	91.6
CCC	43.3	45.8	48.2	50.6	53.0	55.3	57.7	60.1	62.5	64.9

**Figure 19:** Sensitivity analysis for different coupon rate assumptions (rock-bottom price)<sup>123</sup>

If the coupon rate is altered from 1% to 10%, rock-bottom spreads of a B-rated bond experience a widening of 240 bps, CCC-rated bonds even widen 738 bps.

Figure 20 depicts the impact of different recovery rates on the rock-bottom spread of the exemplary 8%, 10-year bond. As expected, higher recovery rates lead to lower rock-bottom spreads, because the residual value in the event of default is higher and therefore the spread the investor requires to be adequately compensated for the possibility of default is lower. Of course, the effect is notably more pronounced for low-grade bonds.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
AAA	8	7	6	6	5	4	4	3	2	2
AA	21	20	18	16	14	12	10	9	7	5
A	41	37	33	30	26	23	19	15	12	8
BBB	122	110	99	88	77	67	56	46	35	25
BB	407	365	325	286	249	212	177	143	110	78
B	990	865	751	647	552	463	381	305	233	166
CCC	2848	2209	1762	1423	1153	930	742	579	436	309

**Figure 20:** Sensitivity analysis for different recovery rate assumptions (rock-bottom spread, bps)<sup>124</sup>

To sum up, this chapter was so far aimed at providing an insight into the basic mechanics of the rock-bottom spread methodology for pricing plain vanilla senior bonds. The pricing of corporate and financial hybrid bond requires an extended model, which is able to price the hybrid specific features,

<sup>122</sup> Own calculations, following Rappoport (2001b), p. 7.

<sup>123</sup> Own calculations, following Rappoport (2001b), p. 7.

<sup>124</sup> Own calculations, following Rappoport (2001b), p. 8.

i.e. subordination, deferral and extension. Although modeling these features adds some complexity, the underlying rock-bottom spread methodology remains the same.

## 4.2 Extended Valuation Framework

As worked out before, most hybrid bonds share in common three key structural features: Subordination, coupon deferral and extension. As it is the case for plain vanilla senior bonds, the cash flows of hybrid bonds are dependent on the financial state of the issuer, represented by the respective issuer rating. Therefore the basic rock-bottom spread methodology can simply be adapted to account for the additional cash flow implications resulting from the three main structural features.<sup>125</sup> Additionally, the developed extension of the model (see Rock-Bottom Spread Calculator\_Hybrid) uses the most recent 18-state average annual migration matrix for European issuers (1985-2009) published by Moody's<sup>126</sup> in order to provide greater pricing granularity (replacing the exemplary 8-state rating migration matrix). The discounting is based on the respective real spot, forward and swap curves (replacing the simplified flat government yield curve assumption).

### 4.2.1 Subordination

Subordination is the first key structural feature, which distinguishes corporate and financial hybrid bonds from senior debt (see chapter 3.1.1 *Subordination*). Due to the fact that hybrid bonds rank just ahead of common equity in the capital structure, in the event of default, the recovery rate of subordinated bonds is considerably lower compared to senior debt. Moody's issuer-weighted average corporate debt recovery rates (1985-2009) exhibit a 31.3% recovery rate for subordinated bonds and 24.7% for junior subordinated bonds.<sup>127</sup> Goulden/Keenan (2005) propose a 0% recovery rate for hybrid bonds, mainly because their entire input assumptions are based on a worst-case scenario. In this context, the authors also refer to the structural similarity between hybrid bonds and preferred shares, which showed an average recovery rate of 6.5% between 1982 and 2003. In their view, setting the recovery rate to 0% for hybrid bonds hence seems justified and not overly pessimistic.<sup>128</sup> By simply adjusting the recovery rate in the basic valuation framework, the adaption and implementation is straight forward. In accordance with Moody's empirical data, the base case for the extended hybrid valuation framework will be a 30% recovery rate. A scenario analysis for different recovery rate assumptions will allow for transparency and make the assumptions debatable.

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<sup>125</sup> Goulden/Keenan (2005), p. 9ff.

<sup>126</sup> Emery (2010), p. 21.

<sup>127</sup> Emery/Ou (2010), p. 6.

<sup>128</sup> Goulden/Keenan (2005), p. 12f.



#### 4.2.2 Deferral

The second key structural feature forces or allows the issuer to defer the contractually agreed coupon payments on a mandatory or optional basis. As outlined before, the rock-bottom spread framework is built around the assumption that the various financial states of a company are represented by its rating (see chapter 3.1.2 *Deferral*). While mandatory coupon deferrals are tied to some predefined financial ratio (the purpose being to ensure cash preservation at a time of financial stress), optional coupon deferral mechanisms are subject to management's discretion and usually linked to dividend restrictions, i.e. the company's ability to make dividend payments to shareholders is linked to coupon payments on hybrid bonds. For modeling purposes, coupon deferral will be linked to the financial state of company, i.e. the trigger for the deferral mechanism depends on the underlying financial state of the company, which in turn can be represented by the assigned issuer credit rating. Goulden/Keenan (2005) point out that linking deferral to rating states is reasonable in particular because of Moody's view that deferral only occurs in case a company is close to default.<sup>129</sup> According to Moody's updated hybrid tool kit of July 2010, non-cumulative coupons and strong or "meaningful" triggers will be given strong equity attribution because they may force coupon deferral in advance of default and therefore fulfill the purpose of being able to ensure cash preservation. Moody's defines "meaningful" triggers as follows:

*"Meaningful" triggers are those that, if breached, result in the suspension of hybrid coupons and provide cash flow relief in a deteriorating financial condition. The triggers are designed to be breached just below the issuer rating crossover point from investment grade to non-investment grade (effectively, the Ba1/Ba2 issuer rating categories)."*<sup>130</sup>

From a modeling perspective, according to Goulden/Keenan (2005), optional coupon deferral (which is cumulative) can be preponderantly neglected because it is highly unlikely that an investment grade company chooses to optionally defer coupon payments (and therewith also dividend payments).<sup>131</sup> Further, since optional coupon deferral mechanisms are cumulative (cash cumulative or ACSM/ non cash cumulative) the actual discounted cash flow impact (around which the whole rock-bottom spread valuation framework is built) is very limited. This is in line with Moody's view that "history shows that the deferral option is not likely to be used".<sup>132</sup> Keenan/Staszewski (2010) emphasize too that issuers historically have been very reluctant to defer hybrid coupons payments because of the negative signaling effect (e.g. TUI, Thomson or Wienerberg maintained coupon payments on their

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<sup>129</sup> Goulden/Keenan (2005), p. 13f.

<sup>130</sup> Havlicek/Ogg (2010), p. 7.

<sup>131</sup> Goulden/Keenan (2005), p. 14.

<sup>132</sup> Dulake/Keenan (2005), p. 5.

hybrids despite dividend suspension).<sup>133</sup> Hence, the extended valuation framework only needs to be adapted for a non-cumulative coupon deferral mechanism. Pursuing a conservative approach, the standard coupon deferral trigger for high-grade issuers could be set, in accordance with Moody's, at the crossover point from investment grade to sub-investment grade, which is Ba1/Ba2. Taking into consideration empirical coupon deferral behavior, however, it can be noted that in practice the loss of investment grade does not necessarily imply coupon deferral, i.e. it is only a potential first step towards it.<sup>134</sup> For example, when Lottomatica was issued (at issuance: Baa3/BBB- on senior level) JPMorgan set the initial coupon deferral trigger at Ba3. Currently, Lottomatica is Ba2 (Moody's long term rating) rated and still well above the mandatory deferral trigger (FCF/interest expense was at 1.8x in 2009 vs. 1.35x required).<sup>135</sup> Wienerberg, another high-yield issuer (Ba1/BB) has suspended dividend payments but still services coupon payments. High yield issuers will though have to be analyzed on a case-by-case basis. From a modeling perspective, setting the deferral trigger at Ba1/Ba2 amounts to a worst-case scenario. For a more realistic assessment, the base case will be around Ba3/B1. As before, the results from the valuation framework will be reconsidered in the light of a scenario analysis for different coupon deferral triggers.

#### 4.2.3 Extension

The issuer's ability to extend the hybrid bond by not calling it is, from a modeling perspective, the most complex feature because the decision of the security being called is influenced by various factors, such as the general state of the credit market, the state of the hybrid market in particular, the replacement language and, above all, the financial state of the company (see chapter 3.1.3 *Extension*). Additionally, in contrast to coupon deferral, there exists no clear-cut down- or upside scenario, which would trigger the call option (such as the breach of a "meaningful" trigger). Simply put, at the end of the non-call period the issuer faces the question of whether it is cheaper to replace the outstanding hybrid by a pari passu security with the same key terms or remain financed according to the terms of the outstanding issue.<sup>136</sup> This means that if the issuer can refinance at cheaper levels than implied by the post-call spread (initial spread + step-up), replacing the outstanding issue is reasonable from an economic point of view. The economic decision to call or not to call thus primarily depends on the future financing cost, e.g. if either future (hybrid) market spreads are tighter in general or the credit quality of the company has improved such that future financing becomes cheaper, the issuer will likely call the existing hybrid bond. Another key aspect very hard to predict remains the moral obligation or pressure to call. While the future state of the credit market is implied by the rat-

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<sup>133</sup> Keenan/Staszewski (2010), p. 17.

<sup>134</sup> Keenan/Goulden (2006), p. 20ff.

<sup>135</sup> Keenan/Goulden (2006), p. 20.

<sup>136</sup> Goulden/Keenan (2005), p. 15ff.

ing migration matrix, the future financial state of the company is modeled as function of its rating, i.e. by setting call triggers, which reflect the possible valuation scenarios. For example, setting the call trigger at A3 for high-grade issuers, as proposed by Goulden/Keenan (2005), implies that the future financing cost is lower than the post-call spread and the bond is called, if the company's issuer rating is A3 or higher. Under the assumption of stable credit spreads going forward,<sup>137</sup> the base case is to set the call trigger equal to Moody's current long term issuer rating, corresponding to low / medium extension risk. The scenario analysis will check for plausibility.

As outlined before, the valuation process starts in the final year before maturity. Working backwards, the rock-bottom prices are calculated on an annual basis and the respective rock-bottom spreads deduced via a conventional price-to-yield calculation. In order to be able to price hybrid bonds based on the rock-bottom spread framework, two separate valuation steps are required, i.e. from a modeling perspective, the "non-call" and the consecutive "call" period need to be separated. Valuing the "non-call" period up to the first call date corresponds to pricing an x-year subordinated fixed rate bond (with deferrable coupon payments), which is callable at the end of the x-year period. After the "non-call" period, the bond is either redeemed or it turns into a (quarterly) callable perpetual instrument. This consecutive "call" period, from a modeling perspective, is represented by pricing a "50 year" subordinated (annually callable) floating rate bond (as an approximation for the perpetual). Having accounted for the three key structural features of hybrid bonds on a conceptual level, the following basic example illustrates how each feature is actually valued according to the rock-bottom spread methodology.

**Baseline inputs:**

Default/Downgrade view:	<i>18-state average annual migration matrix for European issuers (1985-2009)</i> <sup>138</sup>
Recovery rate average:	<i>30%</i>
Coupon deferral:	<i>B1</i>
Call trigger:	<i>A2</i>
Information ratio:	<i>0</i>
Diversity score: <sup>139</sup>	<i>1</i>
Coupon (to call):	<i>5.250% (first call date in 5 years)</i>
Step-up spread:	<i>295 bps</i>
Discount rate:	<i>Full spot curve</i>

<sup>137</sup> Expectations about the future state of the credit market are reflected by the rating migration matrix. Alternative credit views (downswing / upswing etc.) can be factored in via modifications of the rating migration matrix.

<sup>138</sup> The "Withdrawn Ratings, WR" were distributed to the other entries according to Israel et al. (2001), p. 250.

<sup>139</sup> By setting the information ratio to 0 and the diversity score to 1 the risk-neutral breakeven spread is calculated.

Perpetual discount rate: 3.01%  
 Moody's Long Term Rating: A2

For illustration purposes, the rating is assumed to remain stable at A2 over the whole lifespan of the bond (see Figure 21):

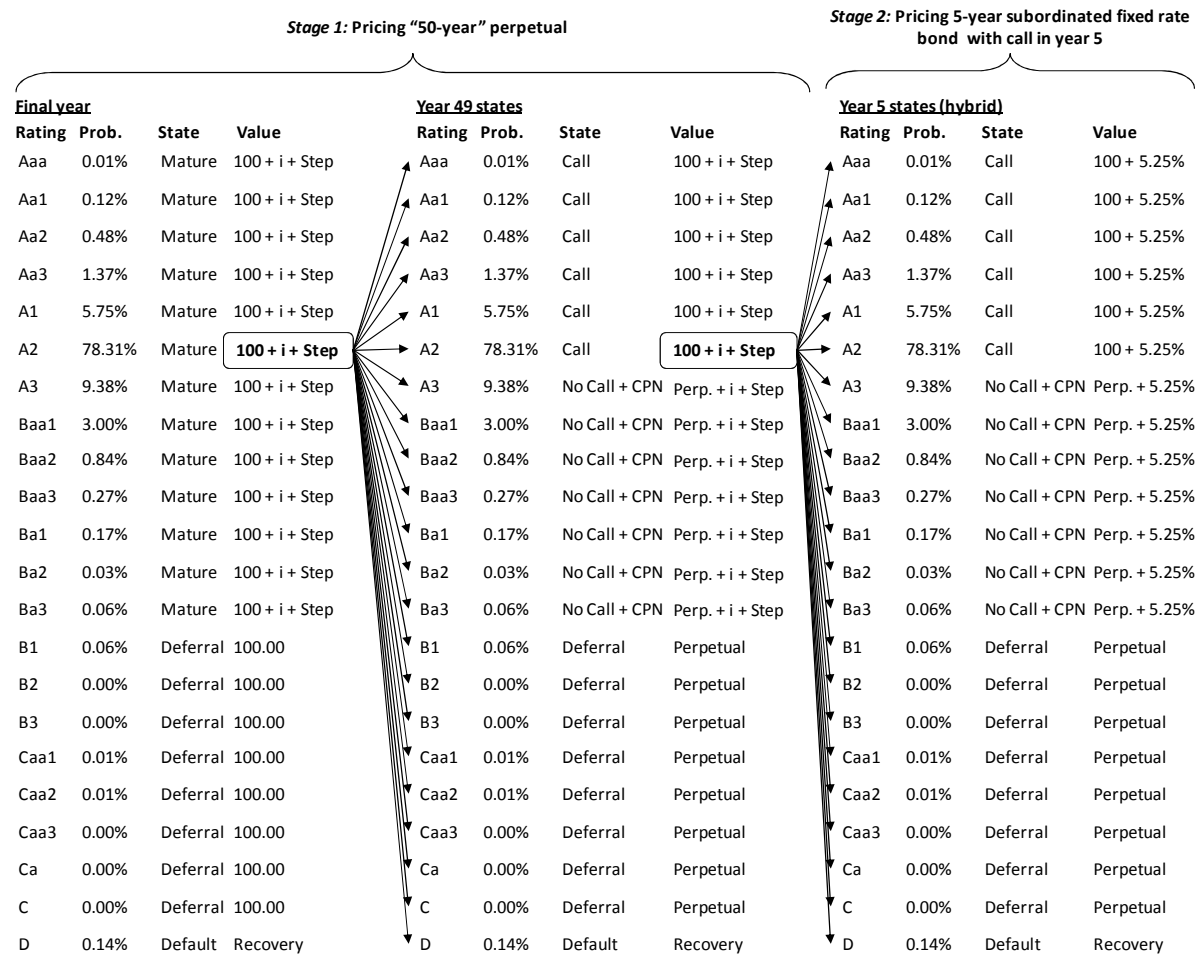


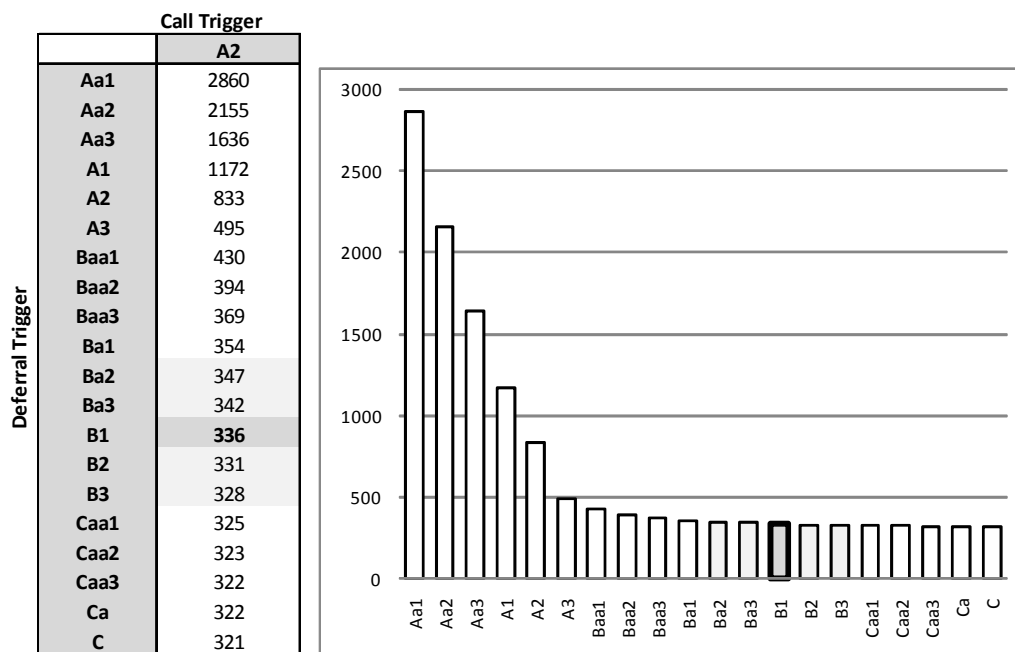
Figure 21: Valuing the hybrid in two stages<sup>140</sup>

In the final year, the possible scenarios and “values in state” (actual cash flows, which are transformed to rock-bottom prices and spreads on an annual basis) the perpetual instrument can take are limited to maturity, deferral and default. Either the bond redeems at “par + LIBOR + step-up spread” (here: 3MO EURIBOR +295 bps) or it hits the B1 coupon deferral trigger and suspends coupon payments. The call feature, of course, is irrelevant in the final year. In the event of default, the value in this scenario amounts to the recovery rate (here: 30). As outlined before, the final year rock-bottom prices are then calculated based on the average values across the various credit scenarios and used as input parameters for the calculations in year 49. Here, also the call trigger comes into play. If the bond hits the call trigger set at A2, it redeems at “par + LIBOR + step-up spread” (3MO EURIBOR +295

<sup>140</sup> Own illustration, following Goulden/Keenan (2005), p. 29ff.

bps). Otherwise, if it doesn't default or defer coupon payments, the values in the state "No call + Coupon" are computed by adding the coupon payments (3MO EURIBOR +295 bps) to the respective rock-bottom prices of the perpetual instrument in the final year. Working backwards, these steps are repeated until the input rock-bottom prices for the second stage, i.e. the last year of the fixed rate hybrid bond, are known. In year 5, the hybrid bond becomes callable for the first time. If called, the bond pays "par + coupon" (here: 5.25%), otherwise it turns into a perpetual. Working further back through the remaining four years is straight forward, as there is no call feature to consider (only deferral).

This concludes the explanatory comments on the extended valuation framework, which now allows to price current hybrid bonds. Before actual hybrids are priced and the results discussed in chapter 5, the following sensitivity analysis will illustrate how the value of the exemplary A2 rated bond (call trigger: A2, deferral trigger: B1) is affected by altering deferral and call triggers.



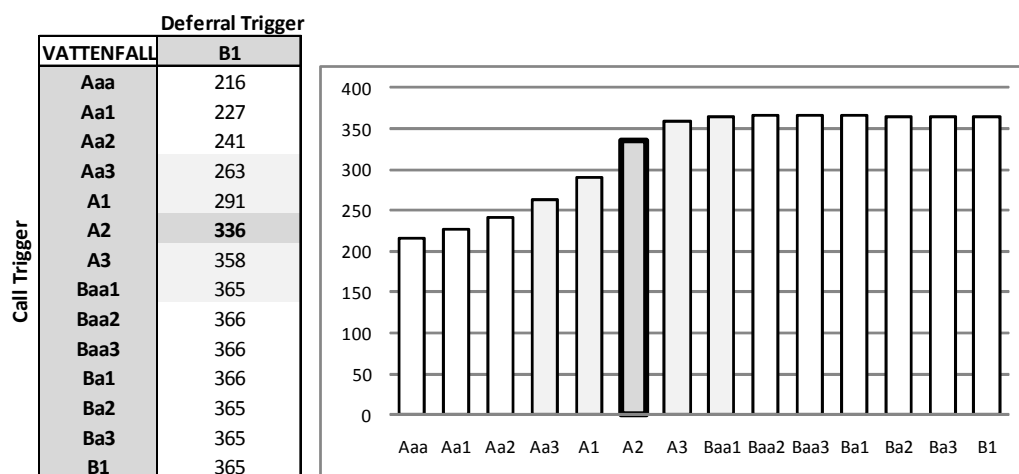
**Figure 22:** Sensitivity to different coupon deferral triggers (rock-bottom spread, bps)<sup>141</sup>

Figure 22 exhibits two interesting interrelations between spread and coupon deferral trigger. First, setting the deferral trigger at high rating levels causes an excessive spread widening, which can be explained by the very high likelihood that the issuer will actually defer coupon payments.<sup>142</sup> For example, if the deferral trigger is set at Aa2 the exemplary A2 rated hybrid bond will defer coupon payments and the low valuation reflects that the bond, if called, will be redeemed at par while not serving coupon payments in between (zero coupon). Second, lowering the deferral trigger below Ba1

<sup>141</sup> Own illustration and calculations, following Goulden/Keenan (2005), p. 22.

<sup>142</sup> Henriques/Goulden (2006), p. 20ff.

only has a marginal impact on the bond's rock-bottom spread because the A2 rated issuer is, as factored in by the rating migration matrix, unlikely to experience deterioration in credit quality to such a great extent. The lower the deferral trigger is set, the lower the rock-bottom spread and the more valuable (and expensive) the hybrid bond becomes to the investor. As seen in Figure 22, a lower bound spread level is reached at around 320 bps. Of course, the impact would be much greater for lower rated bonds. The closer senior rating and deferral trigger come together, the greater the spread sensitivity. From an issuer perspective, the deferral trigger can be regarded as an option to ensure cash preservation at a time of financial stress. Thus, for the exemplary A2 rated issuer the B1 deferral trigger would be an out of the money option and therefore of only little value. The sensitivity analysis to coupon deferral triggers exhibits that lowering the coupon deferral trigger from Ba1 to B1 only leads to a spread tightening of 18 bps whereas lowering the trigger from A3 to Ba1 would impact the fair value spread by 140 bps.



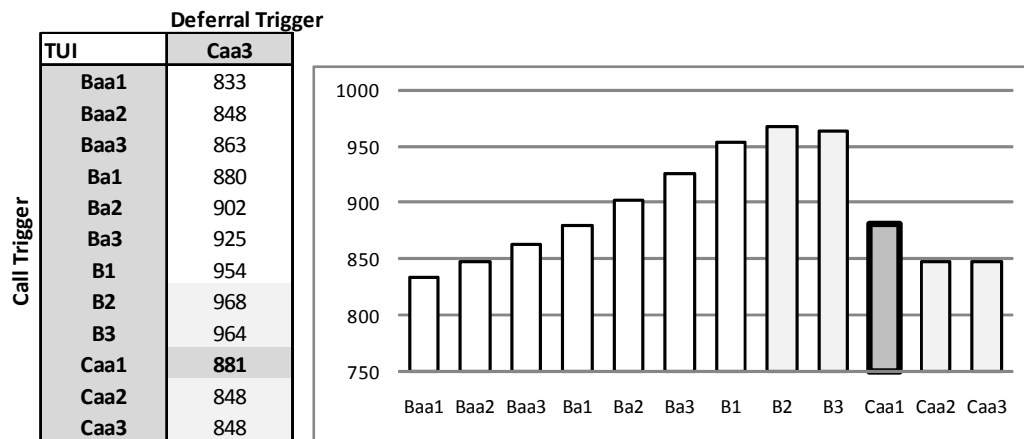
**Figure 23:** Sensitivity of high grade issues to call triggers (rock-bottom spread, bps)<sup>143</sup>

Figure 23 depicts the spread sensitivity of the exemplary A2 rated bond to changes in the call trigger rating. Contrary to coupon deferral, which undisputedly negatively impacts the value of a bond the higher the deferral trigger is set (from an investor perspective), bond extension has the opposite effect on the exemplary A2 rated bond.<sup>144</sup> The higher the call trigger is set the lower becomes the absolute rock-bottom spread level. This can be explained by the therewith associated high degree of certainty that the bond will not be called, i.e. it will extend at the first call date. Given the high issuer rating, the bond becomes a very valuable perpetual security with high cash flows (step-up spread) and a low probability of default. Setting the call trigger to Aaa, for example, corresponds to pricing a perpetual bond. On the other hand, low call triggers (unrealistic in practice) serve as insurance against default, because the bond would be called before actually defaulting. In Figure 23 and upper bound

<sup>143</sup> Own illustration and calculations, following Goulden/Keenan (2005), p. 24.

<sup>144</sup> Henriques/Goulden (2006), p. 23f and Goulden/Keenan (2005), p. 23.

spread level is reached at around 365 bps. Of course, the latter effect is much more pronounced for lower rated bonds (for example Caa1). As can be seen in Figure 24, the low call trigger prevents the bond from defaulting. Although unrealistic in practice, this example is very well suited for demonstrating the rock-bottom spread mechanism.



**Figure 24:** Sensitivity of low grade issues to call triggers (rock-bottom spread, bps)<sup>145</sup>

<sup>145</sup> Own illustration and calculations, following Goulden/Keenan (2005), p. 24.

## 5 Pricing Hybrid Bonds

The last chapter is aimed at analyzing the results from the extended rock-bottom spread framework. Having applied the valuation framework to a number of currently outstanding European corporate hybrids, the computed fair values in terms of rock-bottom spread levels can now be compared to currently prevailing market spread levels (measured against the respective government benchmark). While market spreads are also driven by investor sentiment, the valuation framework objectively quantifies fundamental data and implied credit returns and translates these input parameters into a fair value spread. Therefore, the valuation framework allows for a transparent and market independent assessment, whereas the market potentially over- or understates the associated underlying credit risk. In case the observed market spread falls short of the computed rock-bottom spread, the investor is not properly compensated for the inherent credit risks. If market spread levels exceed the respective rock-bottom spread levels, then the hybrid tends to trade cheaply. The relative value is determined by subtracting the prevailing market spread level from the rock-bottom spread level.<sup>146</sup>

### 5.1 Data and Results

The selected euro-denominated hybrid corporate bonds can be characterized as being a representative sample of the current corporate hybrid universe (in terms of the various hybrid features, ratings, maturities etc).

#### **Baseline inputs:**

Default/Downgrade view:	<i>18-state average annual migration matrix for European issuers (1985-2009)</i> <sup>147</sup>
Recovery rate average:	30%
Coupon deferral: <sup>148</sup>	B1
Call trigger:	<i>Set at Moody's long term rating</i>
Information ratio:	0
Diversity score: <sup>149</sup>	1
Discount rate:	<i>Full Euro benchmark index (comprises euro-denominated fixed-rate French and German government bonds)</i>
Rate at call:	<i>Full 3, 6 or 12 month forward Euribor rate (or, where applicable, forward 5 year Euro SWAP rate)</i>

<sup>146</sup> Cheap < -50 bps; -50 bps < Fair < 50 bps; Dear > 50 bps.

<sup>147</sup> The "Withdrawn Ratings, WR" were distributed to the other entries according to Israel et al. (2001), p. 250.

<sup>148</sup> From a modeling perspective, setting the deferral trigger at Ba1/Ba2 amounts to a worst-case scenario. For a more realistic assessment, the base case is set at B1. See chapter 4.2.2 *Deferral*.

<sup>149</sup> By setting the information ratio to 0 and the diversity score to 1 the risk-neutral breakeven spread is calculated.



Figure 25 and Figure 26 summarize the results from the valuation framework. At first sight, the overview reveals the overall plausibility and robustness of the rock-bottom spread valuation methodology. Taking into account that all input parameters and base case assumptions used for the valuation are purely based on credit fundamentals, the computed rock-bottom spread levels are to a considerable degree in line with prevailing market spreads (market spreads and rock-bottom spreads exhibit a correlation coefficient of 0.85).

Hybrid Issuer	Coupon	Step-up Spread	Call dates	Moody's LTR	Market Spread	RBS	Delta	Deferral	Call
BAYER AG	5.00%	€+280	29.07.2015	A3	324	339	15	B1	A3
DONG ENERGY A/S	5.50%	€+320	29.06.2015	Baa1	323	387	63	B1	Baa1
HENKEL AG & CO KGAA	5.38%	€+285	25.11.2015	A3	280	363	83	B1	A3
LINDE FINANCE BV	6.00%	€+337.5	03.07.2013	A3	329	430	101	B1	A3
LOTTOMATICA SPA	8.25%	€+505	31.03.2016	Baa3	687	598	-89	B1	Baa3
REXAM PLC	6.75%	€+290	29.06.2017	Baa3	569	501	-68	B1	Baa3
RWE AG	4.63%	5Y swaps+265 / €+365	28.09.2015 / 28.09.2020	A2	361	281	-80	B1	A2
SCOTTISH & SOUTHERN ENER	5.03%	5Y swaps+315 / €+415	01.10.2015 / 01.10.2020	A3	382	321	-60	B1	A3
SIEMENS FINANCIERINGSMAT	5.25%	€+225	14.09.2016	A1	280	328	48	B1	A1
SOLVAY FINANCE FRANCE	6.38%	€+335	02.06.2016	Baa2	372	465	93	B1	Baa2
SUEDZUCKER INT FINANCE	5.25%	€+310	30.06.2015	Baa2	480	392	-88	B1	Baa2
SUEZ ENVIRONNEMENT	4.82%	5Y swaps+290 / €+390	21.09.2015 / 21.09.2020	A3	333	310	-23	B1	A3
TUI AG	8.63%	€+730	30.01.2013	Caa1	738	881	143	Caa3	Caa1
VATTENFALL AB	5.25%	€+295	29.06.2015	A2	324	336	13	B1	A2
VINCI SA	6.25%	€+375	13.11.2015	Baa1	392	429	37	B1	Baa1
WIENERBERGER AG	6.50%	€+325	09.02.2017	Ba1	688	550	-138	B1	Ba1

Figure 25: Results from the valuation framework<sup>150</sup>

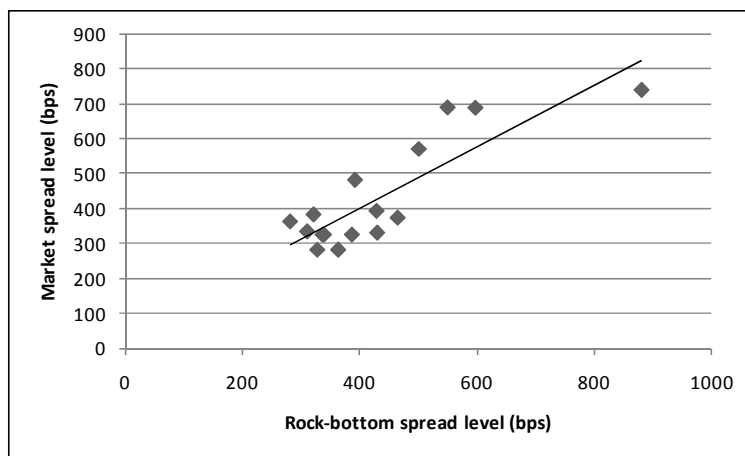
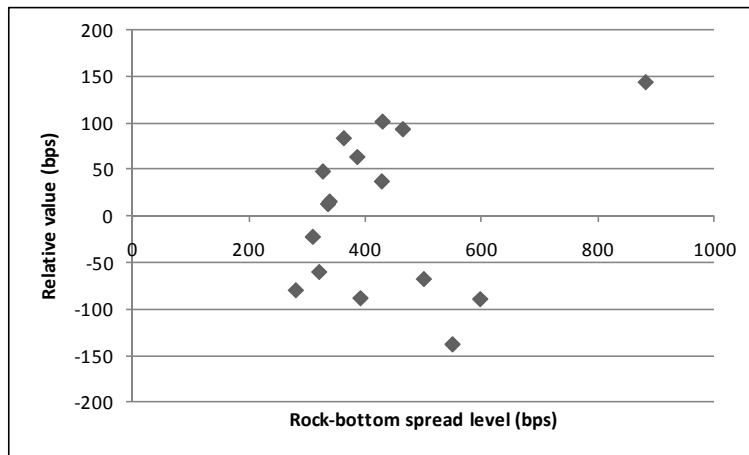


Figure 26: Rock-bottom spreads vs. market spreads<sup>151</sup>

Further, there seems to be no obvious built-in model bias (e.g. dearness or cheapness being dependent on the absolute spread level) or skewness (e.g. only cheap valuation results). For example, the RWE hybrid tends to trade 80 bps cheap (absolute RBS level: 281 bps) whereas TUI's hybrid is 143 bps dear (absolute RBS level: 881 bps). Figure 27 plots the excess returns (rock-bottom spread minus market spread) against the absolute spread level.

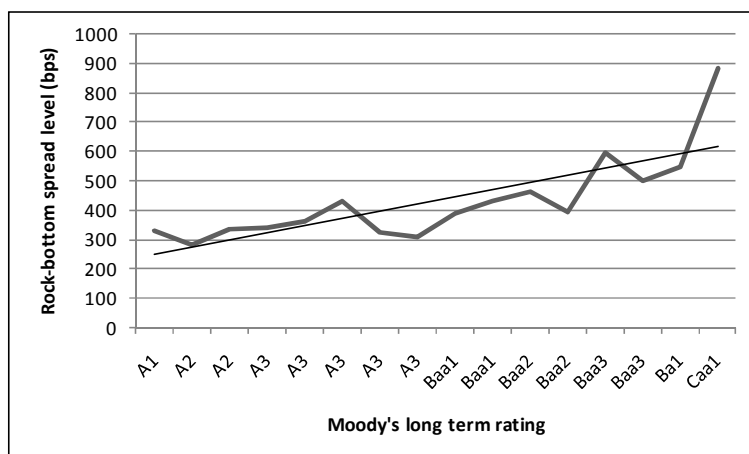
<sup>150</sup> Own illustration and calculations, valuation as of 08.12.2010. All presented results can be reproduced (see enclosed CD). Instructions for applying the model are to be found in the appendix.

<sup>151</sup> Own illustration and calculations.



**Figure 27:** Relative value (rock-bottom spread minus market spread) against absolute spread level<sup>152</sup>

The strong reliance of the valuation framework on the underlying credit rating is clearly revealed by Figure 28. The initial long term ratings, which consequently determine the probability distribution of the discounted cash flows (as implied by the rating transition matrices), are the main driver behind the rock-bottom spread methodology.



**Figure 28:** Rock-bottom spreads vs. Moody's long term rating<sup>153</sup>

One trend indicated by the results in Figure 25 is that higher rated issuers tend to trade fair to dear relative to the computed rock-bottom spread (except for the recently issued corporate hybrids in the utility sector featuring the dual-call structure), whereas lower rated issuers (below Baa2) appear cheap. On average A rated issuers (excluding RWE, SCOTTISH & SOUTHERN and SUEZ) are 52 bps dear (median: 48 bps) and BBB rated issuers 9 bps cheap (median: 16 bps). Hence, the implied probability of credit quality deterioration (extension risk and probability of coupon deferral) by the valuation framework tends to be higher than perceived by market participants. For lower rated high grade issuers (Baa2, Baa3) the opposite holds: The market tends to assess a higher likelihood for credit

<sup>152</sup> Own illustration and calculations, following Henriques/Goulden (2006), p. 21.

<sup>153</sup> Own illustration and calculations.

quality deterioration than actually objectively implied by the underlying rating migration matrix. Low grade names (such as Wienerberg and TUI) show a larger dispersion of excess returns as it becomes more difficult for market participants to evaluate the fair value. As indicated, the recently seen double-call structure (RWE, Scottish & Southern and Suez) has a favorable impact on the absolute rock-bottom spread level. All three bonds tend to trade cheaply compared to prevailing market spreads, also intensified by the latest sell-off across the newly issued corporate hybrids (mainly attributable to challenging technicals). From a fundamental credit risk perspective, RWE's hybrid is 80 bps cheap and the fair value rock-bottom spread of the Scottish & Southern and Suez Environnement hybrid falls short 60 bps and 23 bps, respectively, of current market levels. The direct comparison with similar rated hybrid bonds further reveals that these issues are also cheap in absolute terms, i.e. fundamentally, a higher market price would be justified. Note that the lower fair spread levels of RWE, Scottish & Southern and Suez are solely attributable to the underlying credit fundamentals, i.e. the double-call structure in this case (as the model does not account for different industries etc). The structure itself provides a strong incentive for the issuer to call the bond at the first call date, due to the subsequent long 5 year high spread non-call period (irrespective of RCC language).

Hybrid Issuer	Coupon	Step-up Spread	Call dates	Moody's LTR	Market Spread	RBS	Delta	Deferral	Call
SIEMENS FINANCIERINGSMAT	5.25%	€+225	14.09.2016	A1	280	328	48	B1	A1
<b>RWE AG</b>	<b>4.63%</b>	<b>5Y swaps+265 / €+365</b>	<b>28.09.2015 / 28.09.2020</b>	<b>A2</b>	<b>361</b>	<b>281</b>	<b>-80</b>	<b>B1</b>	<b>A2</b>
VATTENFALL AB	5.25%	€+295	29.06.2015	A2	324	336	13	B1	A2
BAYER AG	5.00%	€+280	29.07.2015	A3	324	339	15	B1	A3
HENKEL AG & CO KGAA	5.38%	€+285	25.11.2015	A3	280	363	83	B1	A3
LINDE FINANCE BV	6.00%	€+337.5	03.07.2013	A3	329	430	101	B1	A3
<b>SCOTTISH &amp; SOUTHERN ENER</b>	<b>5.03%</b>	<b>5Y swaps+315 / €+415</b>	<b>01.10.2015 / 01.10.2020</b>	<b>A3</b>	<b>382</b>	<b>321</b>	<b>-60</b>	<b>B1</b>	<b>A3</b>
<b>SUEZ ENVIRONNEMENT</b>	<b>4.82%</b>	<b>5Y swaps+290 / €+390</b>	<b>21.09.2015 / 21.09.2020</b>	<b>A3</b>	<b>333</b>	<b>310</b>	<b>-23</b>	<b>B1</b>	<b>A3</b>

**Figure 29: Price impact of the new double-call structure**<sup>154</sup>

The difference to the conventional 10 year non-call period becomes even more evident when e.g. looking at the Linde or Henkel hybrid. The high coupons and step-up spreads increase the uncertainty with regard to the extension risk (higher absolute rock-bottom spread levels). Both bonds trade at a premium (Linde: 103.6 and Henkel: 101.0), which makes them unattractive if they are actually called at the first call date because the early redemption leaves the investor with the loss of the high coupon payments. In contrast, RWE (96.7), Scottish & Southern (97.0) and Suez (96.0) all trade at a discount. This is also reflected by the significantly lower yield to call of e.g. Henkel (A3, first call 2015, yield to call: 4.68%) compared to Scottish & Southern (A3, first call 2015, yield to call: 5.63%), Suez (A3, first call 2015, yield to call: 5.30%) or even fairly valued Bayer (A3, first call 2015, yield to call: 5.12%). The basic principle is that callable premium bonds return the smallest yield if called at the earliest call date, whereas discount bonds return the smallest yield if not called before maturity. The following scenario analyses for different call and deferral triggers illustrate how each feature contributes to the pricing of discount and premium corporate hybrids. Figure 30 exhibits the typical pricing

<sup>154</sup> Own illustration and calculations.

pattern of a high grade bond trading at a premium (Linde: 103.6). Linde's hybrid has a yield to call of 4.25% and a yield to maturity of 4.45%. Given the bond keeps its A3 rating until the first call date (2013) it will be called and the investor loses the high 6.00% coupon and the post-call step-up of 337.5 bps above 3 month Euribor. The high absolute rock-bottom spread level of 430 bps reflects this unfavorable, but likely outcome (implied by the underlying rating migration matrix). If the call trigger is lifted to A2 (and the deferral trigger kept at B1) the spread tightens 67 bps to 363 bps even 116 bps to 314 bps if set at A1. As outlined before, the higher the call trigger is set in case of a high grade bond trading at a premium, the lower the absolute rock-bottom spread level, because the bond will then most likely not be called at the first call date and turn into a valuable perpetual security with a low probability of default and a high cash flows. Changing the deferral trigger from B1 to Ba2 only marginally affects the valuation (fair spread level widens 11 bps from 430 bps to 441 bps).

Description		Deferral Trigger					
Issuer:	<b>LINDE FINANCE BV</b>	<b>LINDE</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>Ba3</b>	<b>Ba2</b>
ISIN:	XS0171231060	A1	298	304	314	325	336
Call Date:	03.07.2013	A2	349	355	363	373	382
Coupon:	6.00%	A3	422	425	<b>430</b>	436	441
Step-up:	€+337.5 bps	Baa1	440	442	445	448	451
Call Trigger:	A3	Baa2	447	448	449	451	452
Deferral Trigger:	B1						
Long Term Rating:	A3						
Instrument Rating:	Baa2						
Equity Credit:	Basket C / Intermediate						
Current spread:	329						
Rock-bottom spread:	430						
<b>Dear</b>	<b>101</b>						

**Figure 30: Scenario analysis: Linde**<sup>155</sup>

On the other hand, hybrid bonds trading at a discount (Rexam: 93.1) exhibit a different sensitivity to call trigger changes, because they return the smallest yield if not called before maturity. Rexam's hybrid has a yield to call of 8.05% and a yield to maturity of 5.18%. Therefore, the bond gets more valuable if the call trigger is lowered from Baa3 to Ba2 (spread tightens 11 bps).

Description		Deferral Trigger					
Issuer:	<b>REXAM PLC</b>	<b>REXAM</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>Ba3</b>	<b>Ba2</b>
ISIN:	XS0307868744	Baa1	449	467	493	526	557
Call Date:	29.06.2017	Baa2	464	480	502	530	556
Coupon:	6.75%	Baa3	469	482	<b>501</b>	525	546
Step-up:	€+290 bps	Ba1	468	479	495	514	532
Call Trigger:	Baa3	Ba2	467	476	490	505	532
Deferral Trigger:	B1						
Long Term Rating:	Baa3						
Instrument Rating:	Ba2						
Equity Credit:	Basket C / Intermediate						
Current spread:	569						
Rock-bottom spread:	501						
<b>Cheap</b>	<b>-68</b>						

**Figure 31: Scenario analysis: Rexam**<sup>156</sup>

<sup>155</sup> Own illustration and calculations.

Lifting the coupon deferral trigger from B1 to Ba2, the result is even more pronounced because the likelihood of coupon deferral increases. Lowering the call trigger from Baa3 to Ba2 now implies a spread tightening of 14 bps and if the call trigger is lifted to Baa1, spreads even widen by 10 bps. This is due to the fact that in this scenario, the bond will most likely be extended (at a moderate coupon step-up for a Baa3 rated issuer) while additionally facing increased coupon deferral probability.

To sum up, the analysis of the valuation results shows that the extended valuation framework allows to price current hybrid bonds by objectively and transparently quantifying the inherent credit risk, i.e. fundamental data and credit returns. By comparing the current level of market spread and the calculated rock-bottom spread level, the relative cheapness or dearness can be determined. What remains to be answered (in a potential subsequent study) is whether the derived relative values can be used as trading signals, for example that over time, market spreads tend to mean revert towards the fundamentally justified rock-bottom spread.<sup>157</sup>

## 5.2 Model Critique

The strength of the rock-bottom spread valuation framework clearly lies in the fact that it is entirely based on a discounted cash flow approach. This offers great flexibility as basically any stream of cash flow subject to credit risk can be replicated and valued.<sup>158</sup> The valuation framework was, for example, relatively easily adjusted to being able to model the cash flows of the recently issued hybrid bonds in the new “double call” structure format. Further, as rock-bottom spreads are entirely independent from market spreads, the fundamentally justified (implied through the credit rating migration matrix) fair value can be determined, irrespective of sentiment. Built around relatively few assumptions, the model needs only limited information with regard to the issuer’s credit quality. The strongest assumption of the rock-bottom spread methodology is that the underlying financial state of a company can be represented by the issuer credit rating. Changes in the credit quality of an issuer are implied by rating migration matrices and, as also the coupon deferral trigger and the call trigger are likewise directly linked to the credit rating, the implications on the rock-bottom spread are quite significant. The academic literature is ambivalent with regard to the information content of credit ratings. Although various papers find that credit ratings contain information relevant for pricing, others emphasize that ratings may be inadequate pricing mechanisms.<sup>159</sup> Especially withdrawn ratings

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<sup>156</sup> Own illustration and calculations.

<sup>157</sup> Keenan and Goulden (2006) found that the most stable hybrids analyzed indeed exhibited some pattern of mean-reversion. They note, however, that the mean level is mostly above the rock-bottom spread. See Keenan/Goulden (2006), p. 19.

<sup>158</sup> Rappoport (2001b), p. 11.

<sup>159</sup> John et al. (2010), p. 489f.

can have a detrimental effect on the accuracy of a valuation framework based on credit ratings as input factor. In case a rating is withdrawn, the company gets excluded from the rating pool and the information is lost. Additionally, credit migration matrices are subject to certain estimation errors (e.g. sampling error). Gupton and Finger (1997) argue, however, that in the long-run any inconsistencies are mitigated.<sup>160</sup> Therefore, it can be argued that the applied 18-state average annual migration matrix for European issuers (1985-2009) should exhibit a sufficiently stable long-term behavior with regard to credit quality changes over time.

The maybe most serious disadvantage of the rock-bottom spread valuation framework (and any other quantitative approach) is that a quantitative description of the underlying credit fundamentals is not possible in any case. For example, call and deferral features can only be roughly approximated (link to the financial state of the company via the credit rating). In reality, such decisions are dependent on various exogenous factors not captured by the model (e.g. moral obligation to call, reputation).

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<sup>160</sup> Gupton/Finger (1997), p. 25 and p. 70.

## 6 Summary and Conclusion

To sum up, the first theoretical building block of the thesis elaborated a conclusive and comprehensive definition of corporate and financial hybrid bonds, resulting in a clear-cut delimitation from other hybrid securities. Hybrid bonds have in common that they offer the advantage of being tax-deductible (debt-like cost of capital) while containing equity-like features owing to which credit rating agencies grant them partial equity credit. The three key structural features of hybrid bonds were then presented and discussed. Holders of hybrid bonds are subordinated in the case of default and often rank just ahead of common equity in the capital structure. Therefore, subordinated bonds exhibit significantly lower recovery rates in the event of liquidation than senior debt, a structural risk the investor needs to be compensated for. The higher yield spread on hybrid bonds can thus be partly interpreted as the premium paid to the holder of the bond for the higher loss incurred given a default. The second key structural feature of hybrid bonds is the issuer's option to defer coupon payments, which provides the issuer with the needed flexibility to preserve cash in case of financial stress. Mandatory deferral triggers are more credit supportive because even after a deterioration of credit quality, management may be reluctant to optionally defer coupon payments (reputation). Hybrid bonds usually exhibit very long maturities (from at least 30 years up to perpetual) combined with an issuer call option after five to ten years. It was shown that from an issuer's perspective, the debt and equity-like characteristics of hybrid bonds allow to enhance a company's credit profile because hybrid financing offers a flexible alternative with regard to the composition of the capital structure and funding strategies. Since pure debt refinancing or debt acquisition financing regularly leads to a deterioration of the issuer's credit quality and thus pressure on the credit rating, hybrid financing tends to ease these negative effects. From an investor's point of view, hybrid bonds offer an attractive risk and return profile, especially in a low yield environment. The main incentive for investing in hybrid bonds results from the considerable yield pick-up compared to senior debt. However, an investor on the other hand also incurs the risk implied by the key structural features: subordination, deferral and extension risk. Therefore, it is of utmost importance to conduct a thorough risk evaluation process on an issuer level when investing in hybrid bonds. In recent years, hybrid bonds have become an established asset class among institutional investors. As outlined, combination of debt and equity-like characteristics of hybrid instruments contributes significantly to the attractiveness of the asset class from an issuer perspective. Since 2005, the rating agency treatment of hybrid capital has become a core issue in structuring hybrid bonds, i.e. at most, the issue qualifies for tax deductibility by containing debt-like characteristics while at the same time exhibiting enough equity-like features to merit the most equity credit possible. Moody's and S&P use an analytical framework for evaluating corporate and financial hybrids and take a holistic approach in assessing equity content by

considering the overall effect of hybrid capital on an issuer's credit profile. At the same time, the rating agencies also pay close attention to individual instrument features.

The second part of the thesis focused on the practical implementation and extension of the rock-bottom spread valuation framework. Based on a quantitative description of the underlying credit fundamentals, credit returns and the risk tolerance of the investor the model computed the rock-bottom spread, representing the lowest spread (reservation spread) at which an investor should be willing to bear the fundamental credit risk associated with holding credit instruments. The methodology is built around the assumption that investors require a risk premium (extra return above a risk-free government rate), which compensates them for the structural risks incurred. At first, a basic rock-bottom spread valuation framework was replicated and consequently adapted and extended in order to be able to model and price the additional cash flow implications resulting from the three main structural features, i.e. subordination, deferral and extension. The developed valuation framework, based on JPMorgan's rock-bottom spread approach, finally allowed to price current corporate hybrids by objectively and transparently quantifying the inherent credit risk. Finally, comparing the current level of market spread and the computed rock-bottom spread level returned the relative cheapness or dearness.

As already pointed out in the introduction, an in-depth analysis of financial hybrids went beyond the scope of this thesis. Owing to the great flexibility of the rock-bottom spread approach, however, the model can be adapted and applied to bank hybrid capital - opening up an interesting research field for a potential subsequent study.



**References**

- Altman, E.I., Brady, B., Resti, A. and Sironi, A. (2005):** The Link between Default and Recovery Rates: Theory, Empirical Evidence and Implications. In: *Journal of Business* 78, pp. 2203-2227.
- Altman, E.I. and Karlin, B.J. (2010):** Defaults and Returns in the High-Yield Bond and Distressed Debt Market: The Year 2009 in Review and Outlook. *Special Report*.
- Arak, M. and Martin, L.A. (2005):** Convertible Bonds: How Much Equity, How Much Debt? In: *Financial Analysts Journal* 61, p. 44-50.
- Arnt, H. and Hovard, T. (2010):** Hybrid Bank Capital: Features and Treatment by Regulators and Rating Agencies. *Investment Research, Danske Markets*.
- Barclay, M.J. and Smith, C.W. (1995):** The Priority Structure of Corporate Liabilities. In: *The Journal of Finance* 50, pp. 899-916.
- Bichler, U.W. and Hancock, D. (2003):** What does the yield on subordinated bank debt measure?. *Working Paper*.
- Chincarini, L.B. (2007):** Another look at the information ratio. In: *Journal of Asset Management* 8, pp. 284-295.
- Dulake, S. and Keenan, O. (2005):** All you ever wanted to know about corporate hybrids but were too afraid to ask. *Investment Research, JPMorgan*.
- Emery, K. (2010):** European Corporate Default and Recovery Rates, 1985-2009. *Investment Research, Moody's Investor Service*.
- Emery, K. and Ou, S. (2010):** Corporate Default and Recovery Rates, 1920-2009. *Investment Research, Moody's Investor Service*.
- Felsenheimer, J., Gisdakis, P. and Zaiser, M. (2006):** Active Credit Portfolio Management: A Practical Guide to Credit Risk Management Strategies. *Wiley*.
- Goulden, J. and Keenan, O. (2005):** A Framework for Pricing Corporate Hybrids: Introducing a Rock-Bottom Spread Framework for Finding the 'Fair Value' Price of Corporate Hybrids. *Investment Research, JPMorgan*.
- Goulden, J. and Keenan, O. (2005b):** JPM's Framework for Pricing Corporate Hybrids: Questions and Answers on our Rock-bottom Pricing Model. *Investment Research, JPMorgan*.
- Gupton, G.M. and Finger, Ch.C. (1997):** CreditMetrics: Technical document. *RiskMetrics Group*.
- Graham, B. and Dodd, D. (2008):** Security Analysis: Principles and Technique. *McGraw-Hill*.

- Havlicek, B. and Ogg, M. (2009):** Moody's Guidelines for Rating Bank Hybrid Securities and Subordinated Debt. *Investment Research, Moody's Investor Service.*
- Havlicek, B. and Ogg, M. (2010):** Revisions to Moody's Hybrid Tool Kit. *Investment Research, Moody's Investor Service.*
- Havlicek, B. and Ogg, M. (2010b):** Frequently Asked Questions: Revisions to Moody's Hybrid Tool Kit. *Investment Research, Moody's Investor Service.*
- Henriques, R. and Goulden, J. (2006):** A Framework for Valuing Financial Hybrids: Introducing and Applying our Hybrids Valuation Framework to Bank Tier I Debt. *Investment Research, JPMorgan.*
- Hjort, V. et al. (2010):** Global Credit Strategy: Perpetuals in Motion. *Investment Research, Morgan Stanley.*
- Israel, R.B., Rosenthal, J.S. and Wei, J.Z. (2001):** Finding Generators for Markov Chains via Empirical Transition Matrices, with Applications to Credit Ratings. In: *Mathematical Finance 11*, pp. 245-265.
- Israelsen, C. L. (2004):** A refinement to the Sharpe ratio and information ratio. In: *Journal of Asset Management 5*, pp. 423-427.
- John, K., Ravid, A. and Reisel, N. (2010):** The Notching Rule for Subordinated Debt and the Information Content of Debt Rating. In: *Financial Management 39*, pp. 489-513.
- Keenan, O. and Goulden, J. (2006):** European Corporate Hybrids: "Don't Look Back in Anger". *Investment Research, JPMorgan.*
- Keenan, O. (2010):** European Corporate Hybrids: A new generation of hybrids beckons. *Investment Research, JPMorgan.*
- Keenan, O. and Staszewski, R. (2010):** European Corporate Hybrids: All you ever wanted to know about corporate hybrids. *Investment Research, JPMorgan.*
- Kish, J. R. and Livingston, M. (1992):** Determinants of the call option on corporate bonds. In: *Journal of Banking and Finance 16*, pp. 687-703.
- Kleindienst, Ch. (2007):** Corporate Hybrid Debt. A Long-term Funding Alternative. *Investment Research, UniCredit.*
- Kleindienst, Ch. (2010):** New Hybrid Wave in the Utility Sector. *Investment Research, UniCredit.*
- Kreitmair, S. and Kleindienst, Ch. (2010):** Corporate Hybrid Bonds: To call or not to call, that is the question. *Investment Research, UniCredit.*

- Kreitmair, S. and Kleindienst, Ch. (2010b):** Corporate Hybrid bonds: Market update 1H10. *Investment Research, UniCredit.*
- Kreinin, A. and Sidelnikova, M. (2001):** Regularization Algorithms for Transition Matrices. In: *Algo Research Quarterly 4*, pp. 23-39.
- Larsen, P.T. and Magnussen, J. (2010):** Corporate Hybrid Capital: Exploring the debt/equity continuum. *Investment Research, Danske Markets.*
- Leland, H.E. (1994):** Corporate Debt Value, Bond Covenants, and Optimal Capital Structure. In: *The Journal of Finance 49*, pp. 1213-1252.
- Leland, H.E. and Toft, K.B. (1996):** Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads. In: *The Journal of Finance 51*, pp. 987-1019.
- Mauro, M. (2010):** Preferred Securities Quarterly Guide. *Investment Research, Bank of America Merrill Lynch.*
- Mauro, M. and Chesnicka, M. (2010):** Primer on credit ratings and capital structure. *Investment Research, Bank of America Merrill Lynch.*
- Modigliani, F. and Miller, M.H. (1958):** The cost of capital, corporation finance and the theory of investment. In: *The American Economic Review 48*, pp. 261-297.
- Rappoport, P. (1999):** Valuing Credit Fundamentals: Rock-Bottom Spreads. *Investment Research, JPMorgan.*
- Rappoport, P. (2001):** Rock-Bottom Spreads. *Investment Research, JPMorgan.*
- Rappoport, P. (2001b):** Rock-bottom spread mechanics. *Investment Research, JPMorgan.*
- Ryan, K., Ross, J. and Yen, J. (2010):** The New Wave of Hybrids - Rethinking the Optimal Capital Structure. In: *Journal of Applied Corporate Finance 19*, pp. 56-64.
- Ryll, M. (2009):** Difficult Conditions for Corporate Hybrids - What is Important in These Times?. *Investment Research, LBBW.*
- Ryll, M. (2010):** Are Corporate Hybrids set for a revival?. *Investment Research, LBBW.*
- Ryll, M. (2010b):** Emancipation of Corporate Hybrids. *Investment Research, LBBW.*
- Schäffer, R. (2007):** Bankhybride – Klassifizierung aus aufsichtsrechtlicher Sicht. *Investment Research, LBBW.*
- Shah, T., Hampden-Turner, M. and King, M. (2008):** Hitting rock bottom: Comparing spreads to fundamentals. *Investment Research, Citigroup.*

---

**Sparrow, J., Maurer, B. and Albrecht, R. (2007):** Corporate Hybrids: Still Evolving. *Investment Research, The Royal Bank of Scotland.*

**Sprinzen, S. et al. (2008):** Hybrid Capital Handbook: September 2008 Edition. *Investment Research, Standard & Poor's.*

**Von Allmen, R. (2007):** Bewertung von Hybrid Anleihen. *Diploma Thesis.*

**Zenner, M. et al. (2006):** Rethinking Your Capital Structure With Hybrids. *Investment Research, Citigroup.*

**ABBREVIATIONS**

ACSM	Alternative coupon settlement mechanisms
CF	Cash flow
CoC	Change-of-control
DRD	Dividends received deduction
DSR	Number of days from the settlement date to the redemption date
EURIBOR	Euro interbank offered rate
FFO	Funds from operations
ISIN	International securities identification number
LIBOR	London interbank offered rate
LT2	Lower tier 2
RBP	Rock-bottom price
RBS	Rock-bottom spread
RCC	Replacement capital convents
REIT	Real estate investment trust
T1	Tier 1
UT2	Upper tier 2
WACC	Weighted average cost of capital

## APPENDICES

## A1 Appendix

Description	
Issuer:	<b>BAYER AG</b>
ISIN:	XS0225369403
Call Date:	29.07.2015
Coupon:	5.00%
Step-up:	€+280 bps
Call Trigger:	A3
Deferral Trigger:	B1
Long Term Rating:	A3
Instrument Rating:	Baa3
Equity Credit:	Basket D / intermediate
Current spread:	324
Rock-bottom spread:	339
<b>Fair</b>	<b>15</b>

		Deferral Trigger				
BAYER		B3	B2	B1	Ba3	Ba2
Call Trigger	A1	258	264	273	283	292
	A2	292	297	305	314	322
	A3	330	334	<b>339</b>	346	351
	Baa1	343	345	349	353	357
	Baa2	348	349	352	354	356

Figure 32: Scenario analysis: Bayer<sup>161</sup>

Description	
Issuer:	<b>DONG ENERGY A/S</b>
ISIN:	XS0223249003
Call Date:	29.06.2015
Coupon:	5.50%
Step-up:	€+320 bps
Call Trigger:	Baa1
Deferral Trigger:	B1
Long Term Rating:	Baa1
Instrument Rating:	Baa3
Equity Credit:	Basket C / intermediate
Current spread:	323
Rock-bottom spread:	387
<b>Dear</b>	<b>63</b>

		Deferral Trigger				
DONG		B3	B2	B1	Ba3	Ba2
Call Trigger	A2	306	315	329	344	358
	A3	343	351	363	377	389
	Baa1	371	378	<b>387</b>	397	405
	Baa2	384	388	395	401	407
	Baa3	387	390	395	400	404

Figure 33: Scenario analysis: Dong Energy<sup>162</sup>

Description	
Issuer:	<b>HENKEL AG &amp; CO KGAA</b>
ISIN:	XS0234434222
Call Date:	25.11.2015
Coupon:	5.375%
Step-up:	€+285 bps
Call Trigger:	A3
Deferral Trigger:	B1
Long Term Rating:	A3
Instrument Rating:	Baa2
Equity Credit:	Basket C / intermediate
Current spread:	280
Rock-bottom spread:	363
<b>Dear</b>	<b>83</b>

		Deferral Trigger				
HENKEL		B3	B2	B1	Ba3	Ba2
Call Trigger	A1	278	284	294	304	314
	A2	314	319	327	337	345
	A3	354	358	<b>363</b>	370	376
	Baa1	367	370	374	378	382
	Baa2	373	374	377	379	382

Figure 34: Scenario analysis: Henkel<sup>163</sup><sup>161</sup> Own calculations.<sup>162</sup> Own calculations.<sup>163</sup> Own calculations.

Description	
Issuer:	<b>LOTTOMATICA SPA</b>
ISIN:	XS0254095663
Call Date:	31.03.2016
Coupon:	8.25%
Step-up:	€+505 bps
Call Trigger:	Baa3
Deferral Trigger:	B1
Long Term Rating:	Baa3
Instrument Rating:	Ba2
Equity Credit:	Basket C / Intermediate
Current spread:	687
Rock-bottom spread:	598
<b>Cheap</b>	<b>-89</b>

		Deferral Trigger					
		LOTTOMATICA	B3	B2	B1	Ba3	Ba2
Call Trigger	Baa1	489	511	542	583	621	
	Baa2	534	553	581	616	649	
	Baa3	559	575	<b>598</b>	626	651	
	Ba1	568	581	598	619	640	
	Ba2	571	582	596	613	640	

**Figure 35: Scenario analysis: Lottomatica**<sup>164</sup>

Description	
Issuer:	<b>RWE AG*</b>
ISIN:	XS0542298012
Call Dates:	28.09.2015 / 28.09.2020
Coupon:	4.625%
Step-up:	5Y swaps+265 / €+365
Call Trigger:	A2
Deferral Trigger:	B1
Long Term Rating:	A2
Instrument Rating:	Baa1
Equity Credit:	Basket C / Intermediate
Current spread:	361
Rock-bottom spread:	281
<b>Cheap</b>	<b>-80</b>

		Deferral Trigger					
		RWE*	B3	B2	B1	Ba3	Ba2
Call Trigger	Aa3	189	193	200	208	214	
	A1	217	222	228	236	242	
	A2	273	276	<b>281</b>	287	292	
	A3	304	307	310	314	317	
	Baa1	316	318	320	323	325	

\* double call

**Figure 36: Scenario analysis: RWE**<sup>165</sup>

Description	
Issuer:	<b>SCOTTISH &amp; SOUTHERN ENER*</b>
ISIN:	XS0541656509
Call Dates:	01.10.2015 / 01.10.2020
Coupon:	5.025%
Step-up:	5Y swaps+315 / €+415
Call Trigger:	A3
Deferral Trigger:	B1
Long Term Rating:	A3
Instrument Rating:	Baa2
Equity Credit:	Basket C / Intermediate
Current spread:	382
Rock-bottom spread:	321
<b>Cheap</b>	<b>-60</b>

		Deferral Trigger					
		SSE*	B3	B2	B1	Ba3	Ba2
Call Trigger	A1	211	217	226	236	246	
	A2	252	257	266	276	284	
	A3	310	315	<b>321</b>	329	335	
	Baa1	335	338	342	348	352	
	Baa2	346	348	351	354	357	

\* double call

**Figure 37: Scenario analysis: Scottish & Southern Energy**<sup>166</sup>

<sup>164</sup> Own calculations.

<sup>165</sup> Own calculations.

<sup>166</sup> Own calculations.

Description	
Issuer:	<b>SIEMENS FINANCIERINGSMAT</b>
ISIN:	XS0266838746
Call Date:	14.09.2016
Coupon:	5.25%
Step-up:	€+225 bps
Call Trigger:	A1
Deferral Trigger:	B1
Long Term Rating:	A1
Instrument Rating:	A3
Equity Credit:	Basket C / Intermediate
Current spread:	280
Rock-bottom spread:	328
<b>Fair</b>	<b>48</b>

		Deferral Trigger				
SIEMENS		B3	B2	B1	Ba3	Ba2
Call Trigger	Aa2	264	268	273	279	283
	Aa3	292	295	299	305	309
	A1	321	324	<b>328</b>	332	335
	A2	341	343	345	348	350
	A3	351	352	353	355	356

Figure 38: Scenario analysis: Siemens<sup>167</sup>

Description	
Issuer:	<b>SOLVAY FINANCE FRANCE</b>
ISIN:	XS0254808214
Call Date:	02.06.2016
Coupon:	6.38%
Step-up:	€+335 bps
Call Trigger:	Baa2
Deferral Trigger:	B1
Long Term Rating:	Baa2
Instrument Rating:	Baa2
Equity Credit:	Basket C / Intermediate
Current spread:	372
Rock-bottom spread:	465
<b>Dear</b>	<b>93</b>

		Deferral Trigger				
SOLVAY		B3	B2	B1	Ba3	Ba2
Call Trigger	A3	390	404	424	449	471
	Baa1	417	430	448	470	489
	Baa2	443	452	<b>465</b>	481	494
	Baa3	449	456	466	479	488
	Ba1	450	456	464	473	481

Figure 39: Scenario analysis: Solvay<sup>168</sup>

Description	
Issuer:	<b>SUEDZUCKER INT FINANCE</b>
ISIN:	XS0222524372
Call Date:	30.06.2015
Coupon:	5.25%
Step-up:	€+310 bps
Call Trigger:	Baa2
Deferral Trigger:	B1
Long Term Rating:	Baa2
Instrument Rating:	Ba2
Equity Credit:	Basket D / Intermediate
Current spread:	480
Rock-bottom spread:	392
<b>Cheap</b>	<b>-88</b>

		Deferral Trigger				
SUEDZUCKER		B3	B2	B1	Ba3	Ba2
Call Trigger	A3	329	341	360	382	401
	Baa1	352	363	379	399	415
	Baa2	372	381	<b>392</b>	406	417
	Baa3	377	384	392	403	411
	Ba1	377	382	389	397	403

Figure 40: Scenario analysis: Suedzucker<sup>169</sup><sup>167</sup> Own calculations.<sup>168</sup> Own calculations.<sup>169</sup> Own calculations.



Description	
Issuer:	<b>SUEZ ENVIRONNEMENT*</b>
ISIN:	FR0010945188
Call Dates:	21.09.2015 / 21.09.2020
Coupon:	4.82%
Step-up:	5Y swaps+290 / €+390
Call Trigger:	A3
Deferral Trigger:	B1
Long Term Rating:	A3
Instrument Rating:	Baa2
Equity Credit:	Basket C / n.a.
Current spread:	333
Rock-bottom spread:	310
<b>Fair</b>	<b>-23</b>

		Deferral Trigger					
		SUEZ*	B3	B2	B1	Ba3	Ba2
Call Trigger	A1	206	212	220	230	239	
	A2	244	250	258	268	276	
	A3	300	304	<b>310</b>	318	324	
	Baa1	322	325	330	335	339	
	Baa2	333	335	337	341	343	
	* double call						

Figure 41: Scenario analysis: SUEZ<sup>170</sup>

Description	
Issuer:	<b>TUI AG</b>
ISIN:	DE000TUAG059
Call Date:	30.01.2013
Coupon:	8.63%
Step-up:	€+730 bps
Call Trigger:	Caa1
Deferral Trigger:	Caa3
Long Term Rating:	Caa1
Instrument Rating:	Caa3
Equity Credit:	
Current spread:	738
Rock-bottom spread:	881
<b>Dear</b>	<b>143</b>

		Deferral Trigger					
		TUI	C	Ca	Caa3	Caa2	Caa1
Call Trigger	B2	889	928	968	1060	1364	
	B3	894	928	964	1043	1309	
	Caa1	845	863	<b>881</b>	920	1309	
	Caa2	818	833	848	920	1309	
	Caa3	803	816	848	920	1309	

Figure 42: Scenario analysis: TUI<sup>171</sup>

Description	
Issuer:	<b>VATTENFALL AB</b>
ISIN:	XS0223129445
Call Date:	29.06.2015
Coupon:	5.25%
Step-up:	€+295 bps
Call Trigger:	A2
Deferral Trigger:	B1
Long Term Rating:	A2
Instrument Rating:	Baa2
Equity Credit:	Basket D / Intermediate
Current spread:	324
Rock-bottom spread:	336
<b>Fair</b>	<b>13</b>

		Deferral Trigger					
		VATTENFALL	B3	B2	B1	Ba3	Ba2
Call Trigger	Aa3	251	256	263	271	278	
	A1	280	284	291	299	305	
	A2	328	331	<b>336</b>	342	347	
	A3	353	355	358	362	365	
	Baa1	361	363	365	367	369	

Figure 43: Scenario analysis: Vattenfall<sup>172</sup><sup>170</sup> Own calculations.<sup>171</sup> Own calculations.<sup>172</sup> Own calculations.

Description	
Issuer:	<b>VINCI SA</b>
ISIN:	FR0010289496
Call Date:	13.11.2015
Coupon:	6.25%
Step-up:	€+375 bps
Call Trigger:	Baa1
Deferral Trigger:	B1
Long Term Rating:	Baa1
Instrument Rating:	Baa3
Equity Credit:	Basket C / Intermediate
Current spread:	392
Rock-bottom spread:	429
<b>Fair</b>	<b>37</b>

		Deferral Trigger				
VINCI		B3	B2	B1	Ba3	Ba2
Call Trigger	A2	331	340	355	372	386
	A3	375	384	397	413	426
	Baa1	412	419	<b>429</b>	440	450
	Baa2	429	434	441	449	455
	Baa3	434	437	443	448	453

**Figure 44: Scenario analysis: Vinci**<sup>173</sup>

Description	
Issuer:	<b>WIENERBERGER AG</b>
ISIN:	DE000A0G4X39
Call Date:	09.02.2017
Coupon:	6.50%
Step-up:	€+325 bps
Call Trigger:	Ba1
Deferral Trigger:	B1
Long Term Rating:	Ba1
Instrument Rating:	Ba3
Equity Credit:	Basket C / Intermediate
Current spread:	688
Rock-bottom spread:	550
<b>Cheap</b>	<b>-138</b>

		Deferral Trigger				
WIENERBERG		B3	B2	B1	Ba3	Ba2
Call Trigger	Baa2	486	514	559	623	678
	Baa3	495	520	561	619	666
	Ba1	496	517	<b>550</b>	595	632
	Ba2	495	512	540	578	632
	Ba3	490	503	525	578	632

**Figure 45: Scenario analysis: Wienerberg**<sup>174</sup>

<sup>173</sup> Own calculations.

<sup>174</sup> Own calculations.

**A2 Manual (Rock-Bottom Spread Calculator\_Hybrid)**

1. Select a hybrid issue (by ISIN) in the drop-down menu (cell O3).

**SUEDZUCKER INT FINANCE****XS0222524372**

Floating rate @ 1st call	2.1963%
Call date	30.06.2015
Years to call (rounded)	5
Initial spread + Step-up	310
Perp Rate	3.01%
CPN	5.250%
Call Trigger	Baa2
Deferral Trigger	B1
Current Spread	480.36

RBS	391.98
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2. Check (or if necessary adjust) parameters (are set automatically after hybrid is selected).

Recovery Rate Average	<b>30%</b>
Coupon Deferral	<b>B1</b>
Call Trigger	<b>Baa2</b>
Information Ratio	<b>0</b>
Diversitiy Score	<b>1</b>
Coupon	<b>5.250%</b>
Step-up Spread (bp)	<b>310</b>
Perp Rate	<b>3.01%</b>
Senior Rating	<b>Baa2</b>
Years to call	<b>5</b>

3. Click "Value Perpetual" (cell B14)
4. Click "Value Hybrid" (cell B38)
5. **RBS output: Cell O15**

## **Declaration of authorship**

"I hereby declare

- that I have written this thesis without any help from others and without the use of documents and aids other than those stated above,
- that I have mentioned all used sources and that I have cited them correctly according to established academic citation rules."

Date and Signature

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