Universitat de Barcelona

Structured equity products

General understanding and basic structure formalization

Prepared by **Sergi Homs Caballero**

Supervisor of the project
Dr. Montserrat Casanovas Ramón
Faculty of Business Administration, **University of Barcelona**

Summary and key words

The aim of this assignment is to be used as a complementary reference for students who are getting in touch with equity derivative structuring for the first time and eagerly aim to broaden its understanding in what I find an attractive limitless world of opportunities fitting wide variety of needs. Derivatives structuring is about solving problems and meeting needs. Those problems can range from hedging investment risk to speculate on movements. In this assignment we have an overview on the main reference indices used for structured derivatives to further on dedicate a deeper treatment to equity-linked structured products.

We touch on the main marketed variations and emphasize in its structure formalization to have a better understanding of its potential return.

To conclude, the assignment contains an analysis on marketed structured products where we infer in underlying hedging strategy and return profile.

Key words: structured product, equity, underlying asset, index-linked cash flow, exotic options, participation rate, derivative firm.

Resum i paraules clau

L'objectiu del present treball es servir d'ajuda com una referencia complementaria per estudiants que estan entrant en contacte per primer cop amb la estructuració d'instruments derivats que, amb entusiasme, busquen ampliar la seva comprensió sobre el que trobo un inquietant món amb possibilitats il·limitades per lidiar amb un ampli ventall de necessitats. La prioritat es resoldre problemes i satisfer necessitats. Aquest problemes poden anar des de la cobertura d'una inversió exposada a un determinat risc fins a finalitats especulatives. Aquest treball inclou una visió general sobre els principals índexs de referencia susceptibles de ser utilitzats en una estructura i una més metòdica dedicada als estructurats instrumentats sobre la renta variable.

Es presenta una aproximació per a les principals variants comercialitzades i s'emfatitza en l'estructuració formal per assolir un millor enteniment del rendiment potencial de l'estructura.

Per a concloure, el treball conté un anàlisi de productes extrets del mercat on s'infereix en les estratègies de cobertura i les seves implicacions en el perfil de rendibilitat.

Paraules clau: productes estructurats, renta variable, actiu subjacent, indexació, opcions exòtiques, taxa de participació, bróker de derivats.

TABLE OF CONTENTS

I. INTRODUCTION

Derivatives structuring is about designing financial instruments to solve financial economic problems. The problems that derivatives may solve are unlimited. Derivatives can be used to manage exposure to large variety of risks, enhance yield or reduce funding costs. In addition, derivatives can also be used to exploit the tax, accounting and regulatory environment. Although the theoretical pricing and hedging of derivatives has been dealt with in a large number of working papers, articles and books, surprisingly little has been written about the structuring and practical application of derivatives.

This emphasizes the derivatives structuring is first and foremost financial architecture and not financial engineering, The financial engineer only comes in when the structuring process yields products that the derivatives firm has not traded before. Given the enormous progress which financial engineer have made over the last decade, however, must structuring nowadays can be done without having to fall back to a financial engineer.

Throughout the assignment we approach matters from both end-user's perspective and the derivatives firm, including in the latter any form of intermediary. The aim of this assignment is to serve readers with a source of information providing them with a general understanding of derivative structuring. Moreover, although it contains an overview on other kind of reference indices and a thorough treatment of the equity-linked structures, the approach advocated works for any type of derivative irrespective of the reference index used.

This assignment is made up of three parts. In the first part, which covers chapter two, we introduce the general framework of structured products, where we talk about the fundamentals of structured products emphasizing on its malleability and indubitable capacity to respond to wide variety of risks. Further on, we turn to the explanation of the different reference indices used when structuring products. Among them we find fixed income links, commodity links, FX links, credit derivative links and another generation of structures based on securitization that due to its increasing importance raises name to structured finance.

In chapter three we discuss index-linked cash flows. This chapter provides an overview of most of the cash flows structures that are around nowadays. It deals with various rights and restrictions that can be found in derivatives contracts. It is also studied how equity derivatives can be used to tailor specific needs.

To conclude, the assignment counts with an analysis devoted to apply previously mentioned structures to real-life marketed products. The study focuses on structure formalization and the disaggregation of different components to infer on the overall hedging strategy. It aims to achieve a complete grade of understanding of the risks the investor is exposed to.

II. Fundamentals of Structured Products

2.1 Definition of Structured products

A structured product is a combination of financial instruments which in turn form together a new investment product. According to the U.S. Securities and Exchange Commission (SEC), the former[1] Rule 434 defines structured securities as

> "Securities whose cash flow characteristics depend upon one or more indices or that have embedded forwards or options or securities where an investor's investment return and the issuer's payment obligations are contingent on, or highly sensitive to, changes in the value of underlying assets, indices, interest rates or cash flows"

As it follows from the aforementioned definition, through what we may call financial engineering, we obtain a new asset as a result of using the value generated by the volatility of different types of derivatives on a wide spectrum of underlying assets that offer alternatives to conventional stock and bond investments. These products are sometimes referred to as non-conventional investments. They tend to be both more complex—and more risky—than traditional investments, and often tempt investors with special features and higher returns than offered by basic investments. These instruments are generally designed for the Over the Counter (OTC) institutional investment market

Some examples of complex products include notes with principal protection and high-yield bonds that have lower credit ratings and higher risk of default, but offer more attractive rates of return. Complex products may use futures and options, as well as complicated trading strategies, to achieve investment objectives.

Although these products may have attractive qualities, it is crucial to understand each investment's distinct features, risks and rewards

2.2 Features of structured products

Structured securities, regardless the asset class, feature a certain common drivers that have been instrumental in fuelling market activity over the past few decades – either cyclically or continuously[2]. The traditional investor was used to invest in short-time horizon low-risk assets with high profitability both nominal and real. The shift of this situation has pushed clients to modify its investment habits accepting higher degrees of risk and longest

[1]Structured securities products are not currently defined in the federal securities laws.
[2]According to the Staff Summary Report on Issues Identified in Examination of Certain Structured Securities Products Sold to Retail Investors published by the Securities and Exchange Commission on July 27th, 2011, for the full year 2010, the US structured products market sold more than $45bn of products. By contrast, just shy $32bn in structured products were sold during all of 2007, considered to be a good year.

timeframes. The situation previously described lead to a raising trend from entities to seek for the solution that allow to fulfill new client desires.

The strategic solution was carried away by the commercialization of a new wide range of products with clearly different financial features. The variety and complexity of the structure products is huge. Financial entities can define differential strategies based on the effectiveness of original designs, allowing the proper portfolio diversification attending to geographical issuance, sectors, industries or financial instruments used. The variety composes a key factor easing the implementation of specific attraction and loyalty strategies towards the client, as they allow to predetermine different risk-profitability profiles specifics to each segment. It also provides issuers with higher and safe financial margins as a consequence of replacing the traditional term deposit and transferring derivative-based exposures in funded forms to avoid counterparty risk exposure.

From the client' point of view, these imply new tailored ways of accessing to asset exposure in unique forms, with asset references, maturities, currencies, leverage, and coupon/principal payments customized to meet individual requirements, as well as to contribute to achieve a better portfolio diversification. This products also allow investors that are not permitted to deal directly in derivatives to replicate the risk/return profile via securitized structure, and creates an efficient mechanism to purchase an entire portfolio of assets through a single transaction. They usually provide the client with some downside protection (if not full, such as principal-protected class, one of the most demanded one). Unfortunately, and derived for its complex and wide structures, this limitates the ability to be traded at secondary markets and therefore they are illiquid to some extent. Furthermore, the lack of transparency in the pricing and, in many cases, given the sophisticated structure together with the poor financial culture, the client itself is not able to infer in the effective risk the products entail.

The natural building blocks of the derivatives structure are cash flows: payments from one counterparty to another. Broadly speaking, a cash flow is characterized by the amount to be exchanged and the date on which the exchange takes place. With respect to the amount we can distinguish between fixed and index-linked. A fixed cash flow concerns the exchange of a prefixed amount. With an index-linked cash flow the amount to be exchanged is not fixed in advance but depends on the future values of one or more variables, these are the underlying assets or the so-called reference indices. Since the future values of these reference indices are unknown in the present, index linked cash flows are inherently uncertain.

When structuring derivatives the first question to ask is what the relevant reference indices are. In other words, what the relevant risk factors for the problem are. The most popular reference indices to link cash flows to are therefore market prices, such as stock prices and indices, bond prices, interest rates, exchange rates, commodity prices, credit

ratings and the occurrence of a default or credit event. Even so, other indices are used when referenced structured products such as the occurrence of an earthquake hurricane or the accumulated temperature and rainfall.

Events like the last ones are not real indices in the sense that they take on all kinds of values over time. We can, however, treat them as such by assigning them a value of 0 of the relevant event does not occur and a value of 1 if it does. Therefore, there are basically indices which can take a whole range of possible values and indices which can take only two values. The latter can be referred to as digital indices.

Having identified the relevant payment dates and reference indices, the next step is to link the cash flows on these dates with these indices, and package all the cash flows into a single contract.

2.3 TYPOLOGY OF STRUCTURED PRODUCTS

The variety is boundless. So is the complexity. Nevertheless, structured products can be classified in many ways, according to different variables. One of the most recurrent classification consists in the guarantees offered to the investor. Within this classification, we find the principal-protected products, which secures the refund of the nominal invested and just compromises its future returns. The basic structure of principal-protected products incorporates options that implies restricting the overall risk, as illustrated in figure 2.1.

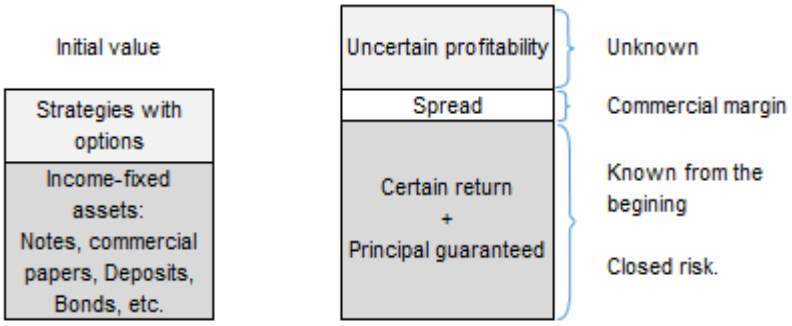


Figure 2.1. Principal-protected structured product construction scheme.
Source: compiled by author

On the other hand, we find those products that do not offer a guarantee over the principal, thus it is partially guaranteed. In these instruments the investor puts at risk the face value of the investment and therefore these are products that offer higher return expectations. Within this category we find the well-known so-called structures reverse convertibles, where the investor receives a fixed above-the-market yield in exchange for assuming the risk of receiving the face value of their investment in shares of a particular company at a price return preset at the time of their subscription. The underlying basic

structure is selling options, which involves taking an unlimited (up to the capital invested) risk of loss.

Secondly, we can distinguish them according to how the structure's returns are distributed. Within this category we find structures with implicit yield (zero-coupon), where the fixed or variable profitability is settled once upon the maturity of the product, without no intermediate cash flows alongside the operation. Other structures offer explicit yields in form of fixed/variable flows with different temporal settlement frequencies (quarterly, semi-annually, etc.). As well, both forms can take place together, making way to structures with mixed yield, as part of the profits are received with periodicity (usually fixed) and the other is received at maturity (usually variable).

Thirdly, they can be distributed according to the investor's pursued objective. On the riskiest side we find speculators, who seek to capitalize on the expectation of a certain directional movement of an underlying asset. The investor bets towards a determined trend assuming a higher risk. More moderated investors use products as a coverage, where the objective is total or partial coverage of an existing risk in the investor's portfolio. Others look for products with tax advantages, where the aim is to fully adapt it to the current tax legislation. Products with maturities higher than 2 years were launched with bullet payments (principal plus any form of interest paid at maturity), taking advantage from the 40% taxable base reduction over movable income. Spanish personal income tax legislation annulated this reduction on 2007, but still contemplating the application for structured products issued before 2006. As well, investors can look for portfolio diversification with different allocations criteria.

Fourthly, products can be classified according to strategic typologies depending if it directional, with a bullish market view of the underlying asset if the investor bets on the upside, or bearish if the bet is for the downside; differential (spread), where the product performance varies depending on a positive differential behavior of an asset over another (i.e. Ibex-35 over Eurostoxx 50), regardless whether rates have risen or fallen; and fluctuation ranges in the prices of market variables, as the construction of this products combines the purchase and sale of call/put options, such as straddles. (Lamothe and Pérez, 2003)

Fifthly, and last, structured products can be divided according to the nature of the underlying asset. Under this criteria, products can be classified as equity links, which will be treated deeply further on; fixed income links; commodity links; credit derivative links, relying on the payer's creditworthiness; foreign exchange links; inflation links; insurance links[3], for instance on meteorology; and mixed as well, as a combination of any

[3] For further information, consult Erik Banks book *Synthetic and structured assets*.

aforementioned classes. From now onwards we will use this criteria when inferring in any of this category.

Alternatively, some authors usually distinguish among structured products of first, second, third and fourth generation4. The first three have in common a number of features where we can emphasize the fact of being created by an underlying swap operation, so that the issuer rarely supports any of the implicit risks. Therefore, the issuer can design a financial product that meets the specifications demanded by investors, without worrying about the risk assumed, since it can be covered. Within these categories we find IFRN (inverse floating rate note), IAN (indexed amortizing note) and SCN (synthetic convertible notes), which can be found included in aforementioned categories. However, during 1955 begins to emerge a new type of structured financial products so sophisticated and so widely used that authors starts to refer to structured finance. The objective pursued is basically the same as the classic structured products: adapt the cash flows to the risk preferences of investors. Among them we can find products arisen from the securitization such as ABS (asset backed securities) or MBS (mortgaged back securities); credit derivatives such as CDS (credit default swaps) or CSO (credit spread options); and hybrid financial products such as synthetic CDO's).

2.4 STRUCTURED FINANCE AND SECURITIZATION

Structured finance has become a major segment in the financial industry since the mid-1980s. Structured finance is a broad term used to describe a sector of finance that was created to help transfer risk using complex legal and corporate entities. This transfer of risk, as applied to the securitization of various financial assets, has helped provide increased liquidity[5] or funding sources to markets like housing and to transfer risk to buyers of structured products; it also permits financial institutions to remove certain assets from their balance sheets as well as provides means for investors to gain access to diversified asset classes.

Securitization is a well-established practice in the global debt capital markets. It refers to the sale of assets, which generates cash flows, from the institution that owns them, to another company that has been specifically set up for this purpose, and the issuing of notes by this second company which is an SPV[6]. The creation of SPV ensures that the underlying asset pool is held separate from the other assets of the originator. This is done so that in the event that the originator is declared bankrupt or insolvent, the assets that has been

[4] It is Juan Mascareñas, unlike other authors I have reviewed, who later introduces the fourth generation wrapping up those created through securitization of a set of assets where risk-profitability is distributed differently among investors.
[5] In the United States, corporations like Fannie Mae and Freddie Mac are companies whose purpose is to expand the secondary mortgage market through buying individual mortgages and pooling them into MBS allowing lenders to reinvest into more lending.
[6] SPV stands for Special Purpose Vehicle. It is referred by other authors as SPE (special Purpose Entity) or SPC (Special Purpose Company).

transferred to the SPV will not be affected. This is known as being bankruptcy-remote (Moorad Choudhry, 2003). The process of securitization often involves credit enhancements, in which a third party guarantee of credit quality is obtained, so that notes issued under securitization are often rated as investment grade up to AAA-grade (S&P's nomenclature).

Finally, the pooled underlying assets are separated into different tranches with different features and therefore different returns. This is known as tranching, which refers to the creation of different classes of securities (typically with different credit ratings) from the same pool of assets. It is the system used to create different investment classes for the securities created. Tranching allows the cash flow from the underlying asset to be diverted to various investor groups. This is accomplished through the use of credit support (enhancement), such as prioritization of payments to the different tranches.

Investor interest in the ABS market has been considerable from its market's inception. This is because investors perceive asset-backed securities as possessing a number of benefits. Investors can diversify sectors of interest, access different risk-reward profiles derived from the ability to tailor risk-return profiles and access sectors that are otherwise not open to them. Figure 2.2 illustrates the process of securitization.

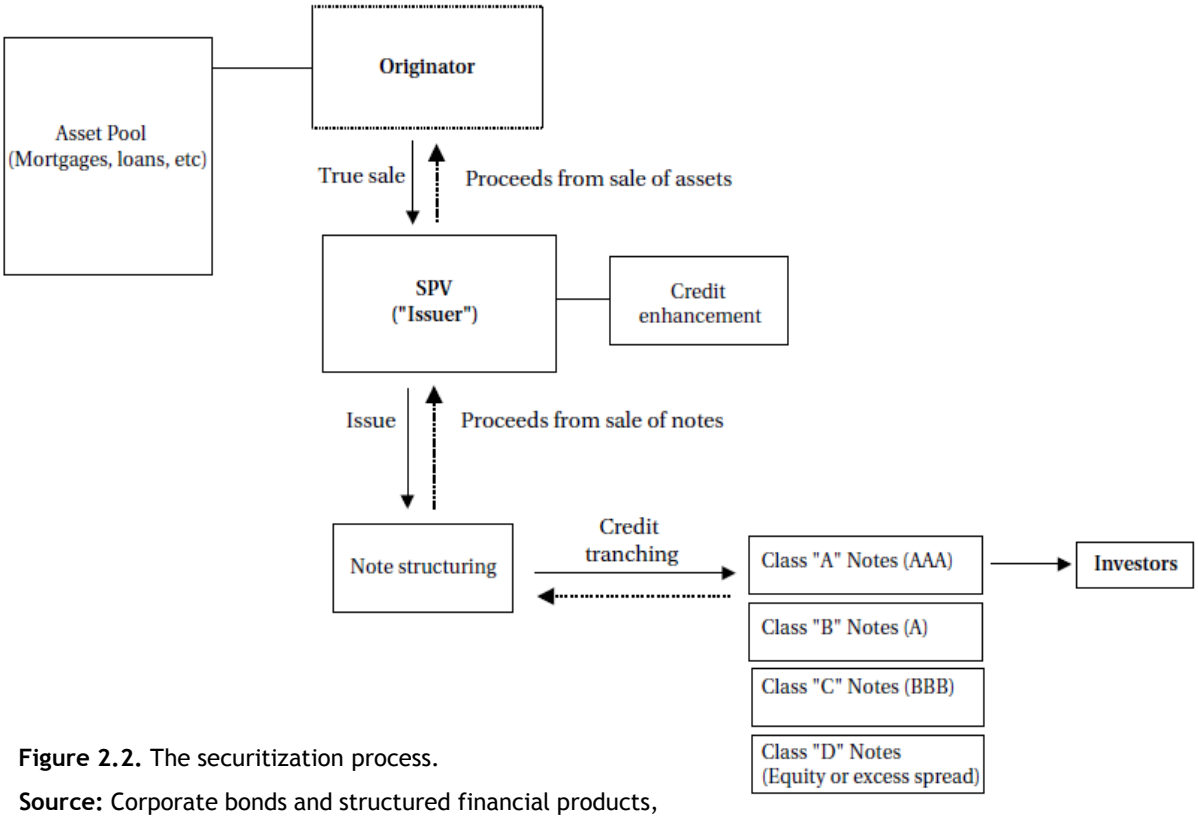


Figure 2.2. The securitization process.

Source: Corporate bonds and structured financial products, by Moorad Choudhry

2.5 FIXED INCOME LINKS

Fixed income structured products are the result of mixing the profitability of the zero coupon curve and the financial value of the volatility on the future development of the interest rates at a given time horizon. Multiple forms of derivatives can be used to provide higher performance expectations. We will mention some examples of the most common fixed income link structures.

One type of structure are structured deposits based on increase expectations of the curve. This kind of deposits are rewarded at a variable interest rate referenced to a swap performance. By using them, investors seek to capitalize on upturns in the positive slope of the profitability curve. In general, it is recommended the use of floors to evade extreme interest downturn situations. The duration of this instrument is usually close to zero, which makes the structure's market value not very sensitive to parallel shifts on the interest rate curve. However, it is sensible to changes in the slope: an increasing slope would benefit the investor, and a decreasing slope would have negative effects.

Another type of structured products are structures of dual deposit of debt or other assets, which usually consists on a short term deposit with yield outperforming the market in exchange of compromising to purchase public debt (can be used as well with private debt) at maturity at a preset price and date.

Finally, we find structured deposits for market situations with positive slope. These are structures that capitalize on positive interest curve slope, and inside this category we find a variety that try to take advantage when interest rates are not expected to rise as much or fast as expected. Figures inside of this category are inverse floaters, capped floaters, collared FRN (floating rate notes), and so forth, which are out of the scope of this assignment[7].

2.6 COMMODITY LINKS

A commodity-linked note pays a return linked to the performance of a commodity (e.g. natural gas or aluminum) or basket of commodities over a defined period. On the maturity date, the note pays the initial principal amount plus return, if any, based on the percentage change in the underlying commodity (or basket). Examples of this kind of structures could be a principal-protected referenced to oil prices, where the profitability will depend on the performance of the underlying.

[7] For further information, consult Jakub Bankura's paper *What investors should look for in connection with structured notes and when? An analysis of the performance of structured notes.*

2.7 FOREIGN EXCHANGE LINKS

This type of note pays a return linked to a global foreign exchange (FX, commonly referred as Forex) market. It is usually a short-term note that pays out a fixed minimum rate of interest determined by the movement in foreign exchange rates over the life of the note. On the maturity date, the note pays the initial principal amount plus return, if any. Inside of this term, we also find dual currency notes. These types of notes provide an interest rate on a short-term note in one currency (base currency) in return for accepting possible repayments of the note principal in another currency (alternate currency). This product may be suitable if you desire yield enhancement and exposure to either of the two currencies. An example within this category would be a buffered principal-protected linked to EUR/USD quotation. It is a fixed term deposit which return is referenced to the EUR/USD exchange rate variation, in a way that if at the end of each year this rate lies within preset boundaries, the investor will receive higher yields than if it invested directly in the underlying.

2.8 CREDIT DERIVATIVE LINKS

This structured products are linked to the zero coupon curve and to the financial value of the credit risk derivatives of either the counterparty or to indexes of such risks as iTraxx[8]. Principal events to consider when valuating credit derivatives are: default, cross-default, convertibility, restructuring, bankruptcy, material adverse change. Which can be grouped into three different categories (Lamothe and Pérez, 2003).

The first one, noncompliance in time or form of the obligations subscribed in the contract. Even then, there is a grace period, usually approximated to two weeks, where the default is potential: Failure to Pay[9] is defined to be a failure of the reference entity to make, when and where due, any payments under one or more obligations. If the situation is solved within this period, credit event is deemed not to take place.

Secondly, market value decline of an asset derived from the worsening perception the market has about the issuer creditworthiness. In this cases, the credit risk is considered to be higher and so is the ability to reflect it in detriment of the price.

Finally, we find decreased in the issuer's credit rating by a rating agency such as Standard & Poor's or Moody's. This rating downgrades have a significant impact when it implies a rate lower than *investment grade*[10]. The difference between the former one is that the value

[8] iTraxx is the brand name for the family of credit default swap index products covering regions of Europe, Australia, Japan and non-Japan Asia, constructed on a set of rules with the overriding criterion being that of liquidity of the underlying credit default swaps (CDS), usually separated by regions and industries.
[9] Extracted from ISDA credit event definitions at http://credit-deriv.com/isdadefinitions.htm
10 This is, grades equal to BB and lower, according to S&P. For further information, go to http://www.standardandpoors.com/spf/general/RatingsDirect_Commentary_979212_06_22_2012_12_42_54.pdf

decline is just perceived by the market participants and it is not officially recognized by rating agencies.

Once different events are classified, we can distinguish between two cases of products referring to the credit risk variable. On one side, credit linked notes are products that include an option favoring the issuer where the investor assumes the third's party risk of default, different than the issuer. On the other side, we find basket credit linked notes, where the underlying is not just one, but two or more, supported by a credit default swap that is liquidated when any of these underlying assets incur in any credit event defined in the contract (default, cross-default, and so on as mentioned earlier).

Regarding the valuation of credit derivative links, the main factors with notorious influence are the own underlying market performance subscribed at the contract. To estimate the value behavior of such contract we would need to use predictive statistics models able to infer in the underlying's issuer creditworthiness over time. The event of credit defined in the contract, in this case the lack of specific valuation models depending on the event makes it difficult to infer on how this variable affects the overall valuation. Another relevant variable is the probability distribution time structure of default, given the lack and not so homogeneous sample information (historic information). For last instance, both parts are interested in knowing the so-called recovery rates: the portion of the total that would be refunded in case of credit event. Related to this, other rates can be used, such as one that reflects the amount subjected to default once the credit event has occurred. Has to be mentioned that there is certain grade of correlation between previously mentioned rates.

III. EQUITY LINKS

3.1 INTRODUCTION

Derivative structuring is about solving problems. These problems may take many different forms. Corporate treasurers for example will always be on lookout for ways to reduce their company's funding costs, or to enhance the yield on short-term investments. In addition, they may want to hedge or to speculate on movements in interest rates, exchange rates and commodity prices, credit exposure, etc. Investment managers will be interested in reducing the costs of exposure adjustments, hedging against or speculating on expected market movements, and all forms of yield enhancement. In this chapter we introduce the general framework to solve problems like these. However, the discussion is kept very general, to further on focus on practical matters.

When analyzing the design of equity-linked structured products it is meaningful to infer on series of technical variables present as expressed below. Before getting into deeper treatment of the equity-linked structured products, we will have an overview on general issues to consider when dealing with this kind of products.

The first problem is that the reference index may not be expressed in money terms. Stocks do not present a problem, but this is not true for stock market indices which are just numbers without units. To solve that problems we implicitly multiply non-money indices by a monetizer. This is knows as monetization. For example, when the IBEX 35 index is at 11.350 we think of it as an amount of money, this is, 11.350 EUR. Although an index can be monetized into any currency we like, most non-money indices do have a natural currency of denomination, usually it corresponds to the origin of the firm's stock it represents.

But sometimes it may not be denominated in the currency in which we want to get paid. In other words, the index currency is different from the index currency. The solution is the introduction of an explicit currency translator which converts the index into the payment currency. The most common way to solve it is to use the spot rate at payment date. This is not the only alternative though. Instead of it, we could convert the observed value of the reference index using a prefixed exchange, the average exchange rate or the highest or lowest exchange rate over the observed period, and the highest or lowest exchange rate of the prefixed rate and the spot rate on the payment date. Note that when translating the index currency is different from the payment currency, the variations depend on stock prices and exchange rate movements.

It is important to note that when it comes to multiplication and currency translation every component cash flow in the package with its own multiplier and currency translator.

Another problem concerns the size of the cash flow. A cash flow equal to the value of the reference index will typically only be small, especially when the index is expressed as a

percentage. To solve this, we can simply multiply the index value by a fixed multiplier. For example, instead of a cash flow equal to the value of the IBEX 35, we could talk about a cash flow equal to 10 or even 250.000 times the index value. The multiplier can be a prefixed number or in special cases a complex function.

3.2 STRUCTURE INSTRUMENTALIZATION

Knowing how to link cash flows to reference indices, we are ready to get into the instrumentalization. Wrapping up, we first identify the relevant reference indices and payment dates. Subsequently, we hook up the cash flows on those payment dates with the reference indices, and package all cash flows into a single contract. Although there is a huge variety in the problems that derivatives structures are confronted with, the resulting solutions can be classified into two different groups: index linked notes and forwards and swaps.

A very common problem is what to do with a temporary (maybe long-term) cash surplus. One solution is to pay the cash flow to some counterparty in return for a single payment by that counterparty in the future. This is known as buying a zero-coupon note. With a traditional zero-coupon one counterparty pays the other an amount the size of which is fixed in the present. The coupons paid on a note are traditionally seen as a compensation for the use of capital, while the redemption payment constitutes the return of that capital to the lender. By buying a note an investor acquires the right to a stream of cash flows. These cash flows perform both the task of compensating the investor for making his capital available to the issuer of the note as well as repaying that capital.

With zero-coupons all future cash flows go one way, this is, one counterparty always pay the other. But possibilities in finance are limitless. Often the best solution to a problem is to trade one cash flow for another, sometimes getting rid of those unwanted or less desirable cash flow and replace it with a more attractive one. This gives rise to contracts where both counterparties pay each other. Such contracts are known as forwards. The payoff of a forward contract consists of two future cash flows, one from each counterparty to another. Under traditional forwards the payment dates of both cash flows are the same, one cash flow is fixed and the other is index-linked (with forwards on interest rates, they usually trade fixed amounts with variable ones linked to euribor). However, there is no reason why this should be the case.

Sometimes one need to replace not just one but a whole series of future cash flows. It is recurrent to think about a bank treasurer who funds at a floating rate but is used to pay at a fixed one. Therefore he might be looking to exchange those index-linked payments he is receiving for fixed payments (this could be as well the case if he funds at floating rates and he believes interest rates will go up, he may be looking for fixed rate payments in exchange of variable ones). Fortunately, this does not present a problem as the idea behind forwards

can easily be extended into a multi-period base. This gives rise to contracts which are known as swaps.

A swap therefore is a strip of forwards that oblige involved counterparties to exchange cash flows on two or more future payment dates. Traditionally, as with forwards, swap payment dates are equal for both 'legs'; the cash flows in one leg are fixed and the cash flows in the other leg are index-linked. Again, depending in the situation at hand, cash flows may occur at different times and both legs of the swap may have index-linked cash flows.

All in all, derivative structuring is about packaging fixed and index-linked cash flows into financial contracts to solve economic problems. Conceptually the procedure starts identifying the relevant payment dates and reference indices, to later on link the cash flows on the payment dates to the reference indices in such a way that the problem at hand is solved. Additional rights and/or restrictions can be added if required, to finally ask the derivatives firm to quote a price for the contract.

3.3 INDEX-LINKED CASH FLOWS

3.3.1 INTRODUCTION

So far we have looked at the formalities of the equity links. This has been just a straightforward introduction to a wide complex world. From the bottom we find cash flows which equal to the value of the reference index at some future date, the so-called vanilla products. But there is more, vanilla cash flows can be combined into more complex cash flows using a number of operations in any combination one sees fit. First, we can structure cash flows which are equal to the sum of two of more cash flows. An investor might, for example, be interested not so much in a cash flow equal to the value of a single stock as in a cash flow equal to the value of a portfolio of ten different stocks. We can also structure cash flows which are equal to the difference between two cash flows (spread strategies) or to the product or ratio of two cash flows. Another recurrent possibility is to structure cash flows that equal the highest or lowest of two or more cash flows.

Much of the secret of derivatives structuring lies in the construction of the index-linked cash flows. This chapter therefore provides an overview of the most popular index-linked cash flows used in derivatives structuring. It is not a complete overview, as it is meant to give the reader a general flavor of some of the more popular possibilities. Apart from discussing many index-linked cash flows qualitatively, we will also discuss one or more formal expressions for each cash flow.

Formalization is always given special treatment as it will eventually embody a contract specifying how the payoff will be calculated. A formal expression does so much more precisely and efficiently than written text.

3.3.2 ASSUMPTIONS AND NOTATION

Unless stated otherwise, we will assume that all cash flows are settled immediately after the amount to be exchanged has been determined (note, however, that due operational constraints in practice the size of an index-linked cash flow will have to be determined few days before the payment date, as will be seen in the last chapter where we will analyze already marketed structured products). Time will be determined in years. The present time is denoted ad t=0 and payment date (maturity) is denoted by T. The value at time t of the reference index is denoted as I_t. In the case there is more than one reference index, we differentiate then using superscripts. In the case it is needed to use exchange rates, the number of units of payment currency one has to pay for one unit of non-payment currency at time t is denoted as E_t. All reference indices are assumed to be at 100 and pay no dividends. The issue size or notional amount of a note is denoted N. The number of shares in the reference index that an amount N buys is denoted M (N/I_0). All notes are assumed to be issued at par (issue price equal the notional amount) to ease return calculations.

As well, for simplicity we will assume that the distributor and the issuer of the note are one and the same. Keep in mind, however, that in practice is it not just banks that issue and distribute equity-linked notes.

3.3.3 VANILLA INDEX-LINKED CASH FLOWS

As discussed earlier, a vanilla index-linked cash flow is a cash flow equal to the value of the reference index on the payment date. For example, a cash flow equal to the EUR value of the IBEX 35 index one year from now. Formally, this means we now have a cash flow equal to

$$CF_T = M \times I_T$$

This cash flow depends linearly on the index value. A higher (lower) value of the reference index will produce proportionally higher (lower) cash flow. If the reference index's natural natural currency of denomination was not the currency in which we wanted to get paid[11], and we converted the index currency at the exchange the exchange rate on the payment date, the cash flow would become equal to

$$CF_T = M \times E_T \times I_T$$

Where E denotes the exchange rate. This expression shows that the cash flow now varies with the reference index as well as the exchange rate. The cash flow is higher the higher

[11] Note that if we translate an index in a currency in which we want to get paid, different that the natural index currency, we are implicitly using a fixed exchange rate.

the index and the higher the exchange rate. This is known as composite cash flow. If we did not want the cash flow to depend on the exchange rate we could convert the index currency at a prefixed rate, yielding a quantoed index-linked cash flow. If we used the t=0 exchange rate to do so, we would end up with a cash flow equal to

$$CF_T = M \times E_0 \times I_T$$

In the above expression time *T* plays a double role. It not only denotes the cash flow payment date but also the date the amount to be paid is determined. In other words, with a standard vanilla index-linked cash flow the exchange takes place as soon as the amount to be exchanged has been determined. It is also possible to delay the payment for a while by fixing the amount to be exchanged some time before the actual payment date. In that case we speak of an index-linked cash flow with delayed settlement. Formally, this means we now have a cash flow equal to

$$CFt = M \times I_{t'} \text{ with } t' < T$$

Where now *T* denotes the payment date and t' denotes the date the reference index is monitored to determine the amount to be exchanged at time *T*. Delayed settlement is not a concept that is limited to vanilla cash flows. We can delay the settlement of any index-linked cash flow. In equity derivatives delayed settlement cash flows are not very common. In the interest rate area, however, delayed settlement is the rule and immediate settlement the exception as the interest to be paid over some period of time is typically fixed at the beginning of that period on the interest rate at that point of time.

Adding a knock-in or knock-out feature to a vanilla index-linked cash flow is no different from adding one to a fixed cash flow. If we combined our index-linked cash flow with a knock-out condition that said the cash flow would occur unless at one of the monitoring points barrier variable was equal to or higher than a fixed barrier level *H*, we would get a cash flow equal to

$$CF_T = M \times D \times I_T$$

where

$$D = 0, if\ \exists j\ I_J \geq H,$$

$$D = 1, if\ \forall j\ I_J < H$$

This is sometimes referred to as digitals or an asset-or-nothing. As with fixed cash flows, a knock-out and an equivalent knock-in index-linked cash flow always sum to an ordinary index-linked cash flow.

3.3.4 BASKETS AND SPREADS

In many cases the problem to be solved does not depend on one single stock price or one single stock market index, but on a number of them. Not many investors for example invest all their money in one single stock or even in one single market. A common thing therefore is to work out with cash flows equal to sums of stock prices or stock market indices. These are referred to as baskets. With a total of N reference indices this creates cash flows such as:

$$CF_T = M^1 \times I_T^1 + M^2 \times I_T^2 + \cdots + M^N \times I_T^N,$$

where I_T^1 denotes the time *T* value of reference index *i=1, 2, …., N* and the M^i terms are the multipliers that come with each index in the basket. The above cash flow equals the sum of *N* vanilla index-linked cash flows. Again, the size of the cash flow depends linearly on the values of the reference indices. Higher (lower) index value produce a higher (lower) cash flow.

Since we are simply talking about a sum of vanilla index-linked cash flows, currency conversion is easily incorporated. Suppose the second and the N^{th} reference index were denominated in a currency different from the payment currency. In that case we would first convert them into the payment currency and then sum the resulting cash flows with the others just as before. Converting at the time T exchange rate, this would yield a cash flow of

$$CF_T = M^1 \times I_T^1 \times E_T^1 + M^2 \times I_T^2 \times E_T^2 + \cdots + M^N \times I_T^N \times E_T^N,$$

where E_T^i denotes the exchange rate between the currency of i^{th} index and the payment currency at time *T*. To eliminate the dependence on these exchange rates we can quanto both foreign indices in the same way as before for use any other form of currency translation.

Instead of only index-linked cash flows we could also include a fixed cash flow in the sum. With a fixed amount plus an index-linked cash flow it is important, however, to note that by itself the fixed cash flow does not imply a minimum value for the total cash flow. In some cases, however, the index-linked part of the cash flow cannot be negative by its nature, which produces the illusion of a minimum value where in some general terms there is none.

Instead of the sum we sometimes need a cash flow equal to the difference between two reference indices. Such cash flows are referred to as spreads and can be formally expressed as

$$CF_T = M^1 \times I_T^1 - M^2 \times I_T^2$$

For example, I^i could be the price of a share of Telefonica and I^2 the IBEX 35 index and the multipliers could be set such that $M^1 \times I_0^1 = M^2 \times I_0^2$. In that case the above cash flow would give us the outperformance of Telefonica relative to the IBEX 35 index over the period from *t=0* to *t=T*.

As with sums, we do not need to restrict ourselves to vanilla cash flows. We can use any cash flow we want, including fixed cash flows. When working with a fixed and a vanilla index-linked cash flow a special case arises when the fixed cash flow is set equal to the present value of the reference index of the vanilla cash flow. In that case we speak of a long change and a short change, depending on whether it is expected to rise or to fall. The long change can be expressed as

$$CF_T = M \times (I_T - I_0)$$

And the short change as

$$CF_T = M \times (I_0 - I_T)$$

Instead of calculating the change from the present value of the reference index one may also use the index value on a later date. This means replacing I_0 by the delayed settlement cash flow $I_{t'}$, in which case we speak of a forward-starting long or short change.

3.3.5 Ratios and products

Sometimes we need a cash flow that expresses the magnitude of one reference index relative to another. This means we have to divide two cash flows. Assuming both cash flows are vanilla index-linked cash flows, this means we have a cash flow equal to

$$CFt = \frac{M^1 \times I_T^1}{M^2 \times I_T^2}$$

When calculating this cash flow we first monetize, currency translate (if necessary) and multiply the values of both reference indices. Dividing money amounts, however, produces a number without unit and also takes the biggest part of the multipliers out. We therefore need to re-monetize and re-multiply the resulting ratio. This re-monetization is just a formality, however, as all the relevant monetization and currency translation will have been done before the calculation of the ratio. We therefore always monetize rations into the payment currency.

Instead of both component cash flows being index-linked, one of them could be fixed. We could for example create a cash flow equal to the value of the reference index at time *T* divided by the value of the same index at *t=0*. We could use this as a measure for the change in the reference index over the period from *t=0* to *t=T*. A ratio higher than one would indicate

the index had gone up and a ratio lower than one that it had gone down. This is known as wealth ratio. This also shows that when both component cash flows are index-linked they need not necessarily be linked to different referent indices.

At other times we may need a cash flow equal to the product of two other cash flows. This would produce a cash flow equal to

$$CF_T = (M^1 \times I_T^1) \times (M^2 \times I_T^2)$$

Note that with a cash flow equal to the product of two other cash flows both cash flows have to be index-linked, because if one was fixed it would just be a change of multiplier.

3.3.6 BEST-OF AND WORST-OF

The attraction of derivatives structuring is in large part due to the possibility of creating cash flows equal to the highest or lowest of two or more other cash flows, often referred to as the best or the worst, respectively. Although the terminology is very common, it can be somewhat confusing at times since what is best (worst) for one counterparty is worst (best) for the other. Suppose we had two cash flows; a fixed amount *K* and a vanilla index-linked cash flow. Taking the highest of these two can formally be written as

$$CF_T = Max(K, M \times I_T)$$

If the index on the payment date is such that it yields an index-linked cash flow larger than K this cash flow is identical to a vanilla index-linked cash flow. However, for index values that produce an index-linked cash flow smaller than K this cash flow is identical to a fixed cash flow equal to *K*, offering the investor a minimum predetermined return. Taking the lowest of the two cash flows can be expressed as

$$CF_T = Min(K, M \times I_T)$$

If the index-linked cash flow is larger than *K* this cash flow is identical to a fixed cash flow of *K* and equal to the vanilla index-linked cash flow otherwise.

There are no restrictions on the nature and number of component cash flows we can use. If we had three vanilla index-linked cash flows and we wanted a cash flow equal to the highest of these N, this could be denoted as

$$CF_T = Max(M^1 \times I_T^1, M^2 \times I_T^2, \dots, M^N \times I_T^N)$$

As before, every cash flow brings its own multiplier. When structuring a cash flow like this we need to take care that the multipliers are chosen in such a way that the *N* component cash flows are comparable in size. Suppose the reference indices were currently at notoriously different values, and they were equally volatile. Using same multipliers for all *N*

components in that case will lead to cash to a cash flow equal to $M^x \times I_T^x$ where I_T^x is the reference index with the highest initial value among the others, thus the max operator would be trivial from the beginning.

Note that contract with the best-of clause can be seen as floored and worst-of clause can be seen as capped, but in this case we talk about index-linked cap and floor.

We can also use a fixed or index-linked cash flow with a knock-in or knock-out barrier to set the cap or floor level. This would mean that the cap or floor would apply only if or unless the barrier reached a certain level. Putting a fixed floor on an index-linked cash flow means taking the highest of a fixed cash flow and the relevant index-linked cash flow. If we make the fixed cash flow knock out when the index is equal to or higher than *H*, we end up with a cash flow equal to

$$CF_T = Max(D \times K, M \times I_T)$$

with

$$D = 0, if\ \exists j\ Ij \geq H,$$

$$D = 1, if\ \forall j\ Ij < H$$

If the floor does not knock out, the cash flow would be identical to an ordinary best-of. On the other hand, if the floor knocks out the cash flow would simply be equal to a vanilla index-linked cash flow, leaving the investor without downside protection.

3.3.7 Arithmetic averages

A popular type of cash flow equal to the average of a number of index values over some period of time. Such a cash flow is equal to the sum of a number of vanilla index-linked cash flows with delayed settlement. Suppose that over some period of time we monitored the reference index N times. A cash flow equal to the average of these N observations could in that case formally be described as:

$$CF_T = \frac{1}{N} \times (M^1 \times I^1 + M^2 \times I^2 + \cdots + M^N \times I^N)$$

where I_i denotes the value of the reference index at the i^{th} monitoring point, *i=1, 2,…, N*, and M_i is the accompanying multiplier. Although every component cash flow can have a different multiplier, in which case we speak of a weighted average, in most cases all multipliers are the same. This means we can rewrite the previous formula as

$$CF_T = \frac{M}{N} \times (I^1 + I^2 + \cdots + I^N) = M \times \frac{\sum_{i=1}^{N} I^i}{N},$$

in which case we speak of an unweighted average.

Even with an unweighted average we still need to set the monitoring points. We can determine the average over the full lifetime of the relevant contract, but this is not always desired. The so-called average period is the period between the first and the last monitoring point, may only cover the first part of the life of the contract, the middle part or only the last part. In between the first and the last part. In between the first and the last monitoring point we can scatter monitoring points any way we want. Usually monitoring is done on a daily, weekly or monthly basis, but there is no reason why monitoring points should always be equally spaced.

Note that the number and location of the monitoring points is an important determinant of the volatility of the average. When the number of monitoring points is increased the average becomes less volatile.

Thanks to the presence of a large number of component cash flows, if we wanted to floor or cap a cash flow equal to the average there are various alternatives available. Apart from flooring or capping the average as a whole, we can floor or cap every component cash flow separately. With every component capped at the same fixed level *K* this yields a cash flow equal to

$$CF_T = M \times \frac{\sum_{i=1}^{N} Min(K, I_i)}{N}$$

This is only one of the possibilities though. We could cap different component cash flows at different fixed levels, or instead of fixed cap we could introduce index-linked cap levels. An interesting variation occurs if we cap every component at a factor times the value of the average to date. In that case we would end up with a cash flow equal to

$$CF_T = M \times \frac{\sum_{i=1}^{N} Min(\beta A_i, I_i)}{N}$$

Where A_i denotes the average index value over the first *i* monitoring points and β is a constant. In a way the average is restricting its own behavior here.

3.3.8 Moving best-of and worst-of

Cash flows equal to the highest or lowest of a number of reference index values over some period of time can also be very useful in derivatives structuring. Like averages, cash flows

like these are made up of a number of vanilla-index linked cash flows with delayed settlement. Instead of taking the average, however, this time we take the highest or the lowest. Assuming all component cash flows have the same multiplier, a cash flow equal to the highest of *N* subsequent index values can formally be written as

$$CF_T = M \times Max(I_1, I_2, \dots, I_N)$$

The expression for the lowest index value is similar and is given by

$$CF_T = M \times Min(I_1, I_2, \dots, I_N)$$

Cash flows equals to these can be interpreted in the same way as the highest or lowest in general: at maturity the receiver or payer chooses one cash flow from a set of vanilla index-linked cash flows which equal the reference index values at a number of points in time.

The variations found are similar to those found in averages. The so-called lookback period. This is the period of time between the first and the last monitoring point. The longer the lookback period, the more opportunity we have to observe an extreme high or low index value. Within the lookback period monitoring can be done daily, weekly, monthly or anything else, with the monitoring points equally or not equally spaced. As well, the more often we monitor the index, the more likely we are to find an extremely high or low index value.

3.3.9 Piecewise linear cash flows

A vanilla index-linked cash flow has a linear relationship with the value of the reference index on the payment date. We can also structure cash flows which have other functional relationships with the index value at maturity. A very popular alternative is a piecewise linear functions. With a piecewise linear cash flow the size of the cash flow is a fragmented function of the index value.

When dealing with piecewise linear cash flows we have to decide on issues like the number and location of the changes in the slope, this is, the values of I_T where the participation rate[12] changes, and the participation rate among fragments, this is, the slope. Clearly, this allow a lot of variation.

3.3.10 Cliquets

Sometimes it is advantageous to see the change in the reference index over a longer period of time as the sum of the index changes over a number of subsequent shorter periods. So-called cliquet cash flows are equal to the sum of the floored, capped or collared[13] changes

[12] The participation rate indicates the product's level of exposure to changes in the price of the underlying and represents, in essence, how leveraged the return is.
[13] Simultaneously capped and floored.

over a number of subperiods. Assuming all component cash flows have the same multiplier, a 5-year floored cliquet cash flow which accumulates the index changes on a yearly basis can be expressed as

$$CF_T = M\ x \sum_{i=1}^{5} \text{Max}(F,\ I_i - I_{i-1})$$

Where *i* counts the years from inception and *F* denotes the floor level. This cash flow is made up of five parts corresponding to the five years until the payment date. Each year contributes an amount equal to the change in the reference index over that year, floored at *F*.

If we also cap the yearly absolute returns we get a cash flow equal to

$$CF_T = M\ x \sum_{i=1}^{5} \text{Max}(F,\ I_i - I_{i-1}, \text{C})$$

where *C* corresponds to the yearly cap level. In this case, every year's contribution is equal to the index value of the year but never less than *F* not more than *C*.

Looking at the above formulas, we see that with cliquet cash flows we have to decide on a series of variables such as the number of subperiods, the level of floors and the level of caps.

The more subperiods we introduce, the higher the cash flow can become as there is more opportunity to collect contributions. With respect to the floor and/or cap it is important to note that flooring and/or capping the contributions of the individual years is different from flooring and/or capping the whole cash flow at once.

3.3.11 Hamsters

Adding a number of digitals may produce very interesting cash flows. For example, it allows us to create cash flows the size of which depend on the number of days, weeks or months the reference index spent within some particular range. For every period that the index did not get out of the range we would add something to the size of the cash flow. Since cash flows like these grow bigger the more time the index spends within the range, they are called hamsters[14].

When dealing with piecewise linear cash flows we have to decide on the range inside of which the hamster grows, this is, where the cash flows accumulates value. Therefore, outside of it does not. The range can be fixed in advance but it can also be made to move

[14] Other authors refers to them as corridor options, time trades or range accruals.

over time and/or with the index. Another thing to determine is the elementary period, as the hamster grows stepwise. Every elementary period during which the index does not venture outside the range makes a contribution to the cash flow. If the elementary period is a week we say that the hamster grows on a weekly basis. As mentioned before, every elementary period the underlying value is within the boundaries, a contribution to the value is made, and such contribution has to be determined from the beginning, yet it may be a prefixed amount but it could also be made to move over time and/or with the index. Finally, the monitoring points within the elementary periods where the underlying value is checked.

Note that it is possible to have only one monitoring point per elementary period. We could for example let the cash flow grow on a daily basis and each day monitor the index only at the close of trading[15].

Suppose we set the lower range boundary at H^1 and the upper range boundary at H^2 to create one-year hamster with weekly contributions of K. This means we would get a cash flow equal to

$$CF_T = \sum_{i=1}^{52} D \times K$$

Where

$$D = 0, if\ \exists j\ I_j \leq H_1\ or\ I_j \geq H_2,$$

$$D = 1, if\ \forall j\ H_1 < I_j < H_2,$$

i counts the number of weeks and j counts the monitoring points within the week i. With the above hamster there are 52 elementary periods of one week. With daily monitoring the index would be monitored five times per week. If at all five monitoring points the index was inside the range, the relevant week would contribute an amount K to the cash flow at least once, the week would made no contributions.

The above description makes it clear that the hamster is nothing more than the sum of 52 digitals. Every one of these digitals has an American double knock-out barrier feature which covers a one-week period and, if alive, pays an amount K at time T. The first digital barriers covers the first week, the second digitals barrier covers the second week, etc. Note that its digital has the same multiplier, this is that different weeks may contribute different amounts to the final cash flow.

[15] It is worth noting that it is irrelevant that the index value fluctuates outside the range as long as it is inside during monitoring points.

Since there are so many different types, there are also a lot of different types of hamster. One distinction is between in-range hamsters and out-range hamsters. Contrary to the hamsters discussed so far the latter only pay when the index is outside the range. In range and outrange hamsters are each other's mirror image in exactly the same way as knock-in and knock-out digitals are, while out-range hamsters are sums of equivalent knock-in digitals. We will concentrate on in-range hamsters.

Another distinction is between straight hamsters and reverse hamsters. The former build up the cash flow over time, while the latter build down the cash flow over time. Reverse hamsters start off with a fixed amount and make deductions for elementary period the index is outside the range. In other words, a reverse hamster is a fixed amount minus straight out-range hamster. Note that the amount at the start did not necessarily be equal to the total number of elementary periods times the contribution. If it is lower, however, the cash flow may become negative.

So far, the contribution outside the range has been equal to 0. We can, however, also create a hamster where the contribution outside the range is negative instead of 0. Such a give-and-take hamster would pay a positive give amount for every elementary period the index was in the range and a negative take amount for every period it was outside the range. Basically, this is a combination of an in-range hamster with a positive elementary contribution and an out-range hamster with a negative elementary contribution. Again, this structure allows for a negative cash flow as the hamster may take more than it gives. The index may spend more time outside the range than inside, and even if not the elementary take amount may have been set higher than the elementary give amount.

Another possible variation is the so-called multiple range hamster. Instead of a binary payment structure, this hamster has a more detailed range structure where different amounts are paid in different ranges. A layered pay-out structure means choosing and error range a less narrow range (containing the narrow range). When the reference index stays within the narrow range, the highest contribution is paid. If the index gets out of the narrow range, but stays within the less narrow range a lower contribution is paid. If the index comes outside the less narrow range there is no contribution. This is also referred to as a wedding cake structure.

Normally the range boundaries will be chosen not so far apart. If the range is very wide the probability that the index escapes from the range will be very small, which defeats the purpose of constructing a hamster. What can be done, however, is set the upper range boundary equal to infinity, or the lower range boundaries equal to 0. In the first case the relevant range is the outcome space above the lower range boundary, and in the second case it is the space between the upper range boundary and zero. We call this a one-sided hamster.

One problem with the above hamsters is that the range is fixed in advance. It therefore only takes one jump of the reference index to essentially kill the hamster, even if the index stabilizes again afterwards. One solution is to periodically revise the location of the range boundaries. We could for example maintain the same range width but relocate the range such that the reference index started in the middle of the range again. In that case, the range would more or less, follow the reference index. If the index suddenly jumped outwards or downwards this would be corrected in the next range revision. Such a cliquet hamster is the same as an ordinary hamster, but this time the knock out barriers are forwards-starting instead of fixed in advance.

Using digitals with bivariate barriers we can extend the hamster concept to the case of two reference indices and create bivariate hamsters. These pay a fixed amount for every elementary period the two periods are within their boundaries. We can also combine in-range and out-range hamster in such a way that the hamster only grows when one index is within the range and the other outside of it. The variation s for bivariate hamsters are similar as for univariate hamsters, but there are more of them.

3.3.12 INCOME-GENERATING STRUCTURES

All notes discussed so far pay investors a return on investment which heavily depends on the index value at maturity and sometimes also on the path taken by the index to get there. Instead of paying investors a higher return the more the index moves in the direction they predicted, we simply pay them a prefixed amount. As a result, we no longer have return profile graphs with upward and downward sloping lines, but also horizontal lines.

So far we have dealt with notes that do not provide any intermediate coupon. To accommodate this we can either introduce a fixed coupon or simply break up the payment that the zero makes on top of the redemption of the principal and spread it over a number of coupons that are paid during the life of the note.

Sometimes investors are seeking to balance current income with growth of capital. In that case adding a small fixed coupon is often the easiest solution. Suppose a standard principal protected bull note which we wanted to equip with a fixed annual coupon. This is easy to arrange. One way is to let the bank pay the coupons to the investor while deducting those payments from the coupons paid to the derivatives firm. Alternatively, the bank could pay the derivatives firm the usual coupons while in return the derivatives firm would not only pay the regular payment at maturity but also the desired intermediate coupons. The derivatives firm would pay the coupons to the bank and the bank would pass those coupons on to the holders of the note. At maturity the coupons paid during the note's life are worth

$$C_T = \sum_{i=0}^{T} e^{ir_i}(N \times R)$$

where *R* denotes the coupon rate. By introducing intermediate coupons we are reducing the amount of money available to buy options. As a result, the note's participation rate will drop. The relation is depicted in figure 3.1.

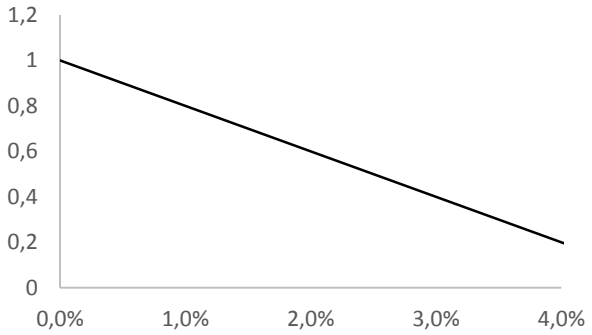


Figure 3.1. Trade-off between coupon rate and participation rate for a vanilla bull note assuming no spreads
Source: compiled by author

No matter if the index rises or falls, investors still receive their coupons on top of the regular note payoff. However, the introduction of non-zero coupons causes a significant drop in the participation rate.

3.3.12.1 Reverse convertibles

Within income-generating structures we found a very popular variety first launched in 1993 known as reverse convertibles. These securities provide a predictable (preset), steady income that can outperform traditional fixed income returns, even those of high-yield bonds (junk bonds). These structured products consists in a coupon-bearing short-term note (up to 1-2 years) that is linked to the performance of a reference asset The structure is composed by a debt instrument that pays and above-the-market coupon (usually monthly or quarterly); and a derivative that gives the issuer the right to repay principal to the investor in form of a set amount of the underlying asset, rather than cash, if the price of the underlying asset moves below predetermined price, usually equal to the value at initial fixing date.

By buying a reverse convertible note, we are getting a yield-enhanced[16] bond, but we do not participate in any upside appreciation of the underlying asset. Instead, in exchange for higher coupon payments during the life of the note, you effectively give the issuer a put option on the underlying asset. Investors contracting these products are betting that the value of the underlying asset will remain stable or go up.

[16] According to the Swiss Structured Products Association (SVSP) classification of structured products.

There are two structures to determine whether the investor will receive their original investment amount or the stock. The basic structure consists in, at maturity, if the stocks closes at or above the initial, 100% of the original investment is received. If the stock closes below the initial price, a predetermined number of share is delivered. This means that the investor will end up with shares that are worth less than the original investment. On the other side, we find what is known as knock-in structure or barrier structure, where the investor receive either the entire initial investment or shares of the underlying stock at maturity. With this structure, though, the investor is benefited from some downside protection. Let's have a closer look at the possible outcomes according to the performance of the underlying asset.

Within the first scenario, the stock price never declines below the knock-in level but ends below the initial price. In this case, there is a full return of principal in cash, despite the decline in the price, plus any fixed coupon payments that are independent from the stock performance throughout the life of the note.

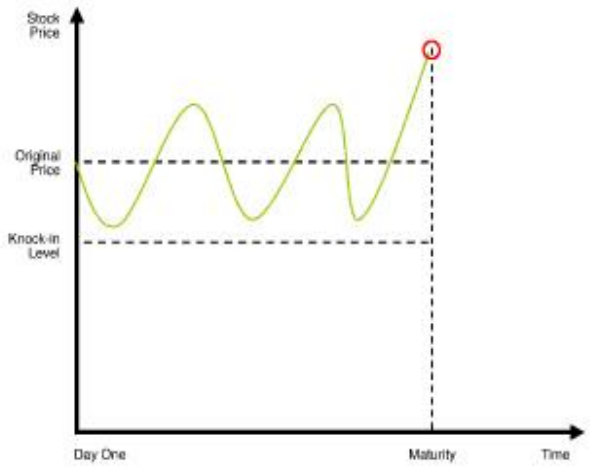


Figure 3.3. Underlying performance for BRC
Source: FINRA webpage

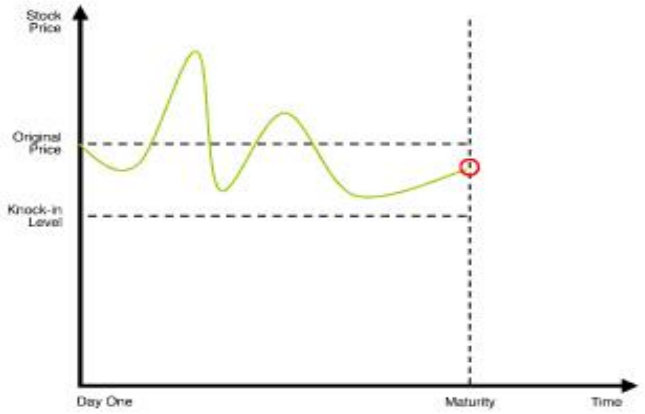


Figure 3.3. Underlying performance for BRC
Source: FINRA webpage

In the second scenario, the best case scenario, the stock price never declines below the knock-in level, and ends above the original price. Therefore, the full return of principal of cash takes place together with any fixed coupon payments agreed, but there still no participation in the increase in the stock price.

According to the third scenario, the stock price declines sometime below the knock-in price, an ends below the initial price. This time, a predetermined number of shares of stock, worth less than the initial investment, plus any fixed coupon payment is delivered. Sometimes, depending on the issuer and the product, if the stock price ends between the original price and the knock-in level, full return of principal in cash can be determined, however it is not usual.

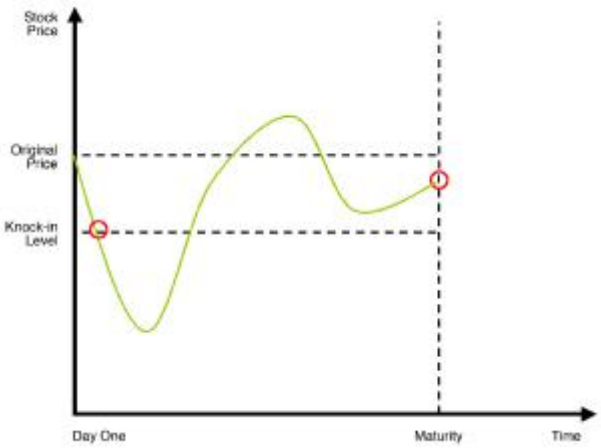


Figure 3.4. Underlying performance for BRC
Source: FINRA webpage

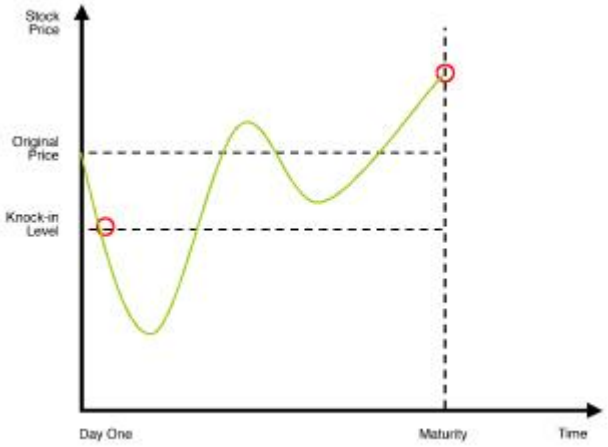


Figure 3.5. Underlying performance for BRC
Source: FINRA webpage

Finally, the stock price can decline below the knock-in level, but as long as it ends above the original price, the investor receive the amount invested in cash, plus any fixed coupon payments. The outcome of this performance is the same as in the first and the second case. Note that as the stock's price declines, the value of the option puts increase and it makes easier for the issuer to provide the reverse convertible holder with the subscribed coupons.

Generally speaking, the higher the coupon rate the note pays, the higher the expected volatility of the reference asset. In turn, the more volatile the reference asset, the greater the likelihood that the knock-in level will be breached, and the investor could receive less than a full return of principal at maturity.

IV. Analysis of structured products

4.1 Introduction

The last part of this assignment is devoted to put into practice what has been written in previously chapters to analyze the fundamentals of a structured product issuance. In it, it is first described the main product features starting from a deep product understanding followed by the structure formalization corresponding explanations about the affecting variables, to further on discuss about the hedging strategy the issuer is likely to use and concluding with the return profile.

Targeting of popular commonly-traded products with additional features to enrich the structure analysis has been determinant. As well, it has been discriminated between already-expired products to be able to conclude about the corresponding settlement. The term sheets (or prospectus) used in this chapter can be found in annex one.

4.2 Analysis of a capped 95% PPN on the Standard & Poor's 500® Index in USD

4.2.1 Product description

A principal-protected note (hereinafter PPN) is a security that guarantees a minimum return usually equal to the investor's initial investment (the principal amount). These investments are tailored for risk averse investors wishing to protect their investments while participating in gains from favorable market movements. As it offers capital protection, investors investing in these products expect upsides in the underlying asset with possibility of price decline.

The PPN we have chosen is marketed by Clariden Leu AG, a private bank based in Switzerland that was acquired and finally integrated at 2012 by Credit Suisse. At the time the product was issued it counted with credit rates within investment grade category, specifically Aa2 grade according to Moody's (low credit risk) and is subject to supervision of FINMA, the Swiss financial market supervisory authority.

A favorable scenario to invest on these products is a downward trend of interest rates for the term of the product. This is especially important when structures are built with long time horizons. Investors present a strong bullish stock market expectations over time within a scenario of low volatility with tendency to increase. The ideal scheme would take advantage of those moments where the historical volatility of the underlying asset is above the implicit volatility quoted at the time the product is built.

Its issuance size is expected to be USD 5,000,000 with denominations of USD 1,000, a total of 5,000 PPN. Specifically, it offers partial capital protection as it guarantees the refund at maturity of the 95% notional amount. Hence, the floor rate is set at -5%. As well, an additional feature is added to the product as it is capped at 160% of the initial fixing level, meaning that the profitability cannot exceed a predetermined threshold. In this case, if the performance of the S&P 500 increases more than a 60%, the investor will not participate on it as it receives a return up to the 60% subscribed at the contract.

This product is issued at a 100% participation rate. That is, basically, that if the index increases a 20%, investor will be responsible for the full 20%, otherwise, if the participation rate was 150%, he will be responsible for the 30% (1.5 times the 20%).

As the note offers partial capital protection, it makes sense that the note is capped as it is a trade-off game, where reduced risk exposure is compensated with reduced potential gains. Another way to do so would be to get rid of the cap and set a participation rate lower than 100%, which would make the note less responsive to underlying's movements.

As shown in the final term sheet, it consists on a 5-years investment with bullet payment and no intermediate coupons, issued at par value which is paid out the April 30th of 2010, where the starting price level is fixed the April 23th when the 5 years start to run until the April 24th of 2015. At that date, the closing price is determined and the performance is therefore locked in. Finally, redemption of the 95% capital invested plus the return according to the underlying's performance takes place the April 30th of 2015. It is illustrated for simplicity in figure 4.1.

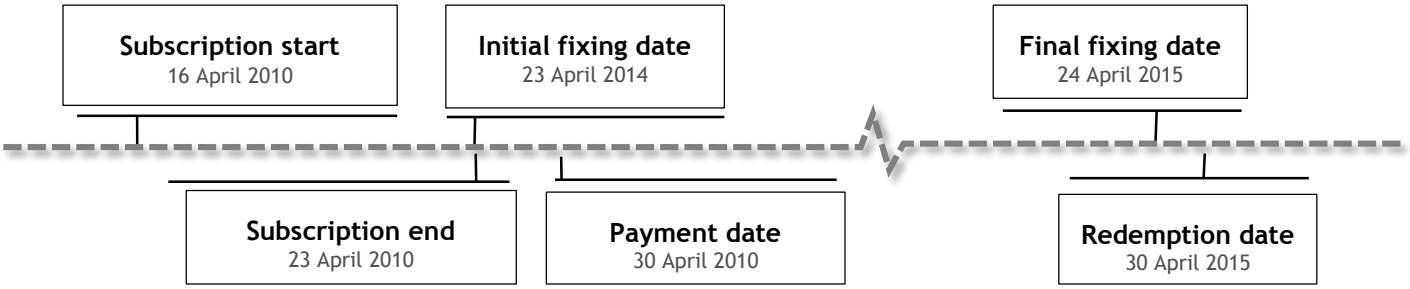


Figure 4.1. Investment lifecycle
Source: compiled by autor.

4.2.2 STRUCTURE FORMALIZATION

Principal protected notes are made of a fixed and an index-linked part, where the first is guaranteed and the latter depends on the underlying performance.

The fixed part is composed by a secured partial 95% redemption of the initial investment at expiry. It can be formally written as *N x (1+ f)* where *f* is the floor rate and equals to -0.05 deriving to a fixed bullet payment equal to *N x 0.95*.

Additionally, as part of the index-linked payoff, the investor will receive at maturity 100% of the positive performance in percent of the underlying up to the cap. Therefore, negative performances of the underlying are not to alter the 95% capital guaranteed and positive performance is limited to the cap level, set at 160% of the initial index level.

The overall expression that gathers up both fixed and index-linked payments can be expressed as follows

$$CF_T = N \times \left[1 + f + Max\left(0, Min\left(c, \alpha \frac{I_T - I_0}{I_0}\right)\right)\right]$$

$$CF_T = 5{,}000{,}000 \times \left[0.95 + Max\left(0, Min\left(0.6, \frac{I_T - I_0}{I_0}\right)\right)\right]$$

If we have a closer look, we see that at maturity, the cash flow the investor receives cannot be below 95% neither above 1.55% of the notional amount, as shown in figure 4.2.

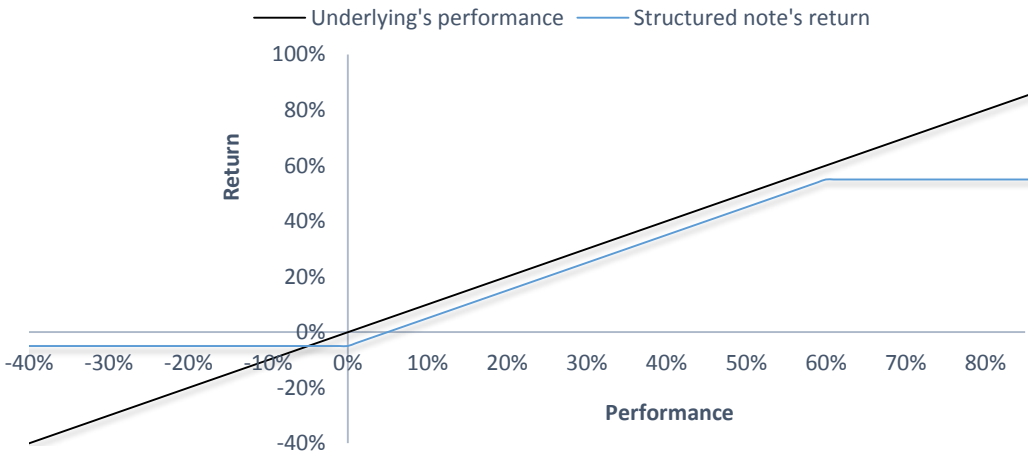


Figure 4.2. Structured note's return vs. underlying's return
Source: compiled by author.

4.2.3 HEDGING STRATEGY

Principal protected notes are the result of combining zero coupon securities and the price of options on stock or stock indexes. Some elements has to be taken into account when dealing with this kind of products.

The interest rate used to update the implied cash flows will determine the price of the structure until maturity. Principal protected notes offer redemption of the total or partial capital invested at maturity. This can be achieved by acquiring public securities with expiry equivalent to that of the structured product. More specifically, sovereign zero coupon notes are perfect for this purpose. These kind of securities are issued by the government at discount, and yield is derived from the differential of the price paid and the notional value to be received at expiry. Sovereign debt is considered to be the safest investment, as it is issued and backed by the government. In fact, it is often used as cost of opportunity because it is deemed to be risk-free interest rate.

The price of the derivative used will have direct influence in the profitability of the overall structure performance. After acquiring zero coupon bonds, the remaining money (after deducting the profit margin taken by intermediaries) is used as a part of a strategy with options. The money available to invest in options will determine the participation rate.

Vanilla European at the money (ATM, equal to the initial price of the underlying) calls will provide us with unlimited profit potential. Given the amount to invest in options, the higher the bid price the lower the participation rate. Since we already invested in zero-coupon bonds, the participation rate has decreased considerably as the money available to buy calls did so. That is the trade-off of securing the partial redemption of the principal. To solve this, we can sell vanilla European put options to collect money to buy more calls aiming to achieve the participation rate the issuer subscribed in the contract. Through writing puts, we are capping our returns. That is the trade-off to achieve a higher participation rate. To achieve the participation rate equal to 100%, the bank wrote puts with strike 1.6 times the initial underlying price.

In this case, as the product offers a 95% principal redemption and the notional equals to USD 1,000, the issuer has to pay back to the investor an amount totaling USD 950. With USD 5,000,000 to be placed in the market, at expiry the issuer is entitled to pay back USD 4,750,000. At the time this structured was launched, government issued 5-year zero-coupon bonds of notional equivalent to USD 1000 at an average price of 82.930 (USD 829.30 per bond), that after 5 years will be paid out, with no intermediate coupons, at nominal value leading to annualized yields equivalent to 3.814%. At prevailing interest rates, the lump sum to be paid at time t=0 equals to:

$$CF_0 = \frac{N \times (1 - F)}{(1 + r)^T} = \frac{4{,}750{,}000}{(1 + 3.814\%)^5} = 3{,}939{,}175\ USD$$

The bank therefore invests USD 3,939,175 in zero-coupon bonds to secure principal redemption. From the remaining money the bank will take out an amount to cover its commercial margin and the rest, together with the money collected by issuing puts, is used to buy calls.

4.2.4 SETTLEMENT

The return will be determined by the 5-year performance of the S&P 500 index. On April 23th of 2010 the S&P 500 index closing price was 1,217.28. This is the origin value taken for

Lifecycle Events

24.04.2015	ℹ	**Final Redemption Cash** Please be informed that the settlement will be cash according to the following terms: 155%
02.04.2012	⚠	**Integration Clariden Leu AG into Credit Suisse AG** On April 2, 2012, Clariden Leu Ltd. has been integrated into Credit Suisse AG. The integration was completed as a merger by absorption between Clariden Leu Ltd. and Credit Suisse AG, with Credit Suisse AG being the absorbing entity. The documentation of products issued by Clariden Leu Ltd or its Nassau Branch, respectively, prior to the merger date will not be adjusted. Therefore, you will still find documentation produced by Clariden Leu Ltd. on this website. In the merger, all rights and obligations of Clariden Leu Ltd. in connection with its structured products have automatically been transferred by operation of law to Credit Suisse AG or its Nassau Branch, respectively.

reference. It is already monetized at a factor 1 times the index number and multiplier of the cash flow has been set at the same factor as well. There is no need for currency translation as it is expressed in USD, the domestic index currency. During the lifecycle of the PPN there has been no significant events affecting the overall value of the structure. Below is a list with information matter of interest for investors during the product's lifecycle

At maturity, on April 24th of 2015 the final index closing price is 2092.83. In figure 4.3 it is shown both the S&P 500 index and the structured note's returns throughout the products lifecycle. As we can observe, product's return is 5 percentage points below the index performance due to the initial downgrade to 95%, this is, that underlying's return starts at 100% while structured product's return does so at 95%. It is not true for periods where the

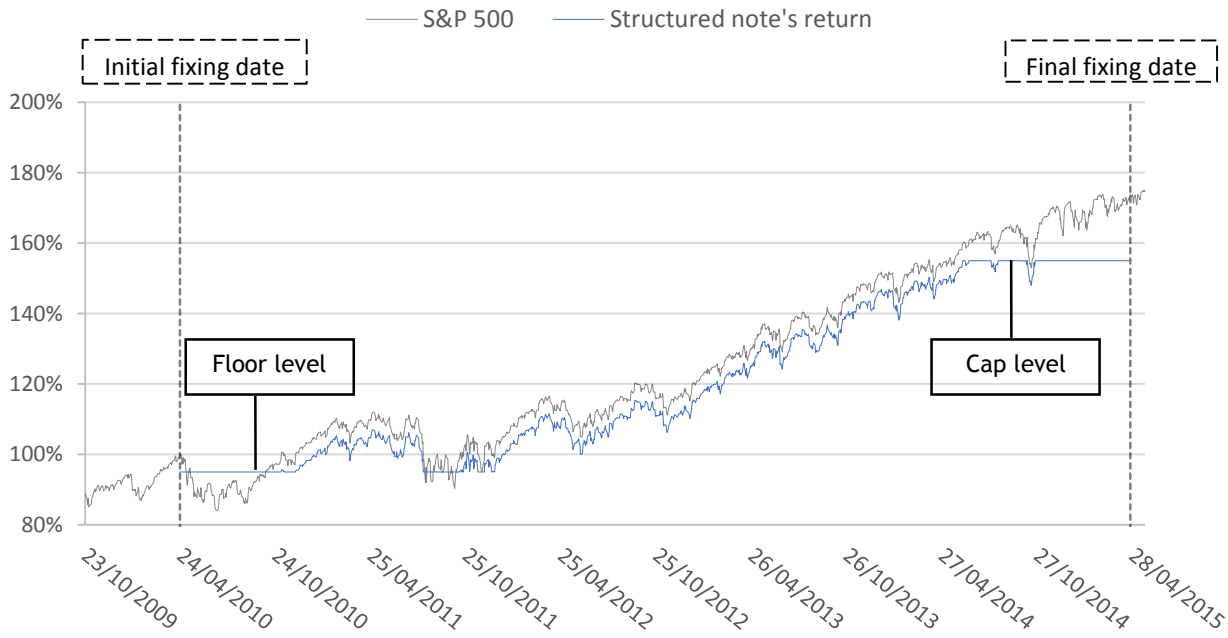


Figure 4.3. Structured's note return vs. S&P 500 performance
Source: made by author. Data extracted from S&P Dow Jones Indices LLC webpage

underlying suffer downturns below its initial level and the floor level is reached but never overstepped.

As the index exceeds the cap level at maturity, the investor is just responsible for the 60% increase and do not participate in upturns behind this limit. Taking this into account, we can determine the cash flow at time *T* the following way

$$CF_T = 5{,}000{,}000 \times \left[0.95 + Max\left(0, Min\left(0.6, \frac{2092.83 - 1217.28}{1217.28}\right)\right)\right]$$

$$CF_T = 5{,}000{,}000 \times \left[0.95 + Max\left(0, Min(0.6\,, 0.7193)\right)\right]$$

$$CF_T = 5{,}000{,}000 \times [0.95 + 0.6]$$

Thus, each investor will receive on April 30th of 2015 its 95% principal of USD 950 plus a 60% return of USD 600 which amount a total of USD 1,550. As at the beginning the investor had to disburse the full notional amount (it was not issued at discount), the 5-year return on the structured note equals to 55% (an outstanding annualized 9.16%). Below in figure 4.4 is the interannual S&P 500 variation during the structured's lifetime, where we can observe the return the investor would have earned if he decided to invest directly in the underlying, either through index participations (with no participation on dividends) or through portfolio replication.

Month	Price Close	Variation	Variation (including dividends)
04/2015	2085,51	10,70%	12,98%
04/2014	1883,95	17,93%	20,44%
04/2013	1597,57	14,28%	16,89%
04/2012	1397,91	2,52%	4,76%
04/2011	1363,61	14,91%	17,22%

Figure 4.4. Interannual S&P 500® Index variation
Source: made by author. Data extracted from S&P Dow Jones Indices LLC webpage

4.3. Analysis of a BRC on Roche Holding AG, Swatch Group AG and ABB Ltd in CHF.

4.3.1 Product description

Barrier reverse convertibles (hereinafter BRC) have been introduced in the previous chapter. To summarize, BRC provide the investor with outstanding high fixed coupons that do not depend on the underlying asset or index basket performance during the investment lifetime. Nonetheless, the investor is exposed to the possibility of receiving its investment in shares if the underlying price decline below some level and ends up below the initial price. It differs from vanilla reverse convertibles in the fact that these provide some downside protection as redemption in shares will be additionally restricted to the possibility of reaching some predetermined level (knock-in or barrier). Due to the barrier, the probability of maximum redemption is higher; the coupon, however, is smaller than for a traditional reverse. In point of fact, if the barrier is breached the product changes into a reverse convertible.

The BRC we have chosen is marketed by Credit Suisse, a Swiss multinational financial services holding company with three divisions including investment banking, private banking and asset management, considered to be one of the world largest financial conglomerates[17]. At the time the product was issued, the issuer Credit Suisse has been rated A by Standard & Poor's, A by Fitch and A1 by Moody's.

This kind of structures are based on selling put options, therefore they are subject to a large degree of risk. A determinant factor favoring the success of the structure is to select a basket of stocks with undervalued quotation, where analyst recommendations point upwards, with positive and high correlation, and volatility with downward trend. Investors investing in BRC expect small downturns or lateral movements.

Its issuance size is expected to be CHF 1,250,000 with denominations of CHF 1,000, a total of 1,250 BRC. A 1-year BRC that provides investors with 6.50% annual return divided in two semi-annual coupons that are irrespective of the development of the underlying. Therefore, the potential return is limited. It is structured with a basket of three different stocks: Roche Holding, Swatch group and ABB. As we commented before, it includes an addition feature as it incorporates a knock-in clause at 75% of the initial fixing price, which will determine the final settlement. If during the lifecycle any underlying breaches the knock-in level and ends below the initial fixing price, the investor will receive a predetermined number of shares (according to a ratio) of the worst-performing stock (out

[17] In fact, due to his size, complexity, organization and business activities as well as his systematic importance, together with UBS AG, they are dedicated specialized teams to supervise their activities and procedures by the local financial market supervisory (FINMA).

of all the underlying), this is, the underlying in respect of which its final level divided by its initial price results in the lowest value).

As shown in the final term sheet, it consists on a 1-years investment issued at par value which is paid out the 16th of 2014, where the starting price level is fixed three days before when the 1 year start to run until the May 12th of 2015. At that date, the closing price is

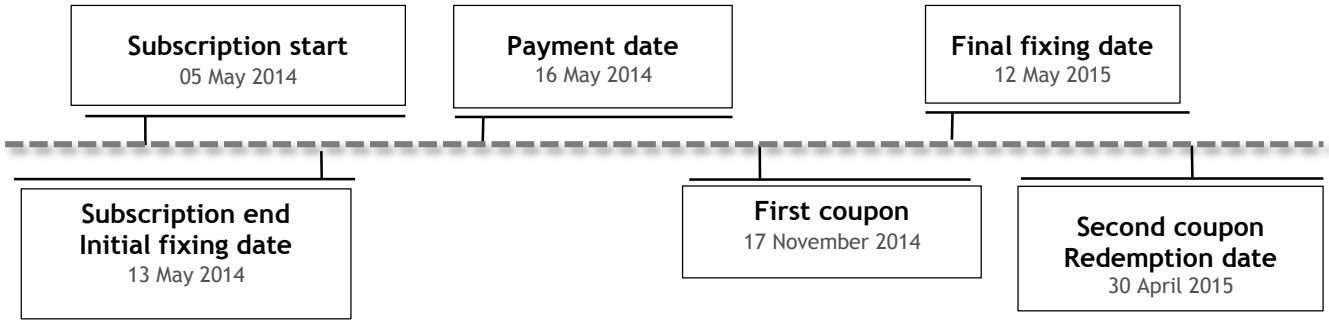


Figure 4.5. Investment lifecycle
Source: compiled by author

determined and the performance is therefore locked in. Semi-annual intermediate coupons are dated November 17th of 2014 and May 18th of 2015. Finally, redemption takes place the May 16th of 2015. It is illustrated for simplicity in figure 4.5.

4.3.2 Structure formalization

We can break down the barrier reverse convertible into two parts according to the grade of certainty. At absolute grade of certainty (regardless the underlying basket of assets development) the investor receives coupons that will depend on the yield earned on the debt instrument and the premium received for writing the corresponding puts. The annual interest rate the investor would end up with is 6.5%. The 6.45% corresponds to the premiums earned and the remaining 0.05% comes from interest gains from debt instruments, both expressed in percentage points of the notional amount. Those coupons are distributed in two dates: the first one is received on November and the other is to be received at May, when the investment matures. Aforementioned cash flows can be expressed as

$$CF_t = N \times \left(\frac{Earning\ from\ premiums + earnings\ from\ interest}{n}\right)$$

$$CF_{\frac{T}{2}} = 1{,}000 \times \left(\frac{0{,}0645 + 0{,}0005}{2}\right) = 32.25 + 0.25 = CHF\ 32.5$$

$$CF_T = 1{,}000 \times \left(\frac{0{,}0645 + 0{,}0005}{2}\right) = 32.25 + 0.25 = CHF\ 32.5$$

where *n* accounts for the annual number of coupons, and earnings are expressed in percentage points of the notional amount.

Additionally, the investor will receive its principal back at maturity if the underlying behaves in a predetermined way. As it depends on previously specified conditions, we can categorize this amount to be received as index-linked. BRC repays principal back unless the following two conditions are simultaneously met: one or more underlying assets breaches the knock-in level and one or more of them present prices below initial fixing prices at maturity. To formally express those conditions, we will introduce qualitative variables

$$CF_T = N \times \left[1 + Min\left(c, D \times \left(\frac{I_T^1 - I_0^1}{I_0^1}, \frac{I_T^2 - I_0^2}{I_0^2}, \frac{I_T^3 - I_0^3}{I_0^3}\right)\right)\right]$$

with

$$D = 1, if\ \exists t\ I_t^1 \leq 0{,}75 I_0^1\ or\ I_t^2 \leq 0{,}75 I_0^2\ or\ I_t^1 \leq 0{,}75 I_0^3,$$

$$D = 0, if\ \nexists t\ I_t^1 \leq 0{,}75 I_0^1, I_t^2 \leq 0{,}75 I_0^2, I_t^1 \leq 0{,}75 I_0^3,$$

where *C* is the cap rate expressed in absolute terms. Note that monitoring is continuous in time as we are dealing with a continuous barrier. As the cap *c* is expressed in percentage variation of the underlying initial price, it is equal to 0%.

The cap rate sets the price level that will determine whether the settlement is done in cash or rather than it, in shares. The number of shares to be received is determined at the beginning as it is equal to the amount of shares that would be purchased with the notional at initial price. If we look back at the above expression, we see that in the case that one of the index does not rise enough to make the note payoff reach the cap level, and at any time during the note's lifecycle it ended below the initial level, the payoff to the investors will be equal to

$$CT_T = N + \frac{I_T^i}{I_0^i} N - \frac{I_0^i}{I_0^i} N = I_T^i \times M^i$$

Where M^i equals the ratio $\frac{N}{I_0^i}$ which shows the number of shares in stock *Z* that would be obtained if we invested our *N* directly in the underlying in time *t*=0. This means that if conditions set through variable *D* are met, the note payoff would be equal to the value of M^i shares in the index at maturity.

The overall expression that gathers up both fixed and index-linked payments can be expressed as follows

$$CF_T = N \times \left[1 + 0{,}065 + Min\left(c, D \times \left(\frac{I_T^1 - I_0^1}{I_0^1}, \frac{I_T^2 - I_0^2}{I_0^2}, \frac{I_T^3 - I_0^3}{I_0^3}\right)\right)\right]$$

If we have a closer look, we see that the only feature that makes the BRC different from the traditional reverse convertible is the qualitative variable D, which introduces an additional restriction consisting in breaching the knock-in level.

We can appreciate how the profit is closed and limited to the interest received plus the cap rate. However, the loss is unlimited up to the capital invested. Below in figure 4.6 it is shown the profitability of the BRC relative to the underlying.

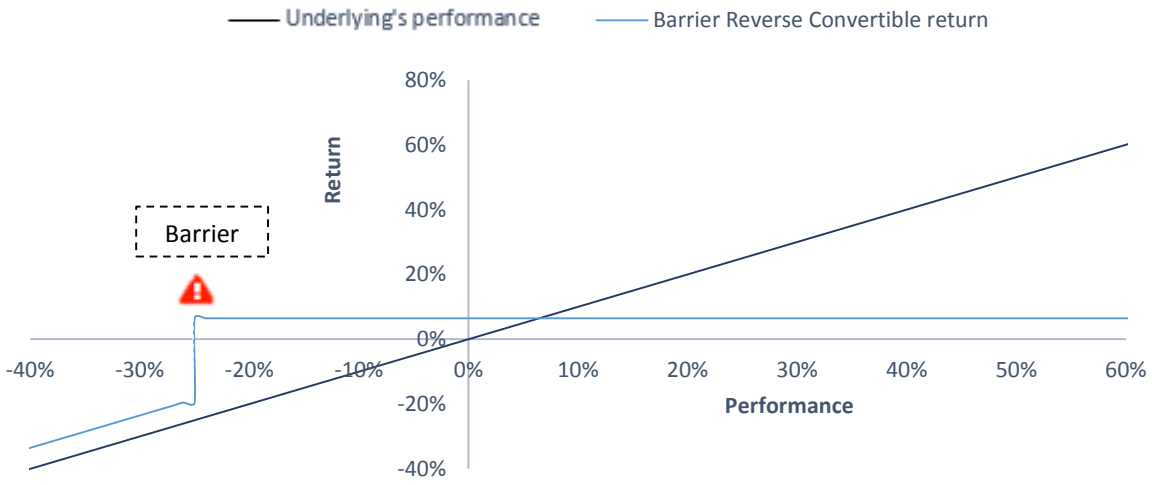


Figure 4.6. Return profile BRC in function of the underlying performance.
Source: compiled by author.

4.3.3 HEDGING STRATEGY

BRC provide the investor with steady coupons along the investment. These coupons are made up of the interest of a debt instrument and the premium obtained for adopting short positions with options. Zero coupon notes are the most adequate for this purpose. As

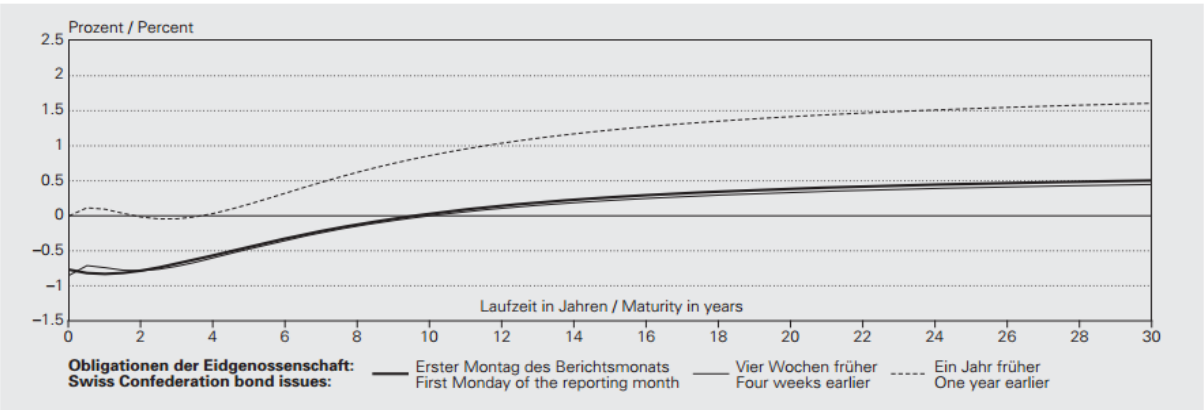


Figure 4.7. Interest yield curve for CHF Swiss confederation debt instruments.
Source: Swiss National Bank webpage.

mentioned before, they are issued at discount and pay off an amount *N* at maturity. Figure 4.7 shows interest rate yield curve for Swiss confederation public bonds issued by the Swiss National Bank (SNB) at May 2015, one year later and other maturities. If we look at the curve showing interest rates one year earlier, the date the structured was issued, we observe how zero coupon notes with 1-year maturity offered interest rates between 0.05% and 0.10%.

The main attractive of BRC are the over-the-market high coupon yields which are obtained by the issuance of European knock-in put options. Those put options differ from vanilla put options in the fact that they remain inactive until they reach the knock-in level (knocks in) from which they are activated and exercisable. European down-and-in put options (a variety within knock-in options), are a form of barrier option that becomes activated only if the price of the underlying asset falls below a pre-determined barrier price level during the life of the option. In a down-and-in option, the barrier level is set at some level below the current spot or prevailing price of the underlying asset. If the asset price does not fall below the barrier level, the option expires worthless.

For our BRC, the puts have to be sold with strike price $I_0^i(1+c)$ and a knock-in level at $0{,}75I_0^i$ as the barrier is set at 75%. Given that *c* is 0% (meaning the cap is at initial fixing price), puts will be subscribed with strike equal to each underlying's initial price. In figure 4.8 there are shown the corresponding initial prices and barrier levels corresponding to each underlying into the basket.

Underlying asset	Exchange	Bloomberg ticker	Initial price (I_0^X) in CFH	Barrier level in CHF
Roche Holding AG	SIX Swiss Exchange	ROG VX EQUITY	257.40	193.05
The Swatch Group AG	SIX Swiss Exchange	UHR VX EQUITY	535.00	401.25
ABB Ltd.	SIX Swiss Exchange	ABBN VX EQUITY	21.08	15.81

Figure 4.8. Underlying initial prices and barriers.
Source: made by author. Data extracted from SIX webpage.

Through this kind of puts, if the barrier level is never reached by any of these three stocks, the investor's principal is in safety and at maturity the BRC will be settled in cash. Unfortunately, as soon as any of these crosses the line, the principal is no longer guaranteed and it will depend on whether at expiry any stock's price ends below its initial fixing, like a traditional reverse convertible. As knock-in puts restrict its functionality, the premium obtained for writing them is lower than that obtained from vanilla puts. The same outcome can occur with the barrier, for lower knock-in levels (lower probability of receiving the share), the lower the premium. Therefore, the coupons are negatively affected by increases in downside protection.

The number of shares to be received at maturity is determined by the initial price of each stock. The ratio $\frac{1}{I_0^i}$ expresses the number of stock *i* shares to be received for each CHF invested on the BRC. If we multiply the ratio for the notional *N* we are solving for the number of shares to be obtained with CHF 1,000 at initial prices. Ratios are expressed in figure 4.9.

Underlying asset	Ratio ($\frac{N}{I_0^i}$)
Roche Holding AG Non-voting equity security	3.8850
The Swatch Group AG Bearer Share	1.8692
ABB Ltd. Registered Share	47.4383

Figure 4.9. Underlying ratios.
Source: compiled by author.

If the any barrier is breached, at maturity, as shown in the final term sheet, the investor will receive the worst-performing underlying, determined by the lowest value of the final price divided by the initial price. As the put holder have now the right to exercise it, assuming rational behavior, the will do so. If that is the case, it will originate an outflow (purchase) equal to *N* and an inflow of $\frac{N}{I_0^i}$ shares with value I_T^i each. The real loss will occur when the value of the shares received is below the price paid for the RCB plus the coupons[18], thus, break-even can be expressed as

$$N \times \frac{I_T^i}{I_0^i} = N \times (1 + 0{,}065)$$

4.3.4 Settlement

From the previous subsections we see that part of the return is invariable and determined in advance. So, the investor ends up with at least a 6.5% of its investment, received through semi-annual payments, which amount a total of CHF 650.

[18] For simplicity, it is not taken into account the time value of money, i.e. cash flows are considered to take place on same dates

For the remaining part, as it depends on the fulfillment of predetermined conditions, it is clearly index-linked. The index-linked return will be determined by the 1-year performance of the three underlying asset and whether or not they knock in and lose the downside protection. Before entering into calculations, we will continuously monitor the underlying's movements in order to identify any possible barrier breach. Figure 4.10 shows the percentage variations of the three underlying assets.

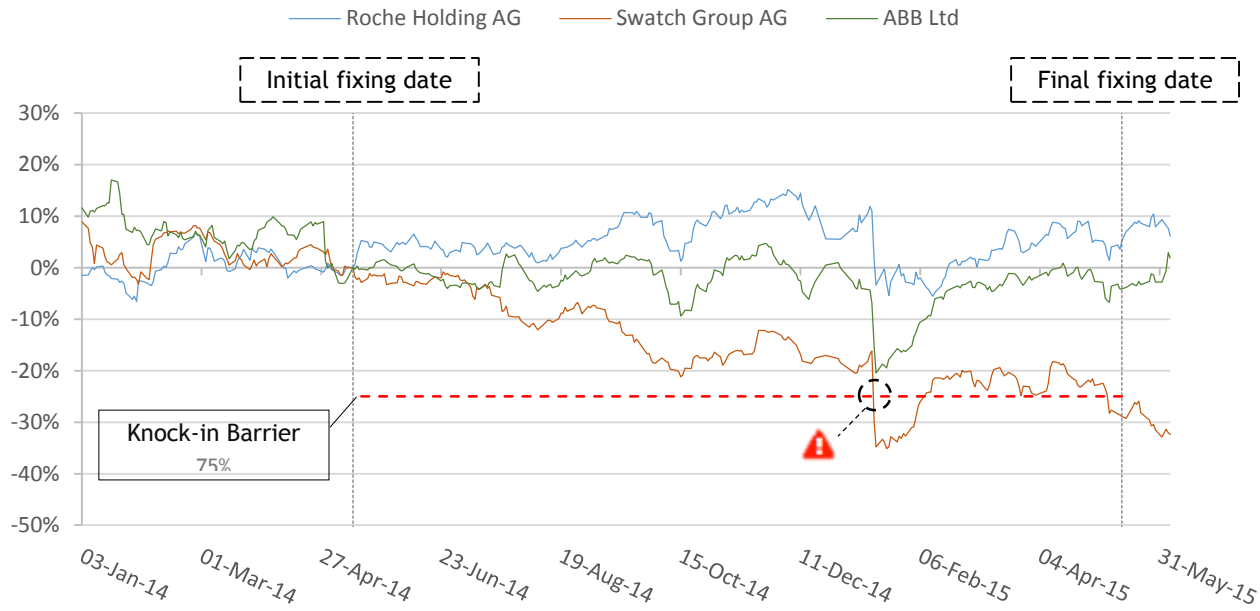


Figure 4.10. Underlying performance in percentage points.
Source: made by author. Data extracted from SIX webpage.

As we can observe, the barrier is breached on January 15th of 2015 when The Swatch Group shares price dropped[19] below its corresponding barrier set at CHF 401.25. Below is a list with information matter of interest for investors during the product's lifecycle showing significant events affecting the value of the structure

Since the barrier is triggered, it no longer offers capital protection at maturity, therefore, it now acquired the features of a traditional reverse convertible. The cash flow at maturity can now be expressed as:

$$CF_T = 1.000 \times \left[1 + 0{,}065 + Min\left(0, D \times \left(\frac{I_T^1 - I_0^1}{I_0^1}, \frac{I_T^2 - I_0^2}{I_0^2}, \frac{I_T^3 - I_0^3}{I_0^3}\right)\right)\right]$$

[19] On January 15th of 2015, the Swiss National Bank (SNB) suddenly announced that it would no longer hold the CHF at a fixed Exchange rate with the euro. As the cap was removed, the CHF soared from an exchange rate EUR/CHF 1.2 to 0.85. The SIX market was heavily affected as domestic companies found it more difficult to export to Eurozone clients. http://www.economist.com/blogs/economist-explains/2015/01/economist-explains-13

with

$$D = 1, if\ \exists t\ I_t^1 \leq 193.05\ or\ \boldsymbol{I_t^2 \leq 401.25}\ or\ I_t^1 \leq 15.81$$

As shown in the final term sheet, the investor is now exposed to the redemption in shares, previously specified by the ratio, of the worst-performing asset if at least one underlying is below its initial price. If that is the case, it is the investor who will bear the usual transaction fees. On May 12th of 2015 the closing prices for each underlying were as follows

Underlying asset	Ratio	Final price	Initial price	Variation	Distance to barrier
Roche Holding AG	3.8850	271.8	257.4	5.59%	28,90%
The Swatch Group AG	1.8692	376.5	535	-29,63%	-7,00%
ABB Ltd.	47.4383	21.27	21.08	0.90%	25,91%

Figure 4.9. Underlying performance in percentage points.
Source: made by author. Data extracted from SIX webpage.

By incorporating the above information in the formula, we can solve for the index linked payment the investor will receive at maturity.

$$CF_T = 1.000 \times \left[1 + Min\left(0, (0.0559, -0.2963, 0.009\ )\right)\right]$$

$$CF_T = 1.000 \times (1 - 0{,}2963) = CHF\ 703{,}7$$

As -29.63% is the variation of the worst-performing asset, we can restate it in a more perceptible way where we can observe how the investor receive an amount equal to the ratio for The Swatch Group (M^2) in shares with value I_T^2 and total value CHF 703,7

$$1000 \times \left(1 + \frac{376.5 - 535}{535}\right) = 1.000 + \underbrace{\frac{1.000}{535}}_{M^2 = 1.8692} \times \overbrace{376.5}^{I_T^2} - 1.000 = CHF\ 703{,}7$$

Taking this into account, together with the interest and premiums, the BRC would generate a cash flow at time *T* equal to

$$CF_T = 1.000 \times [(1 - 0.2963) + 0{,}065] = 703.7 + 65 = CHF\ 768.7$$

Thus, each investor will receive on May 18th of 2015 1.8692 shares worth CHF 703.7 and CH 65 from interest and premiums, which amount a total of CHF 720.2. As at the beginning the investor had to disburse the full notional amount (issued at 100%), the 1-year loss on the barrier reverse convertible equals to 23.13%. Nevertheless, the loss is not realized until the shares are sold in the SIX market.

V. CONCLUSION

Structuring is about packaging fixed and index-linked cash flows into financial contracts to solve financial economic problems. Conceptually, the procedure starts by wondering how the marketer can contribute to potential client needs. Through identifying the relevant payment dates and reference indices and linking them in the payment dates and, if required, add additional rights or restrictions, in such a way that the problem is at hand solved.

It is the derivatives firm who calculates the index –linked payments to be made by both counterparties and checks for the occurrence of special events which may influence the structure and therefore are deemed to be matter of interest for the investor. During the structuring process and the negotiations that follow, derivative firms provide their clients with so-called indicative term sheets which briefly summarize the proposed contract at every stage. When all contract details are agreed upon, the derivatives firm sends the client the final term sheet, the one we used in chapter three.

In this sense, entities are increasingly tight controlled by domestic supervisors. For instance, FINMA, the Swiss Financial Market Supervisory Authority, is the Swiss government body responsible for financial regulation, endowed with supreme authority, in charge for supervising institution's compliance with the any form of legal enforcement. Those institutions ensure correct operating procedures enhancing transparency. Despite nowadays scandals regarding manipulation of interest and exchange rates by large financial institutions, we are subject to a high acceptance level of protection. Term sheets and complementary documentation provide the investor with sufficient information to comprehend what are the risks he is exposed to in order to take rational decisions. Increasing is the complexity of financial needs but so is the consciousness and knowledge of investors.

Much of the art of derivatives structuring lies in the specification of the index-linked cash flow involved. Structured-index linked cash flows allow derivatives structurers to link cash flows to reference indices in very specific ways. The arrival of the OTC derivatives has opened up a whole new world for retail investors. Retail investors nowadays have access to much more complex payoff profiles in the form of equity-linked notes. Potential combinations favors perfect hedging so that the issuer rarely supports any of the implicit risks.

Part of the reason why there is such a great variety of derivatives contracts around in today's markets is the possibility of introducing special restrictions and/or rights into contracts. This allows derivatives structurers to tailor a contract more closely to the specific problem at hand. Knock-in and knock-out features, especially in the form of a barrier condition, are the most popular restrictions, together with callable clause, which gives the issuer the right to redeem prior to maturity. However, as we had the chance to verify, adding additional clauses reduce or constrain the probability to receive the payment, such as knock-in puts are harder to exercise than ordinary puts. Offering protection to the investor reduce profit potential. On the other side, cutting too deep into a note's downside protection or upside potential may create a note that has little attraction left.

VI. REFERENCES

Banks, E. (2006). *Synthetic and structured assets*. England: Wiley finance.

Banque Cantonale Vaudoise. Consulted on 2015, April 23. *BCV structured product division*. Retrieved from http://structures.bcv.ch/ps/ch/FR-CH/index.cfm

Choudhry, M. (2004). *Corporate bonds and structured financial products*. England: Elsevier finance.

Choudhry, M. (2010). *The bond money markets: strategy, trading and analysis*. England: Reed Educational and Profesional Publishing Ltd.

Credit Suisse Group AG. Consulted on 2015, May. *Derivative Credit Suisse*. Retrieved from Structured Products: https://derivative.credit-suisse.com/ch/en/home

Deutsche Bank AG. Consulted on 2015, April 19. *Deutsche Asset & Wealth Management*. Retrieved from Structured product division: https://www.xmarkets.db.com/

Fabozzy, F. J., Davis, H. A., & Choudhry, M. (2006). *Introduction to structured finance*. New Jersey: Wiley finance.

FINRA. Consulted on 2015, April. *Financial Industry Regulation Authority*. Retrieved from Alternative and complex products: https://www.finra.org/investors/alternative-and-complex-products

Investopedia. Consulted on 2015, May 3. *Investopedia, LLC*. Retrieved from Articles: http://www.investopedia.com/articles/

Lamothe Fernández, P., & Pérez Somalo, M. (2003). *Opciones y productos estructurados*. Madrid: Barcanova.

Mascareñas, J. (2010). Productos financieros estructurados. *Monografías de Juan Mascareñas sobre Finanzas Corporativas*.

Mascareñas, J. Consulted on 2015, March 27. *Finance Resources*. Retrieved from Publishing: http://www.juanmascarenas.eu/index.htm

My Structured Products. Consulted on 2015, May. *Structured product information*. Retrieved from Know-how: http://www.my-structured-products.com/

Staff of the Office of Compliance Inspections and Examinations. (2011). *Issues Identified in Examinations of Certain Structured Securities Products Sold to Retail Investors*. NY: US Securities and Exchange Commision.

Styrcula, K., & Brandes, A. Consulted on 2010, February. *ABC of structured Notes*. Retrieved from Investment Manager Consultant Association: http://www.imca.org/investments-issues

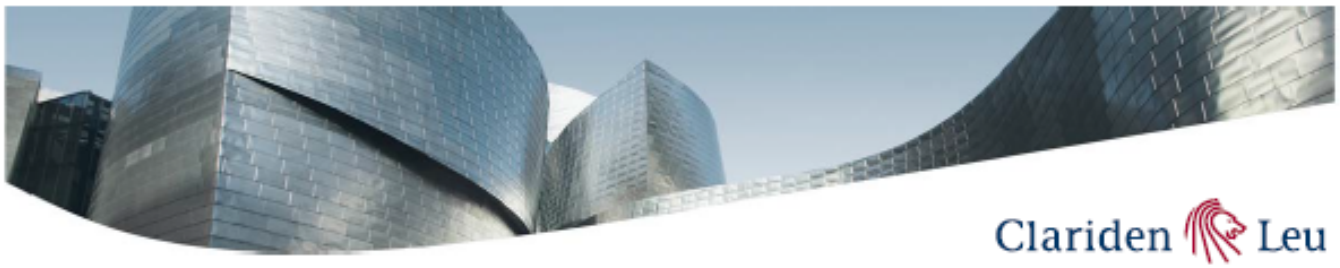
Swiss Structured Product Association. Consulted on 2015, May. *SVSP*. Retrieved from Structured products: http://www.svsp-verband.ch/home/index.aspx?lang=en

Tolle, S., Hutter, B., Rüthemann, P., & Wohlwend, H. (2008). *Structured products in wealth management*. Singapore: Wiley finance.

UBS AG. Consulted on 2015, May. *UBS Key Invest*. Retrieved from Structured products division: http://keyinvest-ch-en.ubs.com/product/list/index

Unicredit. Consulted on 2015, May. *Hypovereinsbank*. Retrieved from Structured product division: http://www.onemarkets.de/de/produkte.html

ANNEX I



Capital Protected Note (with Cap)

Final Terms, 23 April 2010

95% CPN on the Standard & Poor's 500® Index

30 April 2010 until 30 April 2015

Capital Protected Notes (CPN) offer the investor the opportunity of a capital protected investment combined with a participation in the performance of the Underlying up to Cap.

Your market expectation: positive with possibility of price decline

Issuer	Clariden Leu Ltd., Nassau Branch, Bahamas
Lead Manager	Clariden Leu Ltd., Zurich
Rating	Aa2 (Moody's)
Underlying	Standard & Poor's 500® Index (Swiss Sec. Number: 998 434 / ISIN: US78378X1072 / Bloomberg Ticker: SPX Index)
Swiss Sec. Number / ISIN	11 199 350 / CH0111993504 (WKN: A1AV21)
Ticker	CPSPX
Product Category	Complex product. Complex products require specificknowledge regarding the product and its associated risks. Therefore, it is recommended that the investor obtains adequate information regarding the risks associated with the specific product before making an investment decision. For more information on the product's risks, please see page 2.
Product Type	Capped Capital Protected Product (category 1120)*, according to the Swiss Derivative Map of the Swiss Structured Products Association (www.svsp-verband.ch) * Partial Capital Protection
Issue Price	100% (USD 1,000)
Currency	USD
Issue Size	USD 5,000,000 (5,000 Capital Protected Notes)
Denomination	USD 1,000 (Notional Amount) = 1 Capital Protected Note
Initial Fixing Level	1,217.28 (100% of the official closing level of the Underlying on the Initial Fixing Date)
Initial Fixing Date	23 April 2010
Payment Date	30 April 2010
Last Trading Date	24 April 2015 (until 12:00 p.m. CET)
Final Fixing Date	24 April 2015
Redemption Date	30 April 2015
Final Fixing Level	100% of the official closing level of the Underlying on the Final Fixing Date
Capital Protection	95% of the Notional Amount (at expiry)
Cap	160% of the Initial Fixing Level
Partizipation	100%
Redemption Mode	a) If the Final Fixing Level is higher than the Initial Fixing Level, each Capital Protected Note will be redeemed at 95% of the Notional Amount plus **100%** of the positive performance in percent of the Underlying between Initial Fixing Date and Final Fixing Date (Participation). However, the performance of the Underlying will only be taken into consideration up to the Cap, which limits the maximum redemption. The positive performance is calculated as follows: Final Fixing Level minus Initial Fixing Level, divided by the Initial Fixing Level. b) If the Final Fixing Level is equal to or lower than the Initial Fixing Level, each Capital Protected Note will be redeemed at 95% of the Notional Amount.
Minimum Trading Lot	USD 1,000 (1 Capital Protected Note)
Listing	SIX Swiss Exchange listing will be applied for.
Settlement	Cash settlement in USD
Clearing	SIX SIS Ltd, Clearstream Banking, Euroclear
Calculation Agent	Clariden Leu Ltd., Zurich
Publications	www.myproducts.ch, Bloomberg <CLZH>, Reuters <CLARIDENLEU>, SIX Telekurs Ltd
Secondary Market	Under normal Market conditions, secondary trading will be maintained throughout the lifetime of the product, during which the bid and offer prices may differ (spread).
Sales Restrictions	USA, U.S. Persons, UK, European Economic Area, Bahamas
Governing Law / Jurisdiction	Swiss law; exclusive place of jurisdiction is Zurich

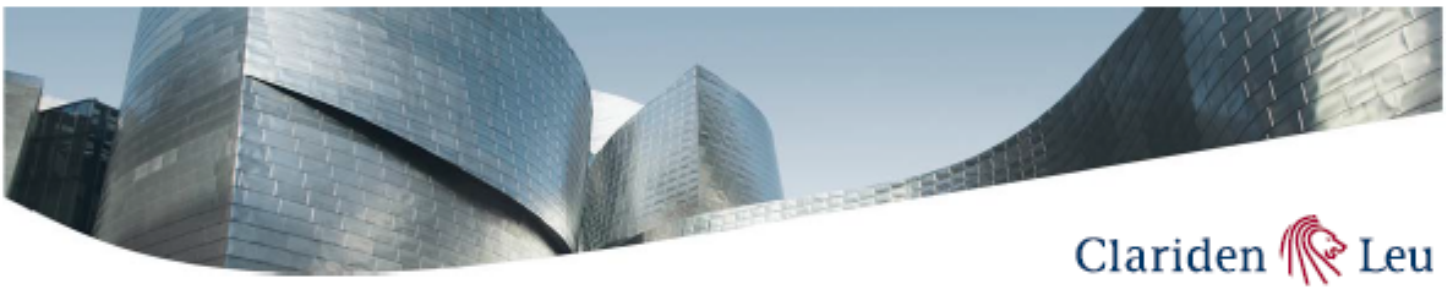
Information / Trading

Clariden Leu Ltd.
Structured Products
CH-8070 Zurich

Telephone: +41 (0) 844 844 002*
E-mail: info@myproducts.ch
Internet: www.myproducts.ch

* Please note that conversations on this line are recorded. We will assume your consent.

The original version of this termsheet is in German, versions in other languages are non-binding translations only.
This termsheet does not constitute a prospectus in the sense of Art. 652a resp 1156 of the Swiss Code of Obligations.



Clariden Leu

Taxes	No Swiss withholding tax, no stamp tax at issuance (primary market); however, federal turnover tax will be charged to Swiss resident investors on secondary market transactions (0.15%) (TK-Code 22). The difference between the present value of the protected redemption price at redemption/sale and its present value at issuance/purchase is subject to income tax for Swiss private investors. The Participation qualifies as tax-free capital gain for Swiss resident private investors and private assets. This product is classified as transparent and IUP for Swiss tax purposes. The payments made by Swiss paying agents to EU resident individuals with respect to these Capital Protected Notes will not be subject to EU withholding tax (TK-Code 2; "out of scope"). The afore mentioned taxes are valid at the time of launch of the issue and are not exclusive. Any taxation will depend on the investor's personal circumstances. The relevant tax laws or the regulations of the tax authorities are subject to change. Clariden Leu Ltd. expressly excludes all liability in respect of any tax implications.
Bond Floor (at issuance)	82.93%
Risk	This investment product is a complex structured financial instrument and involves a significant degree degree of risk. It is intended only for investors who understand and are capable of assuming all risks involved. Before entering into any transaction, investors should determine if this product suits their particular circumstances and should independently assess (with the assistance of any professional advisers) the specific risks (maximum loss, currency risks, etc.) and the legal, regulatory, credit, tax and accounting implications. The Issuer and/or its affiliates make no representation as to the suitability or appropriateness of this investment product for any particular investor or as to the future performance of this investment product. This document does not replace a personal conversation with your relationship manager, which is recommended by Clariden Leu Ltd. before any investment decision. Capital Protected Notes are derivative financial instruments and do not constitute collective capital investments within the meaning of the Federal Act on Collective Investment Schemes (CISA). Accordingly, they are not subject to the regulations of the CISA or the supervision of the Swiss Financial Market Supervisory Authority (FINMA). Consequently, the investor does not have the benefit of the specific investor protection provided by the CISA. The investor is subject to the risk of an impairment of the Issuer's financial strength; therefore, the value of this investment does not only depend on the performance and quality of the Underlying but also on the Issuer's creditworthiness. The product is a direct, unsubordinated, unconditional and unsecured obligation of Clariden Leu Ltd. and ranks equally with all of its other obligations of the equivalent type. The rating of Clariden Leu Ltd. is Aa2 (Moody's). Clariden Leu Ltd. is subject to the supervision of FINMA. The investor may be exposed to a currency risk, if the product is denominated in another currency than that of the country in which the investor is resident. Currency fluctuations may therefore have an impact on the value of the investment. An investment in these Capital Protected Notes is not the same as an investment in the Underlying. Changes in the market value of the Underlying may not result in a comparable change in the value of the Capital Protected Notes. In case of zero performance of the Underlying, the investor will receive only the Capital Protection on the Redemption Date. Nevertheless, the Capital Protected Notes may be traded at a lower value than the Capital Protection during their lifetime. The potential loss associated with an investment in these Capital Protected Notes is limited to the negative difference between the respective purchase price and the Capital Protection. For further details please consult the risk disclosure brochure "Special Risks in Securities Trading", which can be obtained free of charge from Clariden Leu Ltd. In connection with the product, the Issuer and/or its affiliates may pay to third parties, or receive from third parties as part of their compensation or otherwise, one-time or recurring remunerations (e.g. placement or holding fees). Please contact Clariden Leu Ltd. for further information.
Details	This document constitutes Marketing Material and is not the result of a financial analysis or research and therefore not subject to the Swiss Bankers Association's "Directives on the Independence of Financial Research". This document has been produced by Clariden Leu Ltd., Zurich, solely for information purposes and does not constitute an offer or a solicitation of an offer to purchase or to sell any securities. The legally binding terms may be obtained directly from Clariden Leu Ltd.
Disclaimer	"Standard & Poor's®", "S&P®", "S&P 500®", "Standard & Poor's 500" and "500" are all trademarks of Standard & Poor's, a Division of the Mc Graw-Hill Companies and have been licensed for use by Clariden Leu Ltd., Zurich.

Information / Trading

Clariden Leu Ltd.
Structured Products
CH-8070 Zurich

Telephone: +41 (0) 844 844 002*
E-mail: info@myproducts.ch
Internet: www.myproducts.ch

* Please note that conversations on this line are recorded. We will assume your consent.

The original version of this termsheet is in German, versions in other languages are non-binding translations only.

This termsheet does not constitute a prospectus in the sense of Art. 652a resp 1156 of the Swiss Code of Obligations.

CREDIT SUISSE

14 May 2014
Fixed Terms

Selected Key Parameters

Telephone Contacts
Conversations on these phone lines may be recorded.
We assume that you have no objections thereto.

Private Individuals: +41 (0)44 335 76 09
Institutional Investors and Banks: +41 (0)44 335 76 00

Credit Suisse Structured Products

6.50% p.a. Barrier Reverse Convertibles in CHF on Roche Holding AG, The Swatch Group AG and ABB Ltd.(1)

16 May 2014 until 18 May 2015

The Complex Products do not constitute a collective investment scheme within the meaning of the Swiss Federal Act on Collective Investment Schemes (CISA). Therefore, the Complex Products are not subject to authorisation by the Swiss Financial Market Supervisory Authority (FINMA) and potential investors do not benefit from the specific investor protection provided under the CISA. The Complex Products are structured products within the meaning of the CISA.

Risk Category	**Complex Product (2)**	**Product Type**	**Barrier Reverse Convertible**
Product Category	**Yield Enhancement**	**SSPA Code**	**1230 (3)**

I. Product Description

The Complex Products allow the holders to benefit from several payments of the Interest Amount and Premium Amount, irrespective of the development of the value of the Underlyings. Therefore, the potential return on a Complex Product is limited to the positive difference between (i) the aggregate of Interest Amounts and Premium Amounts scheduled to be paid thereunder, plus the Final Redemption Amount, and (ii) the Issue Price (or, if different, the price the relevant investor paid for such Complex Product) (i.e., the return is capped). As long as none of the Barriers have been reached or breached during the Barrier Observation Period, the Final Redemption Amount is equal to 100% of the Denomination. If the value of the Underlyings decreases, the Final Redemption Amount may be substantially lower than the Issue Price. If a Barrier has been reached or breached during the Barrier Observation Period and the Final Level of at least one Underlying is below its Strike on the Final Fixing Date, the potential loss associated with an investment in Complex Products is linked to the negative performance of the Worst-Performing Underlying. Therefore, a total or substantial loss of the amount invested in Complex Products is possible, although any such loss is limited to the amount invested.

Issue Details		
Security Codes	Swiss Sec. No.	**20 214 807**
	ISIN	**CH 020 214 807 5**
	Telekurs Ticker	**CSAXL**
	WKN	**A1UN66**
Issuer	Credit Suisse AG, Zurich, acting through its London Branch, London (A1/A)	
Lead Manager	Credit Suisse AG, Zurich	
Paying Agent	Credit Suisse AG, Zurich	
Calculation Agent	Credit Suisse AG, Zurich	
Trading/Secondary Market	Under normal market conditions, Credit Suisse AG, Zurich, will endeavour to provide a secondary market, but is under no legal obligation to do so. Upon investor demand, Credit Suisse AG, Zurich, will endeavour to provide bid/offer prices for the Complex Products, depending on actual market conditions. There will be a price difference between bid and offer prices (spread). The Complex Products are traded in percentage of the Denomination at a clean price, i.e., the trading price does not contain accrued interest or premium, which is calculated separately, and are booked accordingly. Indicative trading prices may be obtained on Reuters CSZE000 and Bloomberg CSZE.	
Listing	SIX Swiss Exchange Ltd	
Trading Platform	SIX Structured Products Exchange AG	
Issue Size	CHF 1'250'000	
Denomination	CHF 1'000	
Issue Price	100%	
Subscription Period	until 13 May 2014, 15:00 CET	
Issue/Payment Date	16 May 2014, being the date on which the Complex Products are issued and the Issue Price is paid.	
Last Trading Date	12 May 2015, until the official close of trading on the SIX Structured Products Exchange AG, being the last date on which the Complex Products may be traded.	
Minimum Trading Lot / Subscription Amount	CHF 1'000	
Clearing	SIX SIS Ltd, Euroclear S.A., Clearstream Banking	
Form	Uncertificated Securities	
Governing Law/Jurisdiction	Swiss Law/Courts of Zurich 1	
Publication	Any amendment to the Complex Products will be published on www.credit-suisse.com/derivatives.	
Sales Restrictions	U.S.A., U.S. Persons, Singapore, European Economic Area, Hong Kong, United Kingdom	

Redemption	
Final Redemption Date	18 May 2015, being the date on which each Complex Product will be redeemed at the Final Redemption Amount, unless previously redeemed, repurchased or cancelled.
Final Redemption Amount	(i) If **no** Barrier Event has occurred, a cash amount equal to 100% of the Denomination; or (ii) If a Barrier Event has occurred, **and** (a) the Final Level of **each** Underlying is **at or above** its Strike, a cash amount equal to 100% of the Denomination; or (b) the Final Level of **at least one** Underlying is **below** its Strike, the number of Worst-Performing Underlyings specified in the Ratio of the Worst-Performing Underlying. Fractions will not be cumulated and will be paid in cash (based on the Final Level of the Worst-Performing Underlying). In this case, the investor will have to bear the usual transaction fees, based on the Strike of the Worst-Performing Underlying.
Settlement Type	physical settlement or cash settlement.

(1) Herein called the "Complex Products".
(2) Investing in the Complex Products requires specific knowledge on the part of the potential investor regarding the Complex Products and the risks associated therewith. It is recommended that the potential investor obtains adequate information regarding the risks associated with the Complex Products before making an investment decision.
(3) See Swiss Derivatives Map at www.sspa-association.ch.

Ratio	with respect to each Underlying, the relevant Ratio specified in the **table below**, being the number of Underlying(s) per Complex Product based on the Strike of such Underlying.
Worst-Performing Underlying	out of all the Underlyings, the Underlying in respect of which its Final Level divided by its Strike results in the lowest value.
Initial Fixing Date	13 May 2014, being the date on which the Strike and the Barrier and the Ratio are fixed, and from which date the Complex Products may be traded.
Strike	with respect to each Underlying, the relevant Strike specified in the **table below**, being 100% of its level at the Valuation Time on the Initial Fixing Date.
Final Fixing Date	12 May 2015, being the date on which the Final Level will be fixed.
Final Level	with respect to each Underlying, 100% of its level at the Valuation Time on the Final Fixing Date.
Valuation Time	with respect to each Underlying, its scheduled closing time.
Barrier	with respect to each Underlying, the relevant Barrier specified in the **table below**, being 75% of its Strike.

Barrier Event	if the level of any Underlying at any time (observed continuously) on any Barrier Observation Date is **at or below** its Barrier.
Barrier Observation Dates	each exchange business day during the Barrier Observation Period.
Barrier Observation Period	from and excluding the Initial Fixing Date to and including the Final Fixing Date.

Interest | Premium	
Interest Amount	0.05% p.a. of the Denomination, i.e., CHF 0.25 for 180 days.
Premium Amount	6.45% p.a. of the Denomination, i.e., CHF 32.25 for 180 days.
Interest/Premium Payment Date(s)	17 November 2014 and 18 May 2015, being the date(s) on which the Issuer shall pay the Interest Amount and the Premium Amount per Complex Product to the holders, unless previously redeemed, repurchased or cancelled.
Interest/Premium Ex-Date(s)	16 November 2014
Business Day Convention/ Day Count Fraction	Modified following, unadjusted, 30/360.

Underlyings	Bloomberg Ticker	Exchange	Strike	Barrier	Ratio
Roche Holding AG Non-voting equity security	ROG VX EQUITY	SIX Swiss Exchange	CHF 257.40	CHF 193.05	3.8850
The Swatch Group AG Bearer Share	UHR VX EQUITY	SIX Swiss Exchange	CHF 535.00	CHF 401.25	1.8692
ABB Ltd. Registered Share	ABBN VX EQUITY	SIX Swiss Exchange	CHF 21.08	CHF 15.81	47.4383

II. Profit and Loss Prospects

Profit Prospects

The Complex Products allow the holders to benefit from several payments of the Interest Amount and Premium Amount, irrespective of the development of the value of the Underlyings. Therefore, the potential return on a Complex Product is limited to the positive difference between (i) the aggregate of Interest Amounts and Premium Amounts scheduled to be paid thereunder, plus the Final Redemption Amount, and (ii) the Issue Price (or, if different, the price the relevant investor paid for such Complex Product) (i.e., the return is capped). As long as none of the Barriers have been reached or breached during the Barrier Observation Period, the Final Redemption Amount is equal to 100% of the Denomination.

Loss Prospects

If the value of the Underlyings decreases, the Final Redemption Amount may be substantially lower than the Issue Price. If a Barrier has been reached or breached during the Barrier Observation Period and the Final Level of at least one Underlying is below its Strike on the Final Fixing Date, the potential loss associated with an investment in Complex Products is linked to the negative performance of the Worst-Performing Underlying. Therefore, a total or substantial loss of the amount invested in Complex Products is possible, although any such loss is limited to the amount invested.

Calculation Examples of the Final Redemption Amount

Any **Barrier reached or breached** during the Barrier Observation Period ?	Performance of the **Worst-Performing Underlying** on the Final Fixing Date:	**Final Redemption Amount** per Complex Product:
No	**Not relevant**	CHF 1'000 (none of the Barriers have been reached or breached during the Barrier Observation Period).
Yes	**+ 5%**	CHF 1'000 (the Final Level of the Worst-Performing Underlying is at or above its Strike).
Yes	**- 70 %**	Delivery of the number of Underlying(s) stated in the Ratio of the Worst-Performing Underlying.

This table shows exemplary redemption scenarios regarding the Final Redemption Amount as per the Final Redemption Date for illustrative purposes only and does not constitute a price indication for the Complex Products or the Underlyings. During the term of the Complex Products, additional risks and other factors may influence the market value of the Complex Products. As a consequence, the pricing in the secondary market may differ significantly from the above table.

III. Important Risks for Investors

Important Risks

Issuer Risk

Investors bear the Issuer risk. The Complex Products' retention of value is dependent not only on the development of the value of the Underlying(s), but also on the creditworthiness of Credit Suisse AG, which may change over the term of the Complex Products. Furthermore, the Issuer's ability to fulfill its obligations under the Complex Products may be affected by certain other factors, including liquidity risks, market risks, credit risks, cross-border and foreign exchange risks, operational risks, legal and regulatory risks and competition risks.

The Complex Products are direct, unconditional, unsecured and unsubordinated obligations of Credit Suisse AG and are not covered by any compensation or insurance scheme (such as a bank deposit protection scheme). If Credit Suisse AG were to become insolvent, claims of investors in Complex Products would rank equally in right of payment with all other unsecured and unsubordinated obligations of Credit Suisse AG, except such obligations given priority by law. In such a case, investors in Complex Products may suffer a loss of all or a portion of their investment therein, irrespective of any favourable development of the other value determining factors, such as the performance of the Underlying(s).

Credit Suisse AG is licensed as a bank pursuant to the Swiss Federal Act on Banks and Saving Banks and as a security dealer pursuant to the Swiss Federal Act on Stock Exchanges and Securities Trading and is subject to supervision by the FINMA. Credit Suisse AG London Branch is authorised and regulated by FINMA in Switzerland, authorised by the Prudential Regulation Authority, is subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority. Details about the extent of our regulation by the

Prudential Regulation Authority are available from the Issuer on request.

Product Risk

Complex Products involve substantial risks and potential investors must have the knowledge and experience necessary to enable them to evaluate the risks and merits of an investment in Complex Products.

Prospective investors should:

- ensure that they understand the nature of the risks posed by, and the extent of their exposure under, the Complex Products;
- make all pertinent inquiries they deem necessary without relying on the Issuer or any of its affiliates or officers or employees;
- consider the suitability of the Complex Products as an investment in light of their own circumstances, investment objectives, tax position and financial condition;
- consider carefully all the information set forth in the legally binding Terms and Conditions as well as all other sections of the Prospectus (including any documents incorporated by reference therein);
- consult their own legal, tax, accounting, financial and other professional advisors to assist them determining the suitability of Complex Products for them as an investment.

Risk of Total Loss

Complex Products involve a high degree of risk, and prospective investors in Complex Products should recognise that Complex Products may under certain circumstances have a redemption value of zero and the payment(s) of Interest Amount and Premium Amount scheduled to be made thereunder may not be made. Prospective investors in Complex Products should therefore be prepared to sustain a partial or total loss of the amount of their investment therein.

Complex Products are unsecured obligations

Complex Products are direct, unconditional, unsecured and unsubordinated obligations of Credit Suisse AG and are not covered by any compensation or insurance scheme (such as a bank deposit protection scheme). If Credit Suisse AG were to become insolvent, claims of investors in Complex Products would rank equally in right of payment with all other unsecured and unsubordinated obligations of Credit Suisse AG, except such obligations given priority by law. In such a case, investors in Complex Products may suffer a loss of all or a portion of their investment therein, irrespective of any favourable development of the other value determining factors, such as the performance of the Underlyings.

Capped Profit Potential

Investors in Complex Products should be aware that the profit potential in relation thereto is capped. Therefore, a direct investment in the Underlyings may lead to a greater return than an investment in the Complex Products.

Unpredictable Market Value of the Complex Products

The market value of, and expected return on, Complex Products may be influenced by a number of factors, some or all of which may be unpredictable (and which may offset or magnify each other), such as (i) supply and demand for Complex Products, (ii) the value and volatility of the Underlyings, (iii) economic, financial, political and regulatory or judicial events that affect Credit Suisse AG, the Underlyings or financial markets generally, (iv) interest and yield rates in the market generally, (v) the time remaining until the Final Redemption Date, (vi) the difference between the level of any Underlying and the relevant threshold, (vii) Credit Suisse AG's creditworthiness and (viii) dividend payments on the Underlyings, if any.

Trading Market for Complex Products

The trading market for Complex Products may be limited, or may never develop at all, which may adversely impact the market value of such Complex Products or the ability of a holder thereof to sell such Complex Products.

Exposure to the Performance of the Underlyings

Complex Products represent an investment linked to the performance of the Underlyings and potential investors should note that any amount payable, or other benefit to be received, under Complex Products will depend upon the performance of the Underlyings. Potential investors in Complex Products should be familiar with the behaviour of the Underlyings and thoroughly understand how the performance of the Underlyings may affect payments (or any other benefit to be received) under, or the market value of, Complex Products. The past performance of the Underlyings is not indicative of future performance. The market value of a Complex Product may be adversely affected by postponement or alternative provisions for the valuation of the level of any Underlying.

Exchange Rate Risks

The settlement currency may not be the currency of the home jurisdiction of the investor in the Complex Products. Therefore, fluctuations in exchange rates may adversely affect the market value of a Complex Product or the value of the Underlyings.

Broad Discretionary Authority of the Calculation Agent

The Calculation Agent has broad discretionary authority to make various determinations and adjustments under Complex Products, any of which may have an adverse effect on the market value thereof or amounts payable or other benefits to be received thereunder. Any such discretion exercised by, or any calculation made by, the Calculation Agent (in the absence of manifest error) shall be binding on the Issuer and all holders of the Complex Products.

Further Product Specific Risks

Investors in the Complex Products should be aware that an investment therein may result in a loss upon redemption if a Barrier Event has occurred and the Final Level of at least one Underlying is below its Strike. Consequently, the potential loss associated with an investment in the Complex Products is linked to the negative performance of the Worst-Performing Underlying, which is the Underlying with the worst performance out of all Underlyings, and investors therein should be prepared to sustain a partial or total loss of their investment.

This risk disclosure notice cannot disclose all the risks. Therefore, potential investors in Complex Products should consult the latest version of the 'Special Risks in Securities Trading' risk disclosure brochure (the 'Risk Disclosure Brochure') and the Prospectus of which the Terms and Conditions of the Complex Products form a part.

The latest version of the Risk Disclosure Brochure can be obtained, free of charge, from the head office of Credit Suisse AG in Zurich, by calling +41 44 333 2144 or via facsimile no: +41 44 333 8403, or accessed via Internet at the Swiss Bankers Association's website: www.swissbanking.org (under the following path: www.swissbanking.org/en/home/shop.htm).

Swiss Taxation

The following statements and discussions of certain Swiss tax considerations relevant to the purchase, ownership and disposition of the Complex Products are of a general nature only and do not address all potential tax consequences of an investment in the Complex Product under Swiss law. This summary is based on treaties, laws, regulations, rulings and decisions currently in effect, all of which are subject to change. It does not address the tax consequences of the Complex Products in any jurisdiction other than Switzerland.

Tax treatment depends on the individual tax situation of each investor and may be subject to change.

Potential investors will, therefore, need to consult their own tax advisors to determine the special tax consequences of the purchase, ownership and sale or other disposition of a Complex Product. In particular, the precise tax treatment of a holder of a Complex Product needs to be determined with reference to the applicable law and practice at the relevant time.

The investors shall be liable for all current and future taxes and duties as a consequence of an investment in Complex Products. The income tax treatment as depicted below is applicable to individual persons with tax residence in Switzerland and private assets. Withholding tax and stamp taxes are applicable to all investors; however, specific rules apply with respect to certain types of investors and transactions.

No withholding tax (*Verrechnungssteuer*).

The issuance, sale or purchase and redemption of Complex Products are not subject to securities transfer stamp tax (*Umsatzabgabe*).

The delivery of the Worst-Performing Underlying, if any, is subject to securities transfer stamp tax at a rate of up to 0.15 per cent. in case of Underlying(s) issued by a Swiss issuer and of up to 0.30 per cent. in case of Underlying(s) issued by a non-Swiss issuer, provided, in both cases, that a Swiss securities dealer for purposes of securities transfer stamp tax, such as a Swiss bank, is involved as a party or an intermediary in the transaction and no exemption applies. The securities transfer stamp tax is based on the Strike of the Worst-Performing Underlying.

The interest payment of 0.05% p.a. (CHF 0.25 for 180 days) is subject to income tax for Swiss resident private investors. The premium payment of 6.45% p.a. (CHF 32.25 for 180 days) qualifies for tax-free capital gain for Swiss resident private investors.

Certain payments made by Swiss paying agents to EU resident individuals with respect to the Complex Products will be subject to EU savings tax. The Swiss paying agents may therefore withhold such amounts as are necessary to pay the EU savings tax; the tax rate is 35 per cent. [TK-Code 6; "in scope"]

The Issuer expressly disclaims all liability in respect of any tax implications.

Important Notices

By investing in the Complex Products, an investor acknowledges having read and understood the following terms:

Any information regarding the Underlying(s) contained in this document consists only of a summary of certain publicly available information. Any such information does not purport to be a complete summary of all material information about such Underlying(s) contained in the relevant publicly available information. The Issuer only accepts responsibility for accurately reproducing such information contained in publicly available information. Otherwise neither the Issuer nor any of its affiliates accept further or other responsibility or make any representation or warranty (express or implied) in respect of such information.

The Issuer is acting solely as an arm's length contractual counterparty and neither the Issuer nor any affiliate is acting as the financial advisor or fiduciary of any potential investor in the Complex Products unless it has agreed to do so in writing.

The information and views contained herein are those of the Issuer and/or are derived from sources believed to be reliable. This document is not the result of a financial analysis and, therefore, is not subject to the 'Directives on the Independence of Financial Research' issued by the Swiss Bankers Association. The contents of this document therefore do not fulfil the legal requirements for the independence of financial analyses and there is no restriction on trading prior to publication of financial research.

In connection with the Complex Products, the Issuer and/or its affiliates may pay to third parties, or receive from third parties as part of their compensation or otherwise, one-time or recurring remunerations (e.g. placement or holding fees). By receiving payments from third parties in connection with the Complex Products, the interest of the Issuer or such affiliate may be adverse to the interest of the investor in the Complex Products and, therefore, could adversely affect such investor's return on the Complex Products. An investor in the Complex Products may request further information from his or her bank/relationship manager.

Where not explicitly otherwise stated, the Issuer has no duty to invest in the Underlying(s) and an investor in Complex Products has no recourse to the Underlying(s) or to any return thereon. The issue price of the Complex Products will reflect the customary fees and costs charged on the level of the Underlying(s). Certain built-in costs are likely to adversely affect the value of the Complex Products.

The Complex Products are complex structured financial instruments and involve a high degree of risk. They are intended only for investors who understand and are capable of assuming all risks involved. Before entering into any transaction involving the Complex Products, a potential investor should determine if the Complex Products suit his or her particular circumstance and should independently assess (with his or her professional advisors) the specific risks (maximum loss, currency risks, etc.) and the legal, regulatory, credit, tax and accounting consequences. The Issuer makes no representation as to the suitability or appropriateness of the Complex Products for any particular potential investor or as to the future performance of the Complex Products. This document does not replace a personal conversation between a potential investor and his or her relationship manager and/or professional advisor (e.g. legal, tax or accounting advisor), which is recommended by the Issuer before any investment decision. Therefore, any potential investor in Complex Products is requested to ask his or her relationship manager to provide him or her with any available additional information regarding Complex Products.

Historical data on the performance of the Complex Products or the Underlying(s) is no indication of future performance. No representation or warranty is made that any indicative performance or return indicated will be achieved in the future. Neither this document nor any copy thereof may be sent, taken into or distributed in the United States or to any U.S. person or in any other jurisdiction except under circumstances that will result in compliance with the applicable laws thereof.

This document constitutes the **Simplified Prospectus** for the Complex Products in accordance with Article 5 CISA. The prospectus requirements of Article 652a/Article 1156 of the Swiss Code of Obligations are not applicable. The Simplified Prospectus is of summary nature with a view to include the information required by Article 5 CISA and the Guidelines of the Swiss Bankers Association. The legally binding terms and conditions for the Complex Products are set forth in the final terms (the Final Terms) within the meaning of the Additional Rules for the Listing of Derivatives of the SIX Swiss Exchange Ltd and, together with the Base Prospectus for the issuance of Yield Enhancement Products of Credit Suisse AG dated 20 June 2013 (as supplemented as of the date of the Final Terms, the Base Prospectus), constitutes the listing prospectus (the Listing Prospectus) for the Complex Products. Copies of the Listing Prospectus and the documents incorporated by reference therein may be obtained free of charge from Credit Suisse AG, Transaction Advisory Group, ZUGG 3, P.O. Box, 8070 Zurich, Switzerland. This document does not constitute an offer or an invitation to enter into any type of financial transaction.