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„Structured Retail Investment Products:
An Analysis of Four Previous Product Issues
in the Austrian Market”

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Abbreviations

EUSIPA **E**uropean **S**tructured **P**roduct **A**ssociation

Raiffeisen **Raiffeisen** Centrobank AG

Symbols

K	Exercise price
S	Underlying price
T	Total time to maturity
t	Current time to maturity
X	Option premium
H	Barrier

Chapter 1

Introduction

1.1 Introduction

Reverse Convertibles, Bonus Certificates, which can be capped or uncapped, Turbo-Certificates and Twin-win certificates are examples of structured retail investment products, which are commonly sold by financial institutions to retail investors with the purpose of raising financing for their operations. The return of structured retail products is based on a pre-set formula for calculating returns (CELERIER, p. 7 and p. 12). The investment is structured in a way for buyers to understand the link between the underlying asset or market and the return of the product. However, these products are often very complex, due to a positive correlation between product complexity and product profitability for banks and a negative correlation between product complexity and performance for investors (CELERIER, p. 32). But still, these products can be valuable tools for investors to diversify and hedge their portfolio and profitably invest in low volatility periods. Due to this reason, four structured retail products from Austrian issuers will be analyzed throughout this Master Thesis.

The European market for structured investment products is huge. The European Structured Product Association (hereinafter: EUSIPA) provides a quarterly overview upon the EUSIPA countries, which are Austria, France, Germany, Italy, Sweden, as well as Switzerland (EUSIPA2, p. 3). The total number of investment products listed on exchanges of EUSIPA member countries amounts to 449,227 in Q1 2013, while the total number of leverage products sums up to a total of 612,957 in the same quarter (EUSIPA2,

p. 4). More than 100,000 investment products and more than 300,000 leverage products have been issued in EUSIPA countries each quarter, following Q1 2012 (EUSIPA2, p. 7).

The number of products available is practically unlimited, structured retail investment products are available on almost any equity, index or bond and are sold with other underlyings, like commodities, FOREX or futures. The payoff structure differs from product to product, which makes picking the right product a hard, but still very important decision for investors, as the payoff structure cannot be changed during the product's maturity. Also, most products are listed on exchanges, where they can be bought or sold, but as they are often thinly traded with high spreads, investors may suffer losses, when exiting their position before maturity. This thesis therefore elaborates on the Austrian market to provide further understanding of these products for investors.

1.2 Research Questions

The objective of this Master thesis is to deliver valuable insight into the Austrian structured product market in general and more specifically about the four analyzed products, their setup, as well as their opportunities. For investors, it is of major importance to understand the issued products with the limited information which is publicly available. Due to this reason, this Master thesis is merely based on public information, which is available to any investor on the issuer's websites, as well as on the stock exchanges or other public sources of information.

This Master thesis will analyze four previous issues in the Austrian structured product market, which were accompanied by two of the major players Raiffeisen Centrobank AG and Erste Group Bank AG in order to answer the Research Questions:

RQ1: Does the investment into the analyzed structured investment products deliver valuable opportunities for investors, when weighing their advantages against their risks, as well as disadvantages?

RQ 2: Using a decomposition approach: Are the four structured products which were issued in the Austrian market priced fairly according to their individual setup?

RQ 3: Based on a scenario analysis: Under which market conditions does an investment into structured investment products outperform straight bond or equity investments?

1.3 Approach

First, the most important definitions will be elaborated and a short introduction into the field of options will be provided in order to prepare an in-depth discussion of the analyzed structured products. This background information will be used to analyze and discuss the four products, which are the main topic of this thesis.

Then, a general overview of the European structured retail investment product market will be provided, while mainly focusing on the Austrian market. Its recent development, size and trends will be presented in order to prove the importance of structured products in financial markets.

In the second part, the four product issues, which were picked by the author of this thesis, will be discussed in the following order:

1. Raiffeisen Bonus Certificate on S&P BRIC 40 2
2. Raiffeisen Reverse Convertible on Andritz AG
3. Raiffeisen Europe Twin-win Certificate
4. Erste Group Discount Certificate on ATX

The analysis of each product is carried out in the following way: An overview of the issue will be provided, including a payoff diagram to understand the product in general, while then breaking it down into its components in order to understand the setup and to construct the overall payoff from the analyzed investment product at maturity. As a next step, the risks, advantages and disadvantages of investing into the specific product will be discussed, followed by an examination of the factors that affect the price development. A scenario analysis for the behavior during the term to maturity is carried out as a next step in order to determine the factors, which affect the payoff at maturity. Furthermore, the payoff at maturity is analyzed, based on different price scenarios for the underlying, while then finally pricing the product with a decomposition approach, which means,

valuing each of the product's components and summing these up in order to determine a fair market value, given the data at hand. Based on this analysis, the discussion of the product will be concluded, while it will then be decided, whether it is fairly priced and under which market situations it is optimal to invest into this specific product.

Finally, the analysis, which was conducted throughout this Master thesis, will be critically reviewed in order to finally answer the research questions.

Chapter 2

Clarification of Terms and Definitions

2.1 Structured Retail Products

Structured Retail Products

The group of structured retail products consists of any structured product which is sold to retail investors (CELERIER, p. 7). These retail investors are private individuals who are involved into security trading on their own account, but also asset management institutions which redistribute structured products (BOUZOUBAA, p. 23). Structured products are generally defined as products whose payoff as well as risks depend on a formula which is defined ex-ante (CELERIER, p. 7). This formula is non-linear and the payoff at maturity depends on different events, which may occur during the time to maturity and/or at maturity. Structured products involve one or more underlying, which can be any equity, index or bond, but also a commodity, Forex or a future. The position can be leveraged or unleveraged, which is the main factor that divides this group further into structured retail investment products as well as structured retail leverage products.

The setup can be explained as shown in Figure 2.1.

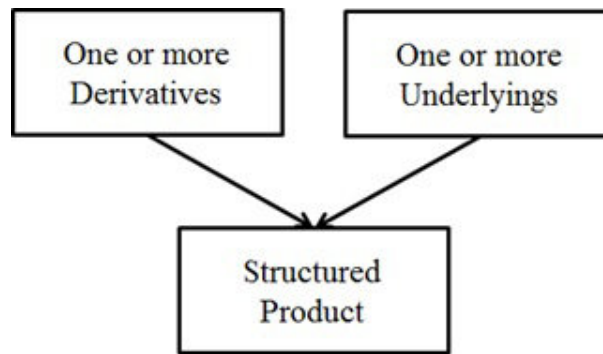


FIGURE 2.1: The General Setup of a Structured Product (by: Stefan Rogel)

Structured Retail Investment Products

Structured retail investment products are structured retail products which fulfill the definition provided above. However, these products involve no leveraged position and provide a non-linear position in the underlying. The group of structured retail investment products includes capital protection, yield enhancement and participation products (EUSIPA2, p. 3).

Capital protection products provide a guarantee that the investor will receive 100% or more of the amount he invested into the product at maturity, as long as no default occurs (MAUDE). Yield enhancement products are subject to a capped return and at the same time provide no guarantee for the initial investment, which exposes the investor to potential losses. Participation products at the same time offer uncapped return, based on the performance of the underlying, but at the same time are subject to possible losses, in case the underlying declines.

This thesis will focus on structured retail investment products in order to provide further insight into the specific setup of four products.

Structured Retail Leverage Products

Leverage products provide a leveraged position in order to generate a leveraged performance with regard to the underlying (JAFFER, p. 157). The risk of total loss is increased through investing into these products. According to the EUSIPA categorization these products include leverage without knock-out, leverage with knock-out and constant leverage. However, these products are not part of this thesis and will therefore not be discussed any further.

2.2 Option Positions

Understanding option positions, the exposure they deliver, as well as their possible pay-offs is of major importance to understand structured products. Options are embedded in structured products in order to change the payoff function of the underlying, as they provide non-linear payoffs. In general, we distinguish between call and put options. According to HULL, p. 562 and p. 573 a call option gives its holder "the option to buy an asset at a certain price by a certain date", while put options give its holder the "option to sell an asset for a certain price by a certain date". We distinguish between American options, which can be exercised at any time up to and including the maturity date and European options, which can only be exercised at the maturity date. More exotic options, like down-and-in put options or down-and-out put options will be discussed, when these are needed for the explanation of any of the analyzed products.

Long Put Option

Through paying a price, which is called the option premium (X), an investor enters a long position into a put option, which gives him the right to sell a pre-defined asset (denoted: S) at a pre-defined price, which is called the exercise price (denoted: K), at a pre-defined time, the maturity date (denoted: T). The payoff function for the holder of a long position in a put option looks as in 2.1.

$$\max(K - S_T, 0) \quad (2.1)$$

Profit from exercising a long put option with K on S at T for a premium X: The position is profitable, as long as S closes below K-X. The graphical payoff is as shown in Figure 2.2.

Short Put Option

An investor enters a short position in a put option, when he sells a put option on a specific underlying (S) to an investor. He receives the option premium (X) for bearing the risk of facing a possible loss, when the counterparty to the transaction exercises its option at the exercise price (K) at maturity. After selling the option, the investor who has the short position in the option enters a passive position and loses any possibilities to change the contract. The payoff function for the individual in the short position looks

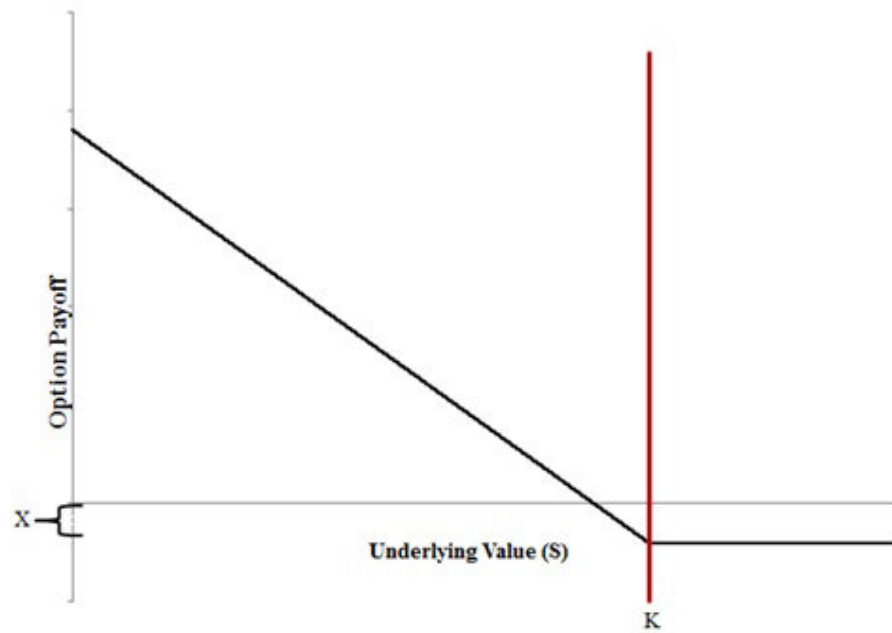


FIGURE 2.2: The Payoff Profile of a Long Put Option (by: Stefan Rogel)

as shown in Formula 3.2.

$$\min(K - S_T, 0) \quad (2.2)$$

The profit from an exercised short position in a put option with K on S at T for a premium X is as shown in figure 3.2. The short position is profitable, as long as S closes above $K - X$.

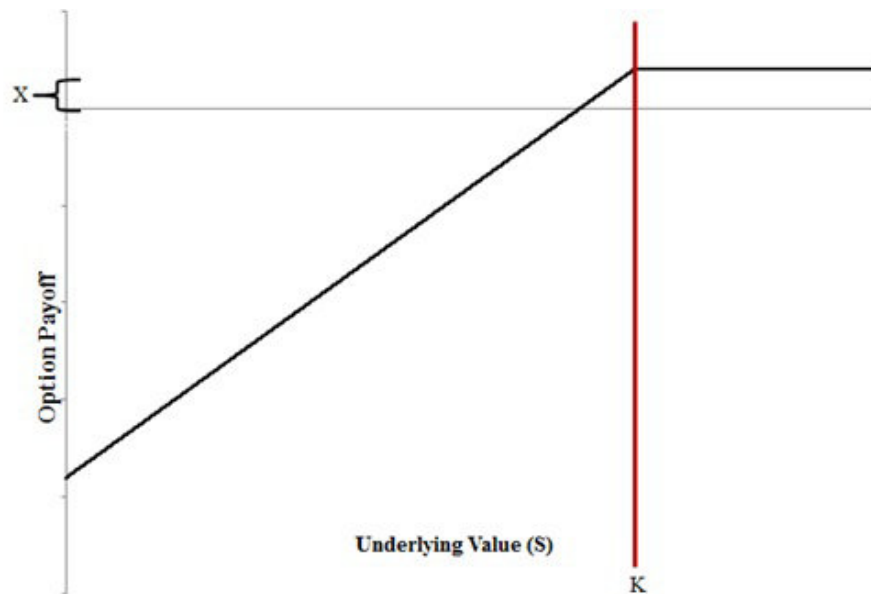


FIGURE 2.3: The Payoff Profile of a Short Put Option (by: Stefan Rogel)

2.3 Risks

In the following, counterparty credit risk, market risk and liquidity risk will be described.

Counterparty Credit Risk

MISHKIN (p. 232) defines credit risk as "the risk rising because borrowers may default". Therefore, counterparty credit risk can be explained through a transaction between a lender who lends an amount of money to another party that is called the borrower. The lender faces a risk that the borrower will not pay back the amount he borrowed. This risk is called counterparty credit risk.

Market Risk

BERKDEMARZO (p. 311) defines market risk as "fluctuations of a stock's return that are due to market-wide news represent common risk. As with earthquakes, all stocks are affected simultaneously by the news." An example of market-wide news are news about the economic environment, which affect all actors in the market, for example, political policy changes or actions by monetary authorities. However, this definition can be extended to all assets of which the return can be affected by market-wide news.

Liquidity Risk

BERKDEMARZO (G-10) define liquidity risk as "the risk of being forced to liquidate an investment (at a loss) because the cash is required to satisfy another obligation." This sort of risk can be observed through a widening bid/ask spread in the market, which is due to a decreasing number of trades, or increasing uncertainty with regard to the asset value.

Chapter 3

European Market

First, the EUSIPA standards will be explained, as these are of major importance for its member countries, including Austria. Furthermore, an overview of the EUSIPA market will be presented, while then focusing on the entire European market and finally explaining the Austrian market in further detail.

3.1 EUSIPA Standards

Throughout this section, the European structured product market will be elaborated. Many countries follow their own regulations and standards, which leads to a fragmented European structured product market, without clear common regulations and a lack of transparency (EUSIPA1, p. 3). To solve this issue, the EUSIPA was founded. The EUSIPA is an umbrella association with the goal of coordinating the European structured product market and its transparency initiatives (EUSIPA1, p. 3). It is used as a discussion platform between decision-makers and market participants to communicate their needs. Currently, its members are Austria, France, Germany, Italy, Switzerland, Sweden and the United Kingdom (EUSIPA2, p. 3). The benefit of this association is that markets grow together and cross-border trade is promoted, to increase the attractiveness and fairness in the European structured product market.

The EUSIPA publishes a common guideline (EUSIPA1), including principles, which are adopted by its members on a voluntary basis in order to govern the issuance of structured products and provide all relevant information easily to investors. At first, a

general overview of the guidelines will be presented. The EUSIPA members assure that the guidelines are followed in their individual market place. The responsible member association for the Austrian market is the "Zertifikate Forum Austria". In general, the EUSIPA guidelines aim at increased informational transparency and improved education of investors (EUSIPA1, p. 5 and p. 9). However, the main aspects which are covered by the EUSIPA guidelines are discussed in the following.

First of all, risks with regard to the issuer should be publicly available for investors (EUSIPA1, p. 4). This information includes the issuer's ratings as well as rating adjustments. Furthermore, the underlying asset has to be well defined and only information which was revealed by sources which are judged as suitable as well as reliable for an independent opinion should be quoted (EUSIPA1, p. 5).

Additionally, prospectus and brochures, as well as other marketing material should deliver a comprehensive source of information for investors in order to facilitate a thorough understanding of the products. Besides this information about specific products, investors are supposed to educate investors with prospectus and brochures about structured financial products in general (EUSIPA1, p. 6).

Prices are supposed to be set on a fair level, according to the complexity of the product and in fully informed and competitive markets (EUSIPA1, p. 7). Information about additional fees needs to be fully available. Besides that, a possibility to trade these products in the secondary market has to be made available and conflicts of interest between third parties, the issuer as well as the investor have to be solved in a discretionary way (EUSIPA1, p. 7).

As previously discussed, the EUSIPA also differentiates between investment products and leverage products. Investment products, which are the main topic of this thesis, provide exposure to the underlying, with the underlying being linked, based on a pre-defined multiplier, which is constant during maturity and the product's payoff structure being structured through a derivative position. Leverage products, in contrast, provide leveraged performance for its owners, leading to an increased risk of total loss.

The EUSIPA presents the following categories in order to classify structured investment products, which can be used to retrieve fast and easy information about a specific product (Table 3.1, based on EUSIPA3).

Capital Protection	Yield Enhancement	Participation
Uncapped Capital Protection	Discount Certificates	Tracker Certificates
Exchangeable Certificates	Barrier Discount Certificates	Outperformance Certificates
Capped Capital Protected	Reverse Convertibles	Bonus Certificates
Capital Protection with Knock-out	Barrier Reverse Convertibles	Outperformane Bonus Certificates
Capital Protection with Coupon	Capped Outperformance Certificates	Twin-win Certificates
	Capped Bonus Certificates	
	Express Certificates	

TABLE 3.1: Investment Product Categorization according to EUSIPA

3.2 EUSIPA Market — An Overview

EUSIPA publishes detailed information about the structured product market in its member countries on a quarterly basis. The EUSIPA data will be used in order to give a first overview of the European structured retail product market.

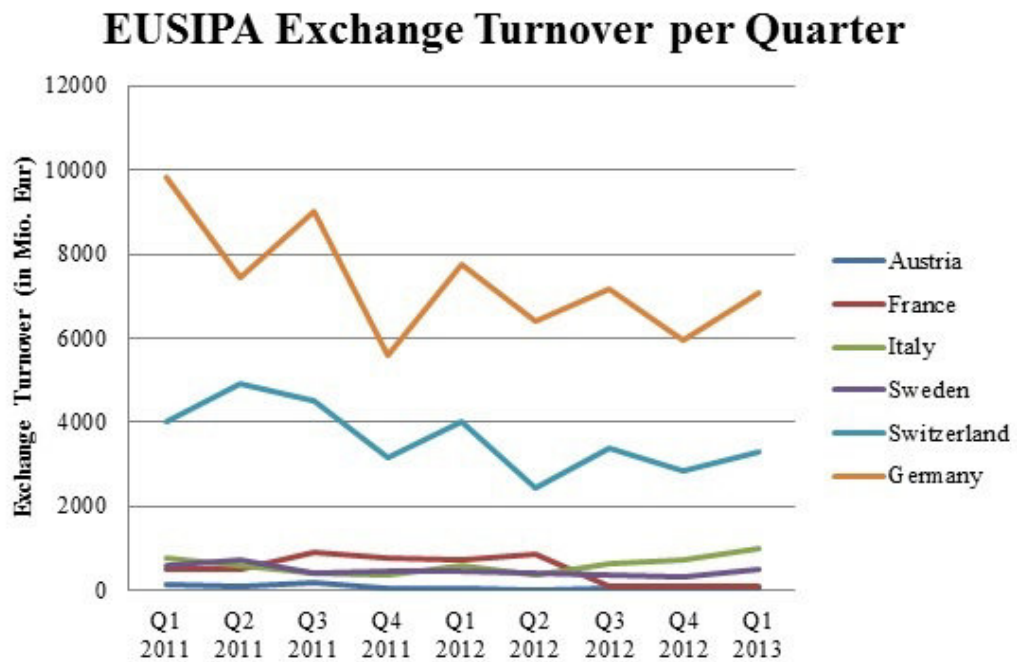


FIGURE 3.1: EUSIPA Exchange Turnover per Quarter (by: Stefan Rogel)

As illustrated by Figure 3.1 and as will be discussed further in the next paragraph, the German market is by far the most important in Europe. Exchange turnover per quarter dominates the other countries by far and is higher than the turnover of the other markets in total, which is mainly the result of the size of the German exchanges. This fact makes

them a target for international product issues, as the liquidity of the issuer's products is enhanced through being listed on a German exchange.

As a result of the factor above, in terms of new listings on exchanges, the German market is dominant (EUSIPA2, p. 4). In the first quarter of 2013, the number of new listings of investment products summed up to 140,794, which is 40 times as much as the number of issues in the other EUSIPA countries, which sum up to 3,689 issues in total (EUSIPA2, p. 4). The Swiss market is the second most important with 2,398 issues and Austria the third most important with 523 issues in the first quarter of 2013 (EUSIPA2, p. 4).

3.3 European Market

The structured retail product market grew from 1996 onwards (CELERIER, p. 8), reaching its peak in 2007 with the amount of products sold in the European market equaling €250 billion (ESMA, p. 5). The total amount of issues decreased after the 2008 financial crisis, of which structured products were anticipated to be the centerpiece (DIEDRICH, p. 1). However, even though the amount of the issues in the market was diminishing in the period following the crisis, it rebounded recently.

The total volume of products outstanding reached its peak of €820 billion in 2010 (ESMA, p. 16). Until December 2012, the total amount of structured retail products outstanding rebounded to €770 billion (ESMA, p. 5), which is still €50 billion below the all-time peak in 2010.

The European structured retail product market is the world's biggest market; it accounts for 64% of global structured assets under management (CELERIER, p. 8).

Also, the German market grew in importance, with 1 million product issues in 2012, in comparison to around 162,000 issues in 2007 (ESMA, p. 15). However, one has to consider that a product, which was structured by a foreign bank, but issued in the German market, is considered a German product. The German market is often preferred by international financial institutions, due to the fact that its stock markets are more frequently traded in comparison to other markets, which enhances the products' liquidity.

In terms of products issued in 2012, ESMA, p. 16 found that most products were equity linked (around 60%) and around 25% interest-rate linked. Furthermore, the amount of

products with less than 100% capital protection increased, accounting for 48% in 2012 (ESMA, p. 16). The major reason for this change is argued to be the low-interest rate environment.

Furthermore, the European market for structured retail products is mainly ruled by banks. These products are a sizeable source of funding for banks with an increasing importance as a source for funding in recent history. 80% of the structured retail products which are sold in the European market are sold by banks (ESMA, p. 16).

3.4 Austrian Market

The Austrian market is merely ruled by 5 banks, which are in fact Raiffeisen Centrobank AG, Erste Group Bank AG, Bank Austria, Volksbank Investments and the Royal Bank of Scotland. These banks account for 75% of the open interest in the Austrian market (ZFA, p. 1). According to ESMA, (p. 17) in 2011, around 4% of Austrian household financial wealth was invested in structured products, which is more than the European average, which is stated to be less than 4%.

Open interest in Austria oscillates around €13 billion in the period from August 2012 until July 2013, reaching a peak of €13.7 billion in September, October and November 2013 and a low of €12.9 billion in July 2013 (ZFA, p. 9). Investment products dominate the Austrian market with a market share of 99.3% in July 2013, while leveraged products have a market share of 0.7% (ZFA, p. 10).

However, even though open interest of investment products accounts for 99.3% of the market share, the overall quantity is lower. Outstanding quantity of investment products equaled 2,706 in July 2013 versus 4,105 of leveraged products for the members of the Zertifikate Forum Austria, which equals 39.7% and 60.3% respectively (ZFA, p. 6). This fact indicates that investment products in general have a higher individual transaction volume than leveraged products, as these products increase the investment exposure of the individual investor.

With regard to the absolute number of trades on Austrian exchanges for members of the Zertifikate Forum Austria, investment products have a market share of 84.3%, while leveraged products have a market share of 15.7%, equalling €225 million and €42 million

respectively (ZFA, p. 8). The number of trades is increasing in comparison to previous months.

The discussion above shows that, recently, the Austrian structured product market has been subject to a downward trend, with leveraged products increasing their absolute market share. However, it is still very low in comparison to investment products, which attract the majority of funds. Furthermore, structured products become more actively traded on Austrian exchanges.

Chapter 4

Raiffeisen Centrobank AG BRIC Bonus Certificate 2

4.1 Overview of the Bonus Certificate on S&P BRIC 40

The main facts of the transaction are summarized in the following table 4.1. It is based on RAIFFEISEN4, RAIFFEISEN5 and RAIFFEISEN6.

Product Data	
Term	36 months
Issues Price	100.00€
Issue Surcharge	2.00€
Number of Units	1,000,000 Units
Multiplier	0.04079
Issue Date	13.03.2012
Maturity Date	13.03.2015
Initial Valuation Date	12.03.2012
Final Valuation Date	10.03.2015
Issuer	Raiffeisen Centrobank AG
Reference Asset	S&P 40
Initial Reference Price	2,451.60€
Bonus Level	117.00€
Barrier	1,470.96€
Final Reference Price	Closing Price

TABLE 4.1: Overview of the Bonus Certificate on S&P BRIC 40

On March 13th, 2012 Raiffeisen Centrobank AG (hereinafter: Raiffeisen) issued 1,000,000 units of 36 months Bonus Certificates (ISIN: AT0000A0U9N4) on the S&P BRIC 40 Index as an underlying and a multiplier of 0.04079 at an issue price of 100.00€, as was calculated in Formulas 4.3 and 4.4. The transaction raised 102,000,000€ in total, as shown by Formulas 4.1 and 4.2.

$$\text{no. of units} * (\text{issue price} + \text{issue surcharge}) = \text{amount raised} \quad (4.1)$$

$$1,000,000 * 102.00\text{€} = 102,000,000\text{€} \quad (4.2)$$

The multiplier of 0.04079 specifies that the certificates are linked at a one-to-0.04079 relationship to the value of the S&P BRIC 40 and each certificate represents the payoff of 0.04079 units of the S&P BRIC 40 as shown in Formulas 4.3 and 4.4. The transaction will be settled in cash at the maturity date and no stocks of the index will be exchanged between the investors and Raiffeisen, meaning that no stocks are directly involved in any of the transactions (RAIFFEISEN4, p. 17). The multiplier is calculated as shown in 4.3 and 4.4.

$$\text{Issue Price} : \text{Initial Reference Price} = \text{Multiplier} \quad (4.3)$$

$$100\text{€} : 2451.60\text{€} = 0.04079 \quad (4.4)$$

The initial valuation date is scheduled for March 12th, 2012 and the issue date for March 13th, 2012. The initial reference price is set at 2,451.60€, which corresponds to the average of the underlying on the initial valuation date and was calculated by Raiffeisen. The issue price is 100.00€, which represents the price for which one certificate is sold to investors. Its investors do not receive any dividend or interest payments during the maturity of the certificate. Additionally, an issue surcharge of 2.00€ is charged by Raiffeisen.

The Bonus Level is set equal to 117€, which corresponds to a value of the S&P BRIC 40 of 2,868.37, while the barrier is set at 60€, which corresponds to a value of the

S&P BRIC 40 of 1,470.96, based on the multiplier. These calculations are explained in Formulas 4.5 to 4.8.

$$Bonus\ Level * (1 : Multiplier) = S\&P\ BRIC\ 40 * € \quad (4.5)$$

$$117€ * (1 : 0.04079) = 2,868.37€ \quad (4.6)$$

$$Barrier * (1 : Multiplier) = S\&P\ BRIC\ 40 * € \quad (4.7)$$

$$60€ * (1 : 0.04079) = 1,470.96€ \quad (4.8)$$

The meaning of these specific values will be explained throughout the next paragraphs, when the set-up as well as the payoff structure of the product will be analyzed.

The final valuation date of the certificate is March 10th, 2015 on which the final reference price is determined, and the maturity date is March 13th, 2015 which is the date, on which the certificate is settled in cash. The barrier observation period is the period from and excluding the initial valuation date up to and including the final valuation date. The final reference price corresponds to the average of the underlying on the final valuation date.

The final amount that will be paid out to investors at maturity is based on the index value during the term of the certificate, as well as the index value on the final valuation date and is summarized in Figure 4.1.

4.2 The Product Set-up

The payoff structure from the certificate can be replicated through two positions: a factored long position in the underlying which is, in this case, the S&P BRIC 40 as well as a factored long position in a European down-and-out put option on the S&P BRIC 40. The positions, their payoff and the exposure the investor faces will be discussed in

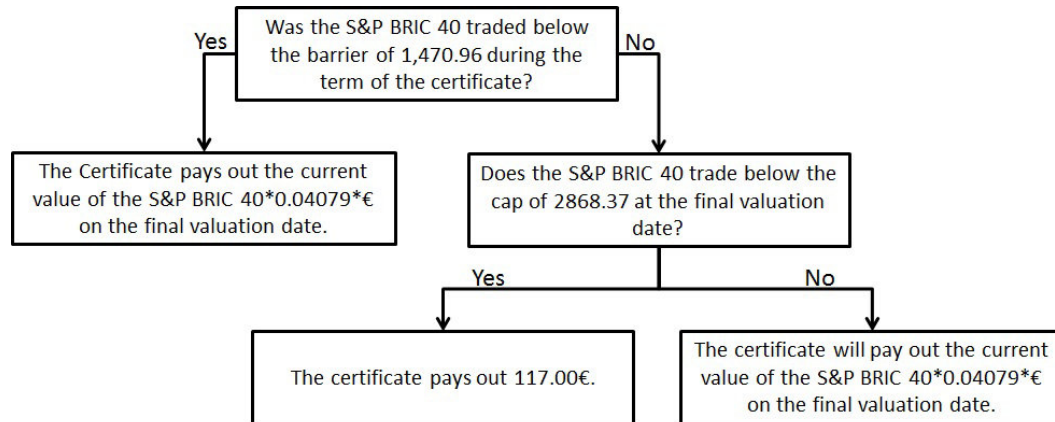


FIGURE 4.1: Payoff Diagram from the Bonus Certificate ob S&P BRIC 40 (by: Stefan Rogel)

the following in order to explain the payoff structure from the certificate. However, it is important to mention that the investor does not directly enter a position in the S&P BRIC 40, as the certificate is settled in cash. The same can be said about the option position.

4.2.1 A Factored Long Position in the S&P BRIC 40

A long position in a security means that the buyer enters the ownership of a security and benefits from its price going up, while he suffers losses in case it goes down (BERKDEMARZO, p. 345). In case of the certificate, the investor enters a factored long position in 0.04079 times the value of the S&P BRIC 40. Therefore, he faces the full exposure of the index sinking or increasing in value. An investor enters a long position in a security, in case he assumes that the security will rise in value and thus will be able to sell his position profitably in the future.

The investor in the certificate enters the factored long position at the initial reference price of the S&P BRIC 40 of 2,451.60€ on the initial valuation date on March 12th, 2012 and sells the position in the index on the maturity date at March 13th, 2015 at a price corresponding to the value of the index on the final valuation date on March 10th, 2015, multiplied by 0.04079. In case the index is below 2,451.60 on March 10th, 2015, he will suffer a loss. In case the index is above 2,451.60, the investor will incur a profit.

The payoff function from the long position in the S&P BRIC 40 looks as shown in Formula 4.9.

$$\text{payoff from long position} = \text{S\&P BRIC 40} * 0.04079 * € \quad (4.9)$$

Figure 4.2 shows the payoff from the factored long position in the S&P BRIC 40 from Formula 4.9.

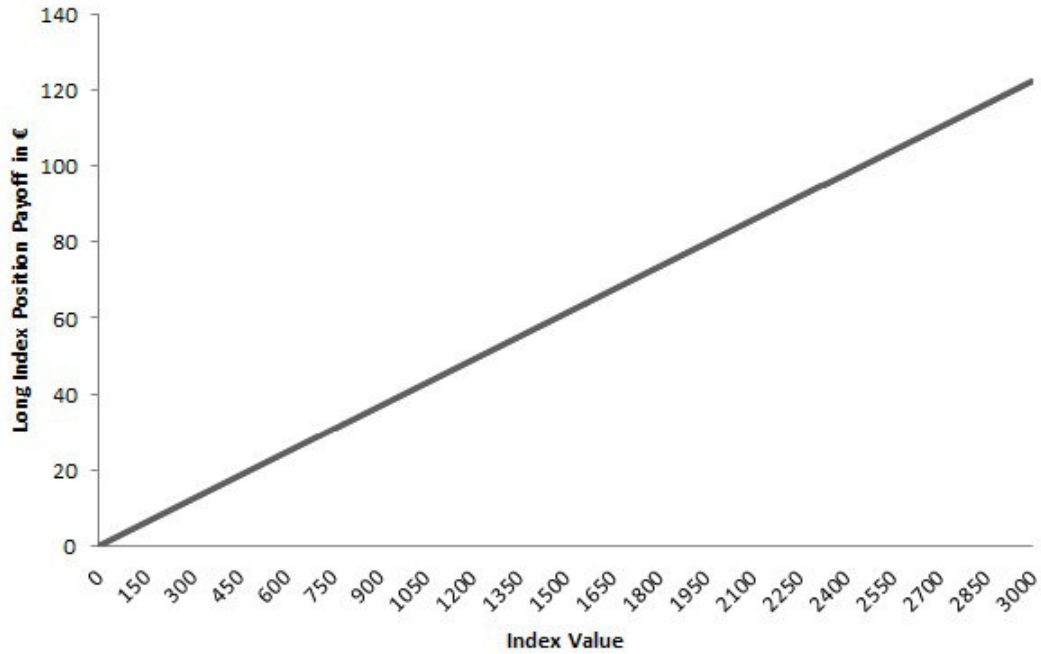


FIGURE 4.2: Payoff from a Factored Long Position in the S&P BRIC 40 (by: Stefan Rogel)

4.2.2 A Long Down-and-out Put Option on the S&P BRIC 40

According to HULL (p. 481 and p. 567), a down-and-out option terminates its existence, when the underlying asset price reaches a certain level. The down-and-out option involved in the certificate has an exercise price set equal to the bonus level, which is 117.00€. As it is a put option, the option holder acquires the right to sell 0.04079 times the index at a level of 2,451.60*€ at the final valuation date, which is March 10th, 2015 and finally settled on March 15th, 2013, which means it is European-type.

However, the European down-and-out option terminates its existence, as soon as the barrier is reached. The barrier (denoted: H) is equal to 60€, which is 0.04079 times the index level of 1,470.96*€. In case the S&P BRIC 40 trades below this boundary during the term of the option, the option is terminated and cannot be exercised at the strike price of 117.00€ anymore. Therefore, the hedging opportunity is lost and the

option holder does not have the ability to sell his stock at the strike price anymore. The general payoff function for a down-and-out put option can be seen in 4.10, but will be explained further throughout this section. How this formula was derived, will be explained in the following.

$$\begin{aligned} & \max(K - S_T, 0), \text{ if } S_t > H \text{ for all } t \leq T \\ & 0, \text{ if } S_T \leq H \text{ for all } t \leq T \end{aligned} \quad (4.10)$$

The payoff function for the factored long position in a put option on the S&P BRIC 40 with an exercise price of 117€ as long as the option does not trade below the barrier and is terminated is shown in Formulas 4.11 and 4.12.

$$\max(K - S_T, 0) \quad (4.11)$$

$$\max(117 - S_T, 0) \quad (4.12)$$

In case the index level falls below the barrier, the option will be terminated and cannot be exercised.

The general payoff function for Raiffeisen's short position, as long as the option does not trade below the barrier and is terminated looks as shown in Formula 4.13.

$$\min(S_T - K, 0) \quad (4.13)$$

The payoff function for a short position in the S&P BRIC 40 with an exercise price of 117.00€ as long as the option does not trade below the barrier and is terminated looks as in Formula 4.14.

$$\min(S_T - 117.00\text{€}, 0) \quad (4.14)$$

The factored position looks as in Formula 4.15.

$$\min((0.04079 * 2,868.37 * \text{€}) - K, 0) \quad (4.15)$$

As long as the S&P BRIC 40 index level is not below a level of 2,868.37, it pays off for the option holder to exercise his option and sell the factored position for 117.00€. As a result, he will make a profit equal to the difference between the exercise price ($K=117.00\text{€}$) and the current share price S_T . In case the S&P BRIC 40 trades above the exercise price, it does not pay off for the option holder to exercise the option, as the investor can sell the shares in the market for a higher price. Therefore, the payoff from the options is equal to zero.

Figure 4.3 shows the payoff from the down-and-out put option on the S&P BRIC 40.

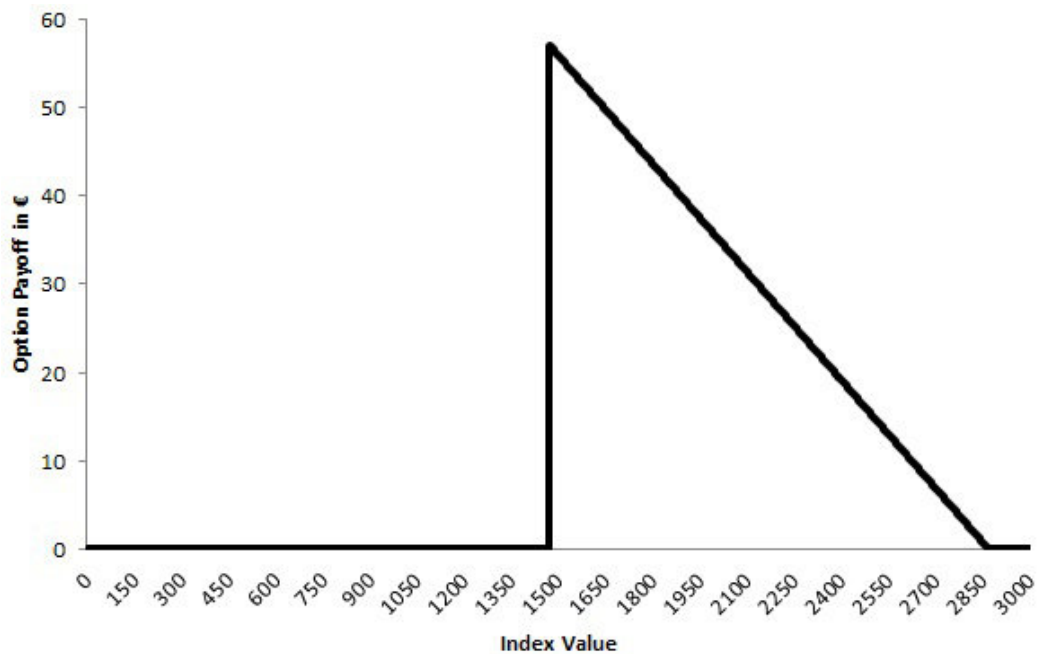


FIGURE 4.3: Payoff from the Down-and-out Put Option (by: Stefan Rogel)

4.2.3 Overall Payoff

The overall payoff from the certificate is determined based on the final reference price of the S&P BRIC 40, as well as the S&P BRIC 40 index level during the term to maturity. When investing the investor enters a long position in 0.04079 times the S&P BRIC 40 times Euro, as well as a factored long position in a European down-and-out put option

in 0.04079 times the S&P BRIC 40 times Euro. The combination of both leads to a payoff function as in Formula 4.16

$$\begin{aligned} \text{Payoff} = & -\text{Issue Price} + \text{Payoff from Long Index Position} + \text{Payoff} \\ & \text{from Long Down - and - out Put Option} \end{aligned} \quad (4.16)$$

The payoff is shown in 4.17.

$$\begin{aligned} \text{Payoff} = & -117 + (S_T - 117) + \\ & \max(117 - S_T, 0) \text{ if } S_t > 60\text{€ for all } t \leq \text{March 10th, 2013} \\ & 0, \text{ if } S_t \leq 60\text{€ for all } t \leq \text{March 10th, 2013} \end{aligned} \quad (4.17)$$

The factored payoff can be seen in 4.18.

$$\begin{aligned} \text{Payoff} = & -(0.04079 * 2,868.37) + (S_T - (0.04079 * 2,868.37)) \\ & + \max((0.04079 * 2,868.37) - S_T, 0) \end{aligned} \quad (4.18)$$

Figure 4.4. shows the payoff from investing into one Bonus Certificate on the S&P BRIC 40.

4.3 Risks, Advantages and Disadvantages of Bonus Certificates

Investors into bonus certificates face different risks, advantages and disadvantages compared to investors, which directly invest into stocks, as the payoff structure is changed through the long down-and-out put option the investors enter.

Risks

Investors in bonus certificates face increased counterparty credit risk, as their payoff depends on two parties: The investor is confronted with the risk of Raiffeisen defaulting on the final payment on the maturity date.

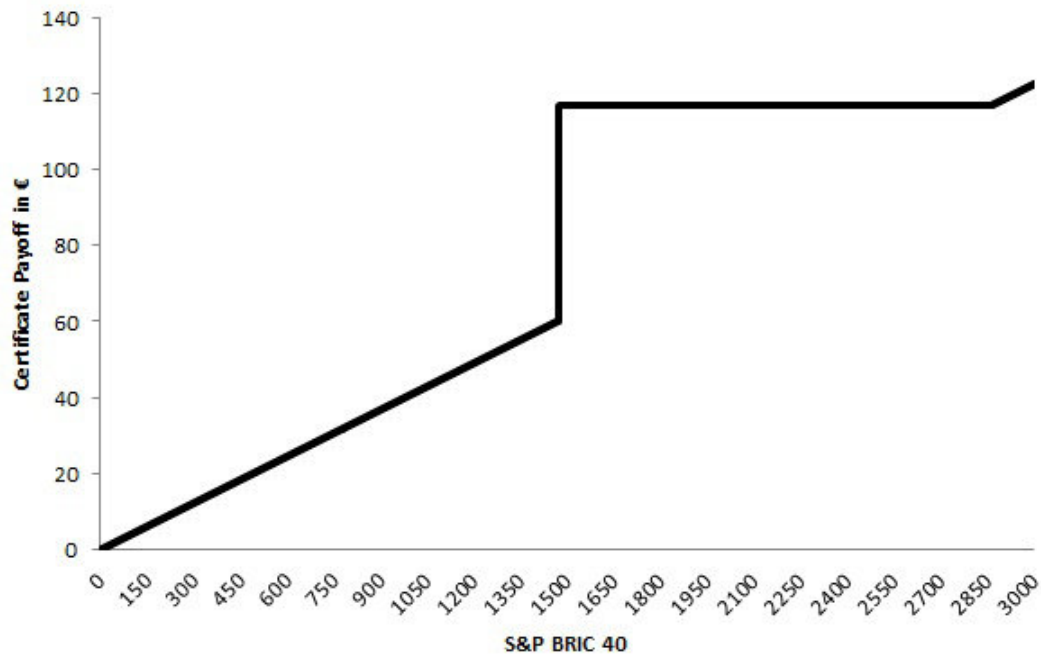


FIGURE 4.4: Payoff from the BRIC Bonus Certificate (by: Stefan Rogel)

Market-wide news influence the S&P BRIC 40 level, which is the major factor influencing the payoff of the Bonus certificate. Positive news might have a positive impact on the index level and therefore increase the payoff of the certificate at maturity. Nevertheless, harmful news can alter stock prices in a negative way, which might reduce the payoff in case the barrier is reached leading to high losses. Therefore bonus certificates have a higher market risk.

Bonus certificates are usually more liquid than other structured investment products due to the high volume which is issued at a lower price. However, their trading volume is lower than the volume traded of a traditional stock. In order to enhance their liquidity, bonus certificates are usually traded on various stock exchanges. For example, the bonus certificate on S&P BRIC 40 is traded in Vienna, Frankfurt and Stuttgart (RAIFFEISEN5, p. 1). However, their liquidity risk is higher than that of stock investments but lower than that of other structured investment products.

Advantages

Bonus certificates offer a bonus payment above the return of plain bond or stocks investments in stagnating markets, as will be discussed in 4.7. However, whether this payment will be made depends on the price of the underlying during the term of the certificate, which was already discussed previously.

Also, bonus certificates are considered as less risky compared to a direct investment into stocks, as the bonus is paid as long as the underlying does not fall below the barrier level, which is especially advantageous in periods of stagnating markets, as the bonus is paid until the stock breaks the barrier. Even in case the stock price rises significantly - above the level of the bonus payment - the investor will receive a payment, which is equal to the stock price and therefore he does not face less return through investing in a bonus certificate, in comparison to investing into its capped counterparts.

Another advantage is that bonus certificates are traded in the same way as shares on stock exchanges, where they can be sold or bought in case cash is needed by the investor.

Disadvantages

Using bonus certificates for investment does not only have advantages, but also disadvantages. The bonus payment is the big advantage of a bonus certificate in stagnating markets. However, this payment gets lost in case the underlying stock drops below the barrier, which will lead to the payoff equalling the current price of the underlying. In case it will not recover to its old level, the bonus certificate will produce significant negative return for investors.

Also, selling the product before maturity may result in a loss, as the certificate is still affected by the uncertainty of fluctuating stock prices and the time value of money, due to its time to maturity and since it pays off its face value only at maturity.

Moreover, the product is subject to a leverage effect, which may result in large changes in value of the certificate, even though the changes in value of the underlying were small. The leverage effect is explained as the tendency of an asset's changes in volatility being negatively correlated, to its return (SAHALIA, p. 2). This is particularly the fact at levels around the barrier level, when the certificate is at risk of losing the bonus payment.

Investors are not subject to any dividend payments the companies make, which may become a major disadvantage for them, especially in case special dividends are declared or the dividend policy of the companies changes and dividend payments are increased. These special dividends affect the stock price and may harm investors in case the stock falls below the barrier.

Finally, the liquidity of the certificate is lower than that of a regular stock, as already discussed before, which may make the investor subject to significant liquidity risk.

	Barrier during term	Factored Index Value on Final Valuation Date times Euro	Payoff on Maturity Date
Scenario 1	not reached	under Bonus Level	117€
Scenario 2	not reached	above Bonus Level	$S_{10.03.2015} * 0.04079 * €$
Scenario 3	reached	under Bonus Level	$S_{10.03.2015} * 0.04079 * €$
Scenario 4	reached	above Bonus Level	$S_{10.03.2015} * 0.04079 * €$

TABLE 4.2: Payoff Scenarios for Bonus Certificate

4.4 Scenarios

The payoff of the certificate depends on two main factors. First, it depends on whether the barrier was breached in the period excluding the initial valuation date and including the final valuation date. Second, it depends on the stock price on the final valuation date. The payoff can be summarized in the four scenarios which are described in Table 4.2.

In scenario 1, the barrier was not breached during the term of the note. Therefore, the long down-and-out put option is not terminated and can still be exercised. The S&P BRIC 40 trades below the factored bonus level of 117.00€ and it pays off to exercise the option. Through exercising it, the option pays off 117.00€, as it allows the stock to be sold at its exercise price. The investor receives the amount of 117.00€ at the maturity date.

In scenario 2, the factored S&P BRIC 40 index never traded below the barrier of 60.00€ and the long down-and-out put option can still be exercised. However, the index level is above the bonus level and it would not provide positive payoff to exercise the option. The investor will receive the factored amount of the index at maturity and the option will stay unexercised, as exercising it is not profitable to the investor in this scenario. Selling the factored index in the free market is more profitable than selling it through the put option, as only a price above 117.00€ can be achieved, when the stock is sold on the market. The payoff at maturity is equal to $S_{10.03.2015} * 0.04079$.

The barrier was breached in scenario 3. In case the factored index trades below 60.00€ the down-and-out put option cannot be exercised and as a result, the protection of the option is lost. The option cannot be used to sell the factored index for 117.00€ in this

scenario. As a result, the stock holder is required to sell the stock in the market and will receive a payoff equal to $S_{10.03.2015} * 0.04079$ at the maturity date.

In scenario 4 the barrier was breached and the down-and-out put option cannot be exercised. However, the factored index trades above the exercise price of 117.00€. The situation is similar to scenario 2, as the index trades above the exercise price and will lead to the option not being exercised by its holder as it would deliver negative payoff. The payoff from the certificate is equal to $S_{10.03.2015} * 0.04079$.

4.5 Price Development of the Product

The price of the certificate develops differently, depending on whether the index already breached the barrier and the option is terminated, or whether the index still trades above it and the option can still be exercised. Therefore, the following analysis is split into these two scenarios.

In the first scenario, the option is already terminated. After the option is terminated, the certificate equals an index investment which does not offer any dividend payments. The payoff of the certificate equals the factored index value on the final valuation date. Increasing dividend payments have a negative effect on the value of the certificate as the index decreases in value through dividends that are paid out, but the investor in the certificate does not benefit from these and faces a decreasing index value. To conclude, there is a negative correlation between index level and the value of the certificate, meaning that, as dividends increase, the price of the certificate decreases.

Risk free interest rates are another factor which affects the value of the certificate. In general, increasing interest rates indicate an increasing index level, while falling interest rates are an indicator for a decreasing index level (HULL, p. 230). The investor benefits from an increasing index level as he entered a long position the index. However, he will impair losses from decreasing interest rates and a decreasing index level. As a result, the correlation between interest rates and the value of the certificate is positive.

The next factor is time to maturity. As the time to maturity decreases, the value of the certificate increases due to the reduced uncertainty which is a negative correlation between the time to maturity and the certificate's value in this scenario.

In case the index did not breach the barrier, the option is not terminated and can still be exercised. In this scenario, the value of the option needs to be included to determine the price of the certificate.

Volatility is another factor influencing the value of the certificate. Above the bonus level increasing volatility can have a positive impact on the value of the certificate, as a higher volatility increases the chance for the index to increase in value and therefore generate a higher return for the investor. The higher volatility might on the opposite lead to a decreasing index level. As long as the index trades at a level which is above the barrier, the chance for the index to fall below the barrier is considered as low. However, for a decreasing index level, the payoff is secured at the bonus level. For prices above the bonus level, higher volatility may increase the value of the certificate. As a result, there is a positive correlation between volatility and the value of the certificate when the long down-and-out put option is not terminated and the index trades above the bonus level.

Volatility might also increase while the index trades below the bonus level and close to the barrier. In this scenario increasing volatility has a negative impact on the value of the long position in the down-and-out put option. The index level is already close to the barrier and as volatility increases, the probability of the index to decrease and the option to be terminated increases. In this case, the option cannot be exercised anymore and the index cannot be sold at the level of the cap, decreasing the overall value of the certificate. In contrast, as volatility decreases, the probability that the down-and-out put option knocks out is also decreased. This has a positive impact on the value of the certificate, as the risk of losing the insurance function of the option does not increase. To conclude: below the cap, there is negative correlation between volatility and the value of the certificate, while there is positive correlation between volatility and the value of the certificate above the cap.

The next factor which needs to be considered are dividend payments. As previously discussed, dividends are distributed to stock holders in the form of cash or shares. However, investors in the certificate do not receive any dividends. Therefore they face a decreasing index level without the benefit of receiving the dividend. An increasing dividend level also increases the probability of the down-and-out put option to be terminated which has a negative impact on the value of the certificate. At the same time, decreasing dividends have a positive impact on the value of the certificate as the probability of the

option to be terminated decreases. This relationship is a negative correlation between dividend payments and the value of the certificate.

Interest rates have a two-fold effect on the value of the certificate. First, they affect the index value and second, they affect the value of the option. As previously discussed, a positive correlation between interest rates and the index level exists, and, as a result, also to the value of the certificate. The relation between interest rates and the option value is different. High interest rates decrease the value of the option, while lower interest rates lead to a higher value of the option (HULL, p. 228). Consequently, there is a negative correlation between interest rates and option value. With rising interest rates the value of the option decreases, but the expected index return increases. The effect on the value of the certificate depends on which of both factors dominates and cannot be clearly determined.

Furthermore the price increases with declining maturity which is a negative correlation between maturity and price as long as the index trades above the barrier.

4.6 Pricing

Throughout this section, the Raiffeisen Centrobank AG BRIC Bonus Certificate 2 will be priced with a decomposition approach. Based on the discussion in 4.2 about the Product Set-up, the positions which are part of the product: the factored long position in the S&P BRIC 40, as well as the European long down-and-out put option on the S&P BRIC 40 will be priced. For this valuation, historical data is used in order to determine their price on the issue date (13.03.2012) and to determine whether the product was sold for a fair price to investors.

A factored long position in the S&P BRIC 40

As discussed in 4.2.1, a factored long position in the S&P BRIC 40 will be entered at the initial reference level of 2,451.60 on the issue date 13.03.2012. The initial reference level of the asset was determined as 2,451.60 and is multiplied by the multiplier of 0.04079 times Euro in order to determine the price of the position, as in Formula 4.19.

Stock Price	€100.00
Volatility (% per year)	21.99%
Risk-Free Rate (% per year)	0.47%
Time to exercise (in years)	3
Exercise Price	€117.00
Barrier	€60.00
Type	Barrier Down-and-out Put

TABLE 4.3: Data Used for Valuation of the Option

$$\begin{aligned}
 \text{Initial Reference Price} * \text{Multiplier} * \text{€} &= \text{Price of Position} \\
 2,451.60 * 0.04079 * \text{€} &= \text{€100.00}
 \end{aligned}
 \tag{4.19}$$

A fair price for the long position is equal to €100.00.

A Factored Long Down-and-out Put Option on the S&P BRIC 40

European down-and-out put options are not commonly traded on financial markets. Therefore, the option will be priced with DerivaGem and appropriate data as an input in order to determine its value. The input data from Table 4.3 is used.

As no data for the volatility of the S&P BRIC 40 index could be found, to value the option, the annualized volatility from the SPDR S&P BRIC 40 ETF (CUSIP: 78463X798) from SPDRS is used. It is found to be equal to 21.99% on November 26th, 2013.

On March 19th, 2012 the Board of Governors of the Federal Reserve System released their weekly review of selected Interest Rates (FED1). The 3-year interest rate for U.S. government securities is equal to 0.47% on March 12th, 2013. DerivaGem finds the value of the option as equal to 12.79€.

Fair Price for the S&P BRIC 40 Bonus Certificate

As the investor enters a factored long position in the S&P BRIC 40 and a long position in the European down-and-out put option on the S&P BRIC 40, the results of the previous calculation need to be summed up which leads to the result in Formula 4.20.

$$100.00\text{€} + 12.79\text{€} = 112.79\text{€} \tag{4.20}$$

S&P BRIC 40 index level	Certificate Payoff	Factored Index Payoff
0	€ 00.00	€ 00.00
250	€ 10.20	€ 10.20
500	€ 20.39	€ 20.39
750	€ 30.59	€ 30.59
1000	€ 40.79	€ 40.79
1250	€ 50.99	€ 50.99
1500	€ 117.00	€ 61.18
1750	€ 117.00	€ 71.38
2000	€ 117.00	€ 81.58
2250	€ 117.00	€ 91.78
2500	€ 117.00	€ 104.01
2750	€ 117.00	€ 112.17
3000	€ 122.37	€ 122.37

TABLE 4.4: Table Stock Price Scenarios

The calculation shows that the product is sold at a discount to investors. However, it is as an approximated valute as the data did not satisfy the requirements for a perfect valuation.

4.7 Stock Price Scenarios

Throughout this section, the payoff at maturity from the certificate will be compared to the payoff from a direct investment into the S&P BRIC 40 Index. Table 4.4 compares both payoffs, depending on the level of the S&P BRIC 40 at the final valuation date. Furthermore, Figure 4.5 shows the payoff from both investments against various levels of the S&P BRIC 40 graphically.

Both payoffs are increasing functions of the S&P BRIC 40 level at the final valuation date. As the index level increases, the payoff increases. However, payoffs from the two positions differ between factored index levels in a range of 60.00€ and 117.00€. This is due to the European down-and-out put option with an exercise price of 117.00€ that is included in the certificate. The European down-and-out put option insures the investor from losses in this range and secures a payoff of 117.00€. However, in case the index falls below 60.00€ during the certificate's term or closes above 117.00€ at maturity, both payoffs are similar.

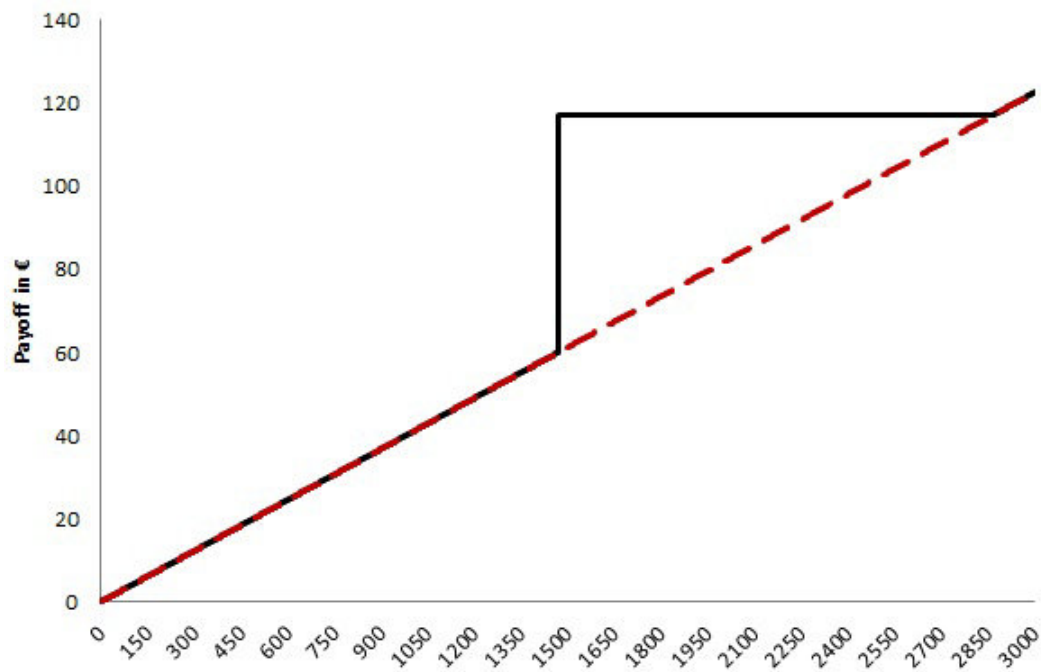


FIGURE 4.5: Graph Index Level Scenarios (by: Stefan Rogel)

It is important to consider that the certificate does not pay any dividends, but faces the exposure from a falling index level due to dividend payments made by companies which are listed on the index during the term of the note. For low or no dividend paying stocks, this fact does not lead to major changes in the overall payoff, but might lead to significantly lower returns with high dividend stocks, as an investor in the certificate gives up the dividend payments.

To conclude, when making an investment decision, it is important to weight the insurance function of bonus certificates versus the forgiven dividend payments, as for high dividend stocks these might outweigh the advantage of the insurance function. However, the bonus certificate leads to higher payoff in general.

4.8 Conclusion of the S&P BRIC 40 Bonus Certificate

The payoff of the S&P BRIC 40 Bonus Certificate can be reconstructed through a factored long position in the S&P BRIC 40, which is entered at a level of 2,451.60€, as well as a long position in a European down-and-out put option on the S&P BRIC 40 with an exercise price at 2,868.37€ and a barrier at 1,470.96€. The analysis showed that the investor faces increased risk through counterparty credit, as well as liquidity risk.

Furthermore, he faces market risk. Therefore, the product is sold at a discount through offering positions which are in fact worth 112.79€ for 102.00€ in order to compensate for the increased risk.

Furthermore, the bonus certificate offers a bonus payment above average return, which is especially valuable in stagnating markets, as it gets lost in case the level of the underlying falls below the barrier level and profits can be increased through directly investing into the underlying in case it is expected to increase significantly. Finally, the investor does not receive any dividend payments and faces a leverage effect. To conclude, a bonus certificate can be a valuable tool for investors in case they expect stagnating markets, but in case the level of the underlying is expected to increase or decrease significantly, other investment opportunities may offer a higher return.

Chapter 5

Raiffeisen Centrobank AG

Protected Reverse Convertible on Andritz AG

5.1 Overview of the Protected Reverse Convertible on Andritz AG

On June 12th, 2013 Raiffeisen Centrobank AG issued 100,000 protected reverse convertibles at a price of 1,000€ per note, raising 100,000,000€ in total (RAIFFEISEN3). The protected reverse convertible is based on the underlying Andritz AG (ISIN: AT0000730007).

Throughout this section, the set-up of the protected reverse convertible on Andritz AG is determined in order to analyze the payoff structure, as well as to determine a fair valuation based on the securities that can be used to replicate the note's payoff using a decomposition approach. Furthermore, advantages and disadvantages of protected reverse convertible notes will be discussed, as well as two scenario analyses conducted in order to determine the payoff structure of these notes and to compare the payoff of the note to a direct investment into the shares of Andritz AG.

The main facts of the transaction are summarized in Table 5.1. The data is based on RAIFFEISEN3.

Product Data	
Term	18 months
Issues Price	1,000.00€
Number of Units	100,000 Units
Multiplier	24.77
Issue Date	12.06.2013
Maturity Date	12.12.2014
Initial Valuation Date	10.06.2013
Final Valuation Date	09.12.2014
Issue Surcharge	2.00€
Issuer	Raiffeisen Centrobank AG
Reference Asset	Andritz AG (ISIN: AT0000730007)
Initial Reference Price (Strike)	40.375€
Issue Price	1,000.00€
Trigger Price (Barrier)	30.28125€
Final Reference Price	Closing Price

TABLE 5.1: Overview of the Protected Reverse Convertible on Andritz AG

In the following, it is explained how the data in Table 5.1 was determined. The protected reverse convertible on Andritz AG, which was issued on June 12th, 2013 has its initial valuation date on June 10th, 2013. On the initial valuation date, the initial level of the underlying stock, which is Andritz AG in this case, is determined. The strike price is equal to 100% of the closing price of the stock of Andritz AG on June 10th, 2013 which is equal to 40.375€ (retrieved via onvista.de for the stock of Andritz AG). Based on the strike price, the barrier (also called trigger price) can be determined. According to the final terms of the product, which were published on May 21st, 2013 (RAIFFEISEN3), the barrier is determined as 75.00% of the initial price of 40.375€ and calculated as shown in Formula 5.1.

$$barrier = 40.375€ * 0.75 = 30.28125€ \quad (5.1)$$

These protected reverse convertible notes pay a fixed interest rate at an annualized rate of 6%, which is paid out at maturity as a lump sum payment, equaling an interest rate of 9% for the 18 months period, but also pay out 100% of the par value at the maturity date on December 12th, 2014, in case the shares of Andritz AG never traded below the barrier of 30.28125€ during the term of the note. Otherwise, they pay out the cash value of 24.77 shares of Andritz AG, or the shares itself, in case the stock touches or is traded below the barrier of 30.28125€ during the term and the stock closes below the

initial price of 40.375€. The value of the shares is based on the stock price at the final valuation date. The number of shares that will be paid out is calculated based on their initial level of 40.375€ and the issue price of 1,000€ per note and therefore calculated as shown in Formula 5.2.

$$\text{Number of shares to be paid out} = 1,000\text{€} : 40.375\text{€} = 24.77 \text{ shares} \quad (5.2)$$

The note pays out the cash value of 24.77 shares of Andritz AG in case the shares trade below or equal to 30.28125€ during its term to maturity and close below 40.375€ on the final valuation date. Finally, the investors do not receive any dividend payments during the maturity of the note. The payoff is explained graphically in Figure 5.1.

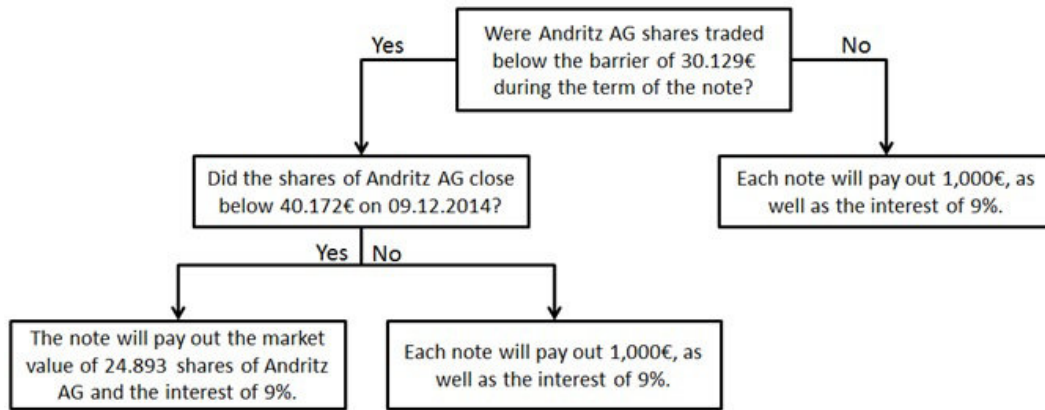


FIGURE 5.1: Payoff Diagram from the Protected Reverse Convertible on Andritz AG (by: Stefan Rogel)

5.2 The Product Set-up

The payoff structure from the protected reverse convertible note on Andritz AG can be replicated through the following two positions: a zero-coupon bond from Raiffeisen Centrobank AG, as well as 24.77 short positions in European down-and-in at-the-money put options on Andritz AG. The positions will be discussed in the following section in further detail.

5.2.1 A Zero-coupon Bond from Raiffeisen Centrobank AG

According to BERKDEMARZO (p. 218), a zero-coupon bond is defined as “a bond that does not make coupon payments. The only cash payment the investor receives is the face value of the bond on the maturity date.” In line with this definition, investors in these protected reverse convertibles enter a long position in a zero-coupon bond with a specified denomination of 1,000€ and an issue price of 100% (RAIFFEISEN3). The annualized coupon is 6%, while the 18 months coupon is 9% (RAIFFEISEN3). Therefore, the zero-coupon note costs 1,000€ when entering the contract on the issue date on June 12th, 2013 and pays out 1,090€ on the maturity date on December 12th, 2014.

The face value of the bond is calculated as shown in Formula 5.3 and 5.4.

$$\text{Issue Price} * (1 + r) = \text{Face Value} \quad (5.3)$$

$$1,000\text{€} * (1 + 0.09) = 1,090\text{€} \quad (5.4)$$

The payoff structure of the zero-coupon bond is independent of the stock price of Andritz AG on the final valuation date and therefore looks as in Figure 5.2. on December 12th, 2014.

5.2.2 A Short Down-and-in At-the-money Put Option

Besides the long position in the zero coupon bond, the investors enter a short position in 24.77 European down-and-in at-the-money put options on Andritz AG with an expiration date on December 9th, 2014 and an exercise price of 40.375€ with a barrier of 30.28125€, which is 75% of the strike price. These options can only be exercised if the stock trades below the barrier of 30.28125€ during the life of the option.

A short position in a put option means that the investor has sold the right to sell the underlying asset, which is Andritz AG in this case, by December 9th, 2014 for 40.375€ (denoted by K) to the buyer of the option, in this case Raiffeisen (application of HULL, p. 205-210). This option is a special type of option which falls into the category of barrier options. According to HULL (p. 480) barrier options are defined as “options

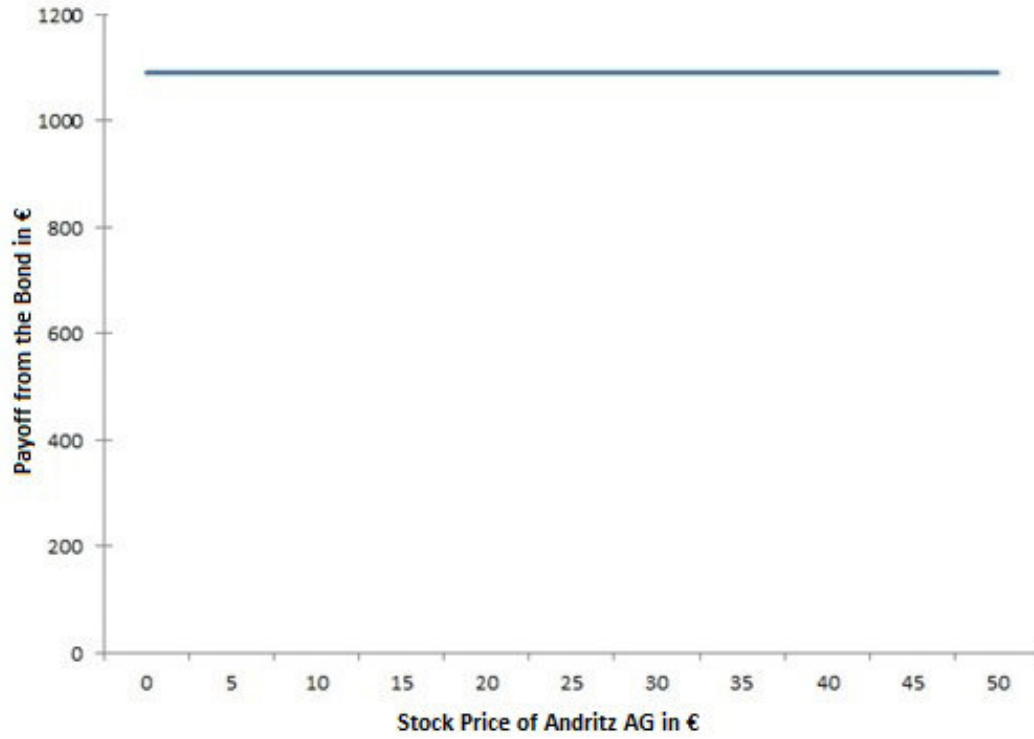


FIGURE 5.2: Payoff from a Zero-coupon Bond (by: Stefan Rogel)

where the payoff depends on whether the underlying asset's price reaches a certain level during a certain period of time". Barrier options are divided into different sub-categories, of which knock-in options are one type. The European down-and-in put option becomes a regular European put option that starts to exist as soon as the stock trades below the barrier level of 30.28125€, denoted by H (DEWEERT, p. 58). Exercising it is profitable for its holder, as long as the stock of Andritz AG does not trade above 40.375€. At a price of 40.375€, the holder is indifferent between exercising and not exercising it, as the payoff of exercising the option is equal to zero. Above 40.375€, the option holder will leave the option unexercised, as exercising it would lead to a negative payoff (application of BUTLER, pp. 114-122). Furthermore, the option is said to be at-the-money when its strike price equals the price of Andritz AG on the day it was issued. The general formula for the short position in the European down-and-in put option is as shown in Formula 5.5. Applied to the case at hand it is equal to Formula 5.6.

$$\begin{aligned}
 & \min(S_T - K, 0), \text{ if } S_t < H \text{ for all } t \leq T \\
 & 0, \text{ if } S_T \geq H \text{ for all } t \leq T
 \end{aligned}
 \tag{5.5}$$

$$24.77*$$

$$\begin{aligned} \min(S_{December\ 9th,2014} - 40.172\text{€}, 0), \text{ if } S_t < 30.28125\text{€ for all } t \leq December\ 9th,2014 \\ 0, \text{ if } S_t \geq 30.28125\text{€ for all } t \leq December\ 9th,2014 \end{aligned} \quad (5.6)$$

According to HULL (p. 209), the payoff from a short position in a European put option is shown by Formula 5.7.

$$- \max(K - S_T, 0) = \min(S_T - K, 0) \quad (5.7)$$

Applying the formula for the options in this case leads to Formula 5.8.

$$\begin{aligned} 24.77 * [-\max(40.172\text{€} - S_{December\ 9th,2014}, 0)] \\ = 24.77 * \min(S_{December\ 9th,2014} - 40.172\text{€}, 0) \end{aligned} \quad (5.8)$$

According to HULL (p. 209) the payoff from a long position in a European put option is shown by Formula 5.9.

$$\max(K - S_T, 0) \quad (5.9)$$

Applying the formula for the option which is discussed in this section leads to Formula 5.10.

$$24.77 * \max(40.172\text{€} - S_{December\ 9th,2014}, 0) \quad (5.10)$$

The payoff from the option is shown in Figure 5.3.

Figure 5.3 shows that the option seller can lose a maximum of 1,000€ (see Formula 5.11).

$$24.77 * 40.375\text{€} = 1,000\text{€} \quad (5.11)$$

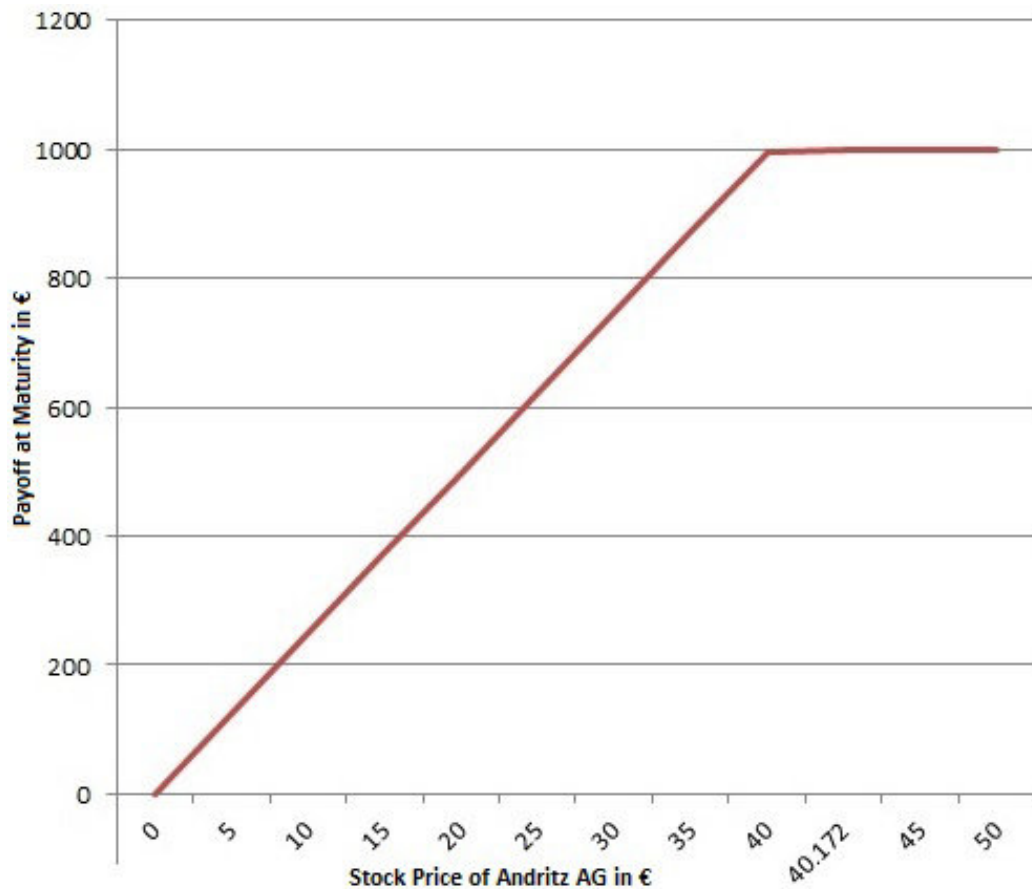


FIGURE 5.3: Payoff from a Short Down-and-in At-the-money Put Option (by: Stefan Rogel)

5.2.3 Overall Payoff

Based on the previous analysis, investors who purchase a protected reverse convertible on Andritz AG enter two positions. First, a zero-coupon bond from Raiffeisen with an issue price of 1,000€ and a face value of 1,090€, as well as short positions in 24.77 European at-the-money down-and-in put options on Andritz AG with an exercise price of 40.375€. The bond's issue price can be considered as collateral for the short position in the put options, while the interest paid by Raiffeisen is an interest payment for the collateral, as well as a payment for the put options that were sold by the investors.

Combining the payoff from the zero-coupon bond and the European down-and-in at-the-money put options, the overall payoff for the investor at maturity is as shown in Formula 5.12 and 5.13.

Graphically, the payoff at maturity is shown in Figure 5.4.

$$\text{Face Value of the Zero-coupon Bond} + \text{Payoff from Option} \quad (5.12)$$

$$1,090 + 24.77^*$$

$$\min(S_{\text{December 9th, 2014}} - 40.172\text{€}, 0), \text{ if } S_t < 30.28125\text{€ for all } t \leq \text{December 9th, 2014}$$

$$0, \text{ if } S_t \geq 30.28125\text{€ for all } t \leq \text{December 9th, 2014}$$

$$(5.13)$$

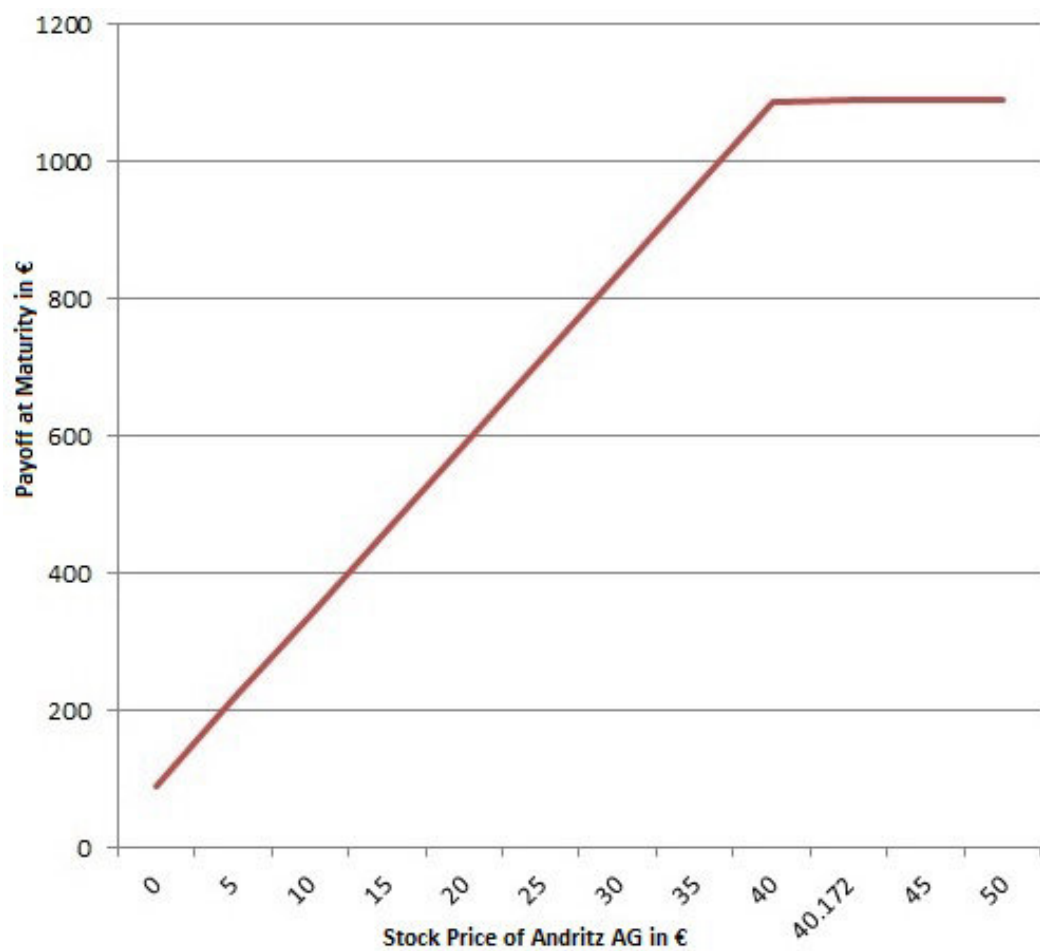


FIGURE 5.4: Payoff from the Protected Reverse Convertible on Andritz AG (by: Stefan Rogel)

5.3 Risks, Advantages and Disadvantages of Protected Reverse Convertibles

Investors into protected reverse convertible notes face different risks compared to other investment vehicles. Therefore, the risks of investing into structured notes will be discussed first while then discussing its advantages and disadvantages.

Risks

Investors face three main types of risks: counterparty credit risk, market risk and liquidity risk. Counterparty credit risk was defined in 2.3. Through investing into protected reverse convertibles, the investor is exposed to the risk of default of two parties, while through a straight investment into a stock, he just faces the default risk of one party. First, the issuer may default and might not be able to repay the amount due at maturity, and, second, the default of the underlying company which is Andritz AG. In case Andritz AG defaults, its shares become worthless and Raiffeisen can exercise all options and require full payment for these, even though the stock may be worthless.

As defined in 2.3, the concept of market risk is applied in the following. The investor faces market risk, in case the value of Andritz AG stock falls significantly due to a changing market situation, and therefore Raiffeisen can exercise the options and repay the investor less than he invested. Furthermore, Raiffeisen itself is exposed to market risk which might push the company itself into default which hinders them from repaying the loan to the investor. As a result, the investor faces increased market risk as two of his counterparties are subject to market risk.

Liquidity risk was defined in 2.3. Protected reverse convertibles have a lower liquidity than stocks (which can simply be traded in the stock market) due to the lower number of trades. As a result, the investor might be required to sell the protected reverse convertible at a significant discount due to its lack of liquidity and face an additional loss in case he is required to sell it rapidly.

Advantages

Investing in protected reverse convertible notes has a variety of advantages. The product allows for higher yields with shorter maturity than plain bonds, but also bears higher risks for its investors (BNP1, p. 44). Also, in the scenario analysis for different stock

prices, which is conducted in 5.4, it is found that reverse convertibles are a good instrument in stable equity markets with little upward and downward potential, because they deliver enhanced return under these circumstances. The investment has a lower volatility than the underlying shares due to the final coupon payment which protects the investor from a total loss, but at the same time the upward potential of the underlying security is limited. Furthermore, the product allows the investor to short a put option which is not straight forward possible in all legislations for private investors.

Disadvantages

Investors into protected reverse convertibles do not only face advantages, but also disadvantages. Protected reverse convertibles are structured products and therefore neither plain debt nor equity investments (BNP1, p. 44). The return is capped and, as a result, the expectations on stock return must be lower than the cap, otherwise investing into shares is more beneficial to investors. However, even though the return is capped, investors still face full exposure to falling share prices. Furthermore, the return is less predictable than a plain investment into bonds, as the initial payment can be fully converted into the cash value of the shares which significantly lost in value, and therefore the product might offer a negative return.

5.4 Scenarios

During the 18 months term, four different scenarios are possible, which will be analyzed in this paragraph. Table 5.2 summarizes the possible events, as well as the corresponding payoffs in the different scenarios.

In scenario 1, the stock of Andritz AG did not trade below the barrier of 30.28125€ during the term of the option. As a result, the down-and-in put options on Andritz AG cannot be exercised, even though it would pay off to exercise the options. The payoff to the holder of the protected reverse convertible note on Andritz AG equals the face value of the zero-coupon bond which equals 1,090€.

In scenario 2, the stock of Andritz AG never traded below the barrier during the term of the options and the down-and-in put options cannot be exercised by Raiffeisen. However, Raiffeisen would not exercise the options, even if it was possible due to the fact that

	Barrier during the life of the option	Stock price on December 9th, 2014	Payoff to the investor on December 12th, 2014
Scenario 1	Not reached	Below K	1,090€
Scenario 2	Not reached	Above or equal K	1,090€
Scenario 3	Reached	Below K	1,090€ - 24.77 * min(S - 40.172€, 0)
Scenario 4	Reached	Above or equal K	1,090€

TABLE 5.2: Understanding the Payoff of the Protected Reverse Convertible on Andritz AG

the stock trades above or equal to the exercise price and exercising them would deliver a negative or no payoff to Raiffeisen. The note pays out 1,090€.

In scenario 3 and 4, Raiffeisen has the possibility to exercise the down-and-in put options due to the fact that the barrier was reached during the life of the option as the stock of Andritz AG traded below 30.28125€.

In scenario 3, the stock price of Andritz AG trades below the exercise price of 40.375€ on December 9th, 2014 and the barrier was reached. Therefore, Raiffeisen will exercise the 24.77 options and get the positive payoff from exercising them. The payoff of the options to Raiffeisen is shown by Formula 5.14.

$$24.77 * \max(40.172 - S_{December\ 9th,\ 2014}, 0) \quad (5.14)$$

Therefore, investors lose an amount equal to Formula 5.15 in case the options will be exercised.

$$24.77 * \min(S_{December\ 9th,\ 2014} - 40.172€, 0) \quad (5.15)$$

The investor's overall payoff in scenario 3 will be equal to the face value of the zero-coupon bond and the loss through Raiffeisen exercising the options (Formula 5.16).

$$1,090€ + 24.77 * \min(S_{December\ 9th,\ 2014} - 40.172€, 0) \quad (5.16)$$

In scenario 4, the stock price of Andritz AG is above the exercise price of 40.375€ on December 9th, 2014. Raiffeisen will not exercise the options, as it would deliver no or a negative payoff as shown by Formula 5.17.

$$24.77 * \max(40.172\text{€} - S_{\text{December 9th, 2014}}, 0) \quad (5.17)$$

The payoff from the option to its holder will be equal to 0, and the note's payoff will be equal to 1,090€ as shown in Formula 5.18.

$$1,090\text{€} - 24.77 * \min(S_{\text{December 9th, 2014}} - 40.172, 0) = 1,090\text{€} - 0 = 1,090\text{€} \quad (5.18)$$

5.5 Price Development of the Product

Different factors impact the price development of the protected reverse convertible on Andritz AG. The main factors were pointed out in Raiffeisen's base prospectus (RAIFFEISEN1, p. 49). These include the price of the underlying, the implicit volatility, the interest rates and the remaining term of the product. The factors are tested in the following to analyze whether the price of the product behaves like stated in the prospectus.

The price of the protected reverse convertible rises when the price of the Andritz AG stock rises and decreases when the stock price of Andritz AG decreases, keeping all other factors constant (RAIFFEISEN1, p. 49). This relationship between the two variables is called positive correlation (BOWERMAN, p. 147). This positive relationship between the two products can be explained by an increasing stock price of Andritz AG indicating that the European down-and-in put options become less likely to be exercised as the stock price moves further away from the barrier.

Furthermore, the implicit volatility, which is also called the implied volatility of the underlying, impacts the price of the note. According to HULL (p. 577) volatility is defined as "a measure of uncertainty of the return realized on an asset". While the implied volatility is determined through the option price by using the Black-Scholes model or a similar model, the historical volatility is estimated from historical data (HULL, p. 303

and p. 295). With an increasing volatility of the underlying stock, the value of the put options increases when keeping all other factors constant. The note holder entered a short position in 24.77 put options and therefore bears the exposure of a short position, the value of his position decreases while the value of the long position increases. A similar exposure can be observed for decreasing volatility. This relationship, with one variable increasing while the other one decreases, is called negative correlation (BOWERMAN, p. 147). The price of the protected reverse convertible on Andritz AG is negatively correlated to the volatility of Andritz AG stock, keeping all other factors constant.

Another factor which has an impact on the price of the product are risk-free interest rates. Changing risk-free interest rates affect the price of the product in two ways. First, changes in these lead to a change in the price of the put options. Second, these changes affect the present value of the zero coupon bond's face value at maturity. In the first case, when considering the value of the put option, it is important to understand that the holder of the protected reverse convertible entered a short position in down-and-in put options, and therefore the impact on his position is the reverse of the impact on a long position. When interest rates increase, the cost of put options decrease keeping all other factors constant (HULL, p. 228). This is the result of rising interest rates, making put options less attractive, as it becomes less likely that these options can be exercised with a profit. As the investor entered a short position, this behavior is advantageous and the value of the product increases. In contrast, falling interest rates can indicate falling stock prices (HULL, p. 230). Falling stock prices are advantageous for the holder of put options, as these are more likely to be exercised in-the-money. This leads to raising prices of put options (HULL, p. 228). As the investor is in a short position, this behavior is disadvantageous for him and the value of the product decreases with falling interest rates when keeping all other factors constant. The previous discussion proves a positive correlation between interest rates and the investor's exposure to the short position in the protected reverse convertible.

In the second case, lower interest rates lead to a higher present value of the zero coupon bond's face value at maturity as this payment is fixed at a rate of 9% for 18 months. Therefore, lower interest rates have a positive impact on the present value of the bond payments, and therefore on the value of the bond (BERKDEMARZO, p. 227). The same applies to increasing interest rates. Increasing interest rates cause a lower present value of the zero coupon bond. As a result, negative correlation between interest rates and the

present value of the zero coupon bond can be concluded. The discussion demonstrates a positive correlation between interest rates and the value of the short put option position and a negative correlation between interest rates and the present value of the long position in the zero coupon bond. Therefore, it cannot explicitly be confirmed, in which direction the value of the product will develop when the interest rates change and all other factors are kept constant, because it depends on which effect dominates.

As the remaining term decreases, the price of the zero-coupon bond increases. The bond trades at a discount and approaches the bond's face value as it approaches its maturity. Therefore, the bond price rises continuously, as time passes by. This has a positive impact on the value of the note and its price increases with time passing while keeping all other factors constant.

Furthermore, dividends are a major factor affecting the price of the protected reverse convertible. According to HULL (p. 304), dividends reduce the stock price on the ex-dividend date. This effect increases the price of put options. As the investor in the note entered a short position, this effect is negative for him, while an increasing dividend lowers the price of a put option and the effect is therefore positive for the investor's short position. However, only non-anticipated changes in dividends have an impact on the value of the options, as anticipated changes were already incorporated in the valuation of the option and therefore have no impact on its actual price.

5.6 Pricing

In this section, the product is priced with a decomposition approach and discounting the future payments to their present value at the issue date on June 12th, 2013. First, the down-and-in at-the-money put option is priced with DerivaGem, based on data gathered from Onvista.de and finance.yahoo.com by the algorithm of the software. Second, the face value of 1,090€ of the zero coupon bond which will be paid on December 12th, 2014 is discounted based on the risk-free interest rate of Austrian 1.5 year AAA bonds. It was retrieved from the Vienna stock exchange to the present value on June 12th, 2014.

Stock Price	40.38€
Volatility (% per year)	34.19%
Risk-free Rate (% per year)	0.34%
Time to Exercise (in years)	1.5
Exercise Price	40.38€
Barrier	30.28€
Type	Barrier: Down-and-in

TABLE 5.3: Overview of the Bonus Certificate on S&P BRIC 40

Value of the European Down-and-in At-the-money Put Options

To price the down-and-in at-the-money put option on Andritz AG, the input data from Table 5.3 is used.

The stock price and the exercise price were already discussed previously. The volatility was retrieved from onvista.de, as the backward looking average of 250 days for the stock of Andritz AG on August 9th, 2013 with a value of 30.92%. The time to exercise is set as 1.5 years, as the protected reverse convertibles on Andritz AG have a term equalling 18 months. The 2-year risk-free rate of 0.34% from June 12th, 2013 is based on the weekly review of selected interest rates from the Board of Governors of the Federal Reserve System, dated June 17th, 2013 (FED2).

DerivaGem calculates the value of the option as 0.00000024€ per option. Therefore, the value of all 24.77 put options involved in the product is equal to the value calculated in Formula 5.19.

$$24.77 * 0.00000024€ = 0.000006€ \quad (5.19)$$

Value of the Zero-coupon Bonds

The payoff from the zero coupon bond at maturity equals 1,090€. This amount is discounted at the risk-free interest rate of 0.34% to its present value for the 1.5 year period as shown in Formula 5.20.

$$1,090€ : 1.0034^{1.5} = 1,084.46€ \quad (5.20)$$

Fair Price for the Protected Reverse Convertible

$$1084.46\text{€} - 0.000006\text{€} = 1084.46\text{€} \quad (5.21)$$

The value in Formula 5.21 is an approximation for the price of the protected reverse convertible. It does not incorporate transactions costs but also no brokerage and commission fees. Furthermore, protected reverse convertibles are less liquid than straight stock, bond or option investments. However, the calculation proves that investors in the protected reverse convertible enter a short position in options which are worth 0.000006€ for which they are effectively paid 84.46€. Therefore, the product appears to be undervalued with a price of 1,000€ when it was initially sold.

5.7 Stock Price Scenarios

One of the major factors affecting the return of the protected reverse convertible on Andritz AG is the price development of the underlying. The note's pay out on December 12th, 2014 depends on the stock price of Andritz AG on December 9th, 2014 and on whether the stock was traded for a price below the barrier of 30.28€ during the term of the note because otherwise the European down-and-in put option cannot be exercised. Throughout the scenarios, it is assumed that the stock of Andritz AG traded under the barrier level of 30.28€ during the term of the note. If it did not trade below this barrier, it will deliver a return of 1,090€ independent from the share price at maturity (Table 5.4 and Figure 5.5.). These scenarios aim at determining under which stock prices it is more advantageous for the investor to directly invest into the stock and under which it is more beneficial to buy a protected reverse convertible on Andritz AG.

Investing in the protected reverse convertible pays off as long as the stock price is expected to fall below the barrier of 30.28€ during the term of the note and at the same time does not close below 40.38€ or if the barrier of 30.28€ will not be reached during the term of the note and the stock is expected to close below 44.00€. An investment into the protected reverse convertibles limits the return to 9% during the 18 months period.

Andritz AG Stock Price	Payoff from Protected Reverse Convertible	Payoff from an Investment into Andritz AG Stock
€ 0.00	€ 89.91	€ 00.00
€ 5.00	€ 213.76	€ 123.85
€ 10.00	€ 337.61	€ 247.70
€ 15.00	€ 461.46	€ 371.55
€ 20.00	€ 585.31	€ 495.40
€ 25.00	€ 709.16	€ 619.25
€ 30.00	€ 833.01	€ 743.10
€ 35.00	€ 956.86	€ 866.95
€ 40.00	€ 1,080.71	€ 990.80
€ 40.38	€ 1,090.00	€ 1000.09
€ 44.00	€ 1,090.00	€ 1090.00
€ 45.00	€ 1,090.00	€ 1114.65
€ 50.00	€ 1,090.00	€ 1238.50
€ 55.00	€ 1,090.00	€ 1362.35
€ 60.00	€ 1,090.00	€ 1486.20

TABLE 5.4: Table Stock Price Scenarios

If the stock is expected to trade above 44.00€ on December 9th, 2014 directly investing into the stock is more beneficial than investing into the note as the direct investment allows to capture the full upside potential of an appreciating stock. In case the stock is expected to close below 40.38€, the equity investment produces a negative return and is therefore no beneficial investment opportunity.

To finally conclude the scenario analysis, protected reverse convertibles are a good instrument to use in stable equity markets with little upward and downward potential because they deliver enhanced return. In strongly upward moving markets, direct equity investments are the better investment while in sharply downward moving markets, both investments produce a negative return and the investor should look for other opportunities.

5.8 Conclusion of the Protected Reverse Convertible on Andritz AG

The protected reverse convertible on Andritz AG can be reconstructed through a zero-coupon bond from Raiffeisen Centrobank AG with an issue price of 1,000€ and an annualized coupon of 6% as well as a short down-and-in at-the-money put option with an

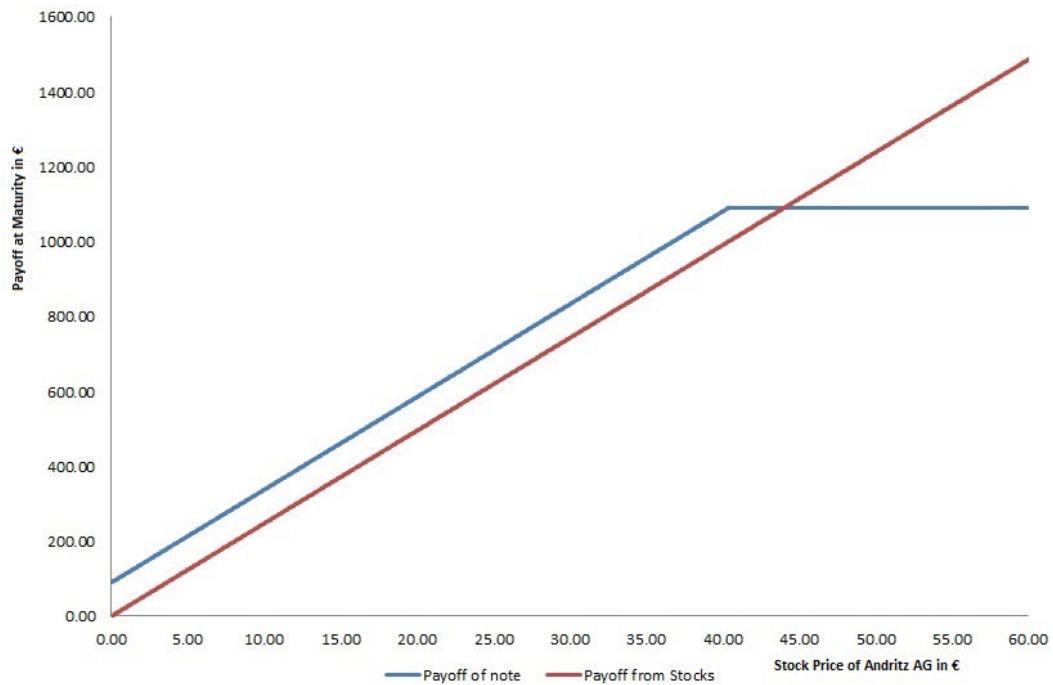


FIGURE 5.5: Stock Price Scenarios for the Protected Reverse Convertible on Andritz AG (by: Stefan Rogel)

exercise price of 40.38€ and a barrier of 30.28€.

The analysis throughout this section showed that protected reverse convertibles are sold at a discount as they include positions which are worth 1,084.46€ while they only cost 1,000€. However, their risk is higher in comparison to a direct stock investment. Counterparty, market and liquidity risk increase while also having other disadvantages.

Anyway, the yield of protected reverse convertibles is higher in comparison to bonds, while the volatility is decreased at the same time in comparison to the underlying. Finally, they offer the possibility to short a put option which is not possible for any normal investor. Their price is positively correlated to the underlying, unpredictable towards the risk-free interest rates and negatively correlated to time to maturity as well as dividend payments.

To conclude, protected reverse convertibles offer a high variety of advantages in stable equity markets, but, in sharply downward moving markets, neither stock investments nor investments into the protected reverse convertible are a good solution. Also, in rising markets, investors should look out for investment opportunities other than protected reverse convertibles.

Chapter 6

Erste Group Discount Certificate ATX 30.09.2013

6.1 Overview of the Erste Group Discount Certificate ATX

The main facts of the transaction are summarized in Table 6.1. The information is based on ERSTE1, ERSTE2 and ERSTE3.

On December 10th, 2012 Erste Group issued 100,000 cash settled Discount Certificates (ISIN: AT0000A0XSR8) on the Austrian index ATX at an issue price of 20.53€ and

Product Data	
Term	291 days
Issues Price	20.53€
Number of Units	100,000 Units
Multiplier	0.01
First Trading Day	10.12.2012
Maturity Date	30.09.2013
Final Valuation Date	26.09.2013
Issuer	Erste Group Bank AG
Reference Asset	ATX
Initial Reference Price (Strike)	2,345.69€
Issue Price	20.53€
Cap	22.00€
Final Reference Price	Closing Price
Subscription Ratio	0.01

TABLE 6.1: Overview of the Erste Group Discount Certificate ATX

raised a total amount of 2,053,000€. The amount raised is calculated as shown in Formulas 6.1 and 6.2.

$$\text{Units issued} * \text{Issue Price} = \text{Money Raised} \quad (6.1)$$

$$100,000 * 20.53\text{€} = 2,053,000\text{€} \quad (6.2)$$

The Austrian Technology Index (ATX) is the most important index in Austria and is a capitalization weighted price index which includes 20 Austrian blue chip stocks and which is traded on the Vienna Stock Exchange and denominated in Euro (ERSTE2, p. 4).

By a multiplier of 0.01, the price development of the discount certificates is linked to the index. The multiplier associates a 1 unit increase in the reference index raising the payoff of the underlying at maturity by 0.01€. According to the ratio, the initial reference price translates into 23.46€, which demonstrates that the certificate was issued at a discount compared to the reference price, as it was issued at a price of 20.53€. The calculation is shown by Formula 6.3.

$$2,345.69\text{€} * 0.01 = 23.46\text{€} \quad (6.3)$$

A discount certificate behaves like the underlying, in case the underlying increases, the payoff of the discount certificate increases, and in case the underlying decreases, the payoff of the underlying decreases. At maturity, the discount certificate pays out a cash amount (ERSTE1) equal to the current value of the underlying times the multiplier times Euro as long as the ATX closes below 2,200. Payoff is limited by the cap while losses are unlimited. The discount certificate's payoff at maturity is calculated as demonstrated Formula 6.4.

$$(\text{Index Level} * 0.01) * \text{€} = \text{Payoff at maturity} \quad (6.4)$$

Another characteristic of discount certificates is that these pay no interest to their holder during their maturity period as they are issued at a discount and only pay out a face value, equal to the current price of the underlying times the multiplier. Also, discount certificates are not subject to any dividend payments of the companies which are listed on the ATX.

The final payment of the certificate at maturity is determined based on the ATX closing price on the last trading day which is September 26th, 2013 and described by the payoff diagram in Figure 6.1.

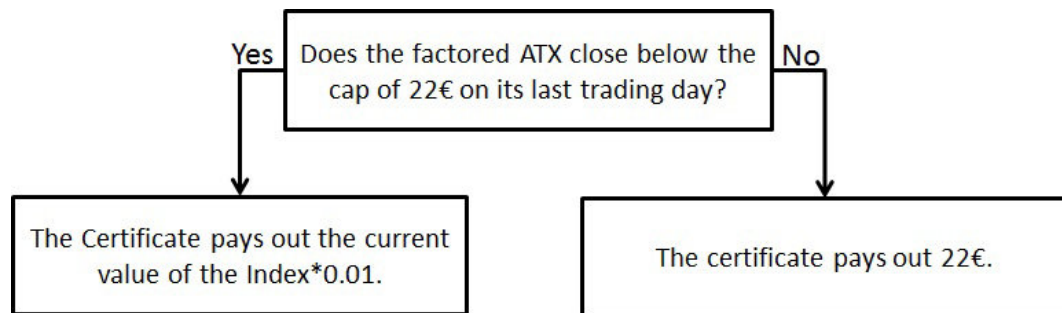


FIGURE 6.1: Payoff Diagram from the Erste Group Discount Certificate ATX (by: Stefan Rogel)

6.2 The Product Set-up

The payoff of a discount certificate can be replicated through combining two positions. A long position in a zero coupon bond with a face value of 22€ as well as a short position in a put option with an exercise price of 22€ which allows the owner of the put option (in this case Erste Group) to sell the underlying at the exercise price. In the following, these positions will be discussed in order to determine the overall exposure the investors face as well as the expected payoff.

6.2.1 Long Position in a Zero Coupon Bond

According to BERKDEMARZO (p. G-18), a zero-coupon bond does not make any coupon payments and simply pays out its face value at maturity which equals 22€ in this case and is paid out on September 30th, 2013.

The bond payments only depend on the issuer's ability to repay the loan and on no further factors. However, issuers with a lower credit worthiness need to pay higher interest rates due to the higher uncertainty with regard to whether these are able to pay the face value at maturity. The payoff function at maturity is shown by Formula 6.5.

$$\text{Face Value} = 22\text{€} \quad (6.5)$$

The payoff structure from the zero-coupon bond in relation to the underlying index on September 30th, 2013 looks as shown in Figure 6.2 and is as previously discussed independent from the underlying.

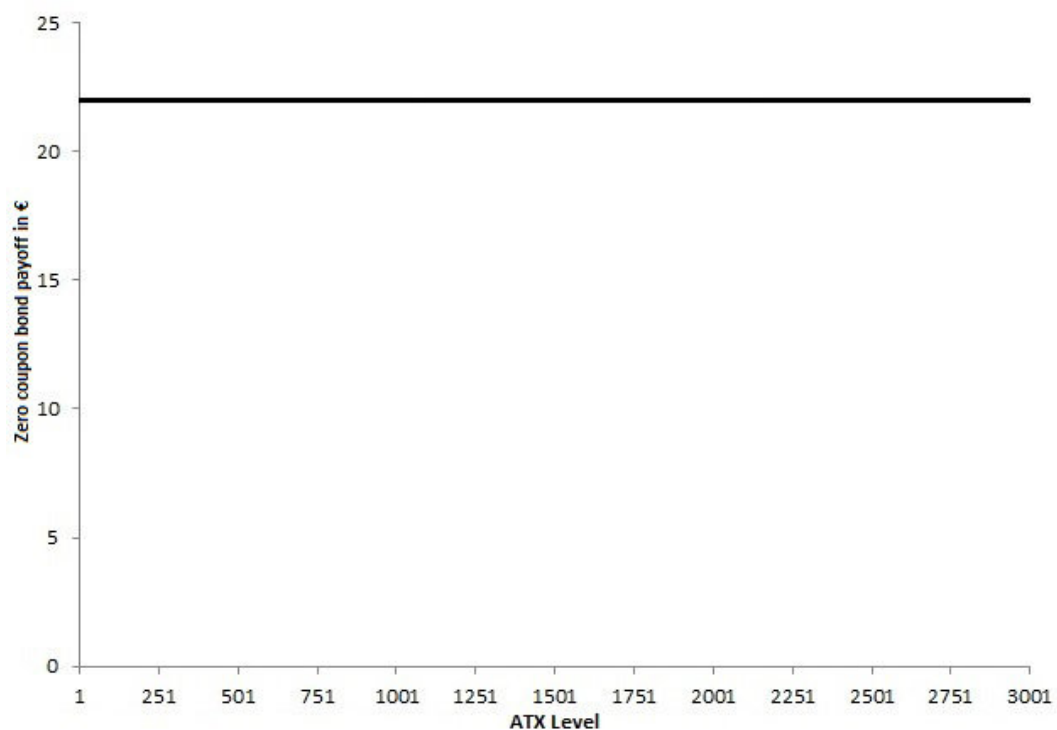


FIGURE 6.2: Payoff from the Zero Coupon Bond (by: Stefan Rogel)

6.2.2 Short Position in a European Put Option

As already discussed in 2.2, a short position in a put option means that the investor sells a put option to the issuer, i.e. Erste Group. The option is European type and has an exercise price of 22€ (denoted by K) at maturity (September 30th, 2013) and the underlying is the ATX. However, the option is factored by 0.01 to the index meaning that the option is in-the-money as long as the index trades below 2,200 giving the investor a

negative payoff and therefore decreasing the amount he will receive at maturity. As long as the ATX closes above 2,200, the option is out-of-the-money and the investor does not face a loss from the option. The payoff function is as shown by Formula 6.6.

$$\min((S_{\text{September 30th, 2013}} * 0.01 * \text{€}) - 22\text{€}, 0) \quad (6.6)$$

The graphical payoff can be seen in Figure 6.3.

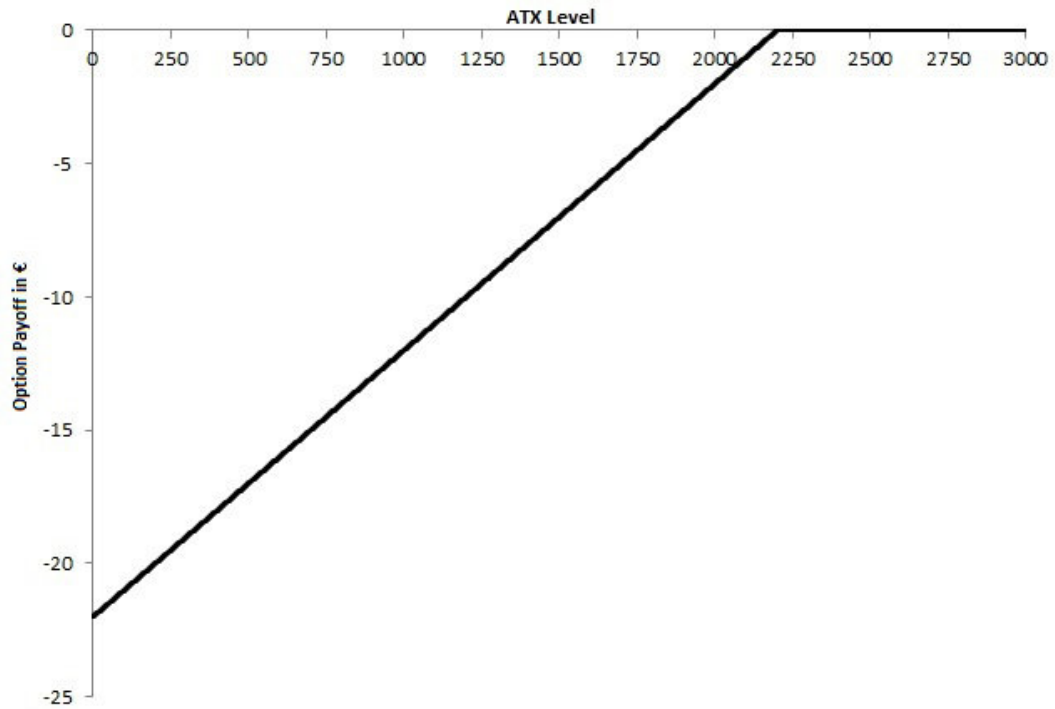


FIGURE 6.3: Payoff from the Short Position in the European Put Option (by: Stefan Rogel)

6.2.3 Overall Payoff

The payoff from the certificate depends on the payoff from the option as well as the payoff from the zero-coupon bond at maturity. The zero-coupon bond will pay out 22€ at maturity while the payoff from the short position in the put option depends on the closing price of the ATX on the last trading day. In case the ATX closes below 2,200, the option payoff will be negative. As soon as the ATX closes above 2,200, the payoff from the option will be zero, as it will stay unexercised because its payoff will be negative.

The combined payoff from both positions is as shown by Formula 6.7 and 6.8.

Face Value from Zero-coupon Bond + Option Payoff = Payoff at Maturity (6.7)

$$22\text{€} + \min((S_{\text{September 9th, 2013}} * 0.01 * \text{€}) - 22\text{€}, 0) \quad (6.8)$$

Gaphically, the payoff is shown by Figure 6.4.

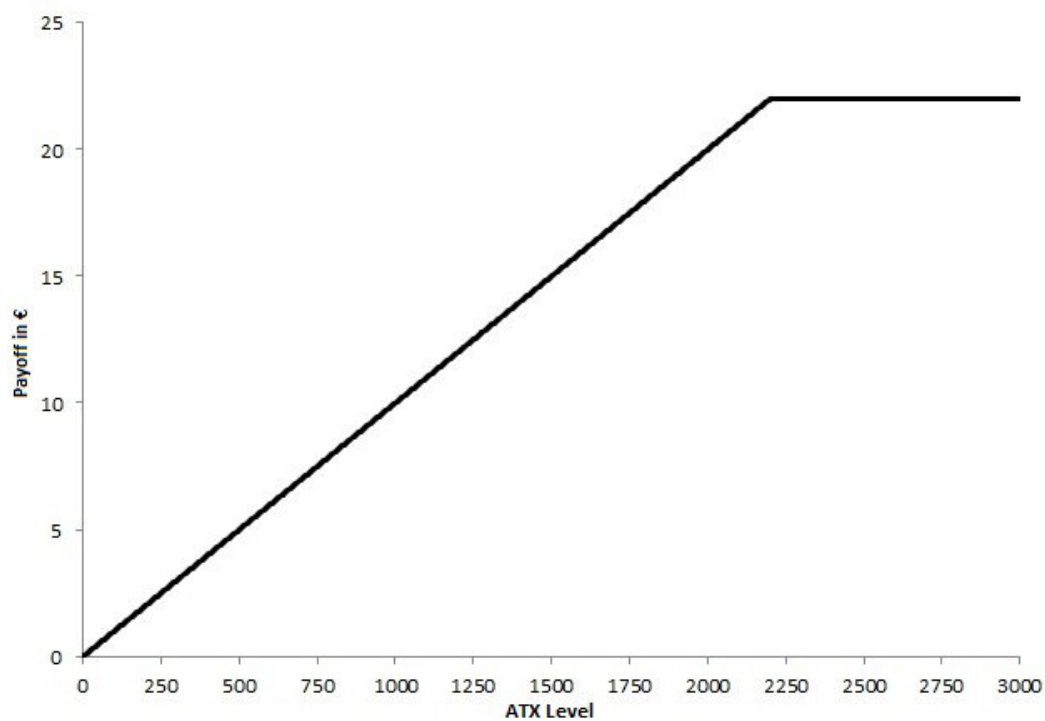


FIGURE 6.4: Payoff from the Erste Group Discount Certificate on ATX (by: Stefan Rogel)

6.3 Risks, Advantages and Disadvantages of Discount Certificates

Risks

As the previously discussed products, discount certificates face increased counterparty credit risk, market risk and liquidity risk which were previously defined in 2.3.

In comparison to a direct investment into the ATX, counterparty credit risk is increased through the discount certificate, as the investor faces the additional risk that Raiffeisen may default on their final payment at maturity.

Market risk is the other major factor which affects the payoff from the discount certificate. As already previously discussed, the ATX is a capitalization weighted price index which includes 20 Austrian blue chip stocks. Therefore, it replicates a portfolio consisting of different companies in the Austrian market which makes the index particularly subject to market risk. Also, market risk can affect the payment at maturity which is made by Raiffeisen.

Finally, the liquidity risk is increased. The number of trades of discount certificates is lower in comparison to the individual stocks of the ATX which would be required in order to replicate the portfolio.

Advantages

Discount certificates have a variety of advantages, especially in stagnating or slightly decreasing markets, as will be proved in Sections 6.4 and 6.7. First of all, discount certificates have short maturities which allow investors to change their investment strategy in the medium run and do not get stuck with a single underlying for a longer period. This grants investors higher flexibility, especially in comparison to other structured products or most bonds. Second, the discount certificate is issued at a discount. Its price is lower than the initial reference price, and therefore investors have the possibility to enter a discounted position in the underlying. Third, the discount allows investors to generate a positive return even in a marginally decreasing or in a stagnating market environment. However, on the opposite, its return is capped, which will be discussed under disadvantages in further detail. Fourth, the discount certificate gives investors the possibility to enter a factored position which grants an investor with limited funds the opportunity to enter a position in an otherwise unaffordable underlying, for example the ATX. Finally, discount certificates can be traded on various exchanges which allows the investor to exit their investment through selling it on an exchange.

	Underlying Closing Price on 26.09.2013	Payoff at Maturity
Scenario 1	above or equal to cap	22€
Scenario 2	below cap	$S_{\text{September 26th, 2013}} * 0.01 * \text{€}$

TABLE 6.2: Understanding the Payoff of the Erste Group Discount Certificate on ATX

Disadvantages

Besides its advantages, discount certificates also have several disadvantages: The major factor is that the return is capped at a certain level. This is especially in strongly upward moving markets a disadvantage for investors, as these are stuck with an investment which gives less return than the underlying and cannot benefit from the upward trend. However, on the opposite, downside losses are unlimited. The investor can suffer significant losses in case the discount certificate falls below its issue price and can even lose its entire initial investment, in case the value of the underlying falls to zero.

Even though the certificate can be traded on exchanges, selling the certificate prior to maturity may lead to a loss even compared to directly selling the underlying in the free market, as the payoff at maturity is uncertain due to the capped return. Furthermore, the liquidity is lower in comparison to a direct investment into the underlying. Also, no early redemption is possible with discount certificates, and only one payment is made at maturity while selling the certificate on an exchange is the only exit opportunity.

Furthermore, discount certificates do not pay any interest or dividends leaving the investor fully exposed to changes in these. Changes in these factors may be beneficial for investors but can also be harmful. The effects of changes in dividend or interest payments on the discount certificate will be discussed throughout Section 6.5.

Finally, discount certificates have a fixed maturity date which can be a disadvantage for investors in case the underlying falls shortly before maturity, as they do not have any exit opportunities besides selling it on an exchange.

6.4 Scenarios

The discount certificate's payoff depends on the closing price of the ATX on September 26th, 2013 and can be explained by the two scenarios which are shown in Table 6.2. In Scenario 1, the factored ATX closes above or equal to the Cap of 22€, while in Scenario 2, the factored ATX closes below the cap of 22€.

As long as the factored ATX times Euro closes above the cap of 22€, which is the case in Scenario 1, the payoff will be 22€, as the put option is out-of-the money and will not be exercised. Therefore, the investor receives an amount equal to the face value of the zero coupon bond and does not lose any money due to the option being exercised.

In Scenario 2, the factored ATX times Euro closes below 22€. The investor will receive an amount equal to the face value of the zero coupon bond which is 22€. However, the short put option will be in-the-money which leads to a loss. The investor will receive an amount equal to the current factored ATX level times Euro at maturity.

As proved by the two scenarios above, the investors' payoff is limited at a level of 22€. Below, they will receive the value of the factored ATX times Euro.

6.5 Price Development of the Product

The price for which the certificate is traded during its term to maturity depends on different factors, which are the implied volatility of the underlying asset, risk-free interest rates, a changing dividend payout policy of companies which are listed on the ATX, decreasing time to maturity, as well as uncertainty in the financial markets. During the following discussion, it will be assumed that one specific factor changes, while the other ones are kept constant.

Implied volatility affects the value of the short put option. Increasing implied volatility increases the chance of the option to be exercised, which increases its value. As the investor is in a short position, the value of his position decreases as the value of the option increases. Changes in the implied volatility increase the probability of the underlying to rise in value, which makes the discount certificate relatively less interesting for investors, as the return of the certificate is capped at a specific level. In this case, investors prefer

directly investing into the asset, as they can fully benefit of its increasing value. On the other hand, increasing volatility also increases the probability of the underlying to fall in value, which would lead to a negative return for the certificate holder and therefore makes the discount certificate less interesting due to the short position in the put option. To conclude, the correlation between the implied volatility and the price of the certificate is negative. As the implied volatility increases, the value of the certificate decreases.

Additionally, the risk-free interest rate affects the value of the discount certificate through affecting the present value of the zero-coupon bond, as well as the value of the option. Increasing risk-free interest rates decrease the present value of the zero-coupon bond, as its interest rate is fixed at a specific level. As the increasing risk-free interest rate decreases the face value of the zero-coupon bond in present value terms, the value of the discount certificate decreases. Consequently, there is a negative correlation between the risk-free interest rate, the value of the zero-coupon bond and the value of the certificate. Furthermore, the risk-free interest rate influences the value of the short put option. Increasing risk-free interest rates lead to a decreasing value of the option, while decreasing interest rates lead to an increase in the value of the option, which implies that increasing interest rates are beneficial for the investor's short position, while decreasing interest rates are harmful for this position. As interest rates have a twofold effect on the value of the discount certificate, the development of its value depends on which effect dominates.

An unanticipated increase in dividend payments will have a negative impact on the value of the certificate. The change in the dividend payout policies of companies which are listed on the index decrease its overall level as their stock prices decrease. The probability that the put option will be in-the-money at maturity increases, which also increases its value. The increasing value of the put option has a negative impact on the investor's short position. To conclude, dividend payments are negatively correlated to the value of the certificate.

Finally, the time to maturity will be analyzed. When the time to maturity decreases, the value of the put option decreases. Given a specific level of volatility, the probability that the value of the underlying will change significantly and the option will be in-the-money or deeper in-the-money decreases. Due to the short position, the value of the

certificate increases, as the value of the option and time to maturity decreases. Thus, the correlation between the time to maturity and the value of the certificate is negative.

6.6 Pricing

The Erste Group discount certificate on the ATX will be priced with a decomposition approach to determine its value for the first trading day which was December 10th, 2012. As discussed in Section 6.2, the product's payoff can be replicated through a long position in a zero coupon bond, as well as a short position in a European put option on the ATX.

The time to maturity is counted to be equal to 291 days, which equals $291/365 = 0.8$ years.

Long Position in a Zero Coupon Bond

The risk-free interest rate is based on the FEDERAL RESERVE statistical release from December 17th, 2012 (FED3) and is equal to 0.18% for 1-year U.S. government securities on December 10th, 2012.

$$22\text{€} : 1.0018^{0.8} = 21.97\text{€} \quad (6.9)$$

Thus, based on Formula 6.9 in present value terms, dating December 10th, 2012 the zero coupon bond is worth €21.97.

Short Position on a European Put Option

The risk-free rate of 0.18% will be also used for valuing the put option.

The closest approximation for the volatility of the ATX which could be found is the 1-year backward looking volatility equaling 15.66% on November 21st, 2013 (TELE-TRADER). As the products are analyzed based on public information in order to identify the possibilities for private investors to judge on these products, this data will be used.

The input data for DerivaGem is summarized in Table 6.3. DerivaGem finds the option's value equal to 2.04€.

Stock Price	20.53€
Volatility (% per Year)	15.66%
Risk-free Rate (% per Year)	0.18%
Time to Exercise (in Years)	0.8
Exercise Price	22€
Type	European Put

TABLE 6.3: Data Used for Valuation of the Option

Price of the Discount Certificate

The long position in the zero coupon bond is valued at 21.97€, while the short position in the European Put option is valued at 2.04€, which leads to a price of 19.93€ for the Erste Group Discount Certificate on ATX. The calculation is shown by Formula 6.10 below.

$$21.97€ - 2.04€ = 19.93€ \quad (6.10)$$

Valued at 19.93€ and given an issue price of 20.53€, the Erste Group Discount Certificate is issued with a markup of 0.60€.

6.7 Stock Price Scenarios

In the following, the payoff at maturity of an investment into the discount certificate and a factored direct investment into the index will be compared to determine under which market conditions investing into a discount certificate is more beneficial than directly investing into the index.

At first, both payoffs at maturity will be compared. As proved by Figure 6.5, directly investing into the index delivers at least the same and at index levels above 2,200 even a higher payoff than investing into the discount certificate. This is due to the fact that the payoff of the certificate is capped at 22€, which limits the payoff at this level, while a direct position in the index is uncapped and the investor can benefit from the entire increase of the ATX. Under these circumstances, directly investing into the ATX is clearly more beneficial than investing into the certificate. However, this analysis does not take the discount at which the certificate is issued into account. In order to determine

whether the return on investment is higher from any of the assets, the simple return needs to be compared.

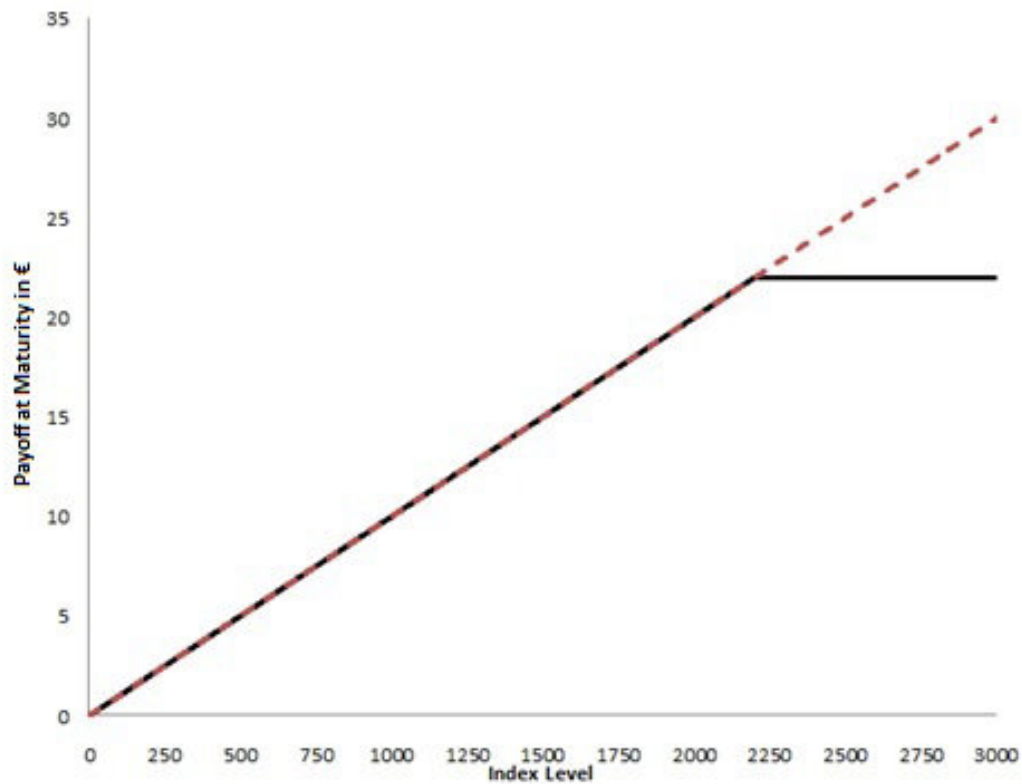


FIGURE 6.5: Stock Price Scenarios Erste Group Discount Certificate on ATX (by: Stefan Rogel)

A position in the factored index at a level of 23.46€ costs 20.53€ with the discount certificate which represents a discount that serves as a protection against possible losses from the index while directly entering a factored position into the index at a level of 23.46€ would cost 23.46€ and leaves the investor fully exposed to any downward development of the index. This buffer was not considered in the previous discussion as the discount enhances the return of the discount certificate in comparison to a stock investment up to an index level of 2,514.

Also, the investor does not face any losses from the discount certificate as long as the index trades above or equal to a level of 2,053 while he faces a loss from the stock, as soon as it trades below 2,346, as his initial investment was higher and he does not benefit from the discount.

The different stock price scenarios show that investing into the discount certificate pays off as long as the index is not expected to increase above a level of 2,514, as in this case,

a direct investment into the index would deliver a higher payoff. However, as long as the index trades in a range between 2,053 and 2,514, the certificate will deliver a positive payoff which is higher compared to investing into the index. As long as the index closes below 2,053, the certificate provides a negative payoff.

6.8 Conclusion of the Discount Certificate on the ATX

The discount certificate on the ATX can be replicated with a long position in a zero coupon bond and a short position in a European put option. Using discount certificates has a variety of advantages for investors. First of all, their maturity tends to be short and leads therefore to higher flexibility for its investors. Second, these certificates are issued at a discount which allows a positive return in stagnating or marginally decreasing markets. Third, the position is factored, which offers an investment opportunity even with limited funds.

However, investors face a variety of disadvantages. The return is capped at a certain limit, while losses are unlimited. Their liquidity is lower in comparison to a direct investment into the underlying and also make no interest or dividend payments. Finally, the maturity is fixed and no early redemption is possible.

A negative correlation between implied volatility, the risk-free interest rate, dividend payments, as well as time to maturity between the underlying and the certificate was found. Furthermore, it was found that the certificate is sold at a markup of 0.60€ . Using the discount certificate pays off, as long as the index is not expected to increase above a level of 2,514, because otherwise directly investing into the index would deliver a higher return.

To conclude, using the discount certificate pays off under specific market conditions. However, its investors also face various advantages and disadvantages while the risk is increased.

Chapter 7

Raiffeisen Centrobank AG Europe Twin-win Certificate on EURO STOXX 50

7.1 Overview of the Raiffeisen Centrobank AG Europe Twin-win Certificate on EURO STOXX 50

The main facts of the transaction are summarized in Table 7.1. The data is based on RAIFFEISEN7, RAIFFEISEN8 and RAIFFEISEN9.

Raiffeisen Centrobank AG issued 100,000 twin-win certificates (ISIN: AT0000A0Z801) on the Euro Stoxx 50 with a term to maturity of 39 months and an issue price of 1,000€ each on February 26th, 2013 in order to raise a total of 100,000,000€ (RAIFFEISEN8).

According to RAIFFEISEN8, the Euro Stoxx 50 is a Blue-chip index which includes 50 stocks of sector leaders from 12 Eurozone countries. The Euro Stoxx 50 (ISIN: EU0009658145) is a plain price index, which means that the index is not adjusted for dividend return and is purely based on the level of the stocks which are listed in it (FRANKFURT1).

Twin-win certificates are issued at an issue price that is determined upfront while their initial value is the closing price of the underlying and is determined on the initial valuation date. For this certificate, the initial valuation date is February 25th, 2013 and the

Product Data	
Issue Size	€ 100,000,000
Term	39 months
Issues Price	1,000.00€
Number of Units	100,000 Units
Multiplier	0.3771
Issue Date	26.02.2013
Maturity Date	26.05.2016
Initial Valuation Date	25.02.2013
Final Valuation Date	23.05.2016
Issue Surcharge	2.00€
Issuer	Raiffeisen Centrobank AG
Reference Asset	EURO STOXX 50
Bonus Level	200%
Barrier	60%
Initial Value	€ 2,651.86

TABLE 7.1: Overview of the Twin-win Certificate on EURO STOXX 50

issue date is February 26th, 2013. The initial value was 2,651.86 and was determined by Raiffeisen and is equal for all investors.

The certificate is linked by a multiplier of 0.3771 to the underlying which is determined through dividing the issue price, by the initial value of the underlying and multiplied by Euro (see Formula 7.1).

$$1,000€ : 2,651.86 * € = 0.3771 \quad (7.1)$$

Twin-win certificates behave differently from the underlying: they provide a positive payoff for the investor as long as they do not trade below a certain level, which is called the barrier during its term or if they trade below the barrier but the underlying closes above its initial value. The barrier for the product which is analyzed in this section, is set at a level of 60% of the initial value, equalling 1,591.12, based on the initial value.

The calculation of the barrier is shown in Formula 7.2.

$$2,651.86 * € * 0.6 = 1,591.12€ \quad (7.2)$$

In case the underlying trades above the initial value at maturity the certificate will pay out an amount equal to the level of the underlying at the final valuation date, multiplied by the multiplier and € which is described by Formula 7.3.

$$\text{level of the index} * 0.3771 * € = \text{amount payed out to investors} \quad (7.3)$$

However, the EURO STOXX 50 might also close below the initial value of 2,651.86 but may not have breached the barrier during its term. In that case, the payoff of the certificate is based on Formula 7.4.

$$(2,651.86 - \text{index level}) * € * 0.3771 + 1,000€ = \text{amount payed out to investors} \quad (7.4)$$

In the last case, the certificate has breached the barrier and trades below or above the level of the barrier of 1,591.12 at maturity. Then, the payoff is merely a function of the multiplier times the level of the index which is explained by Formula 7.5.

$$\text{level of the index} * 0.3771 = \text{amount payed out to investors} \quad (7.5)$$

Furthermore, the certificate does not pay any dividend or interest which may have a negative effect on the investor's payout at maturity in case companies pay higher dividends than were assumed by investors before entering the position in the certificate.

The total payoff at maturity can be explained by the payoff diagram in Figure 7.1.

7.2 The Product Set-up

The payoff profile from the twin-win certificate on the EURO STOXX 50 can be restructured through using a combination of two options, i.e. a long position in a European zero-strike call as well as a long position in a European down-and-out put option.

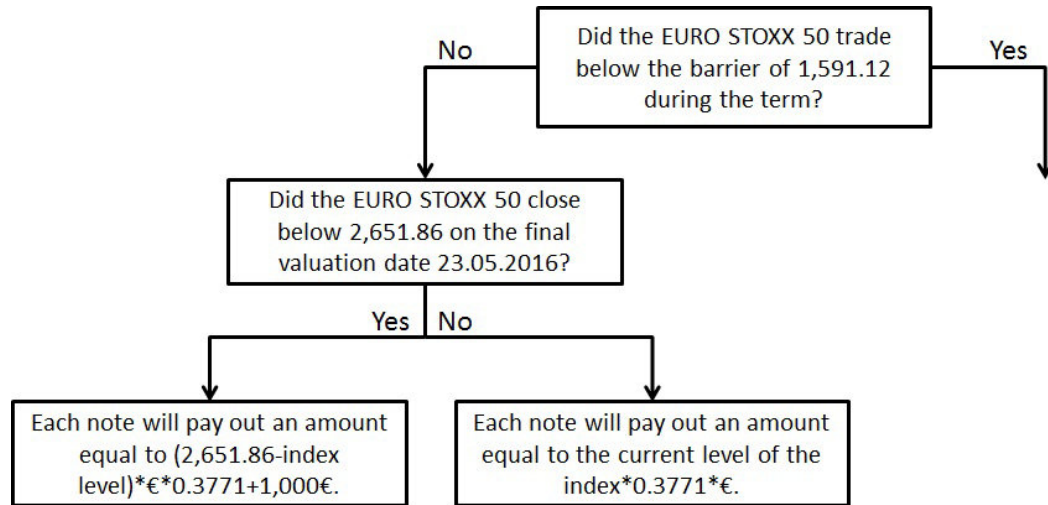


FIGURE 7.1: Payoff Diagram from the Twin-win Certificate on EURO STOXX 50 (by: Stefan Rogel)

7.2.1 A Factored Long Position in a Zero-strike Call

According to CHOUDHRY (p. 544) a zero-strike call is defined as a “call option with strike price set at zero”. These are often used to transfer the ownership of an illiquid asset to a customer and its price is usually set at par (CHOUDHRY, p. 544). The option is a European type call option which has its strike price set equal to 0€ (K) and the maturity date is equal to May 23rd, 2016 while its value is paid out on May 26th, 2013 and the underlying is the EURO STOXX 50 (RAIFFEISEN8). However, the position is factored by 0.3771.

The option is at-the-money as long as the underlying trades for a value equal to 0 and is in-the-money, when the underlying trades above a level of 0. The further the underlying increases, the higher is the payoff to the option holder.

The payoff from the long position in a European call is generally described by Formula 7.6.

$$\max(S_T - K, 0) \quad (7.6)$$

The payoff from the option to the option holder is described by Formula 7.7.

$$\max(S_{23.05.2016} - 0, 0) * 0.3771 * € \quad (7.7)$$

The payoff is factored by the multiplier of 0.3771 as described above in order to emulate the product's payoff structure. Also, as the option is a zero-strike call the exercise price is set equal to zero. The payoff at maturity looks as in Figure 7.2.

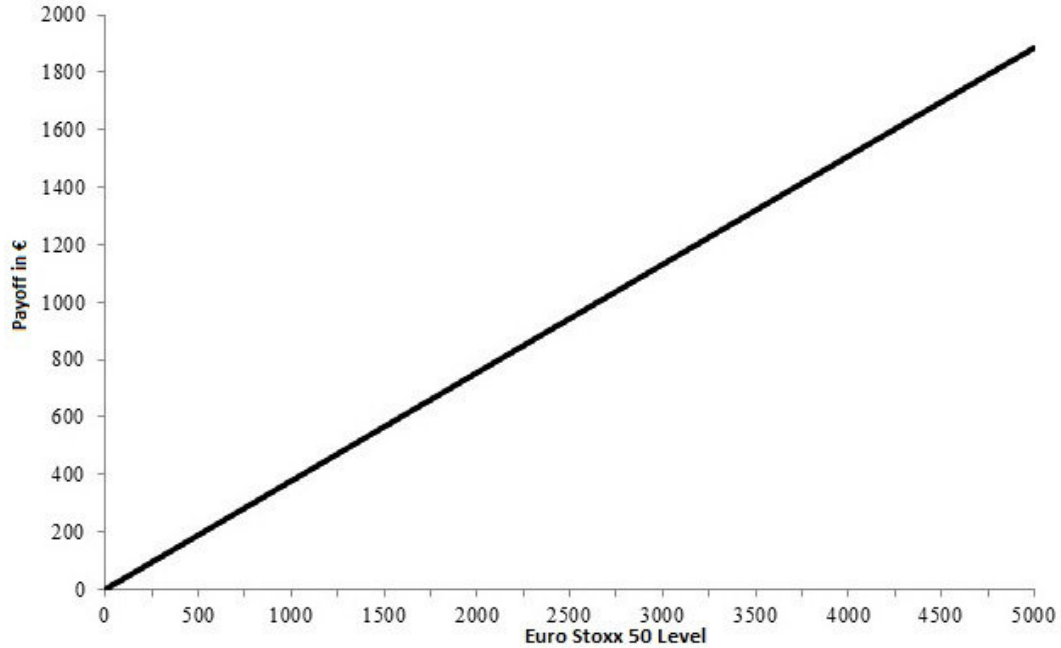


FIGURE 7.2: Payoff from a Zero-strike Call (by: Stefan Rogel)

7.2.2 Two Factored Long Positions in European Down-and-out Put Options

As discussed in 4.2.2., a long position in a down-and-out put option terminates its existence as soon as the underlying asset price reaches a certain level. The down-and-out put option in this case has an exercise price equal to the initial level of 2,651.86, denoted K , and a barrier, which is equal to 1,591.12, denoted H . As the investor's position is factored, he receives the right to sell 0.3371 times the underlying (the EURO STOXX 50). The maturity date of the option, T is equal to the final valuation date May 23rd, 2016, while its value is paid out on the maturity date which is May 26th, 2016.

The payoff function for a factored long position in a down-and-out put option was already discussed in detail in 4.2.2.. The payoff function looks as in Formula 7.8.

$$\begin{aligned}
 &0.3771 * (K - S_T) * \text{€}, \text{ if } S_T > H \text{ for all } t \leq T \\
 &0, \text{ if } S_T \leq H \text{ during } t \leq T
 \end{aligned}
 \tag{7.8}$$

The payoff function for the down-and-out put option on the EURO STOXX 50 looks as in Formula 7.9

$$\begin{aligned} &0.3771 * (2,651.68 - S_T) * \text{€}, \text{ if } S_T > 1,591.12 \text{ for all } t \leq \text{May 23rd, 2016} \\ &0, \text{ if } S_T \leq 1,591.12 \text{ during } t \leq \text{May 23rd, 2016} \end{aligned} \quad (7.9)$$

As long as the EURO STOXX 50 trades below the exercise price of 2,651.86, it pays off for the option holder to exercise his option and sell the position for the exercise price. However, as soon as the EURO STOXX 50 trades below the barrier level of 1,591.12, the put option is terminated and cannot be exercised on the maturity date.

Figure 7.3 explains the payoff from the two short position in the European down-and-out put options on the EURO STOXX 50 graphically.

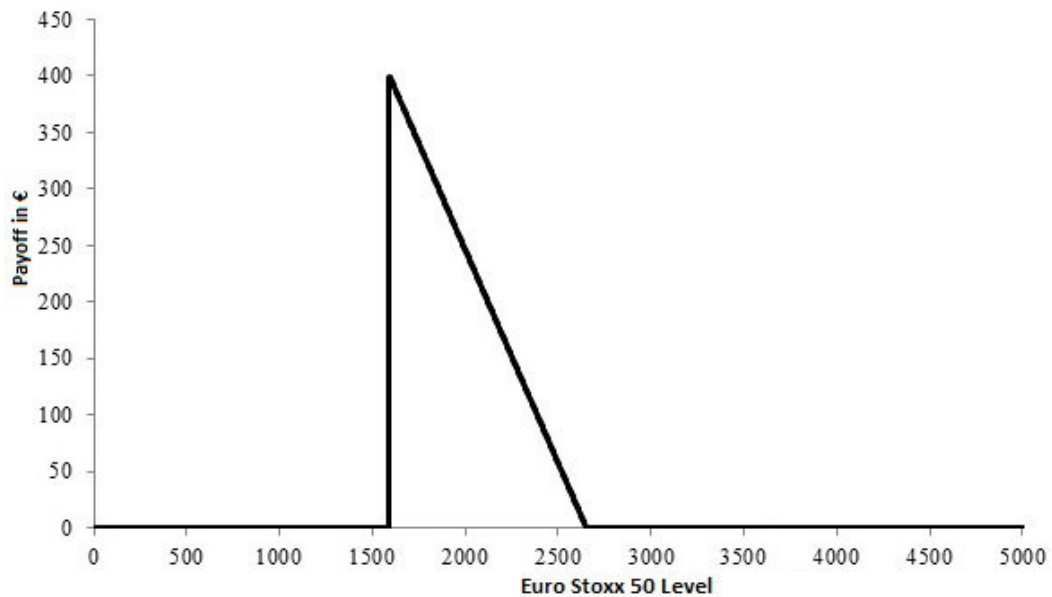


FIGURE 7.3: Payoff from one European Down-and-out Put Option (by: Stefan Rogel)

7.2.3 Overall Payoff

The overall payoff depends on the value of the EURO STOXX 50 on the final valuation date as well as on the index level during the term to maturity.

The combination of the the two positions leads to the payoff function at the maturity date which is shown by Figure 7.4 and Formula 7.10.

$$\begin{aligned}
& \max(S_{23.05.2016} - 0, 0) * 0.3771 * € + \\
& 0.3771 * (2,651.68 - S_T) * €, \text{ if } S_T > 1,591.12 \text{ for all } t \leq \text{May 23rd, 2016} \quad (7.10) \\
& 0, \text{ if } S_T \leq 1,591.12 \text{ during } t \leq \text{May 23rd, 2016}
\end{aligned}$$

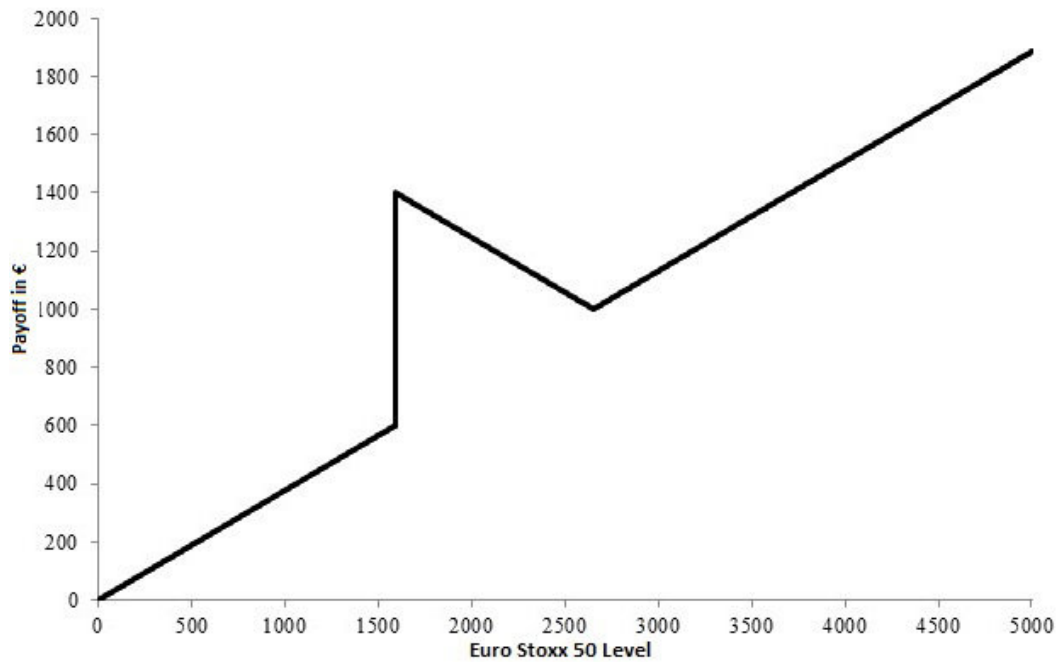


FIGURE 7.4: Payoff from the Twin-win Certificate (by: Stefan Rogel)

7.3 Risks, Advantages and Disadvantages of Twin-Win Certificates

For investors, it is of major importance to understand the risks, advantages as well as disadvantages of twin-win certificates especially in comparison to a direct investment into stocks as the payoff structure of twin-win certificates is changed and therefore delivers benefits for investors under specific situations.

Risks

Counterparty credit risk, market risk and liquidity risk were previously defined in section 2.3 and will be applied in the following to the twin-win certificate on the EURO STOXX 50.

The counterparty credit risk is increased through investing into a twin-win certificate, as the investor faces an increased risk of default due to its exposure to Raiffeisen Centrobank AG as well as the companies in the EURO STOXX 50. However, due to the high number of companies in the EURO STOXX 50, the overall risk is lower compared to a twin-win certificate which is linked to one individual stock.

Market risk is of major importance to investors as the EURO STOXX 50 represents a market index which is especially exposed to economic fluctuations in the European Union and their major trading partners.

Finally, liquidity risk is increased compared to a direct investment into the EURO STOXX 50, as twin-win certificates are issued in a lower number, even though they are listed on exchanges their liquidity is lower than replicating the EURO STOXX 50 through directly investing into the companies.

Advantages

One of the major advantages of a twin-win certificate is that an investor can benefit from rising as well as from falling stock prices. The certificate gives the investor the opportunity to earn positive return down to the barrier level of 60%, even though the stock falls.

However, in case the barrier is broken, the certificate still behaves like a factored underlying, and the investor can benefit from an underlying which increases in value yet again. Furthermore, the investment requires a smaller initial investment, especially due to the factored position and gives smaller investors the ability to enter a position in the EURO STOXX 50 and benefit from its development.

Also, the certificate is traded in secondary markets, which allows investors to exit their position and therefore liquidate the investment.

Finally, investors face an unlimited participation in the upward potential of the underlying and can participate on 100% of the upward development of the underlying in the future, which makes the certificate especially interesting in markets which are expected to increase or fall slightly, but now below the barrier.

	Barrier during Term?	Underlying Price on 23.05.2016?	Payoff at Maturity
Scenario 1	Broken	Above Cap	$S_{23.05.2016} * 0.3771 * €$
Scenario 2	Broken	Below Cap	$S_{23.05.2016} * 0.3771 * €$
Scenario 3	Not broken	Above Cap	$S_{23.05.2016} * 0.3771 * €$
Scenario 4	Not broken	Below Cap	$(2,651 - S_{23.05.2016}) * 0.3771 * € + €1,000$

TABLE 7.2: Scenario Analysis Twin-win Certificate

Disadvantages

The certificate does not provide any guaranteed yield or principal payment, as its payoff is to one-hundred percent linked to the underlying's performance. Even a total loss is possible, as no protection is provided in case the underlying's value falls to zero.

Furthermore, the investor is not entitled to any dividend payments, which can negatively expose the investor to a decreasing value of the underlying and therefore decrease the payout at maturity.

7.4 Scenarios

The payoff of the Raiffeisen Centrobank AG Europe Twin-win Certificate depends on the development of the EURO STOXX 50 during the term of the note as well as on its value on the final valuation date and can be explained by the four scenarios in Table 7.2.

In scenario 1, scenario 2 and scenario 3, the note delivers the same payoff. In scenario 1 and scenario 2, the barrier was broken during the term of the note, which means that the two down-and-out put options were terminated and cannot be exercised anymore. Thus, the only option which can still be exercised is the zero-strike call. As the exercise price of this option is set equal to zero, it delivers a payoff which is equal to the current level of the factored index level multiplied by EURO.

In scenario 3, the payoff is also equal to the payoff of the zero-strike call. The two down-and-out put options can still be exercised, but this would deliver a loss to the holder, as the underlying trades above the exercise price and thus, they will not be exercised. The

only option which is exercised is the zero-strike call. It will deliver a payoff equal to the factored value of the underlying.

In scenario 4, the payoff is determined by the zero-strike call as well as the two factored long positions in the long down-and-out put options. All three options will be exercised, as all are in-the-money. The zero-strike call delivers a positive payoff. However, this payoff alone is below the initial value of the underlying. The loss is offset through one of the down-and-out put options, while the second one delivers an overall positive payoff for the product.

7.5 Price Development of the Product

The development of the certificate's price depends on different factors, i.e. the implied volatility of the underlying asset, the risk-free interest rate, the dividend payout policy of the companies which are listed on the index and a decreasing time to maturity. As the investor enters two option positions, both positions will be considered throughout the following analysis.

As previously discussed, the EURO STOXX 50 is not adjusted for dividends. When the companies which are listed on the the index pay out dividends, their stock level decreases, which results into a decreasing level of the EURO STOXX 50. However, generally, investors expect dividend payments to be made, which mainly results into significant changes in case the dividend payout policy of listed companies changes in comparison to current expectations.

Increasing dividend payout policy decreases the value of the long position in the zero-strike call. The dividend payments lead to a decreasing EURO STOXX 50, and therefore the payoff, when the option is exercised, decreases (HULL, p. 228). As a result, the value of the zero-strike call is negatively correlated to the level of the dividend payments of the companies which are listed on the index. The effect on the long down-and-out put option is twofold. For normal options, there would be a positive correlation, as increasing dividends lead to a decreasing index level (HULL, p. 228). However, in case the underlying decreases too much, the two down-and-out put options are terminated. Therefore, the effect of dividend payments is not clear and can affect the value of the down-and-out put options in a positive, but also in a negative way. It depends on the

size of the increase in dividend payments making the effect on this position ambiguous. Generally, the effect of a change in dividend payout policy depends on the magnitude of the increase and also on which effect dominates, either the positive correlation to the zero-strike call, or the partly positive and partly negative correlation to the down-and-out put option.

Implied volatility is another factor affecting the value of the option positions. In general, implied volatility positively affects the value of put as well as of call options (HULL, p. 228), meaning that there is a positive correlation between volatility and call and put options. However, for down-and-out put options, volatility behaves differently. It increases the chance of the underlying to fall below the barrier level, which leads to the termination of the option. At one point, strongly increasing volatility will have a negative effect on the value of the down-and-out put option, as the risk of it being terminated will increase implying that from this specific point, the increasing volatility will be negatively correlated to the value of down-and-out put options. To conclude, increasing volatility is positively correlated to the value of call as well as of put options. However, at a specific point, the value of the down-and-out put option will decrease, as the risk of termination increases, leading to the conclusion that increasing volatility has a two-fold effect on the value of the product. It is positive up to a specific level, and negative from there on further.

Another factor affecting the value of the twin-win certificate is the value of the underlying. As the index rises, the value of the zero-strike call increases (HULL, p. 228). Its payoff increases with an increasing index level and is positively correlated to the value of the underlying. The value of the down-and-out-put option in contrast decreases with an increasing underlying value (HULL, p. 228). Even in case the index level decreases, the correlation between the value of the down-and-out put option and the value of the index is not to 100% clear, as, with a falling index level, the risk of the options being terminated increases. As a result, the level of the index and the twin-win certificate are positively correlated. As the index level increases, the holder can profit from the increase due to the long position in the zero-strike call. However, as the index level falls towards the barrier level, the two down-and-out put options will be terminated and the holder faces a significant loss.

Both options are of European type. According to HULL (p. 228), the relationship

between time to expiration and the value of European-type options is ambiguous. As the options can merely be exercised at maturity, a longer maturity can have a negative effect on their value, as uncertainty between the current and the exercise date is higher.

Finally, increasing risk-free interest rates positively affect the value of the zero-strike call. The increasing interest rates increase the expected return which is required by investors, which leads to stocks that tend to increase (HULL, p. 228). This is a positive correlation between the risk-free interest rate and the value of the zero-strike call. The same relationship can be used in order to explain the correlation between risk-free interest rates and the value of the down-and-out put options. As risk-free interest rates increase, the probability of the option to be exercisable in-the-money decreases which implies a negative correlation. To conclude, the effect of risk-free interest rates depends on which effect dominates.

The value of the twin-win certificate and the value of the underlying are positively correlated. The correlation between volatility and the twin-win certificate is ambiguous, while the correlation between dividend payout policy and the twin-win certificate depends on which effect dominates, i.e. the negative correlation between the dividend payout policy and the value of the zero-strike call, or the negative correlation between the dividend payout policy and the value of the down-and-out put option. Furthermore, the relationship between the value of the certificate and time to maturity is also ambiguous. Finally, the influence of risk-free interest rates depends on which effect dominates, i.e. the positive correlation to the value of the call option or the negative correlation to the value of the down-and-out put options.

7.6 Pricing

In the following section, the Raiffeisen Centrobank AG Twin-win Certificate on the EURO STOXX 50 will be priced with a decomposition approach. The setup was previously determined in 7.2. It consists of a factored long position in a zero-strike call as well as two factored long positions in European down-and-out put options. The option positions will be priced according to the initial valuation date, which is February 25th, 2013. The time to exercise for both positions is 39 months, which equals 3.25 years. DerivaGem will be used in order to price these three options.

Stock Price	€1,000.00
Volatility (% per Year)	23.8483%
Risk-free Rate (% per Year)	0.37%
Time to Exercise (in Years)	3.25
Exercise Price	€0.00
Type	European Call

TABLE 7.3: Data Used for Valuation of the Zero-strike call

Stock Price	€1,000.00
Volatility (% per Year)	23.8483%
Risk-free Rate (% per Year)	0.37%
Time to Exercise (in Years)	3.25
Exercise Price	€1,000.00
Barrier	€600.00
Type	Barrier Down and Out Put

TABLE 7.4: Data Used for Valuation of the Option

Zero-strike call on the EURO STOXX 50

The data in Table 7.3 is used as an input for DerivaGem.

On March 4th, 2013 the FED published its weekly review on selected interest rates in its FEDERAL reserve statistical release (FED4). The 3-year interest rate for treasuries with constant maturities was found equal to 0.37% and is used as the risk-free rate for the purpose of valuation.

The volatility is based on the EURO STOXX 50 Volatility (STOXX1), which is an index that incorporates realtime option prices on the EURO STOXX 50 (STOXX1). Data from February 25th, 2013 for the 2-months forward looking volatility was used and found to be equaling 23.8483% (STOXX2).

DerivaGem finds a price of 1,000.00€ for the zero-strike call.

Down-and-Out Put Option on the EURO STOXX 50

The data from Table 7.4 is used as an input for DerivaGem.

The same interest-rate (FED4) as previously discussed is used for the valuation of the down-and-out put option, while the volatility also remains unchanged as previously discussed (STOXX2).

DerivaGem finds a price of 48.20€ for these options.

EURO STOXX 50 Level	Payoff of Note in €	Payoff Investing Stocks in € from into
250	€ 94.275	€ 94.275
500	€ 188.55	€ 188.55
750	€ 282.825	€ 282.825
1,000	€ 377.1	€ 377.1
1,250	€ 471.375	€ 471.375
1,500	€ 565.65	€ 565.65
2,000	€ 1,245.69706	€ 754.2
2,250	€ 1,151.42206	€ 848.475
2,500	€ 1,057.14706	€ 942.75
2,750	€ 1,037.025	€ 1,037.025
3,000	€ 1,131.3	€ 1,131.3
3,250	€ 1,225.575	€ 1,225.575
3,500	€ 1,319.85	€ 1,319.85
3,750	€ 1,414.125	€ 1,414.125
4,000	€ 1,508.40	€ 1,508.40
4,250	€ 1,602.675	€ 1,602.675
4,500	€ 1,696.95	€ 1,696.95
4,750	€ 1,791.225	€ 1,791.225
5,000	€ 1,885.50	€ 1,885.50

TABLE 7.5: Table Stock Price Scenarios

Fair Price for the EURO STOXX 50 Twin-win Certificate

The investor enters two long positions in the down-and-out put options as well as one long position in the zero-strike call which sums up to 1,096.40€ (see Formula 7.10). This calculation shows that the twin-win certificate on the EURO STOXX 50 is sold at a discount to its investors.

$$1,000€ + 2 * 48.20€ = 1,096.40€ \quad (7.11)$$

7.7 Stock Price Scenarios

In the following, the payoff from the twin-win certificate is compared to the payoff of a straight factored investment into the index.

Table 7.5, as well as Figure 7.5 prove that investing into the twin-win certificate is superior compared to replicating the index through investing into the stocks. However, holders of the certificate face a lack of liquidity as previously discussed as well as higher

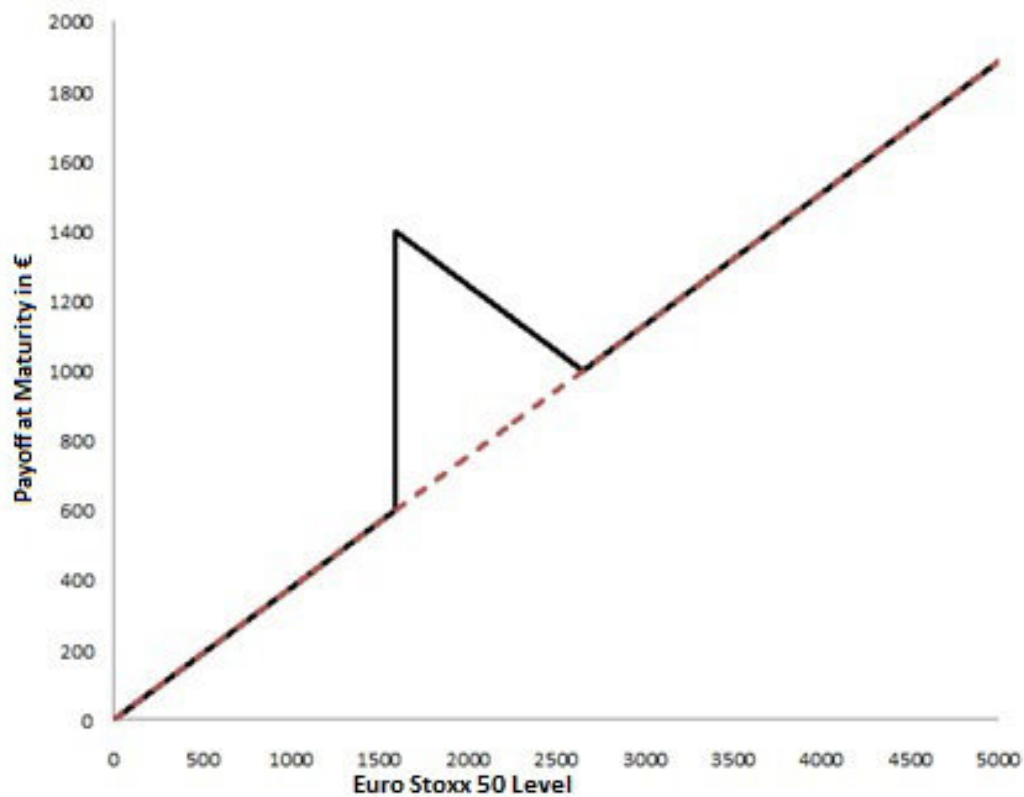


FIGURE 7.5: Stock Price Scenarios for the Twin-win Certificate on the EURO STOXX 50 (by: Stefan Rogel)

risks due to counterparty credit risk, market risk and liquidity risk. Whether this certificate is priced fairly, was determined in the previous section.

7.8 Conclusion of the Twin-win Certificate on EURO STOXX 50

The payoff from the twin-win certificate on the EURO STOXX 50 can be replicated through a long position in a zero strike call as well as a long position in two European down-and-out put options.

The certificate has a variety of advantages, but also disadvantages and risks. The major advantage is that the investor can benefit from rising but also from falling stock prices and, even in case the barrier is broken, the twin-win certificate still performs similar to a regular stock. The certificate allows investors to benefit from the entire upside development of the underlying. Also, investors can enter a factored position in the EURO STOXX 50 and it allows for secondary market trading.

The investors face increased counterparty credit risk, market risk and liquidity risk. Further disadvantages are that the certificate does not provide any guaranteed yield, the investor is not entitled to any dividend payments.

The factors which impact the value of the certificate are ambiguous. It cannot clearly be determined whether the dividend payout policy, volatility, the underlying price development and risk-free interest rates are positively or negatively correlated to the certificate.

Also, the product is sold at a discount. The certificate includes positions which are worth 1,096.40€, but is sold for 1,000€. As shown by the discussion in 7.7, the twin-win certificate clearly outperforms a regular investment into the EURO STOXX 50 and is therefore a very good investment opportunity for investors who are willing to bear the additional risks which are involved.

Chapter 8

Conclusion

Throughout this Master thesis, four retail structured investment products which were issued in the Austrian market were analyzed. During the first quarter of 2013, 523 structured products were issued in the Austrian market in comparison to 140,794 new issues in Germany. Also, in terms of exchange turnover the German market is dominant in Europe. Due to this reason, Austrian issuers frequently issue their products not only in Vienna also on the exchanges in Stuttgart and in Frankfurt in order to enhance the liquidity of their products. The Austrian market is dominated by Raiffeisen Centrobank AG, Erste Group Bank AG, Bank Austria and Volksbank Investments. The products which were analyzed include three products from Raiffeisen Centrobank AG and one from Erste Group Bank AG.

It was found that the products face increased risk as a result of increased counterparty credit risk, market risk and liquidity risk. However, it was also found that structured retail investment products have a variety of advantages. For instance, bonus certificates offer a bonus payment above the return of bond or stock investments, while, at the same time, their payoff is less risky in comparison to a stock investment but are traded on exchanges as shares. On the opposite, the bonus payment can get lost in sharply decreasing markets, as they are subject to a leverage effect and provide no dividend or interest payments and can only be sold before maturity at a loss through an exchange.

Protected reverse convertibles provide a higher yield at shorter maturities in comparison to bond investments while having a lower volatility than the underlying, but, at the same time, provide a protection from total loss. However, disadvantages are the capped

return, full exposure to falling share prices and a more unpredictable return than bond investments.

Furthermore, discount certificates have shorter maturities, allow for higher flexibility, offer the opportunity to enter a discounted position and therefore positive return in marginally decreasing or stagnating markets while also providing a factored position. On the opposite, their return is capped, while losses are unlimited and the only liquidation possibility is through an exchange.

Twin-win certificates can provide positive payoff under rising and deteriorating stock markets while requiring a smaller initial investment and allowing for uncapped participation in upward moving markets. On the opposite, their yield is not guaranteed, and no protection is provided in case the underlying falls to zero.

As proved by this discussion, retail structured investment products offer a high variety of advantages, while, at the same time, their risk is increased and no interest or dividend payments are made, and also maturities are fixed while also having other disadvantages.

Answering RQ1: Does the investment into the analyzed structured investment products deliver valuable opportunities for investors, when weighing their advantages against their risks, as well as disadvantages? As will be discussed throughout the answer to RQ2, retail structured investment products tend to be issued at a discount, which is a compensation for the disadvantages and risks which were mentioned, while the answer to RQ3 will prove under which market conditions it is beneficial to invest in these. It can finally be said that the analyzed products deliver a valuable opportunity for investors under specific market conditions and therefore should be considered when establishing a balanced portfolio, even though they entail higher risk and other disadvantages.

It was found that the three Raiffeisen products were issued at a discount based on a valuation of their components while the product from Erste Group was sold with a markup. Nevertheless, as already discussed in the answer to RQ1, the risk of these products is increased in comparison to an investment into the underlying and the discount is at least partially a compensation for this additional risk. Also, the data which was used is merely based on public sources and does therefore not perfectly fit the data which would actually be required for an optimal valuation. However, in order to finally answer RQ2, using a decomposition approach: Are the four structured products which were issued

in the Austrian market priced fairly according to their individual setup? Three out of four products were found to be priced at a discount using a decomposition approach, while it can be said that the Raiffeisen products tend to be sold at a discount, and no direct judgment about the Erste Group product can be made, as only one product was analyzed and therefore further research is required.

In the scenario analysis, it was found that the structured investment products which were analyzed tend to outperform their underlying under certain conditions. Bonus certificates and twin-win certificates tend to outperform their underlying at maturity while protected reverse convertibles and discount certificates are a good investment in stable or slightly decreasing equity markets. However, this analysis just considers the pure performance of the underlying while leaving the forgiven dividend and interest payments uncovered. This discussion leads to finally answering RQ 3: Based on a scenario analysis: Under which market conditions does an investment into structured investment products outperform straight bond or equity investments? Throughout the analysis it was found that the analyzed structured products outperform their underlying especially in stable or slightly decreasing equity markets. However, investors need to consider the forgiven dividend and interest payments and also the case that trigger events might take place and the return can be significantly reduced.

Finally, it can be said that the analyzed structured retail investment products offer a great opportunity for investors under specific market conditions. However, due to their complexity, investors should invest sufficient time, in order to analyze and understand these products before making their investment decision. The public information which can be accessed by investors was found to be sufficient for such an in-depth analysis.

Chapter 9

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Abstract (English)

Reverse convertibles, bonus certificates which can be capped or uncapped, discount certificates and twin-win certificates are examples of structured retail investment products, which are commonly sold by Financial institutions to retail investors with the purpose of raising financing for their operations. This Master-thesis aims at analyzing four previous product issues in the Austrian market and is merely based on public information which was published by the issuers, academic literature and other public sources for financial data.

Throughout the analysis, the advantages, disadvantages and risks of these products are determined while valuing the products with a decomposition approach in order to finally determine under which market conditions an investment into these structured retail investment products can outperform a direct investment into their underlying. The findings deliver a valuable insight into the general set-up of these products and also finds that three out of four issues tend to be underpriced. Furthermore, it is found that investments into these products makes the most sense when the underlying stagnates.

Abstract (Deutsch)

Aktienanleihen, Bonus-Zertifikate, welche sowohl gedeckelt als auch ungedeckelt sein können, Discount-Zertifikate und Twin-Win-Zertifikate sind Beispiele strukturierter Anlageprodukte für Privatanleger, welche häufig von Finanzgesellschaften an Privatanleger verkauft werden, um ihren Betriebsablauf zu finanzieren. In dieser Masterarbeit werden vier Emissionen im österreichischen Markt mit öffentlich zugänglichen Informationen der Emittenten, akademischer Literatur und anderen öffentlich zugänglichen Quellen für Finanzdaten analysiert.

In der Analyse werden sowohl Vorteile als auch Nachteile und Risiken dieser Produkte analysiert, diese mit einem Aufspaltungs-Ansatz bewertet, um letztendlich herauszufinden, unter welchen Marktbedingungen ein Investment in diese strukturierten Anlageprodukte für Privatanleger sinnvoll ist und diese ihren Basiswert leistungsmäßig übertreffen. Die Ergebnisse liefern einen wertvollen Einblick in den allgemeinen Aufbau dieser Produkte, und es wird herausgefunden, dass drei der vier Emissionen unterbewertet sind. Zudem wird herausgefunden, dass Investitionen in diese Produkte am meisten Sinn machen, wenn der Basiswert stagniert.

Stefan Rogel, B.Sc.

CARREER PROFILE

My goal is to pursue a successful career in the financial services sector.

My greatest strengths are:

- Solid theoretical foundation as well as proven work experience
- Hard working and independent worker with a never give-up-attitude
- Strong analytical skills, as well as exceptional problem solving skills

EDUCATION

University of Vienna, Faculty of Business (expected GPA: 1.8) **Vienna, Austria**
International Business Administration majoring in Corporate Finance, M.Sc. Since 01/10/ 2012
Master Thesis: Structured Retail Investment Products – An Analysis of Four Previous Product Issues in the Austrian Market

Maastricht University, School of Business and Economics **Maastricht, The Netherlands**
International Business Economics majoring in Finance, B.Sc. (GPA: 6.79) 01/09/09 – 30/06/12
Capstone Assignment: The Sense and Nonsense of Corporate Risk Management (Grade: 9.0)

Brock University, Goodman School of Business **St. Catharines, Canada**
Exchange: Business Administration 08/09/11 – 20/12/11

Gymnasium Zitadelle der Stadt Jülich **Jülich, Germany**
General Qualification for University Entrance (Abitur) June 2008

WORK EXPERIENCE

PricewaterhouseCoopers **Vienna, Austria**
Consultant, Financial Service Consulting Starting 01/06/2014

Erste Group Bank AG **Vienna, Austria**
Associate, Group Corporate Workout 01/02/2014 – 31/05/2014

Erste Group Bank AG **Vienna, Austria**
Intern, Group Large Corporate Workout 01/09/2013 – 30/09/2013

- Attending a 4-day training for Corporate and Real Estate Workout
- Creation of risk assessments and presentations about specific workout-cases
- Calculation of risk exposure with regard to particular companies, including their FX exposure
- Researching the legal background for the accounting treatment of hedge fund exposure
- Involvement into every day transactions and client meetings

Generali Deutschland Holding AG*Assistant, Group Asset Accounting***Aachen, Germany**

19/01/12 – 31/09/12

- Bookkeeping and trading of funds for the fund linked life assurance of AachenMünchener
- Documentation and planning of projects with Planisware
- Bookkeeping of Call money returns
- Creation of statistics and duration analysis for various subsidiaries

Assistant, Specialist Center SAP Financial Assets

04/07/12 – 31/09/12

- Planning and time scheduling for a new costing system involving Planisware
- Planisware introductions to new employees
- Testing of SAP updates for usability in everyday situations

Maastricht University*Organization of the ICC@M***Maastricht, The Netherlands**

January - April 2012

- The International Case Competition (ICC@M) is an annual event taking place at Maastricht University School of Business and Economics. 64 bachelor students from 16 business schools all over the world work on different business cases. The event takes one week and includes several social and corporate events.

Ingenieurbüro Dipl.- Ing H. Vössing*Student Trainee in Structural Engineering***Düsseldorf, Germany**

01/07/11 – 31/08/11

- Creation of Excel spreadsheets for project valuation
- Creation of built-in parts lists
- Reprocessing of bidding documents
- Documentation of correspondence

Alten- und Pflegezentrum Heilige Familie*Alternative civilian Service***Hasselsweiler, Germany**

01/01/09 – 30/09/09

- Social work in a senior residence, while being involved in different tasks regarding the facility management and delivery of lunch to different schools, as well as kindergartens within the region; support of residents in everyday life activities.

Ingenieurbüro Dipl.- Ing H. Vössing*Temporary Help in Project Management***Düsseldorf, Germany**

01/03/08 – 14/08/08

- Maintenance of a database in Lotus Notes
- Time scheduling with MS Project
- Measurement of earthworks with MS Excel
- Project documentation using Project Management Systems (PMS)

SKILLS, ACTIVITIES & INTERESTS

Languages: Fluent in German, English; Knowledge in French, Spanish, Dutch
Basics in Chinese/Mandarin

Technical Skills: Microsoft Office, Microsoft Project, Eviews, SAP, Planisware

Certifications & Training: Quality Management, Project Management System (PMS) and Eplass

Interests and Hobbies: Finance and politics within Europe, as well as other parts of the world;
Travelling and getting involved with other cultures; Social and outgoing by nature