

**STRUCTURED PRODUCTS INSIGHTS – PRICING REVERSE
CONVERTIBLES AND DISCOUNT CERTIFICATES IN THE
GERMAN MARKET**

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DISSERTATION SUBMITTED AS PARTIAL REQUIREMENT FOR THE CONFERRAL OF

MASTER IN FINANCE

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September 2017

Resumo

O principal objetivo deste trabalho é a investigação do mercado de produtos estruturados, nomeadamente o mercado de capitais alemão, um dos mais desenvolvidos. Desta forma, este projeto ambiciona proporcionar conhecimento sobre o que é o mercado de produtos estruturados e como este funciona, tornando clara a importância deste tipo de produtos. Para além destes objetivos, esta pesquisa pretende informar sobre as atuais condições de mercado, através da análise do preço destes produtos, recorrendo a exemplos reais, nomeadamente os “*Reverse Convertibles*” e os “*Discount Certificates*”.

De facto, o mundo financeiro sofreu muitas evoluções nos anos recentes. Uma evolução recente é a criação deste “fenómeno estruturado” que combina o mercado tradicional com o mercado derivado. Isto aconteceu devido à importância crescente da engenharia financeira, que por sua vez, através da reformulação dos produtos financeiros, criou uma ligação entre o “velho” (mercado tradicional) e o “novo” mundo (mercado de derivados).

Contudo, esta ligação pode ser muito perigosa se o investidor não estiver bem informado. Posto isto, é importante conhecer bem estes produtos. Em paralelo com o conhecimento teórico, este projeto providencia também uma abordagem empírica a este mundo complexo. Desta forma, a inclusão de um modelo de preço para os “*Reverse Convertibles*” e para os “*Discount Certificates*”, baseado no modelo “*Constant Elasticity of Variance*”, constitui uma importante abordagem para atuais e futuras avaliações de preço por parte dos investidores, o que por sua vez poderá resultar em melhores decisões de investimento.

Palavras Chave

Produtos Estruturados – Modelo de Preço – Mercados Financeiros – Modelo CEV

Classificação JEL

G12; G24

Abstract

The purpose of this dissertation is the investigation of the structured products markets, namely the equity linked structured product German market, one of the most developed. With that, this dissertation aims to provide knowledge about what structured products really are and how they work, making clear the increasing importance of these types of products. Besides that, this dissertation has also as a main objective the information about the actual conditions of the market, by the analysis of these products' prices, through real products examples, namely Reverse Convertibles and Discount Certificates.

In fact, the financial world suffered a lot of evolutions during the recent years. A relative recent one is the creation of this “structured phenomena” that combines the traditional market with the derivatives one. That happened due to an increasing importance of “financial engineering”, that in turn, through the repackaging of financial products, created a link between the “old” (traditional market) and the “new” world (derivatives market).

Nevertheless, this link can be very dangerous if the investor is not well informed. Thus, it is important to understand well structured products. Along with a theoretical knowledge, this dissertation provides also an empirical approach to this complex world. Therefore, the inclusion of a pricing formula for Reverse Convertibles and Discount Certificates, based on the Constant Elasticity of Variance model, constitutes an important proxy for actual and future pricing fairness evaluations by investors, which in turn could result in a better market performance in future investment decisions.

Key words

Structured Products – Pricing – Financial Market – CEV model

JEL Classification

G12; G24

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Introduction

The evolution of financial markets has been a constant over the last years. These markets have become more accessible and less expensive, but, at the same time, more complex. The need for creation of new products increased, due to the demand of more complex payoff structures (Szymanowska et al., 2009), that could give the investors other opportunities to make an additional income. The “structured phenomena” started to be a reality that rapidly achieved Europe, benefiting from a period of low interest rates during the decade started in 1990, where the traditional instruments (like bonds and shares) were not able to satisfy the investor needs (Stoimenov and Wilkens, 2005).

The development of the new structured products world was a natural consequence of this financial market evolution. This new world was born due to the synergies that this market provides to issuers and investors. According to Wasserfallen and Schenk (1996), the huge success of structured products market is connected with the fact that this market has been considered a new alternative to the expensive traditional portfolio investment one. In the latter, the high price of securities, the size of the transaction and management costs, the lack of knowledge by the investors and the risk of losing the investment, were barriers that enabled a lot of investors to enter in the financial world. With the development of the structured products market, these barriers disappeared.

In fact, a structured product is simply a new way of thinking, in other words, a new way of sell and buy in the financial markets. Due to the structure of these products, this new market was able to accommodate innovation, with traditional instruments. This conjunction was accomplished by one simple retail phenomena: the repackaging of the financial products. This repackaging was possible because of the so called and criticised phenomena “financial engineering”, that some blame for the crisis of 2008. “Financial engineering” is simply a new way to construct financial products that meet the demand and offer requests, at relative low prices (Breuer and Perst, 2007). This new financial efficiency was possible due to the higher level of integration between the derivative markets, where the innovation resides, and the traditional markets, where the confidence of the investors is higher (Burth et al., 2001).

This market is in fact a world of opportunities, but only if investors and issuers are able to exploit these new market advantages. For sure, the issuing institutions namely banks, with their know-how and resources, will be ready to exploit these opportunities. According to Carlin (2009), there are several reasons that lead to overprices in this market, being the most important the strategic complexity, which allows issuers to exploit advantages from the uninformed consumers.

Therefore, this dissertation aims to inform the reader about the dynamics of the complex structured products market, allowing him to judge better about the general characteristics and pricing fairness of the different products. In order to tackle this issue, the main objectives are: provide knowledge about what structured products really are and how they work; justify the increasing importance of the knowledge about these products by the investors and the general public; inform about the actual conditions of the market, by the analysis of these products prices', through real products examples. The real products examples considered will be the special case of the Reverse Convertibles (RC) and Discount Certificates (DC), due to the representative trading volume (Wilkins et al., 2003).

To achieve the objectives proposed above, this dissertation will be divided in two important parts: a theoretical and an empirical one. In the theoretical part of this dissertation, it will be presented some of the basic insights about this complex world. This first part will start by a proposed definition for a structured product, followed by a presentation of the most important features in the existence of these products. After that, the several types of structured products will be presented, and a journey by the most important conclusions derived from the past literature (with focus on the price issues) will be conducted on this section. To conclude this theoretical analysis, it will be performed an overview around two important phenomena with increasing importance in financial markets: financial engineer and behavior finance. The second part of the dissertation will include the pricing of two types of structured products (Reverse Convertibles and Discount Certificates), considering eight top German companies as underlying. This analysis will be complemented with an overview around these products issuers' in the German market.

Chapter I - Basic insights from the structured product market

1. Definition

The term “structured products” was created in United States of America during the decade started in 1980 and it is basically the result of the increasing financial engineering process presented in the market since then. This “structured phenomena” rapidly achieved Europe, benefiting from a period of low interest rates during the decade started in 1990 (Stoimenov and Wilkens, 2005).

According to Breuer and Perst (2007), a structured product is a financial product designed to meet highly customized risk and return preferences demanded by the investors. Thus, they defined two important conditions to consider a financial product as a structured product:

- I. The financial product has to be composed by at least two financial instruments;
- II. One of these financial instruments must be a traditional instrument and the other a financial derivative;

Stoimenov and Wilkens (2005) defined the third condition to this definition:

- III. It has to be issued by a bank (which includes investment banks).

It is of extreme importance to state that there is not a single and general definition for the term structured product and that the definition proposed above (based on the three conditions) aims to be one of the most complete and clear definition presented on the literature.

Due to the fact that these financial products are normally linked to the equity financial products, structured products are also commonly known as equity linked structured products. In other words, normally, the traditional instrument or the financial derivative (in most of the cases both) are related with equity products. This feature does not imply that all structured products are equity related products, since there are also debt linked structured products, whose market share is insignificant nowadays. Starting with the traditional instrument, normally, they are related with a company common stock price, a basket of common stocks, a single stock index or multiple stock indexes (Henderson and Pearson, 2011). Nevertheless,

the traditional instrument can also be an interest rate product, like a bond (the most commonly used instrument), which is not an equity related instrument. In the case of the financial derivatives, which are securities that have a price dependence from one or more underlying assets, in the majority of the cases, they are also equity related instruments, being options the most commonly used by far. Like stated in the traditional instrument, the derivative instrument can also be a swap, a forward or a future, which may not be equity related instruments (it depends on the choice of the underlying). Therefore, in the limit, it is possible to create structured products that are not related with equity, despite this does not happen frequently in the market. With that, the attention goes to equity linked structured products, especially the ones whose the financial derivative is an option. In fact, the products that combine a traditional market instrument with an option are the ones with higher trading volume in the market and the most known by the investors.

To conclude this definition, it is important to clarify that leverage products are not considered structured products, since they miss the combination with a traditional instrument. In other words, leverage products are just constituted by single barrier options (or one sided options), so they do not include traditional instruments, like stocks or bonds, in their composition (Wilkins and Stoimenov, 2007), being therefore excluded by this definition of structured product, despite their higher trading volume.

2. Types of products

2.1 The products' components

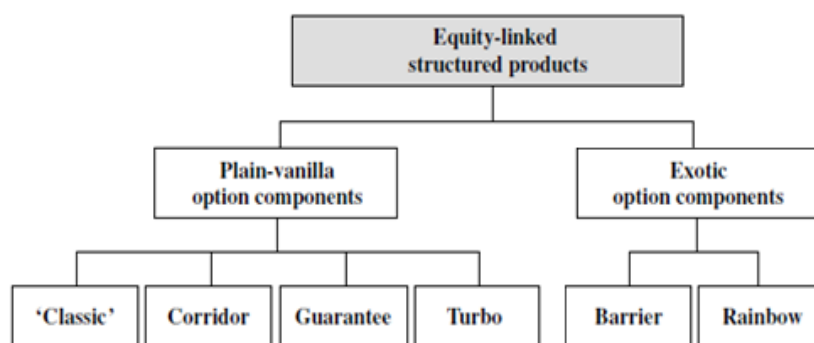


Figure 1 - Types of equity linked structured products according to Stoimenov and Wilkens (2005)

Like stated before, the products most frequently traded at the market are the so called equity linked structured products. The division presented in figure 2 is based on the German Market, which is one of the most complete market for structured products. Therefore, Stoimenov and Wilkens (2005) state that the most important division in equity linked structured products is related with the option choice. Therefore, for one hand, in the case that the option is a plain vanilla option, one can be in presence of:

- Classic products: products structured like bonds, with the special feature that at maturity (or at a set date), the issuer can choose between either redeem the investor by the nominal value of the structured product or redeem the investor by a pre-defined number of specified shares. The payoff of these products can be represented through the following equation¹:

$$\text{Classic payoff} = Ne^{-r(T-t)} + \sum_{i=1}^n Z_i e^{-r(t_i^Z-t)} - e^{-r(T-t^{fixing})} s P_t^K,$$

where:

- N : amount invested;
- T : product maturity;
- t : current time;
- Z_i : amount invested;
- t_i^Z : the payment date of the i – th interest coupon payment $i = 1, 2, \dots, n$;
- r : risk free interest rate;
- t^{fixing} : reference day;
- s : number of options;
- S_t^* : underlying asset price at time t ;
- P_t^K : value of a European put option with strike K and maturity at t^{fixing} .

¹ This equation can be obtained using the put-call parity. The “original” equation is:

$$\text{Classic payoff} = \sum_{i=1}^n Z_i e^{-r(t_i^Z-t)} - e^{-r(T-t^{fixing})} s (S_t^* - C_t^K)$$

The respective graphical representation is similar to the following one:

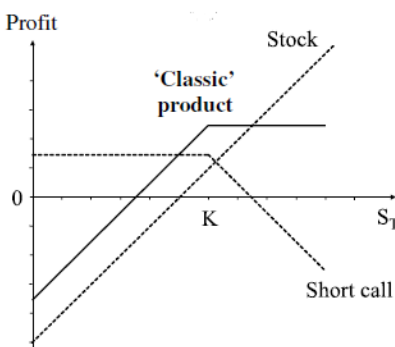


Figure 2 - Graphical representation of the classic products payoff

- Corridor products: the redemption of these products depends whether the price of the underlying behaves within a certain range. Thus, the maximum payout is given by an upper boundary, in other words, the boundary defines the maximum price that the underlying can achieve that benefits more the investor. By the contrary, the lower boundary defines the minimum price that the underlying stock can achieve where a total loss occurs. Thus, the payoff of these products can be represented through the following equation:

$$\text{Corridor payoff} = e^{-r(T-t^{\text{fixing}})}_s(C_t^L - C_t^K),$$

where:

- C_t^L : value of a European call option with strike $L = \text{Lower reference price}/s$;
- C_t^K : value of a European call option with strike $K = N/s$.

The respective graphical representation is similar to the following one:

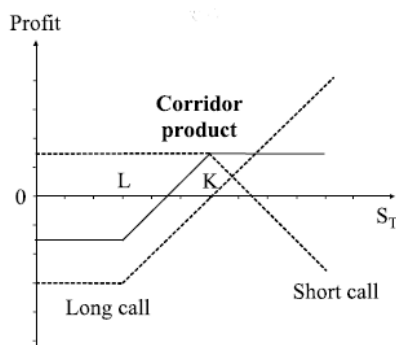


Figure 3 - Graphical representation of the corridor products payoff

- Guarantee products: these products have almost the same features that corridor products, with the specificity that the loss (lower boundary price of the underlying asset) is limited to a specific minimum repayment. It is like a guarantee to the investor, since the investor will receive at least the minimum repayment, no matter what happens with the underlying. Therefore, the payoff of these products can be represented through the following equation:

$$\text{Guarantee payoff} = \sum_{i=1}^n Z_i e^{-r(t_i^Z - t)} + e^{-r(T-t)} s(C_t^G - C_t^K) + sG e^{-r(T-t)},$$

where:

- C_t^G : value of a European call option with strike $G = \text{Guaranteed value}/s$;
- G : Guaranteed value/ s .

The respective graphical representation is similar to the following one:

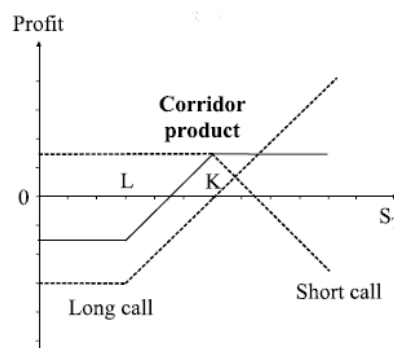


Figure 4 - Graphical representation of the guarantee products payoff

- Turbo products: like the previous category, these products are the same as corridor products but with three special features: if the price of the underlying is below the lower boundary, the investor is redeemed by shares; if the price of the underlying is between the lower and upper boundary, the investor receives twice the development of the underlying (turbo effect); if the price is quoted above the upper boundary, the investor will receive a pre-specified maximum amount. As the above mentioned products, the payoff of these products can be represented through the following equation and respective graphic:

$$Turbo\ payoff = e^{-r(T-t^{fixing})} s(S_t^* - C_t^L - 2 C_t^K),$$

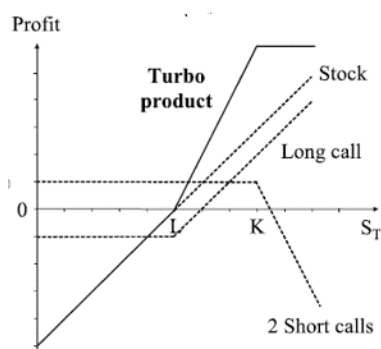


Figure 5 - Graphical representation of the turbo products payoff

On the other hand, there are other products whose respective payoff profile is more intricate. Then, if the option choice is more complex, one are in presence of exotic options that can lead to the creation of two types of products:

- Barrier products: the redemption at maturity done by the issuer depends on the underlying price behavior during the product lifetime. The definition of knock-in or knock-out barriers by the issuer, allows him to choose (in the case of knock in barriers) or not (in the case of knock out barriers) if the redemption to the investor will be done by shares or by money.
- Rainbow products: structured products with the same characteristics of classic ones, but where the issuer has the right to choose the redemption between two underlying assets and not only by one.

These last two products have a complex payoff structure. Despite their increasing importance at the market, they have not the same level of trading volume than the simplest ones. Thus, in order to perform a clear and useful analysis, this research will be focused on the simplest above mentioned structured products.

2.2 The coupon payments

Grünbichler and Wohlwend (2005) proposes a further subdivision based on the existence of coupon payments and when the products under evaluation are classic products. These

division lead to the definition of the two most traded products in the structured market: Reverse Convertibles (RC) and Discount Certificates (DC). Hence, Wilkens et al. (2003), provided one of the most complete explanation about these type of products. Starting for the case of the RC, they are classified as classic products (which includes coupon payments). Their first issue was in the United States of America, by Bankers Trust, in 1993. At this time, the blue chip underlying of companies like Coca-Cola or Johnson & Johnson and the annual interest coupon (normally much higher than the corresponding standard bonds) were the drivers for the huge launch success of these products. Nowadays, these features continue to increase the success of these products, especially in times of low interest rates. With this product, at redemption the investor will get the amount correspondent to all the interest coupons paid to him, plus the repayment of the nominal value of the bond or its redemption by shares (it depends on the issuer's decision). In the case of DC, instead of the coupon payments, the investor receives at the issuance a discount in one or in a bundle of shares, considering the current market prices. These products are like classic structured products, but in this case without coupon payments. As the RC, at the maturity, the issuer can make the redemption trough shares or cash. However, the redemption by shares will only occur if its total market value do not exceeds a pre-defined amount. In that case, this maximum amount will be paid in money. Considering a general overview, these two products are economically equivalent, being the issuance discount and the coupon payments basically the same value, but distributed in different ways.

Based on these definitions, therefore, it is possible to classify the products which are the aim of these study. In sum, they are classic products with (RC) and without (DC) coupon payments.

2.3 Concave versus convex strategies

The division between these products presented above is also considered by Burth et al. (2001) as a concave product, with and without coupon payments, respectively. In their opinion, the investment in structured products can be divide in two investment strategies:

- Convex: investment strategy that create products under which the investors earn at the expiration a minimum guaranteed value, but where the upside potential is limited.

- Concave: this strategy is based in a combination of a position in the underlying asset (typically a single stock) plus a short position in a call option of the same asset. In this strategy, it is possible to the investor to buy the underlying asset at discount (DC) or to buy it at the current price, receiving coupon payments until the maturity of the investment (RC) that basically amount to the discount referenced above.

Despite the several divisions presented by many authors, the main important idea to retain in this section is related with the fact that there is no single “law” under the classification of structured products. Thus, it is possible to create the same product, giving complete different names to the process or to product itself. These differences of classifications have meanings related with the high degree of engineering and psychology effect presented in these type of products. These two effects are so important that will be analyzed in more detail in the next chapter.

3. The existence of an equity linked structured product

The circuit of these products starts with their issue and ends with the respective redemption. During these period there are several players with different responsibilities. Baubonis et al. (1993) defined that at the time of the issue, there are four principal entities: the issuer bank (who creates the product), the retailer (who sells it), the provider of the option hedge (who aims to hedge the risk of the issuer bank) and the investor (who buys the product). In the majority of the cases, the function of issuer, retailer and option hedger is performed by the same institution, which according to the definition presented above, should be a bank.

These products can be sold via exchange-traded markets or over the counter markets (OTC)². The OTC market is the most important one, due to the allowed personalization feature. This personalization feature leads to complexity, which obliges the issuer bank to act as OTC market maker by offering to buy back products issued by themselves, in order to increase the liquidity (Burth et al., 2001).

² Exchange-traded markets are organized markets, like the New York Stock Exchange, that physically exists, and where the liquidity is higher and the products are relatively homogenous, since they obey to certain rules. On the other hand, an OTC market is a “private market” between issuers and investors, where these products are normally customized, where the liquidity is lower.

As mentioned before, these structured products are a combination of financial instruments that are sold as single security, which allows the issuer to define what type of financial instruments they want to include in this “package of a single security”. Henderson and Pearson (2011) suggests that the market capitalization, the past returns, the trading volumes and the implied volatility of these financial instruments are key factors to define what to issue. According to Döbeli and Vanini (2010), the types of issues should also be defined according to the clients investment behavior and risk perception, in order to increase the success of the product among a specific target public.

After the choice of the structured products components, it is important to define what will be the profit for the organization, in other words, the premium. The premium is basically the difference between the price by which the institution sells the structured product minus the price that the institution pays to construct this same product (in order words, the cost of the hedging strategy). This premium tends to be higher if the structured product pays a fixed coupon to the investor (like the case of RC) due to the “bond-like appearance” of the investment, a theory that is defended by many authors, including Burth et al. (2001). These authors also defend that co-lead management³ can also play a role in this premium definition.

4. Advantages and disadvantages - issuer and investor perspective

The development of this structured phenomena occurred due to the synergies that this market provide to issuers and investors. According to Wasserfallen and Schenk (1996), in simple terms, this market is the new alternative to the normal portfolio market. In the last, the high price of securities, the size of the transaction costs, the lack of knowledge by the investors and the risk of losing their investment were barriers that enables a lot of investors to enter in the financial world. With the development of structured products market, these barriers disappeared due to the repackaging of the financial products, possible by the so called financial engineering process. This financial development allows the satisfaction of the increasing investors’ demands, at relatively low prices (Breuer and Perst, 2007). Furthermore,

³ Structured products issued by more than a single bank.

this structured market allows a higher level of integration between the markets, with the possibility to create long and short positions in the derivative market as well as in the underlying market, once again, at relative low prices (Burth et al., 2001). In the special case of RC and DC, the attractive feature is related with the ability to access options products without the need to access to options exchanges (Wilken et al., 2003).

Looking further for the advantages in the investor perspective, the structured market was able to create a better exposure to the equity market, with the ability to provide greater exposure when the market is performing well and behaving more like a bond when the market is performing badly (Baubonis et al.,1993). This new market respond to the investors demand in a way that it satisfies their increasing needs for more complex payoff structures (Szymanowska et al. 2009), in addition with the reduction of the explicit margin requirements, since the nominal values of the product serve as guarantee for the issuer (Stoimenov and Wilkens, 2005) .

On the other hand, in the case of the issuer perspective, the appealing risk and return profile of these products attracted a lot of new clients. Furthermore, these products are fee based and allows the issuers to hedge other positions, reducing their exposure to the equity market (Baubonis et al.,1993). Entrop et al. (2009) consider also other advantages which are the following:

- The upfront hidden fee: this is nothing more than a secure and fixed profit to the issuer. With the issuance of these kind of products, these banks are able at beginning to input a fixed fee, which instantly reduces the nominal value due to the investor and in turn, instantly increases the profit of the issuer bank. In fact, the more complex the structured product, the higher are the implicit fees (Wilkens et al., 2003).
- Control of the market: these authors argue that the issuer is usually the only one that dominates the market for a specific instrument, since the products are so customized that in the limit, there is not any player left interested in buying the product leaving the issuer in a kind of monopoly situation.
- Limited transparency: this factor is presented in two different ways. On one hand, the issuer benefits from the fact that there is little information about bank-specific costs and hedging strategies, making thus harder the evaluation of pricing fairness by the investor. In sum, if the investors do not know the cost of creating these products, they

are not able to evaluate if the product is cheaper or expensive or, in the limit, if the premium is fair or not (this study tries to explicit this situation in chapter III). On the other hand, and in addition to these unknown structure, the little investor sophistication and knowledge of the recent market are factors that influence more the misperception of the investor, forcing them to have less notion in how and what they are investing in fact.

- Absence of contracts and underlying restriction – this characteristic is typical from markets in development, where limits are not yet established. These allow issuers o have freedom to do whatever they want to define their products.

All of these factors allow higher prices, and consequently, higher profits for the issuing institutions, without the true perception of the investor. As examples, in the special case of RC and DC, it is not difficult to find one clear above related advantage: the discount and the high coupon payments, forces the investor to misleads the risk at redemption, which in turn is good for the issuer (Szymanowska et al., 2009) . In this section, it is important to note that some of these advantages for the issuing institution are important disadvantages on the investor perspective.

Chapter II – The evolution of the structured product market

5. The research history

The research about structured products has been increasing over time. There are a considerable number of studies, however it will be considered just the most important of them, since several studies are just an update of previous ones. Thus, the studies that are considered to be the base of this research about structured products are:

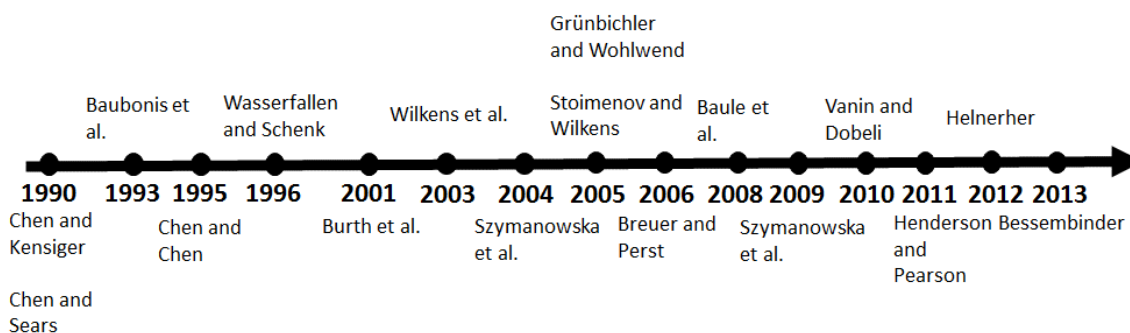


Figure 6 – Time chronology of researches about structured products

5.1 The beginning

As stated before, the research about structured products has been increasing over time. The considered first empirical analysis was conducted by Chen and Kensiger (1990) and Chen and Sears (1990) that analyzed the price fairness of guarantee and classic products without coupon payments, named Market Indexes Certificates of Deposits, using a default-free probability. The first study concluded that these structured products were overpriced at the issue date, and the second one concluded that these same products were underpriced on the secondary market. In other words, the premium charged by the issuing institution was higher at the issue date (primary market) and negative after that. Almost the same analysis was done by Baubonis et al. (1993), but considering hedging costs and tax implications. They found that the bank can earn a premium between 2.5% and 4% at the issue date. Further, Wasserfallen and Schenk (1996) analyzed guarantee products in the Swiss market, and, once

again, concluded that there was overpricing at the issue date and underpricing in the secondary market.

5.2 Introduction to a new century

With the new century, the market for RC and DC started to gain the nowadays importance. Burth et al. (2001) stated that RC and DC were overpriced, being Reverse Convertibles more expensive due to the inclusion of coupons. Further, Wilkens et al. (2003) evaluate the pricing fairness of these products in the German market, and Grünbichler and Wohlwend (2005) in the Swiss one. They were the pioneers in considering credit risk in their analysis. Once again, both concluded that these products were overpriced, being this phenomena more pronounced on the secondary market. Almost at the same time, Stoimenov and Wilkens (2005) also studied the pricing of these products, along with other equity-linked structured products. Once again, it was observed consistently overpricing at the issue date in these products. They also discover that this overpricing decrease as the products achieve their maturity, which justified equity-linked structured products underpricing on the secondary market. Between these three studies, Szymanowska et al. (2004) started to introduce some aspects related with behavioral finance, using for this a sensitivity analysis, based on the framing effect of choices (an introduction to the prospect theory investor), along with a pricing evaluation using the CEV model. In this way, Breuer and Perst (2007) studied the connection between retail banking and financial engineering, using as base these RC and DC products and the relation of these type of products with the utility function of the investor. After two years, a more general study developed by Baule et al. (2008) concluded that these structured products were in fact overpriced, although the reduction of the issuance overpricing registered in the last years.

5.3 The proximity of a new decade

In the proximity of a new decade, the authors intensified the analysis of the relation between the price and the investor behavior. Thus, Szymanowska et al. (2009) justified that the overpricing related in the last studies was possible due to the development of the so called financial marketing. In this way, Vanin and Dobeli (2010) analyzed the effect of this

communication in the difference between stated and revealed investment decisions, when considered the investment of structured products, starting the discussion around behavioral finance. Henderson and Pearson (2011) conduct again a pricing analysis where they found that, considering the characteristics of these products, it is difficult to find analytic reasons to understand the purchase of these products by informed rational investors, giving even more importance to the irrational side of these purchases. As consequence, Helberger (2012) developed an analysis where instead of a normal utility function, it was used the above mentioned prospect theory of investment to explain the behavior of structured products investors. Finally, the last most important upgrade in the study of structured products was conducted by Bessembinder et al. (2013) who introduced the discussion around this trading activity and the transaction costs involved.

6. Behavioral finance and financial engineering

As it is possible to observe, the most recent research studies about structured products started to include two important factors in order to better understand the actions of investors and issuers: behavioral finance and financial engineering. At this stage, it is possible to state that one phenomena is almost a consequence of the other, since nowadays, beyond hedging purposes, financial engineer try to exploit the knowledge of behavioral finance facts. This ability to predict the actions of the investors is the key to launch success financial products, which explains why so many authors spent so much time trying to find theories to model the actions of investors. In fact, an accurate investment behavior understanding can justify the success or not of a financial institution. Thus, and taking in to account these two phenomena, the development of this structured product market was a big step in order to highlight new aspects than can be considered an upgrade in the prediction and understanding of investment behavior. Therefore, due to this, it is extremely important to know the most recent theories and discovers of these fields, which justify the importance of the next topics.

6.1 Financial engineering

The understanding of how behavior finance is important in the complex process of financial engineering was essential in the development of new successful structured products.

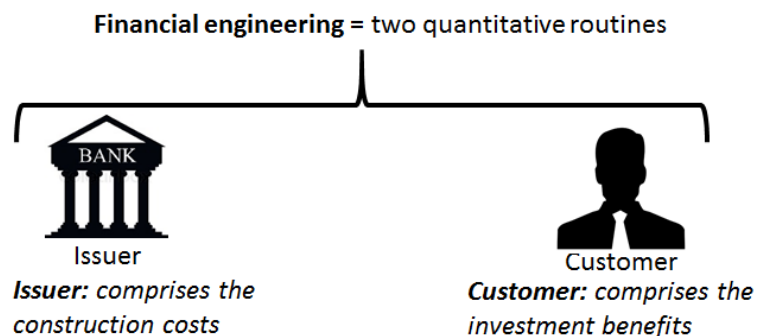


Figure 7 - Financial engineering process according to Breuer and Perst (2006)

There are many definitions of financial engineer process, however one of the simplest is presented by these authors which describe this process has the sum of two quantitative routines. The first one is the quantification of the costs by the issuer related with the creation of a pre-determined structured product, as the combination of a derivative and a traditional investment product. The second routine is related with the quantification of benefits provided by the new product to their target costumer. This conjunction of routines leads to a more formal definition of what was financial engineering, in fact: an analysis which uses several tools and knowledge from the field of economics, mathematics and computer science. Considering the analysis presented in the next topics of this research, one can state that financial engineer nowadays is much more than a quantitive method, due to the increasing importance behavioral finance in this field.

In order to better understand the relation of this engineer process with the behavioral one Szymanowska et al. (2009) developed an important study where the price of RC was evaluated considering “normal” or rational factors (like proximity of the maturity, for instance) and behavioral ones. These authors start by arguing the main idea of this chapter: financial engineering is vital for issuers and retailers of structured products and this process is nothing more than an answer to a shift in inverter’s demand toward more complex products. This answer can be even more effective if it can be easily understand by the investors. It is ironic but the truth is that, with this need of complexity, comes the need of simplicity. In other words, to win this market it is important to have simple answers to this complex demand.

Therefore, in their research, these authors found an overpricing around 6% when one is in presence of an RC product, which is not a surprise considering the previous studies. Their results revealed that this overpricing is just explained in 23% by rational factors. They released that just with rational factors, they were not able to capture all of effects of financial engineer in the price of this products. Thus, along with rational factors, they consider also behavioral ones, which allowed them to increase the power of explanation of the model to more than 35%. The analysis around what were the rational factors and behavior ones considered will be performed in 6.4.

6.2 Prospect theory and mental accounts

As mentioned before, one of the most recent topics of discussion about structured products is related with the introduction of irrational aspects in the investment behavior as justification of the chosen characteristics of these products. This topic has an increasing importance, not only in the specific field of structured products, but in all financial related decisions. The discussion around this topic has many years, however the most specialized research related with it started in the new century. As stated before, Szymanowska et al. (2004) research revealed that the overvaluation of RC products (around 30% and persistent for one-fourth of the lifetime of these products) is not fully related with rational factors by far. Instead they believe that this overpricing may be better explained if we take into account the effect of rational and behavioral factors. By rational factors, these authors considered effects like transaction costs, illiquid trade or absence of arbitrage opportunities, besides other related with model specification and estimation errors. In this research, the authors conduct a sensitivity analysis based on regression procedures where they found that this effects are less likely to be related with a magnitude of overpricing around 30% which was found in the analyzed products. Thus, they believe that exists other possible reasons to explain this overpricing, namely the irrational or behavioral ones.

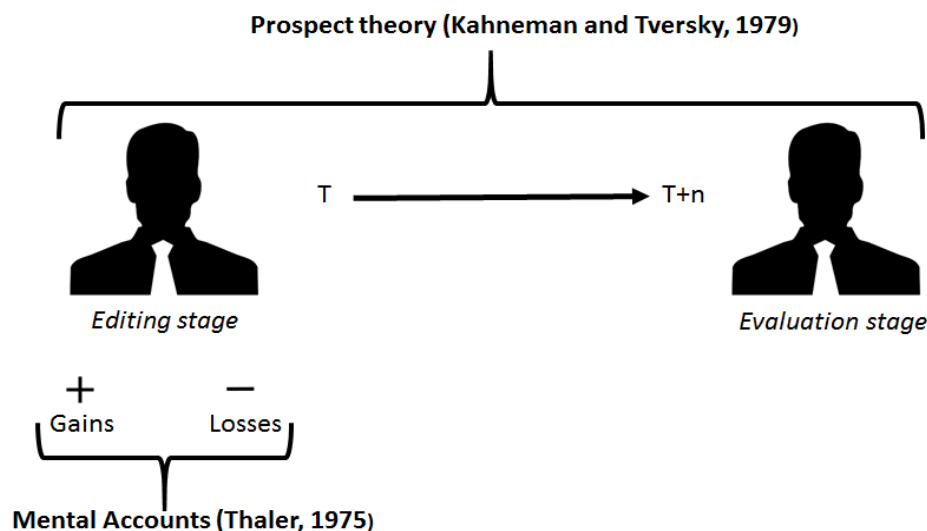


Figure 8 – Scheme of the relation between the prospect theory and the mental accounts

In this sense, the authors argued that the decision process may be related with frames on choices (framing effect), which is a component of the decision process developed by a prospect theory based investor (Kahneman and Tversky, 1979). Based on this theory, an investor evaluate their potential losses or potential gains in comparison with a reference point, in order to take its investment decisions. These authors defend that, with the addiction of this theory to rational factors, it is possible to model better the investment choices.

This theory can be divided in two stages of decision: the editing stage and the evaluation stage. The first stage of this prospect utility function may drive the investor to perform a preliminary analysis in which investment gains and losses are kept in separate psychological accounts, like stated in Thaler mental accounts (Thaler, 1985). This separation in two mental accounts ends up to facilitate the influence of the investment decision by several factors being the most important of them: the way the problem is presented, the reference points chosen to be the base of the decision or the emotions related with the investment moment. Therefore, the investment choice will be also conducted base on these behavioral effects which somehow are key elements that influence the success of one powerful market force: the marketing. These authors argued that the influence of each one of these factors is observable in their study, since, in sum, the presentation of logically similar problems had large differences on investor choices.

These authors state that influence of these factors is even more evident when the product presented in the investment problem is the special case of RC, which was the aim of their study. As mentioned before, these types of structured products have a “bond like appearance” which seems to attract more the investors than the discount inherent to DC products. Thus, in the case of RC, the investor keep in separate mental accounts the coupon payments (gains) and the redemption value (which may result in a loss, if the redemption of the product occurs below its pair value). Due to this separation and especially due to the form of presentation of these products, the investors tend to ignore this important loss perception, being influenced for the high yield offer presented, that has even more importance, in times of low interest rates. In fact, there are not any law that explicitly forbids the retailer to present RC as a higher-coupon bond, which they are not in fact, being thus possible to issuers and retailers to influence in a more effective way the investors’ decisions.

Due to this importance of behavioral factors, even then, these authors argued that the so used utility function was not enough to do an adequate modeling of investment decisions. In fact, this extremely used theory has been proving along the years, that it is not truly adequate to the process of decision making. Since the work of Allais (1953), there have been several researches proving that the real process of decision making is not totally explained by the rational axioms presented in the utility function theory. In sum, the real risk-premium is much more significant than expected utility function suggest⁴.

6.3 Full rational versus boundary investors

With the evolution of time, the analysis to proof that rational reasons are not enough to explain the purchase of these products increased significantly. Using RC and DC products, Breuer and Perst (2007) were able to prove this statement once again. Their research was based in the idea that there are two types of investor, the full rational one and the boundary rational one. In sum, the full rational one is an investor whose choices are driven just by rational factors. On the other hand, the boundary rational investor is someone whose investment decisions are driven not only by rational reasons, but also by behavioral ones. These authors conduct their analysis based on these two type of investors, for each of the two types of products. Briefly, they analyzed the positions of these investors when they have to

⁴ This effect is also known as “equity premium puzzle”.

choose between these structured products and the investment in a riskless asset or in direct stock holding position. Once again, to analyze the behavior of the investor they used the prospect utility function, instead of the normal expect utility function, with the addition of another important factor that may influence the investor decision: the “competence level”. This factor is extremely important in this behavior versus rational analysis and it was defined according to the attitude of different individuals in presence of ambiguity. Thus, it was possible to observe that RC and DC are products that satisfy the needs of an investor who moderately estimate the return of the underlying stock, but underestimate the corresponding volatility. This idea holds true for both types of investors, however it was possible to observe that the demand for DC seems to be significantly overestimated, if a full rational approach were used instead of a boundary rational one. This study revealed that behavior factors are more important to evaluate the possible purchase of RC and DC, rather than rational characteristics like the redemption values or the inherent volatility. In the special case of “competence level”, in fact, RC became more interesting when they are presented to investors with a lower level. This reason justifies the creation of these specific products directly related to these type of investors, which in turn highlights the importance of these characteristics of behavior finance in the investment decision process.

6.4 Representative bias and channel factors approach

As stated before, in their research, Szymanowska et al. (2009) concluded that together rational factors can only explain around 23% of the existing overpricing of RC products. Starting with the rational factors, these authors analyzed in more detail:

- Absence of arbitrage possibilities - these authors consider this as one of the most important topic, since at a first stage this factor can have a major impact in pricing these products. Since investors cannot short sell RC, it is not possible in their investment strategy to exploit the existent overpricing, which in turn lead to an impossibility of market price corrections by this force. However, despite perfect arbitrage opportunities are not possible, this should not be a barrier to other market forces to correct the price.
- The supply and demand level - this factor should be one of these correcting force, however these authors found a consistent overpricing during the entire sample period,

which cannot be explained by a temporary supply/demand imbalances and in turn, which cannot be offset by their respective correction. Therefore the, lack of balance between this two forces can be an explanation to this overpricing.

- Transaction costs - these authors found that this factor may affect the existing overpricing, since it is cheaper to buy one instrument (like a Reverse Convertible) than two instruments (a bond and an option).
- Taxes - at a first stage, transactions could be an explanation to this overpricing. In sum, the coupon payment of the bond in RC's was taken into account until 2001 as interest, which was taxed at the same tax rate of income from employment, for example. This is interest taxation has been replaced by wealth tax, like happened in Netherlands in 2001, the market under analysis by the research of Szymanowska et al. (2009). Since there were overpricing during the unfriendly period of taxation (before 2001), these authors consider that taxation cannot be an explanation to the registered overpricing.

As mentioned before, to achieve a better degree of explanation, they had to include in their analysis behavioral factors. These factors were based in the prospect theory investor, based on Thaler mental accounts and framing effect on choices, factors presented above. Along with the main ideas of these two effects, they consider another important behavior factor: the representativeness bias of these products (Tversky and Kahneman, 1981; Shefrin and Statman, 1993). In summary, this factor is responsible for investors' overweight recent information. As example, Shefrin and Statman (1993) mentioned the case of LYON's (Liquid Yield Option Notes) which were zero-coupon, convertible and callable bonds. The yield of these products were higher, even in times of high interest rates. However, with the decrease of the interests rates and since these products were callable, the issuers started use the call option feature of the bonds, which lead to a quick disappearance of the offer to this market, despite the increasing demand. The major part of the investors were not expecting that these products would be called, since they were not in the recent past. In other words, these representativeness bias effect lead them to underestimate the probability of redemption before maturity. Other example of this effect was presented by Clarke and Statman (1999) that found that writers of investment opinions are more optimistic after a bullish market (when stock prices increase) and pessimistic after a bearish market (when stock prices

decrease), which justify the presence of a representative bias situation once again. With these ideas in mind, these authors found in fact that the higher prices of these RC's occur when the price of the underlying was rising before the maturity. These findings reveal the importance of representative bias, since the investors were able to accept higher prices in these type of situations. They also found that the overpricing of these products is significantly related with the volatility (at the 1% level). In other words, these authors show that issues of these products when the risk is higher are more overpriced. This means that the issuers are able to get higher prices from their customers in potentially riskier situations, leading to the conclusion that investors underestimate a lot the true riskiness of RC's.

Thus, and as stated before, these authors were able to increase the power of explanation of these models from 23% to more than 35%, which in turn reveals the power of behavioral factors in pricing structured products like these.

To understand better the importance of these behavioral factors, Vanin and Dobeli (2010) conducted a questionnaire analysis. In their study, they were able to exploit the hypothetical or the pretended investment decisions of investors. The advantage of these researches was the possibility to compare these hypothetical choices against true investment decisions, since it was possible for the interviewed to be customers of a similar structured product. Besides this, they presented two factsheets to the interviewed, one simpler than the other. This analysis allowed us to understand how behavior influences the decision, since the products were the same and what changed, in fact, was the inherent context. Therefore, one of the most important objectives of their research was to understand better how the communication of these products, in other words, the marketing, affects the context of the investment decision. They believe that this context will end up by affecting the behavior of the customers and their investment decisions.

To perform the analysis in question, they identified three types of risks in the investment behavior of a customer: risk behavior, risk attitude and risk perception. According to previous studies, they believe that risk attitude is an invariable characteristic but the risk perception and risk behavior are not. In short, risk perception is context dependent and it is the main driver for the real risk behavior. This risk perception is responsible for the definition of the risk behavior, in a way that investors compare this context against its hypothetical decisions. Therefore, it is possible to conclude that it is in this context definition where the behavioral

factors influence more. Thus, these authors believe that an easily understood communication of the products, in other words, a good marketing, can be responsible for the definition of different contexts, and in turn, for the definition of different risk perceptions. Besides the above explained framing effect on choices, they based their analysis in one more theory: the channel factors approach. This theory simply states that things in general have to be put in simple terms in order to be effective. In fact, it is not difficult to find decisions in our lifetime where we had chosen simplicity, even knowing that we were paying more than other complex alternative. With this knowledge in mind, these authors start the experience with three basic changes in the factsheet of the structured products in question, being these the following: instead of a term sheet with technical details, it was presented to the costumers a resumed factsheet; the investment choice was expressed in laymen's terms instead of being expressed with any technical jargon or mathematical formula; it were omitted probabilistic statements. The complete and the simplified factsheet were presented to the interviewed. In the first stage, and based on these two factsheets, the investors stated their investment decisions. In the second stage, the two factsheets were introduced in the market and the interviewed were requested to invest. With that, they were able to get two important conclusions, which are the following:

- As expected, the participants of this questionnaire did not based their investment decision according with the expected utility function. Instead, on average, they based their decision in a consistent matter within the behavioral finance theories (namely framing effect on choices and channel factors approach);
- In the case of the channel factor approach, effectively the presentation of these structured products in a simplest way had an important impact on women and first time buyers. Based on the questionnaire and on field experiment set-up itself, for one hand, these authors concluded that the gender difference in investment decisions disappear when the product is presented in a comprehensive manner, which reveal an important increase in women's investment when they are requested to invest based one a simplest factsheet. On the other hand, it was possible to observe that the presentation of the simplest factsheet was responsible for an increase rounding a factor of 3.2 in the percentage of first time buyers;

- The most expected conclusion is related with the fact that investors do not behave according what they say that are going to do. As example, the pretended values of investment were 1.7 times higher than the real ones and the percentage of announced first time buyers was on average 27% of the interviewed, instead of 85%, considering the two factsheets.

6.5 The special case of SPARQS – RC products

All of these new behavior theories were extremely important to understand how investors act in reality, being thus possible to financial engineer to be more effective. Despite the examples provided before, to conclude this section it is important to have a clear example where these two mechanisms, namely behavioral finance and financial engineer were extremely important in the success of new products. The example chosen is provided by Henderson and Pearson (2011) which present the case of Stock Participation Accreting Redemption Quarterly-pay Securities (SPARQS). Despite the name, these products are nothing more than a specific type of RC products categorized in Chapter I. SPARQS are similar to RC products, since they pay interests to the holder and, at maturity, they can be changed for shares of the underlying company. The difference to standard RC is that instead of these products being “called” at a defined maturity or pre-defined set date, the issuer can call this product after a specified period of time. SPARQS can be described as medium-term notes issued by banks which have the respective payments linked to another company’s stock price, multiple stock price, a stock index or to multiple stock indexes. As the major part of structured products, these products are designed and issued by a bank. In this case, these products is issued by Morgan Stanley. What is important in this study is related with the fact that these authors concluded that the premiums of SPARQS are so high that the expected return to the investor can be smaller than the riskless rate. These products are nothing more than the most popular offered retail Structured Equity Products issued in United States, which raises one question: how is it possible that a product with so low expected return has so high levels of investment? To answer this question, these authors started by computing the theoretic model price for the issuer. They stated that almost retail financial products must include premiums over the estimated value of the model price, which is true in fact. Until then many authors computed

the theoretical model prices excluding these external transaction costs. Therefore, they added to the computed model price the following estimated costs:

- Marketing publicity;
- Hedging cost due to the liabilities incurrence with these products;
- Fees associated with the registration of the securities;
- Staff costs due to the design, creation and administration of SPARQS.

Thus, they concluded that these products must be sold at higher premiums over the computed model price. The current prices at market are high enough to cover all of this expenses plus the average commissions of the issuer in this products that are estimated by the authors to be around 1.7%. The interest finding is that this current prices are so large, and time to maturity or call short enough, that the estimated expected return on SPARQS to investors are smaller than the riskless rate. Additionally, these authors found that most reasonable estimates for the returns of the underlying stocks on SPARQS are actually negative.

To better understand how it is possible that people still invest in SPARQS, firstly Henderson and Pearson (2011) tried to find rational reasons to justify it. In fact, in a normal portfolio choice and considering expected returns less than the riskless rate, rational investors will only purchase this product if this returns have a positive covariance with the marginal utility of investors (Merton, 1982). However, this product is linked to stocks, which means that the expected returns of SPARQS products have a positive covariance with market indexes. For large part of the investors, this will mean that this products will have a positive covariance with their consumption and a negative one with their marginal utility, since most of them hold portfolios that have a positive covariance with the market. Besides this rational question, another important rational reason studied by these authors that could justify the investment in these products was the hedge purposes of the investors. Still, this is not a valid reason since the callable characteristic after a certain period of time of this product takes out the control of the investors' hedging strategies. One last rational reason analyzed was the taxation treatment of SPARQS, however, since this product does not have any benefit in taxation, once again it was not possible to justify the purchase of these products through rational reasons.

Therefore, these authors believe that there is not any rational reason behind the investment in these products whose expected return is less than the risk free rate. Instead, they believe that the justification to these investments falls on behavioral reasons, possible due to the financial engineer methods presented in the market. Thus, these authors believe that investors behave like the behavioral theories mentioned above, which allows issuers to influence their investment decisions in significant way, even with products like this one. In other words, these authors justify these investments with the fact that investors behave like the above mentioned prospect behavior theory, which in turn, allow issuers to take advantage, through financial engineer methods, from many behavior effects, like the above mentioned framing on choices, representative bias or channel factors approach theories. The fact that these products are designed and published in a simplest way (channel factors approach) and the fact that they are created based on the positive performance of recent stocks (representative bias) are just two examples where the issuers are able to affect the investors decisions through behavioral analysis, which justify behavioral reasons as the only explanation to these investments.

Chapter III – Pricing RC and DC

7. Methodology

The pricing evaluation of the Reverse Convertibles (RC) and Discount Certificates will be based in one simple equality:

$$Price\ Difference = Real\ Price - Model\ Price$$

Thus, if the *Price Difference* > 0 , one must be in presence of an overpriced structured product. By contrast, if the *Price Difference* < 0 , one must be in presence of an underpriced structured product. This *Price Difference* will be performed for the two categories of products (RC and DC), considering a set of underlying German companies. With the definition of these companies, it will be possible to define the respective most important issuers presented in the market. The Real Price value will be the total market price quoted at a certain date of these two products.

The Model Price will be computed using a duplication strategy. In other words, one must replicate the hedging strategy of the bank. Basically, for these two type of products the replicating strategy comprises a riskless investment (“coupon-bearing bond”) plus a short European-style put option position on the underlying, or instead, a long position in the underlying asset with a short call European-style option on the same underlying asset (Burth et al., 2001):

$$MP = Ke^{-r(T-t)} - P_t = S_t - c_t - \sum_{i=1}^I D_i e^{-r(t_i^D-t)},$$

where:

- *MP*: Model price;
- *K*: strike price;
- *r* : risk free interest rate;
- *T*: product maturity;
- *t*: current time;
- *P_t*: price of an European put style option at time *t*;
- *S_t*: underlying asset price at time *t*;

- D_i : i – th dividend payment on the underlying stock, $i = 1, 2, \dots, I$;
- t_i^D : payment date of the i – th dividend $t \leq t_i^D \leq T$;
- C_t : price of an European call style option at time t .

It will be assumed in the model that there are no tax considerations, that the risk free is continuously compounded and that the dividends are discrete. Note that this previous model is just the model price for DC, since it is not included the price of the coupon payments. Then, if one wants to consider the price of the RC, it is important to add the cost of the coupon payments. Thus, the model price becomes:

$$MP = Ke^{-r(T-t)} - P_t + \sum_{j=1}^J I_j e^{-r(t_j-t)} = S_t - c_t - \sum_{i=1}^I D_i e^{-r(t_i^D-t)} + \sum_{j=1}^J I_j e^{-r(t_j-t)}$$

Where:

- I_j : j – th coupon payment, $j = 1, 2, \dots, J$;
- t_j : payment date of the j – th interest coupon payment $t \leq t_j \leq T$.

To price the options, one will use the Constant Elasticity of Variance (CEV) model of Cox (1976). The basis of this model follows the assumption that the returns of the underlying stock price (S) follow a constant elasticity of variance diffusion process being:

$$dS = (r - q)S_t dt + \sigma(S_t)S_t dW, \text{ where:}$$

- q : the dividend yield considered for the underlying asset price;
- W : Brownian Motion;
- $\sigma(S_t)$: local volatility of S_t by the following equation: $\sigma(S, t) = \delta S_t^{(\beta/2)-1}$.

If $\beta = 2$, this model is equal to the Black and Scholes (1973) model, where in sum, the volatility is constant. It is of common sense, that this assumption is fair away from the truth, since the volatility is not constant over time, and over the different maturities and strike prices. Thus the dynamics of the stock price is not truly represented by a geometric Brownian motion process. Therefore, as alternative, one will use the square root diffusion model and the absolute diffusion model of Cox and Ross (1976), where $\beta = 1$ and $\beta = 0$, respectively. Note, that when $0 \leq \beta < 2$ the S and σ are inversely related, which is a theory in accordance with several authors, like Beckers (1980). Besides this two alternative models, it will also be

considered $\beta = -3$ and $\beta = -6$, due to the fact that, in their research, Jackwerth and Rubinstein (2001) found implicit β as low as -6 in their option prices analysis.

8. Data

8.1 The companies

The main objective of this analysis is to get a closer overview of the complex structured product German market, which implies the knowledge of the most important actors in the market.

The information about structured products was collected from Boerse Stuttgart web site. Boerse Stuttgart is the leader exchange for retail investors in Germany and it is also leader in exchange trading of securitized derivatives at the European level. This exchange allows the investors to use a product finder tool where the different products are clearly classified. Therefore, one used the Reverse Convertibles Finder and the Discount Certificates Finder tools to find the products in question. This finder tools are extremely important since they allow the investor to clearly identify the products, without misunderstandings, which is extremely important in the particular case of these complex products. To validate the classification quality of these finders, it was used a sample of ten products, which were analyzed in more detail, in order to ensure the quality of the respective classification. After the validation process described, one performed the selection of the companies and issuers.

This process of selection was performed in two stages. Firstly, the companies were selected. These companies' stocks are used by the issuers to construct they respective offer of RC and DC, thus this choice is extremely important. To perform this companies selection, it was used the indexes created by STOXX Limited., where the most important companies are presented. STOXX is a leading global supplier of innovative European indexes. One of their reference index is the EURO STOXX 50 INDEX, which is considered to be the leading reference index for blue-chip European companies. In their indexes creation, STOXX follow the Industry Classification Benchmark (ICB).



Figure 9 – Classification of companies by the Industry Classification Benchmark (ICB)

In figure 9, it is possible to observe that ICB divides the business classification in 10 principal industries. This division is extremely important in this research, since, in one side, it allows to mitigate the risk of similar industry environment when pricing these products and, in the other hand side, it allows to get an overview by industry of the several industries' prices. As expected, the objective was to identify in each industry, the German companies with greater influence and importance, since it is expected that for them, Boerse Stuttgart has better and more information about RC and DC products. It was possible to find German companies with representativeness in 8 of these 10 industries. All of these 8 companies also compose the above referenced EURO STOXX 50 INDEX, which even justifies more its choice. By type of industry, the chosen companies and respective key characteristics are the following:

- **Telecommunications:**

Name: Deutsche Telekom AG

Revenue: 73 billion euros (December 2016)

Number of employees: 218,341 employees worldwide (December 2016)

Activities: fixed-line, mobile communications, internet and computational services



Figure 10 – Deutsche Telekom’s logo

- **Health Care:**

Name: Fresenius Medical Care

Revenue: 15 billion euros (December 2016)

Number of employees: 112,163 employees worldwide (December 2016)

Activities: products and services related with dialysis, hospital and medical care at home



Figure 11 – Fresenius’s logo

- **Financials:**

Name: Allianz SE

Revenue: 122 billion euros (December 2016)

Number of employees: 140,253 employees worldwide (December 2016)

Activities: financial and insurance services



Figure 12 – Allianz’s logo

- **Consumer Goods:**

Name: Daimler AG

Revenue: 153 billion euros (December 2016)

Number of employees: 282,488 employees worldwide (December 2016)

Activities: manufacturing and distribution of automotive products



Figure 13 – Daimler’s logo

- **Industrials:**

Name: Siemens AG

Revenue: 79 billion euros (December 2016)

Number of employees: 351,000 employees worldwide (December 2016)

Activities: engineering products and services related with electricity, automation and digitalization



Figure 14 – Siemens’ logo

- **Technology:**

Name: SAP SE

Revenue: 22 billion euros (December 2016)

Number of employees: 355,000 employees worldwide (December 2016)

Activities: development and management of enterprises software



Figure 15 – SAP’s logo

- **Basic Materials:**

Name: Bayer AG

Revenue: 46 billion euros (December 2016)

Number of employees: 115,200 employees worldwide (December 2016)

Activities: production of healthcare and agricultural related products



Figure 16 – Bayer’s logo

- **Utilities:**

Name: E.ON SE

Revenue: 38 billion euros (December 2016)

Number of employees: 43,138 employees worldwide (December 2016)

Activities: generation of electricity and gas production



Figure 17 – E.ON’s logo

In relation to the other 2 categories, namely **Consumer/Services** and **Oil/Gas**, there are not any German company with representativeness in the market. For this reason, this two industries were excluded from the analysis.

8.2 The issuers

According with Boerse Stuttgart, there are 19 issuers with market relevance in trading RC and DC products. These 19 issuers are:

- BayernLB
- Commerzbank
- Deutsche Bank

- Erste Group Bank
- Helaba
- J.P Morgan
- Morgan Stanley
- Société Générale
- UniCredit
- BNP Paribas
- Crédite Agricole
- DZ Bank
- Goldman Sachs
- HSBC
- Landesbank BW
- Raiffeisen Centrobank
- UBS
- Vontobel
- Citi

The companies selection presented in “8.1 The companies” tries to define the most important companies in the market, since, as it was explained, it is expected that larger and famous companies have more RC and DC products issued in the market. As it will be possible to observe, this companies’ selection will affect the number of issuers considered.

8.3 The selection of the information

As explained before, firstly the companies were selected and then the possible issuers. However, it is not possible to considerer all the products issued by these companies, since there are several requirements that need to be met to ensure the coherence and quality of the analysis.

Therefore, the data analysis was performed at a random trade date, where it is considered that the market was not affected by any strong financial event that could have been a source of disturbance of the financial data available. Thus, the date considered was the second week of

August 2017 (from 07/08/2017 to 11/08/2017), when the information for the variables described in “7. Methodology” was collected.

To be considered in the data set, the structured product had to accomplish several conditions:

- The maturity of the structured product must be up to 2.5 years;
- The respective call must be available;
- The issuance conditions must be available;
- The dividend payments of the underlying stock must be known, or easy to predict.

It is of extreme importance to state that, however, still exist some aspects that make impossible the exact replication of the hedging strategy of the banks. These problems are related with the fact that:

- It is difficult to find strike prices and maturities of structured products, exactly equal to the strike and maturity of implicit options;
- The options traded for these type of products are normally American-style and to price the replicating strategy it is necessary European-style options;
- It is also difficult to find quotes for long-term options, especially for maturities over one year, due to the lack of liquidity in the retail market;
- This lower liquidity can result in unreliable estimates for the implied volatility. Thus, implied volatilities of the options can suffer from volatility smile (relation with the strike price) and volatility term structure (volatility relation with time to maturity). This implied volatility issue could also be affected by the first difficult mentioned above.

The best alternative to overpass the first issue is by minimizing its effect. The differences between the strikes and the maturities for the products selected are presented in order to clarify the process:

Type of product	Underlying	Average difference in maturity (in days)	Average difference in strike (in euros)	% to Spot
RC	Allianz	0	0.00	0.00%
	Bayer	0	0.00	0.00%
	Daimler	0	0.00	0.00%
	Deutsche Telekom	0	0.81	5.18%
	E.ON	0	0.05	0.53%
	Fresenius	0	0.04	0.06%
	SAP	0	0.00	0.00%
	Siemens	0	0.00	0.00%
DC	Allianz	2	0.00	0.00%
	Bayer	3	0.00	0.00%
	Daimler	2	0.07	0.11%
	Deutsche Telekom	3	0.55	3.54%
	E.ON	2	0.29	3.46%
	Fresenius	2	0.00	0.00%
	SAP	3	0.05	0.06%
	Siemens	3	0.04	0.03%

Table 1 - Average difference between strike and maturity for RC and DC

As observable in Table 1, and starting with the maturity, it is possible to state that the match between the products and respective options was quite good, being the differences low. In the case of the strike match, there are some differences namely in Deutsche Telekom RC and DC products and in E.ON DC products. Still, it is also possible to observe in the column “% to Spot” that these differences are not so high when considering it as percentage of the underlying spot price.

For the last three problems, the solution was the consideration of the call option replicating strategy (as defined in “7. Methodology”) instead of the put option strategy. Normally, long term call options are more liquid and their exercise prior to maturity is less often (Szymanowska et al., 2004).

The estimate for the implied volatilities was performed considering the Black Scholes model (1973), using the MATLAB function “blsimpv”. The implied volatilities estimates were

monitored against the estimates provided by the source of this information, in this case the Bloomberg terminal.

According to the previous sections, the remaining variables are observable in the market. In summary, the principal sources of information that were used are:

- Bloomberg portal: dividends, spot prices of the underlying companies and options;
- Boerse Stuttgart: information about structured products;

Note that in the case of the risk free rate it will be considered to be 0, for the sake of practicality. In fact, it is possible to use as reference several rates that are marginally negative or marginally positive. However, since these differences from 0 are so low, the consideration of this risk free rate marginally different from 0 will be more computer intensively and it will not bring any value added to the analysis.

Product type	Number of products	Average of Maturity (in years)	Maximum Maturity date (in years)	Average of Interest Rate
RC	833	1.48	2.01	6.02%
DC	620	1.60	2.41	

Table 2 - Principal descriptive figures of the data considered

With all these considerations and restrictions, one get the final data, where the quality and accessibility of the results is ensured. In table 2, it is possible to observe that the final data is composed with 833 RC products and 620 DC products.

Issuer	RC	DC
BNP Paribas	57	23
Citi		110
Commerzbank		144
Deutsche Bank	54	44
DZ Bank		94
Goldman Sachs	632	51
HSBC	16	53
Raiffeisen Centrobank		3

Société Générale		28
UBS	1	1
UniCredit	26	30
Vontobel	47	39
Total	833	620

Table 3 – Number of products by issuer

Furthermore, these considerations also restricted the list presented in “8.2 The issuers” to 12 relevant issuers. Some of them have a lower representativeness in the sample, namely Raiffeisen Centrobank and UBS, which means that the power of the analysis could be limited in these cases, as shown in table 3.

9. Results’ analysis

9.1 General results

In this last section, it will be presented the analysis of the results for the products considered. Before entering into detail, firstly, it will be presented a general overview of the results obtained.

Product type	Beta	Overpricing (average, in %)
<i>RC</i>	2 (BS Model)	2.73%
	1 (Square-root diffusion)	3.48%
	0 (Absolute diffusion)	4.02%
	-3	6.06%
	-6	7.36%
<i>DC</i>	2 (BS Model)	1.63%
	1 (Square-root diffusion)	2.12%
	0 (Absolute diffusion)	2.80%
	-3	5.32%
	-6	6.54%

Table 4 – General overpricing (in percentage) by product type

In table 4, one can state that, on average, RC products are more overpriced than DC products. On average, RC products are overpriced in 2.73% and DC products in 1.63%, when one consider the BS model, and 3.48% and 2.12%, respectively, when one consider the square-root diffusion model.

Authors	Market	RC	DC
Burth et al. (2001)	Swiss	3.22%	1.40%
Wilkens et al. (2003)	German	3.04%	4.20%
Szymanowska et al. (2004)	Dutch	28.75%	-
Stoimenov and Wilkens (2005)	German	2.11%	2.11%
Baule et al. (2008)	German	-	0.92%
Szymanowska et al. (2009)	Dutch	5.92%	-

Table 5 – Overpricing (in percentage) by product type, considering other studies

Despite the fact that the results from previous studies, presented in table 4, do not match in straight line with this empirical study, there are many similarities that allows the comparison of the results obtained with the ones presented in this table. As stated, one can observe that this research is in line with previous studies and there is not a clear change overtime. Considering only the studies related with the German market, one may say that overprice increased slightly. This slightly increase could be explained by the better economic conditions and by the increasing demand for these products, as explained before. When compared with DC products, RC products tend to have a higher overprice, evident not only on this research, which could be explained by the interest rate presented by these products. As explained before, investors tend to associate these products to bonds, which increases its demand. In order to better understand the dynamics of overprice in RC and DC products, it was conducted a regression analysis.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0,574
R Square	0,329
Adjusted R Square	0,323
Standard Error	3,657
Observations	833

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	7	5410,886	772,984	57,810	0,000
Residual	825	11031,227	13,371		
Total	832	16442,113			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	0,363	1,439	0,252	0,801	-2,461	3,187	-2,461	3,187
Interest Rate	-0,222	0,065	-3,436	0,001	-0,350	-0,095	-0,350	-0,095
Maturity year	1,142	0,759	1,503	0,133	-0,349	2,632	-0,349	2,632
Product Strike	0,190	0,012	15,696	0,000	0,167	0,214	0,167	0,214
Volatility	0,040	0,027	1,487	0,137	-0,013	0,093	-0,013	0,093
Spot	-0,166	0,010	-16,108	0,000	-0,186	-0,146	-0,186	-0,146
Dividend Yield	-0,495	0,399	-1,241	0,215	-1,278	0,288	-1,278	0,288
Revenue	0,000	0,000	2,555	0,011	0,000	0,000	0,000	0,000

Figure 18 - Regression analysis for RC products

In this first regression, the dependent variable is the RC overprice (considering BS model) and the independent variables are: interest rate, maturity (in years), strike, volatility of the underlying, spot of the underlying, dividend yield and the annual revenue (in million euros) of the companies considered. As observable, the R square of this model is around 32.9%, which is in level considering this type of analysis (see the regression analysis in Szymanowska et al., 2009). This means that the independent variables considered explains about 33% of the variation of overprice, the dependent variable. Also, the model is statistical significant since the F-value is lower than 0.05. Therefore, it is interesting to analyze the p-values of each independent variable, where it is possible to state that maturity, volatility and dividend yield are not statistically significant to model at a 95% confidence level (their p-value is higher than 0.05). On the other hand, and since their p-value is lower than 0.05, it is possible to state that the other four independent variables are statistically significant to the model at 95% confidence level. Therefore, their dynamics deserve to be analyzed in more detail:

- **Interest Rate** – coefficient of -0.22 - this means that an increase of 1 percentage point in the interest rate of the underlying product, is expected to affect negatively overprice

in 0.22 percentage point. In other words, with a 95% confidence level, it is expected that an increase in the interest rate of the RC product decreases overprice of this same product.

- **Strike** – coefficient of 0.19 - this means that an increase of 1 euro in the strike of the underlying product expects to affect positively overprice in 0.19 percentage point. In other words, with a 95% confidence level, it is expected that RC products with higher strikes are more overpriced.
- **Spot** - coefficient of -0.17 - this means that an increase of 1 euro in the spot price of the underlying company expects to affect negatively overprice in 0.17 percentage point. In other words, with a 95% confidence level, it is expected that RC products with higher spot prices are less overpriced.
- **Revenue** - coefficient of 0 (approximately) - this means that an increase of 1 million euro in the revenue of the underlying company expects to have no impact (or a very small impact) in overprice.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0,637
R Square	0,406
Adjusted R Square	0,400
Standard Error	2,121
Observations	620

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	6	1885,955	314,326	69,866	0,000
Residual	613	2757,866	4,499		
Total	619	4643,821			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	-4,204	0,665	-6,320	0,000	-5,510	-2,898	-5,510	-2,898
Maturity year	1,018	0,273	3,726	0,000	0,481	1,554	0,481	1,554
Product Strike	0,077	0,006	11,926	0,000	0,064	0,089	0,064	0,089
Volatility	0,275	0,017	16,165	0,000	0,241	0,308	0,241	0,308
Spot	-0,064	0,006	-10,863	0,000	-0,076	-0,052	-0,076	-0,052
Dividend Yield	-2,443	0,214	-11,439	0,000	-2,862	-2,023	-2,862	-2,023
Revenue	0,000	0,000	11,286	0,000	0,000	0,000	0,000	0,000

Figure 19 – Regression analysis for DC products

In the case of the DC products, all the variables are statistically significant to the model since the p-values of each independent variable are lower than 0.05. The R square of this model is

around 40.6%, slightly higher than in previous regression. The model is statistical significant since the F-value is lower than 0.05. It is possible to observe that the dynamics of the four variables (interest rate, strike, spot and revenue) detailed in the RC regression are the same when considering RC products. With DC products, there are three new dynamics that must be detailed:

- **Maturity** - coefficient of 1.02 - this means that an increase of 1 year in the maturity of the product expects to affect positively overprice in 1.02 percentage point. In other words, with a 95% confidence level, it is expected that DC products with higher maturity are more overpriced.
- **Volatility** - coefficient of 0.28 - this means that an increase of 1 percentage point in the volatility of the underlying company expects to affect positively overprice in 0.28 percentage point. In other words, with a 95% confidence level, it is expected that RC products with higher underlying volatilities are more overpriced.
- **Dividend Yield** - coefficient of -2.44 - this means that an increase of 1 percentage point in the dividend yield of the underlying company expects to affect negatively overprice in 2.44 percentage point. In other words, with a 95% confidence level, it is expected that RC products with higher underlying dividend yields are less overpriced.

9.2 Results by company

After a general view, it is important to get a closer observation of each company considered, in order to better access how overprice behaves from company to company.

Underlying	RC	DC	Total
Allianz	160	92	252
Bayer	130	45	175
Daimler	108	61	169
Deutsche Telekom	29	46	75
E.ON	278	239	517
Fresenius	12	31	43
SAP	57	49	106
Siemens	59	57	116
<i>Total</i>	833	620	1453

Table 6 – Number of products by company

Before entering in the detailed analysis, it is important to get knowledge about the quantity of products analyzed for each company, in order to better access the power of the results. As observable in table 6, the company with a relatively small number of products is Fresenius, especially in the case of RC products. This seems to be the only case to retain that limits the power of the analysis.

It is extremely important to be aware that the analysis considered next intends to be more logical, than numerical, since the numerical details was already analyzed in “9.1 General Results”, through the regression analysis considered.

With these considerations in mind, it is possible to get a closer overview of overprice for the companies considered.

- **Telecommunications:**


Dividend Yield:	3.30 %			
Spot:	15.05 €			
RC- Interest Rate (average):	7.80 %			
Maturity (average):	1.44 years			
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS model)	2.14%	11.70%	-1.01%
	1 (Square-root diffusion)	2.02%	11.57%	-1.09%
	0 (Absolute diffusion)	1.90%	11.44%	-1.17%
	-3	1.59%	11.10%	-1.38%
	-6	1.34%	10.80%	-1.55%
DC	2 (BSM model)	-0.77%	0.68%	-1.71%
	1 (Square-root diffusion)	-0.91%	0.53%	-1.80%
	0 (Absolute diffusion)	-1.03%	0.40%	-1.89%
	-3	-1.28%	5.03%	-2.34%
	-6	-1.45%	9.96%	-2.72%

Table 7 – Overprice by product for Deutsche Telekom

In table 7, it is possible to state that RC products of Deutsche Telekom are overpriced closer to the average of the sample considered (2.73 %, considering BS model). It is also possible

to observe that for this type of products the average of the interest rate considered is the highest in this sample, as it will be observable. In the case of DC products related with this company, one can observe that they are underpriced, which is a rare case in the sample, along with SAP's products. There are many reasons that could justify this underprice like:

- a temporary imbalance at the market for these products related with offer and demand dynamics;
- these products could be related with the hedging strategy of the issuer banks. Consequently, these issuers could lose here to win in other products;
- an expectation of the issuer to something related with this underlying company.

Despite the reasons, that could be many, it is also true that underprice of these products could be an interest investment.

- **Health Care:**


Dividend Yield:	0.80%			
Spot:	68.27			
RC- Interest Rate (average):	5.78%			
Maturity (average):	1.38			
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS model)	16.09%	35.01%	5.76%
	1 (Square-root diffusion)	15.92%	34.68%	5.78%
	0 (Absolute diffusion)	15.80%	34.46%	5.81%
	-3	15.69%	34.20%	6.07%
	-6	15.80%	34.18%	6.49%
DC	2 (BSM model)	8.59%	14.84%	4.07%
	1 (Square-root diffusion)	8.54%	14.36%	4.48%
	0 (Absolute diffusion)	8.55%	14.04%	4.93%
	-3	8.94%	13.83%	6.23%
	-6	9.50%	13.82%	5.14%

Table 8 – Overprice by product for Fresenius

In the case of Fresenius, the analysis is limited due to the representativeness of this company in the sample, being analyzed just 12 products for RC and 31 for DC (table 6). It is possible

to observe that from all of the underlying companies considered, Fresenius is the one where RC and DC products are more overpriced. Despite of the huge dimension, it is a fact that the Business to Business approach of this company makes it almost unknown for the normal particular investor, especially in a not very well known sector. This reason could justify the reduced demand that in turn could result in a reduced offer, which justifies the small number of products in the sample. This short offer could also translate that the major part of these products could be made by order of the customer, which leaves the bank in a favorable position to charge a higher margin.

- **Financials:**


Dividend Yield:	4.50%			
Spot:	185.58			
Interest Rate for RC (Average):	5.72%			
Maturity (average):	1.47			
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS model)	2.94%	12.72%	-0.66%
	1 (Square-root diffusion)	3.41%	12.83%	0.17%
	0 (Absolute diffusion)	3.97%	12.97%	1.14%
	-3	6.20%	17.49%	1.94%
	-6	8.08%	19.26%	2.56%
DC	2 (BSM model)	3.14%	6.37%	1.29%
	1 (Square-root diffusion)	3.96%	10.28%	1.14%
	0 (Absolute diffusion)	5.03%	16.49%	1.01%
	-3	8.86%	30.84%	0.65%
	-6	10.82%	32.05%	0.36%

Table 9 – Overprice by product for Allianz

The products related with Allianz, presented in table 9, denotes overprice relatively higher considering the sample analyzed, especially for DC products. In the category of DC, these products are the ones in the sample which are more overpriced. One reason for this could be the global reach of this brand in this same market, the financial one, which makes this company very well known by the investors. This knowledge of the investor could justify an

increase in demand and consequently, in offer (this company's products are the second in greater number), realizing margin to issuers overprice these products.

- **Consumer Goods:**


Dividend Yield:	4.94%				
Spot:	60.29				
Interest Rate for RC (Average):	5.70%				
Maturity (average):	1.47				
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)	
RC	2 (BS model)	5.64%	15.63%	0.00%	
	1 (Square-root diffusion)	5.60%	15.39%	0.73%	
	0 (Absolute diffusion)	5.59%	15.16%	1.47%	
	-3	5.72%	14.57%	1.43%	
	-6	5.93%	15.03%	0.99%	
DC	2 (BSM model)	2.74%	7.38%	-1.67%	
	1 (Square-root diffusion)	3.03%	9.83%	-0.83%	
	0 (Absolute diffusion)	3.41%	13.35%	0.26%	
	-3	5.16%	24.20%	0.29%	
	-6	6.49%	26.70%	-0.16%	

Table 10 – Overprice by product for Daimler

In the case of Daimler products, overprice could also be explained almost with the same reasons presented for Allianz. In fact, this company is even more known by the investor, who could drive one of their cars in a daily basis. Thus, for this company, RC and DC products overprice is considerable above the sample average. Excluding Fresenius, and with the advantage that this company has more products considered (total of 169), this underlying company is also the one that does not present underprice for all of the RC considered in the sample, being the minimum overprice close to 0% (considering BS model).

- **Industrials:**

Dividend Yield:	2.95%
Spot:	112.89
Interest Rate for RC (Average):	5.78%
Maturity (average):	1.42



Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS model)	3.44%	23.22%	-0.29%
	1 (Square-root diffusion)	3.43%	22.89%	0.02%
	0 (Absolute diffusion)	3.46%	22.60%	0.35%
	-3	3.69%	21.94%	0.58%
	-6	4.12%	21.54%	0.37%
	DC	2 (BSM model)	0.91%	3.20%
	1 (Square-root diffusion)	1.08%	3.33%	0.05%
	0 (Absolute diffusion)	1.34%	5.33%	-0.18%
	-3	2.57%	16.25%	-0.73%
	-6	3.42%	19.78%	-1.14%

Table 11 – Overprice by product for Siemens

The products related with Siemens present a considerable higher overprice for RC products and a relatively lower overprice for DC, considering the sample average. This company records the maximum overprice for RC products in all of the sample (23.22%, considering BS model). It is also an evidence that if an investor wants to buy products with this underlying company considered, DC products seem to be a better investment decision.

- **Technology:**

Dividend Yield:	1.26%
Spot:	90.35
Interest Rate for RC (Average):	5.28%
Maturity (average):	1.39




Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS model)	0.52%	18.13%	-2.67%
	1 (Square-root diffusion)	0.64%	17.87%	-2.37%
	0 (Absolute diffusion)	0.77%	17.64%	-2.01%
	-3	1.37%	17.09%	-0.49%
	-6	2.28%	16.73%	0.29%
DC	2 (BSM model)	-0.33%	2.05%	-1.70%
	1 (Square-root diffusion)	-0.24%	2.36%	-1.38%
	0 (Absolute diffusion)	-0.13%	4.17%	-0.99%
	-3	0.42%	11.61%	-1.06%
	-6	1.17%	15.21%	-1.53%

Table 12 – Overprice by product for SAP

In table 12, it is possible to observe that SAP's products are the ones with lowest average overprice considering the RC products. In the case of DC products, along with Deutsche Telekom, they are the ones underpriced. The reasons for this phenomena could be the same presented for Deutsche Telekom, which also makes these products a potential investment that deserves to be analyzed in more detail.

- **Basic Materials:**

Dividend Yield:	2.39%			
Spot:	120.97			
Interest Rate for RC (Average):	6.14%			
Maturity (average):	1.56			
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS Model)	2.55%	17.69%	-1.12%
	1 (Square-root diffusion)	3.15%	17.29%	0.38%
	0 (Absolute diffusion)	3.88%	16.92%	1.11%
	-3	6.62%	20.30%	2.27%
	-6	8.30%	20.39%	2.70%
DC	2 (BSM Model)	2.79%	5.10%	1.55%
	1 (Square-root diffusion)	3.65%	8.45%	1.19%
	0 (Absolute diffusion)	4.86%	15.12%	0.86%

-3	8.35%	28.46%	0.00%
-6	9.43%	28.58%	-0.73%

Table 13 – Overprice by product for Bayer

In the case of Bayer’s products, this is an underlying company whose products are relatively closely related with the average of the sample. The brand strength and recognition may be the responsible for this potential market equilibrium.

• **Utilities:**


Dividend Yield:	3.10%			
Spot:	8.51			
Interest Rate for RC (Average):	6.27%			
Maturity (average):	1.48			
Product type	Beta	Overprice (average, in %)	Overprice (maximum, in %)	Overprice (minimum, in %)
RC	2 (BS Model)	1.35%	22.72%	-5.08%
	1 (Square-root diffusion)	2.22%	22.17%	-3.23%
	0 (Absolute diffusion)	3.39%	21.67%	-2.38%
	-3	7.50%	20.44%	-0.44%
	-6	9.06%	19.56%	-0.67%
DC	2 (BS Model)	0.68%	6.97%	-4.79%
	1 (Square-root diffusion)	1.38%	8.67%	-3.34%
	0 (Absolute diffusion)	2.34%	10.77%	-2.87%
	-3	5.88%	19.22%	-4.19%
	-6	7.36%	22.06%	-5.19%

Table 14 – Overprice by product for E.ON

The last company analyzed is E.ON, which is the company with more products, considering all the sample. This may result due to the fact that this company is related with the generation of power, especially through renewable-sources, a sector that have been attracting a lot of investors due to its potentiality. This is an underlying company that presents overprice relatively lower considering the average of the market. It is also the underlying company that presents the higher gap between maximum and minimum price. This gap could be a warning

to investors to analyze carefully their investment decisions when this company is the underlying, since they may have a better alternative.

9.3 Results by issuer

After a closer overview through the underlying companies' perspective, it is also important to get an issuer perspective for these products.

Issuer	Number of products	Maturity (average, in years)	Interest Rate (average, in %)
BNP Paribas	57	1.41	6.97%
Deutsche Bank	54	1.40	5.00%
Goldman Sachs	632	1.50	5.98%
HSBC	16	1.41	4.03%
UBS	1	1.38	3.60%
UniCredit	26	1.40	8.27%
Vontobel	47	1.41	5.99%

Table 15 – Basic information about RC products issues

Starting with RC products, in table 15 it is possible to observe that from the 833 products considered 632 are issued by Goldman Sachs. This is an extremely higher quote considering this sample, which could evidence some dominance of this issuer in the market. Also, on average, this issuer is the one whose products present a higher maturity. The remaining issuers, on average, present a closer offer in terms of maturity. In relation to interest rate offered in RC products, it is also important to state that UniCredit and BNP Paribas are the issuers that offer higher interest rate in their RC products considered. Finally, it is important to retain that, due to the short number of issues considered for HSBC and UBS, the analysis of overprice in these two cases is limited.

Beta	Issuer	Overprice (average)	Overprice (maximum)	Overprice (minimum)
2 (BS model)	BNP Paribas	1.66%	13.41%	-2,81%
	Deutsche Bank	0.76%	5.89%	-2,31%
	Goldman Sachs	2.49%	15.63%	-5,08%
	HSBC	2.29%	9.69%	-1,47%
	UBS	1.99%	1.99%	1,99%
	UniCredit	2.57%	19.90%	-1,32%
	Vontobel	9.70%	35.01%	-0,74%
Total		2.73%		

Table 16 – Overpricing of RC products, by issuer, when beta equals 2

In table 16, it is presented overprice analysis, by issuer, considering the BS model, being overprice for other values of beta presented in Appendix A. As observable, Vontobel is the issuer with highest overprice which may be a reflection of personalized offers. Excluding UniCredit, which has a very low representativeness in the sample, Goldman Sachs is the second issuer with higher overprice. This seems to be a reflection of their higher offer level that allows this issuer to dominate this market. On the other hand, Deutsche Bank is the issuer that presents lower overprice in this type of products.

Issuer	Number of products	Maturity (average, in years)
BNP Paribas	23	1.41
Citi	110	1.62
Commerzbank	144	1.73
Deutsche Bank	44	1.40
DZ Bank	94	1.69
Goldman Sachs	51	1.60
HSBC	53	1.72
Raiffeisen Centrobank	3	1.40
Société Générale	28	1.41
UBS	1	1.40
UniCredit	30	1.40
Vontobel	39	1.40

Table 17 - Basic information about DC products issues

In the case of DC products, one can state that the offer is more widely spread than in RC products. In table 17, it is possible to observe that Commerzbank, Citi and DZ bank are the issuers with more representativeness in the sample considered. It is also possible to state that

there approximately two groups of issuers considering the maturity in years, being in the group of relatively higher maturities Goldman Sachs, Citi, DZ Bank, HSBC and Commerzbank. Finally, once again, it is important to retain the limit power of analysis for UBS and Raiffeisen Centrobank due to the short number of products.

Beta	Issuer	Overprice (average)	Overprice (maximum)	Overprice (minimum)
2 (BSM model)	BNP Paribas	1.30%	5.25%	-0.79%
	Citi	1.93%	14.84%	-2.97%
	Commerzbank	1.22%	11.40%	-3.79%
	Deutsche Bank	1.73%	11.37%	-1.53%
	DZ Bank	1.77%	12.52%	-3.12%
	Goldman Sachs	1.48%	7.38%	-4.79%
	HSBC	2.27%	10.83%	-2.15%
	Raiffeisen Centrobank	0.90%	1.30%	0.53%
	Société Générale	1.33%	5.07%	-1.71%
	UBS	-1.51%	-1.51%	-1.51%
	UniCredit	1.41%	12.57%	-1.46%
	Vontobel	1.86%	12.59%	-1.70%
	Total		1.63%	

Table 18 – Overpricing of DC products, by issuer, when beta equals 2

As performed for RC products, in table 18 it is considered the overprice analysis when beta is equal to 2, being the results for other values of beta presented in Appendix B. As observable, in this sample, HSBC is the issuer with higher overprice, being also one of the issuers whose products present higher maturity. This issuer is closely followed by one of leaders in this product offers, DZ Bank. Once again, Vontobel presents a higher overprice which may reflect their personalized offers. Finally, the issuer with more products considered in the sample, Commerzbank, is the one with lowest overprice, excluding Raiffeisen Centrobank and UBS, where the analysis power is limited.

9.4 Comparison considering BSM Model

The intention of this last section is to perform a quickly cross-sectional analysis, by issuer and company, considering overprice obtained when beta is equal to 2, that is under Black

Scholes model. Here it is important to state that this detailed analysis is performed considering the sample in this research, which includes all advantages and disadvantages of it, intensified when the degree of detail is so high like this.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	5	0.51%	1.25%	-0.15%	1.40	8.50%
	Deutsche Bank	4	-0.46%	0.94%	-1.01%	1.40	5.65%
	Goldman Sachs	11	3.82%	11.70%	0.28%	1.49	8.00%
	HSBC	2	6.87%	8.33%	5.41%	1.40	3.95%
	UniCredit	4	0.80%	3.07%	-0.63%	1.40	10.18%
	Vontobel	3	0.83%	1.33%	0.30%	1.40	8.17%
RC Total		29	2.14%	11.70%	-1.01%	1.44	7.80%
DC	BNP Paribas	1	-0.79%	-0.79%	-0.79%	1.40	
	Citi	12	-0.42%	0.68%	-1.55%	1.71	
	Commerzbank	8	-0.83%	0.33%	-1.47%	1.84	
	Deutsche Bank	4	-1.25%	-1.13%	-1.41%	1.40	
	DZ Bank	8	-0.61%	0.36%	-1.19%	1.78	
	Goldman Sachs	3	-0.74%	-0.52%	-0.93%	1.40	
	HSBC	1	-1.26%	-1.26%	-1.26%	1.40	
	Société Générale	4	-0.88%	-0.02%	-1.71%	1.40	
	UBS	1	-1.51%	-1.51%	-1.51%	1.40	
	UniCredit	2	-1.33%	-1.19%	-1.46%	1.40	
	Vontobel	2	-1.05%	-0.96%	-1.15%	1.40	
DC Total		46	-0.77%	0.68%	-1.71%	1.62	

Table 19 – Overpricing of Deutsche Telekom’s products by issuer, considering BSM

Starting with Deutsche Telekom, in the case of RC, Deutsche Bank is potentially a good choice for someone who wants to invest in this type of underlying. If the interest rate is something that matters to the investor, UniCredit could also be a good choice. In the case of DC, considering the issuers product offers higher than 3 products, Deutsche Bank is once again a good alternative. For larger maturity preferences, Commerzbank seems to be a good choice.

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Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	2	9.89%	13.41%	6.37%	1.38	6.50%
	Deutsche Bank	3	5.82%	5.89%	5.76%	1.38	4.20%
	UniCredit	3	13.07%	19.90%	5.99%	1.38	7.77%
	Vontobel	4	29.16%	35.01%	23.88%	1.38	5.13%
RC Total		12	16.09%	35.01%	5.76%	1.38	5.78%
DC	Citi	5	11.67%	14.84%	4.07%	1.55	
	Commerzbank	7	6.89%	11.40%	4.41%	1.81	
	Deutsche Bank	3	7.32%	11.37%	4.24%	1.38	
	DZ Bank	7	9.40%	12.52%	4.26%	1.53	
	HSBC	3	7.01%	10.83%	4.08%	1.38	
	Société Générale	1	4.24%	4.24%	4.24%	1.38	
	UniCredit	1	12.57%	12.57%	12.57%	1.38	
	Vontobel	4	8.52%	12.59%	4.09%	1.38	
DC Total		31	8.59%	14.84%	4.07%	1.54	

Table 20 – Overpricing of Fresenius’s products by issuer, considering BSM

Considering Fresenius as underlying, in the case of RC, once again, Deutsche Bank seems to be a good choice as UniCredit, if the interest rate is something that matters to the investor. In DC products, considering the issuers with product offers higher than 2, HSBC is a good alternative and for larger maturity preferences, Commerzbank seems to be a good choice.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	10	1.63%	4.90%	-0.15%	1.39	6.70%
	Deutsche Bank	9	1.18%	2.93%	-0.34%	1.38	5.41%
	Goldman Sachs	130	3.24%	12.72%	-0.66%	1.49	5.64%
	HSBC	1	0.80%	0.80%	0.80%	1.39	3.50%
	UBS	1	1.99%	1.99%	1.99%	1.38	3.60%
	UniCredit	3	2.17%	4.41%	0.73%	1.39	7.67%
	Vontobel	6	1.95%	3.63%	1.20%	1.38	6.14%
	RC Total		160	2.94%	12.72%	-0.66%	1.47

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DC	BNP Paribas	6	2.07%	2.48%	1.81%	1.39
	Citi	14	3.64%	6.37%	1.54%	1.57
	Commerzbank	16	3.69%	5.37%	1.82%	1.86
	Deutsche Bank	5	2.10%	2.42%	1.93%	1.38
	DZ Bank	16	3.13%	4.81%	1.29%	1.76
	Goldman					
	Sachs	6	3.90%	5.66%	2.29%	1.64
	HSBC	15	3.48%	6.00%	1.44%	1.86
	Société Générale	6	2.54%	3.02%	1.81%	1.39
	UniCredit	3	2.14%	3.17%	1.61%	1.39
	Vontobel	5	1.69%	1.83%	1.57%	1.39
	DC Total		92	3.14%	6.37%	1.29%

Table 21 – Overpricing of Allianz’s products by issuer, considering BSM

In the case of RC, with Allianz as underlying and considering product offers higher than 3 products, Deutsche Bank is for the third time a potentially good choice. If the interest rate is something that matters to the investor, BNP Paribas could also be a good choice. For DC products with shorter maturities, Vontobel is the best alternative, and for larger maturity preferences, DZ Bank.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	4	2.80%	3.24%	1.63%	1.39	7.63%
	Deutsche Bank	6	2.28%	2.82%	1.70%	1.39	4.83%
	Goldman Sachs	90	6.33%	15.63%	0.24%	1.48	5.76%
	HSBC	2	0.71%	1.42%	0.00%	1.39	3.45%
	UniCredit	2	2.32%	3.18%	1.46%	1.39	7.15%
	Vontobel	4	2.07%	2.14%	1.87%	1.38	4.31%
	RC Total		108	5.64%	15.63%	0.00%	1.47
DC	BNP Paribas	1	1.48%	1.48%	1.48%	1.39	
	Citi	9	3.34%	7.11%	-1.64%	1.59	
	Commerzbank	15	2.54%	7.13%	-1.67%	1.63	
	Deutsche Bank	3	1.63%	1.78%	1.44%	1.39	
	DZ Bank	9	2.66%	5.58%	-1.67%	1.67	
	Goldman Sachs	8	3.56%	7.38%	-1.07%	1.64	
	HSBC	10	3.50%	5.52%	0.69%	1.84	
	Société Générale	2	0.27%	2.19%	-1.66%	1.39	
	UniCredit	1	1.22%	1.22%	1.22%	1.39	
	Vontobel	3	1.16%	1.34%	0.90%	1.39	

DC Total	61	2.74%	7.38%	-1.67%	1.63
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Table 22 – Overpricing of Daimler’s products by issuer, considering BSM

With Daimler as underlying company and considering product offers higher than 3 for RC products, Vontobel issues appears to be a good choice for the investor. If the interest rate is something that matters to the investor, BNP Paribas seems to be a good choice again. For DC products and considering offers above 7 products, Commerzbank issues seems to be the best offer for the investor.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	9	3.65%	11.26%	0.50%	1.40	6.56%
	Deutsche Bank	7	1.13%	2.42%	0.03%	1.40	4.60%
	Goldman Sachs	31	1.25%	7.65%	-0.29%	1.44	5.71%
	HSBC	1	-0.10%	-0.10%	-0.10%	1.40	2.00%
	UniCredit	2	2.61%	4.12%	1.10%	1.40	8.90%
	Vontobel	9	13.12%	23.22%	1.91%	1.40	5.92%
	RC Total		59	3.44%	23.22%	-0.29%	1.42
DC	BNP Paribas	3	0.63%	0.73%	0.57%	1.40	
	Citi	12	1.56%	3.20%	0.24%	1.62	
	Commerzbank	16	0.66%	1.48%	0.21%	1.62	
	Deutsche Bank	2	0.12%	0.19%	0.05%	1.40	
	DZ Bank	9	1.05%	1.48%	0.37%	1.91	
	HSBC	6	0.45%	0.93%	0.08%	1.74	
	Société Générale	3	1.03%	1.68%	-0.05%	1.40	
	UniCredit	3	1.39%	1.92%	0.42%	1.40	
	Vontobel	3	0.38%	0.45%	0.23%	1.40	
	DC Total		57	0.91%	3.20%	-0.05%	1.63

Table 23 – Overpricing of Siemens’ products by issuer, considering BSM

Considering Siemens as underlying, in the case of RC with offers above 7 products, Deutsche Bank seems to be the best choice as BNP Paribas, if the interest rate is something important to the investor. In DC products, considering the issuers with product offers higher than 5, HSBC is a good alternative.

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Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)	
RC	BNP Paribas	6	-0.57%	1.42%	-2.29%	1.39	5.58%	
	Deutsche Bank	6	-1.20%	-0.05%	-1.76%	1.39	4.33%	
	Goldman Sachs	36	-1.05%	3.79%	-2.67%	1.39	5.25%	
	HSBC	1	4.56%	4.56%	4.56%	1.39	4.10%	
	UniCredit	2	0.76%	1.62%	-0.10%	1.39	7.15%	
	Vontobel	6	11.97%	18.13%	2.71%	1.39	5.67%	
	RC Total		57	0.52%	18.13%	-2.67%	1.39	5.28%
DC	BNP Paribas	1	-0.69%	-0.69%	-0.69%	1.39		
	Citi	7	0.46%	2.05%	-1.37%	1.50		
	Commerzbank	12	-0.46%	1.20%	-1.47%	1.64		
	Deutsche Bank	4	-0.64%	0.18%	-1.53%	1.39		
	DZ Bank	6	-0.60%	-0.04%	-1.63%	1.48		
	Goldman Sachs	4	-0.27%	0.43%	-1.03%	1.39		
	HSBC	4	-0.81%	-0.21%	-1.42%	1.38		
	Société Générale	3	-0.42%	0.11%	-1.25%	1.39		
	UniCredit	3	0.53%	1.42%	-0.01%	1.39		
	Vontobel	5	-0.59%	0.07%	-1.70%	1.39		
	DC Total		49	-0.33%	2.05%	-1.70%	1.48	

Table 24 – Overpricing of SAP’s products by issuer, considering BSM

For SAP products, in the case of RC with offers higher than 5 products, for the first time, Goldman Sachs seems to be a good choice, even if one consider important the interest rate offered. For DC products with shorter maturities, HSBC is the best alternative, and for larger maturity preferences, Commerzbank.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	5	3.40%	8.35%	0.18%	1.51	6.00%
	Deutsche Bank	4	1.03%	1.88%	0.10%	1.50	6.28%
	Goldman Sachs	114	2.18%	9.96%	-1.12%	1.56	6.21%
	HSBC	1	0.81%	0.81%	0.81%	1.51	3.90%
	Vontobel	6	10.35%	17.69%	1.39%	1.51	5.26%
	RC Total		130	2.55%	17.69%	-1.12%	1.56
DC	BNP Paribas	2	2.22%	2.48%	1.96%	1.51	
	Citi	12	3.16%	5.10%	1.55%	1.73	
	Commerzbank	6	3.02%	3.77%	1.98%	1.67	

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Deutsche Bank	3	2.61%	3.19%	2.20%	1.50
DZ Bank	8	2.42%	3.13%	1.56%	1.69
Goldman					
Sachs	4	3.21%	4.05%	2.33%	1.50
HSBC	4	2.34%	2.85%	1.83%	1.63
Société					
Générale	3	3.40%	3.67%	3.07%	1.51
Vontobel	3	1.87%	2.06%	1.73%	1.51
DC Total	45	2.79%	5.10%	1.55%	1.63

Table 25 – Overpricing of Bayer’s products by issuer, considering BSM

In the case of RC products, with Bayer as underlying and considering product offers higher than 3 products, Deutsche Bank is an interest choice, in relation to overprice and interest rate offered. In the case of DC products, with offers higher than 2, HSBC and Vontobel present potentially a good investment.

Product type	Issuer	Number of products	Overprice (average, in %)	Overprice (max, in %)	Overprice (min., in %)	Maturity (average, in years)	Interest Rate (average, in %)
RC	BNP Paribas	16	-0.12%	3.97%	-2.81%	1.40	7.63%
	Deutsche Bank	15	-0.25%	3.04%	-2.31%	1.40	4.91%
	Goldman						
	Sachs	220	1.33%	11.55%	-5.08%	1.51	6.21%
	HSBC	8	1.93%	9.69%	-1.47%	1.40	4.51%
	UniCredit	10	0.66%	3.48%	-1.32%	1.40	8.17%
	Vontobel	9	7.20%	22.72%	-0.74%	1.40	7.06%
RC Total		278	1.35%	22.72%	-5.08%	1.48	6.27%
DC	BNP Paribas	9	1.24%	5.25%	-0.60%	1.40	
	Citi	39	0.45%	6.27%	-2.97%	1.60	
	Commerzbank	64	0.23%	5.86%	-3.79%	1.74	
	Deutsche Bank	20	1.93%	5.68%	-0.07%	1.40	
	DZ Bank	31	0.21%	5.95%	-3.12%	1.65	
	Goldman						
	Sachs	26	0.54%	6.97%	-4.79%	1.65	
	HSBC	10	0.43%	4.17%	-2.15%	1.70	
	Raiffeisen						
	Centrobank	3	0.90%	1.30%	0.53%	1.40	
	Société						
	Générale	6	1.44%	5.07%	-0.60%	1.40	
	UniCredit	17	1.13%	2.19%	0.15%	1.40	
	Vontobel	14	1.79%	5.87%	0.07%	1.40	
DC Total		239	0.68%	6.97%	-4.79%	1.60	

Table 26 - Overpricing of E.ON’s products by issuer, considering BSM

Finally, for the case of E.ON, starting for RC, Deutsche Bank is potentially a good alternative. If for the investor the interest rate matters, UniCredit issues could also be considered. In the case of RC, and consider offers higher than 3 products, for larger maturities it is recommended Commerzbank and for shorter maturities UniCredit.

Conclusion

The “new world” of structured products has been developing during the recent years and nowadays this reality has an extreme importance in the financial life of an investor (Stoimenov and Wilkens, 2005). Composed by a theoretical and a practical analysis, this research intended to clarify this complex world.

Considering the theoretical analysis, it was possible to find a clear definition for a structured product (Breuer and Perst, 2007) and to define the existing types of them. One of these definitions is proposed by Stoimenov and Wilkens (2005) and further developed by Grünbichler and Wohlwend (2005), where it is possible to identify two of the most famous structured products: Reverse Convertibles and Discount Certificates. These two products are interesting in the point of view of investor, since they allow to satisfy the increasing complex investors’ needs and they provide access to new markets in a cheapest way. However, due to the lack of information presented in this market, these products are also extremely interesting for issuers, since they allow these entities to charge an upfront hidden fee, in a market where restrictions and law are mostly a project. The behavior finance and financial engineering also play a role in favor of the issuers, as it is possible to note with the bond (for RC) and discount (for DC) features, for example.

This type of research required a practical analysis of the market, which was directed to RC and DC German market, one of the most developed structured product market in the world. In this market, it were analyzed 8 underlying companies and 12 respective issuers. Considering the appropriate restrictions, it were priced 1453 products (833 RC and 620 DC), considering the Constant Elasticity Variance model, with several values for beta, ranging from 2 (Black Scholes model) to -6.

In a general overview, the results revealed an average overprice of 2.73% for RC and 1.63% for DC, when beta is equal to 2. It was also possible to state that this overprice increased as beta decreased to -6. In order to explain this general overprice, through regression analysis, several dynamics were studied that could have influence in this market behavior. In a detailed view, by company, the analysis revealed interesting results, being example of this the higher interest rate in Deutsche Telekom’s RC products or the high level of offer for E.ON’s products with relatively lower overprices, considering the sample. By issuer, in the case of

RC, the analysis revealed Goldman Sachs as the issuer with more offer and the second with higher overprice, and in DC products the analysis show a spread offer, being Commerzbank the issuer with lower overprice. To conclude this detailed view, it was conducted a cross sectional analysis by company and issuer. Considering RC products, Deutsche Bank was the issuer with lowest overprice for 5 companies and BNP Paribas was the issuer with higher interest rate for 3 companies. In the case of DC products, it was possible to observe that HSBC was the issuer with lower overprice for 4 companies and Commerzbank for 3 companies.

In summary, with a theoretical insight, it was possible to achieve a practical overview of this structured phenomena, in order to better inform the investors' decisions in the future.

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Appendixes

A – Overpricing of RC products, by beta and issuer

Beta	Issuer	Overprice (average)	Overprice (maximum)	Overprice (minimum)
1 (Square-root diffusion)	BNP Paribas	1.92%	13.03%	-2.09%
	Deutsche Bank	1.15%	5.91%	-1.57%
	Goldman Sachs	3.47%	15.39%	-3.23%
	HSBC	2.54%	9.38%	-0.68%
	UBS	2.43%	2.43%	2.43%
	UniCredit	2.57%	19.64%	-0.71%
	Vontobel	9.01%	34.68%	-0.14%
	Total		3.48%	
0 (Absolute diffusion)	BNP Paribas	2.15%	12.70%	-1.62%
	Deutsche Bank	1.44%	7.09%	-1.30%
	Goldman Sachs	4.12%	15.16%	-2.38%
	HSBC	3.07%	9.09%	0.22%
	UBS	2.92%	2.92%	2.92%
	UniCredit	2.60%	19.47%	-0.78%
	Vontobel	8.95%	34.46%	0.07%
	Total		4.02%	
-3	BNP Paribas	3.15%	12.55%	-0.67%
	Deutsche Bank	2.67%	14.58%	-1.38%
	Goldman Sachs	6.53%	20.30%	-0.49%
	HSBC	5.13%	14.07%	1.70%
	UBS	4.90%	4.90%	4.90%
	UniCredit	2.92%	19.27%	-0.97%
	Vontobel	9.01%	34.20%	-0.23%
	Total		6.06%	
-6	BNP Paribas	4.13%	14.45%	-0.93%
	Deutsche Bank	3.95%	16.63%	-1.55%
	Goldman Sachs	7.95%	20.39%	-0.67%
	HSBC	6.62%	16.33%	2.09%
	UBS	7.07%	7.07%	7.07%
	UniCredit	3.40%	19.25%	-1.13%
	Vontobel	9.74%	34.18%	-0.49%
	Total		7.36%	

B – Overpricing of DC products, by beta and issuer

Beta	Issuer	Overprice (average)	Overprice (maximum)	Overprice (minimum)
1 (Square-root diffusion)	BNP Paribas	2.11%	7.20%	-0.95%
	Citi	2.06%	14.36%	-2.34%
	Commerzbank	1.91%	10.99%	-2.17%
	Deutsche Bank	2.46%	10.96%	-1.49%
	DZ Bank	2.08%	12.24%	-2.16%
	Goldman Sachs	2.26%	9.30%	-3.34%
	HSBC	2.99%	10.41%	-1.68%
	Raiffeisen Centrobank	1.41%	1.63%	1.20%
	Société Générale	2.01%	8.06%	-1.80%
	UBS	-1.60%	-1.60%	-1.60%
	UniCredit	1.41%	12.29%	-1.58%
	Vontobel	2.26%	12.31%	-1.38%
		Total	2.12%	
0 (Absolute diffusion)	BNP Paribas	3.27%	10.12%	-1.11%
	Citi	2.27%	14.04%	-2.87%
	Commerzbank	2.84%	14.55%	-2.09%
	Deutsche Bank	3.43%	10.64%	-1.57%
	DZ Bank	2.49%	12.05%	-2.29%
	Goldman Sachs	3.31%	15.12%	-1.57%
	HSBC	3.94%	16.49%	-1.57%
	Raiffeisen Centrobank	1.99%	2.02%	1.97%
	Société Générale	2.99%	14.72%	-1.88%
	UBS	-1.68%	-1.68%	-1.68%
	UniCredit	1.44%	12.09%	-1.70%
	Vontobel	2.79%	12.12%	-1.39%
		Total	2.80%	
-3	BNP Paribas	7.33%	22.80%	-1.50%
	Citi	3.26%	22.50%	-4.19%
	Commerzbank	6.27%	27.83%	-2.77%
	Deutsche Bank	6.82%	22.70%	-1.89%
	DZ Bank	4.19%	22.42%	-3.45%
	Goldman Sachs	7.09%	28.46%	-2.04%
	HSBC	7.27%	30.84%	-1.97%
	Raiffeisen Centrobank	4.37%	5.12%	3.65%
	Société Générale	6.14%	28.00%	-2.13%
	UBS	-1.89%	-1.89%	-1.89%

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	UniCredit	1.82%	11.87%	-2.02%
	Vontobel	4.83%	18.25%	-1.72%
	Total	5.32%		
-6	BNP Paribas	8.83%	24.82%	-1.81%
	Citi	3.90%	24.63%	-5.19%
	Commerzbank	7.84%	27.95%	-3.44%
	Deutsche Bank	8.27%	24.73%	-2.22%
	DZ Bank	5.21%	24.44%	-4.44%
	Goldman Sachs	8.80%	28.58%	-2.52%
	HSBC	8.90%	32.05%	-2.27%
	Raiffeisen Centrobank	6.51%	7.86%	5.17%
	Société Générale	7.38%	28.11%	-2.45%
	UBS	-2.07%	-2.07%	-2.07%
	UniCredit	2.28%	11.85%	-2.30%
	Vontobel	5.92%	20.92%	-2.05%
	Total	6.54%		