GLOBAL MARKETS
STRUCTURED PRODUCTS
HANDBOOK EQUITY DERIVATIVES

Intended for Institutional and Accredited Investors (in Singapore) only.

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A Global Leader...

- With strong roots anchored in Europe’s economic history, BNP Paribas supports its customers in today’s changing world and has positioned itself as a leading bank in the Eurozone and a prominent international banking institution.

- BNP Paribas Global Markets offers a full range of products which can be customised to address the various needs of financial institutions and asset managers as well as corporate and retail clients.

Global Markets is part of a strong Corporate and Institutional Bank within a diverse and stable group, BNP Paribas, which has positioned itself as a leader in Equity Derivatives.

Our renowned quantitative skills in advanced product design allow us to work in partnership with clients, delivering solutions to support your interests, your projects and your business, in all markets.

Risk Awards 2019
- Derivatives House of the Year

The Banker Investment Banking Awards 2018
- Most Innovative Investment Bank for Structured Investment Products
- Most Innovative Investment Bank for Equity Derivatives

IFR Awards 2017
- Derivatives House of the Year
- Equity Derivatives House of the Year

Global Capital Derivatives Awards 2017
- Derivatives Bank of the Year

2018 Asian Private Banker Structured Products Awards for Excellence
- Structured Products House of the Year
- Best Provider of Non-Flow Equity-Linked Structured Products
- Best Single Dealer Platform

Global Capital Americas Derivatives Awards 2018
- Volatility Derivatives Bank of the Year
A Forerunner in Structured Products...

BNP Paribas is an established leader in Structured Products, providing solutions to retail distributors, banks and institutional investors worldwide. BNP Paribas offers a rich range of Structured Products, both in terms of underlying assets and payoff structures.

Structured Products designed by BNP Paribas are generally linked to equities, through shares or indices (basket or single) but may also be linked to commodities, funds, foreign exchange, interest rates, inflation and “Hidden Assets.” This expansion beyond traditional underlying assets allows investors to gain access to a wider range of diversification opportunities.

BNP Paribas has a team of experienced structurers offering an impressive spectrum of product expertise. With the design of future Structured Products in mind, BNP Paribas is constantly developing and introducing new products that complement investors’ traditional portfolios, which often consist of a mix of equity and fixed income securities.

Structured Products can be constructed to provide investors with new means of enhancing their existing portfolios. They enable clients to access new markets and diverse asset classes, while providing features such as capital guarantee, leverage or yield enhancement.

Capital guarantee is subjected to creditworthiness of the issuer.

The BNP Paribas Structured Products Handbook is designed to introduce the reader to Structured Products and how they enable investors to meet their distinct investment objectives. The handbook introduces the range of underlyings available, explains the basic mechanism of Structured Products: the combination of a fixed income security and an option-like instrument, and then provides examples of product structures and the most commonly used wrappers. The appendix gives an overview of options, the building blocks of Structured Product design.

1 “Hidden Assets” are non-directly observable market parameters which come into account when pricing equity derivatives (e.g. volatility, correlation, etc.) They form a new generation of assets and display portfolio hedging / diversification properties.
Introduction to Structured Products
What are Structured Products?
Why use Structured Products?
How do Structured Products Work?
Structured Products at your Service
How to use this Handbook
What are Structured Products?

Structured Products are investments that are fully customised to meet specific objectives such as capital guarantee, diversification, yield enhancement, leverage, regular income, tax / regulation optimisation and access to non-traditional asset classes, amongst others.

The strength of a Structured Product lies in its flexibility and tailored investment approach. In their simplest form, Structured Products offer investors full or partial capital guarantee coupled with an equity-linked performance and a variable degree of leverage. They are commonly used as a portfolio enhancement tool to increase returns while limiting the risk of loss of capital.

Structured Products can be extensively customised to meet a specific investor’s risk / return profile and investment objectives.

As fully customised investment tools, Structured Products are shaped by numerous factors. The current Market Outlook influences both the Objectives in terms of the Investor and Distributor Goals as well as the Structured Product Design.

Simultaneously, the Investor and Distributor Goals influence the Structured Product Design which involves selecting the appropriate Underlying Assets, Payoff Structures and Legal Wrappers. This interlinked process enables Structured Products to be tailor-made, corresponding to the investor and market needs.

Objectives

Investor Goals
- Principal Guarantee
- Hedging
- Enhanced Return

Distributor Goals
- Target Fees
- Suitability
- Previous experience

Market Outlook
- Bullish
- Bearish
- Stable
- Uncertain
- Volatile
- Correlated

Structured Product Design

Underlying Assets
- Equities or Indices
- Commodities
- Funds
- Foreign Exchange

Payoff Structures
- OTC
- Note
- Certificates
- Warrants

Legal Wrappers
- Fund
- Life insurance policy
- Structured deposits

Capital guarantee is subjected to creditworthiness of the issuer.
Why use Structured Products?

The key benefits of using Structured Products are:

**Protection**
- **Principal Guarantee**: Capital guarantee at your preferred level
- **Hedging**: Protect the portfolio by hedging the risks of existing investments

**Efficiency**
- **Enhanced Return**: Increase the portfolio’s return while controlling risk
- **Market Access**: Exposure to new or hard to access asset classes (property, emerging markets, etc.) and hidden asset classes (volatility, correlation, etc.)
- **Tax Efficiency**: Benefit from customised, tax efficient portfolio investment solutions

**Diversification**
- **Diversification**: Diversify with the adjustable risk / return profiles and market cycle optimisation capabilities of Structured Products

*Capital guarantee is subjected to creditworthiness of the issuer.*
How do Structured Products Work?

A typical capital guaranteed Structured Product is comprised of two components:

1. A fixed income security, typically a zero coupon bond, which guarantees part or all of the invested principal at maturity.

2. An option-like instrument which provides a payoff in addition to the fixed income payments. This additional payoff is linked to the performance of an underlying asset and takes the form of either regular coupons or a one-off gain at maturity.

In its most basic form, an equity derivative Structured Product consists of a zero coupon bond, purchased at a discount, and an option.

At maturity, the zero coupon bond will be redeemed at par, thereby providing investors capital guarantee.

The option, which offers investors participation in the equity market, pays out the performance of the underlying at maturity, if it is above the strike price (call option).

Capital guarantee is subjected to creditworthiness of the issuer.

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**Zero Coupon Bond**

<table>
<thead>
<tr>
<th>Value</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero Coupon Bond</td>
<td>100</td>
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<tr>
<td>&lt;100</td>
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</tbody>
</table>

**Call Option Value at Expiration**

<table>
<thead>
<tr>
<th>Value</th>
<th>Strike Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option</td>
<td></td>
</tr>
<tr>
<td>Underlying</td>
<td></td>
</tr>
</tbody>
</table>

FOR ILLUSTRATIVE PURPOSES ONLY
Example

An investor wants to invest USD 100 over five years, with full capital guarantee and exposure to the S&P 500 index upside.

With a five-year US Treasury rate of 2.5% p.a., a five-year zero coupon bond is worth 88.4, i.e. 100 in five years is worth 88.4 now. This leaves the structure provider with 11.6 (i.e. 100 – 88.4) to purchase an option on the S&P 500 and pay for administration costs and commission.

Assuming a five-year S&P 500 call option costs 12, and adding 2 for administration and management fee costs, the investor will benefit from an 80% [i.e. (11.6 – 2) / 12] participation in the S&P 500 upside, while having 100% of his capital guaranteed at maturity.

Optimistic Scenario

If the S&P 500 goes up by 40% over the five years, the investor will achieve a return of 32% (80% x 40%) on top of his initial capital.

Pessimistic Scenario

If the S&P 500 is down by 30% after five years, the investor will receive 100% of his capital at maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Structured Products at your Service

Equity Derivatives have continuously evolved since 1992 both in terms of structure (complex combinations, multi-underlying assets and exotic features) and form (adapting to new regulations).

Recently, volatile equity markets and lower interest rates have forced Structured Products providers to be even more innovative.

As one of the world’s top players in Equity Derivatives, BNP Paribas continues to be a leader in Structured Products innovation. Even in rapidly evolving markets, BNP Paribas professionals maintain in-depth knowledge of regulatory matters reinforcing their historical ability to provide investors with optimal solutions to meet their investment goals.

Whatever the investment objective, BNP Paribas’ Structured Products offer investors a valuable alternative to traditional investment vehicles. In this handbook, we present the Structured Products that we believe serve your needs as an investor.
How to use this Handbook

On each of the Payoff pages you will find a Market Outlook Indicator and a Risk Indicator to use as an investment guideline.

The Market Outlook Indicators illustrate the type of market conditions that the product is best suited for.

The Risk Indicator illustrates which risk appetite the product is appropriate for.

Market Outlook Indicator

- Bullish
- Stable
- Uncertain
- Volatile

Risk Indicator

- Low Risk
- Intermediate
- High Risk
Payoffs

Risk Level

- **High Risk**
  - Reverse Convertible
  - Certificate Plus
  - Knock Out Forward
  - Athena

- **Intermediate**
  - Tempo
  - Coupon Comet

- **Low Risk**
  - CPPI
  - Captibasket
  - ODB
  - Stellar
  - Profiler
  - STARlight
  - Lookback

Capital guarantee is subjected to creditworthiness of the issuer.

Market Outlook

- **Stable**
- **Bullish**
- **Volatile**
- **Uncertain**
Capital Guaranteed Products

CPPI Principles

Launch Background: CPPI was launched by BNP Paribas in 1998 to provide leveraged access to funds’ performances, while remaining protected through a systematic insurance in the eventuality of a market downturn.

Constant Proportion Portfolio Insurance (CPPI) structures are ideal for investors looking to supplement their investments without putting capital at risk. They offer 100% capital redemption at maturity in addition to 100% of a basket’s positive performance. The basket is composed of an active asset (usually a fund) and a defensive asset (bonds, cash, inflation, etc.)

CPPIs actively allocate assets over time to achieve maximum performance and capital safety. This dynamic investment strategy facilitates greater exposure to active assets when markets rise and increases the allocation to defensive assets when markets fall.

Typical Underlying: Fund of Funds, Mutual Funds or Equity Indices

How does the allocation strategy work?

During the investment lifespan, the participation in the active asset increases or decreases according to the distance between the basket value and the zero coupon bond curve.

How is the participation in the active asset determined?

- Target participation is typically calculated monthly for Hedge Fund underlyings and daily for Mutual Funds, as a function of the distance and a pre-defined leverage factor.

- If the difference between the current and target participations is lower / higher than a pre-defined range, the allocation will be re-adjusted to the target participation.

- The target participation is capped at a maximum level (usually 200%), and can be 0% if the basket value reaches the zero coupon bond curve (in this case, the investment will be 100% in the defensive asset until maturity).
Benefits

- Capital guarantee at maturity.
- The active asset may benefit from a high leverage opportunity allowing for yield enhancement.
- Transparent valuation supports secondary markets.
- Optimised allocation between the two assets - exposure increases with good performance and / or rise in interest rates.

Risks

- If the active asset falls significantly during the life of the investment, there is a risk of de-leveraging (no more exposure to the alternative asset).
- Sensitivity to interest rates, (through the zero-coupon bond floor)
- Path-dependency.
- Capital is guaranteed only if the product is held until maturity.

Example

- An investor purchases a 5-year CPPI on a fund with the exposure to the active asset floored at 0% and capped at 200%.
- When exposure is greater than 100% the basket “borrows” money to invest in the active asset on a Libor reference.

Illustration of CPPI Example

*Capital guarantee is subjected to creditworthiness of the issuer.*
Himalaya

Principles

Launch Background: Himalaya was developed in 2000 as a mechanism to benefit from the buoyant market scenario by applying a “skimming” mechanism to a diversified basket of shares.

Himalaya can also provide exposure to several different types of underlyings, thereby offering geographical and asset class diversification.

At each observation date, the performance of the best performing underlying is locked-in. This underlying is then permanently removed from the basket. At maturity, the investor receives the average of the locked-in performances, floored at zero.

Typical Underlying: Basket of Shares

Benefits

- Capital guarantee at maturity.
- Automatic selection of each period’s best underlying performance since inception delivers optimised performance.
- Benefit from sector rotation, market cycles and efficient asset class diversification.

Risks

- Once a performance is locked, any additional appreciation of the underlying will not contribute to the product’s performance.
- Capital is guaranteed only if the product is held until maturity.
- Negative performance of the underlyings left free can damage the overall performance.

Example

- An investor purchases a 5 year Himalaya 100% indexed to a basket of 10 shares.
- Every 6 months, the performance of the most performing share in the basket is locked and the share is then removed from the basket.
- At maturity, the investor receives the weighted average of the locked performances.
- Capital is guaranteed at maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
### Optimistic Scenario

<table>
<thead>
<tr>
<th>Months</th>
<th>Share 1</th>
<th>Share 2</th>
<th>Share 3</th>
<th>Share 4</th>
<th>Share 5</th>
<th>Share 6</th>
<th>Share 7</th>
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**Final Performance**

Average of the equally weighted locked-in performances: **44.50%**

### Pessimistic Scenario

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<tr>
<th>Months</th>
<th>Share 1</th>
<th>Share 2</th>
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**Final Performance**

Average of the equally weighted locked-in performance: **-2.90%**

Floored performance: 0%

**Global Markets**

*For illustrative purposes only*
Coupon Comet

Principles

Launch Background: Coupon Comet was created in 2001 to capitalise on the potential market rebound and high volatility that followed the international financial crisis through high annual coupons.

The Coupon Comet structure allows the investor to earn annual coupons in bullish or stable market environments, with a minimum 100% capital redemption at maturity.

The investor receives an annual fixed coupon if none of the shares in the basket have fallen below a predetermined level at the observation date.

Typical Underlying: Basket of Shares

Benefits

- Opportunity to earn coupons higher than standard bond yields as long as the underlying does not breach the predetermined barrier.
- Allows investors to benefit from high implied volatilities in certain shares.
- Capital guarantee at maturity.

Risks

- Coupons may be missed due to the fall in the price of a single share, even if the overall basket performance is positive.
- Capital is guaranteed only if the product is held until maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

- An investor purchases a 5-year Comet Coupon on 3 shares, which pays a 10% annual coupon if none of the shares go below 80% of their initial level on the yearly observation dates.

On year 3, the lowest performing share goes below 80% of its initial level on the observation date. As a result, no coupon is paid that year.

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Captibasket

Principles

Launch background: The Captibasket structure was created in 2002 to allow investors to gain exposure to a basket of shares via an innovative mechanism which locks individual rallies.

If, at any time, the underlying breaches a pre-determined barrier, its performance is locked-in at the barrier level, no matter how sharply it may fall afterwards. This lock-in system secures profits against market downturns.

The final basket performance is calculated as the average of each individual shares performance, including locked performances, with full capital guarantee.

Typical Underlying: Basket of Shares

Benefits

- Optimisation of the performance of shares with a cyclical performance, avoiding the “bell shape” effect (i.e. a sharp rise followed by a sharp fall) thanks to the lock-in system.
- Opportunity to benefit from a temporary rebound.
- Basket diversification which enables the investor to take advantage of different assets’ market cycles or sector rotation.
- Capital guarantee at maturity.

Risks

- Investors may not benefit from the whole rise of the underlying shares.
- Capital is guaranteed only if the product is held until maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

- An investor purchases a 5-year Captibasket on a basket of 3 shares, offering 100% participation at maturity with a +45% performance lock-in level.

- Each share that reaches the +45% barrier is locked-in at that level until maturity, no matter how it may fall or rise afterwards.

<Capital guarantee is subjected to creditworthiness of the issuer.>

The investor receives the average of all share performances at the end of the five years, on top of principal, with full capital guarantee.

\[
\text{Performance at Maturity} = \frac{(45\% + 45\% + 7\%)}{3} = 32.33\%
\]

FOR ILLUSTRATIVE PURPOSES ONLY
**Principles**

Launch background: Option on a Dynamic Basket (ODB) was developed to benefit from the bullish market scenario via a leveraged participation in funds while enjoying protection by systematic insurance in case of a market downturn. It was first used by BNP Paribas Structured Products in 2003.

An Option on a Dynamic Basket (ODB) is a Call option on a dynamic basket which actively allocates between an active asset (usually a fund) and a defensive asset (bond, cash, inflation, etc.). With this dynamic investment strategy, the exposure to active assets is leveraged when markets are rising, and de-leveraged when markets are falling. The structure also ensures full capital guarantee at maturity.

The ODB aims to maximise the exposure to the alternative asset when it is performing well while protecting returns otherwise.

ODBs can be tailored to suit investor needs by:

- Providing coupons, either paid or accumulated until maturity
- Including a Lookback feature. The Lookback feature settles the option based on the maximum value of the dynamic basket during the entire product life cycle.

**Typical Underlying:** Fund of Funds, Mutual Funds or Equity Indices

Capital guarantee is subjected to creditworthiness of the issuer.

**How does the allocation strategy work?**

During the investment lifespan, the exposure to the alternative asset increases or decreases according to the distance between the basket value and a reference line in order to remove exposure to interest rates.

**Difference between ODB and CPPI**

The ODB and CPPI structures are very similar however they have some fundamental differences. Firstly, the ODB is an option whereas the CPPI is a systematic asset management process. The ODB guarantees a minimum investment in the active asset (minimum exposure) whereas the entire basket of CPPI may end up being exposed solely to money market instruments in adverse market conditions. The ODB bears no risk of completely de-leveraging. For ODB, capital guarantee is provided outside the ODB, in contrast to CPPI where the protection is embedded within the cushion management. ODB offers more flexibility as the allocation parameters can be adapted to the investors’ risk appetite: leverage factor, minimum allocation, reference for the distance (fixed line or zero coupon bond), etc.

Finally, in CPPI structures, exposure to the active asset is more sensitive to interest rates. In ODB structures, however, this sensitivity is removed to shield the exposure from interest rate fluctuations. Note valuations are the element in the CPPI structure that are sensitive to interest rates.
How is the participation in the alternative asset determined?

- A target participation is typically calculated monthly for Hedge Fund underlyings and daily for Mutual Funds as a function of the distance and a pre-defined leverage factor.

- If the difference between the current target participations is lower / higher than a pre-defined range, the allocation will be re-adjusted to the target participation.

- The target participation is floored at a minimum participation level (usually 30%) and capped at a maximum participation level (usually 200%).

Benefits

- Capital guarantee at maturity.

- The alternative asset may benefit from a high leverage opportunity, allowing for yield enhancement.

- No possibility of completely deleveraging into the defensive asset (no “knock-out risk”).

- No sensitivity to interest rates in the exposure calculation (the reference line is fixed at inception).

- Flexible structure.

- Optimised allocation between the two assets.

Risks

- Product volatility may increase due to the possible leveraging of the structure.

- Capital is guaranteed only if the product is held until maturity.

- Path-dependency.

- Secondary market depends on market parameters such as interest rates, time to maturity as well as the alternative asset’s return and volatility.

Example

- An investor purchases a 5-year ODB on an Index, with an exposure to the alternative asset floored at 30% and capped at 200%.

Illustration of ODB example

Capital guarantee is subjected to creditworthiness of the issuer.
**Starlight**

**Principles**

Launch background: The Starlight structure was designed in 2003 to offer investors an early redemption at an attractive annual yield if the underlying breaches a pre-determined barrier at any observation date during the investment period.

It also allows investors to gain full exposure to the underlying’s upside, up to the barrier, with full capital guarantee at maturity.

Typical Underlying: Single Index

**Benefits**

- Possible early redemption to avoid capital lock up over the whole period.
- Higher participation on the upside than a plain vanilla call in case of moderate growth.
- Strong annual returns in case of market rebound.
- Capital guarantee at maturity.

**Risks**

- Investors might not benefit from the whole rise of the underlying in case of very bullish scenarios.
- Capital is guaranteed only if the product is held until maturity.

*Capital guarantee is subjected to creditworthiness of the issuer.*
Example

- An investor purchases a 6-year Starlight on the FTSE 100.
- At the end of year 3, if the FTSE is at or above 110% of its initial level, an early redemption occurs with a 20% coupon. Similar early redemption features for years 4 and 5.
- At maturity, the product redeems 100% plus the positive average growth of the FTSE 100, computed as the average of the monthly performances of the FTSE 100 during the last year.

**Starlight Investment**

<table>
<thead>
<tr>
<th>Initial Investment</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>FTSE has risen by 10% or more.</td>
<td>FTSE has risen by 15% or more.</td>
<td>FTSE has risen by 20% or more.</td>
<td>Receive 100% of capital growth in the FTSE 100, plus the average monthly performance of the FTSE 100 in the last year (floored at 0%).</td>
</tr>
<tr>
<td></td>
<td>Receive a 20% coupon and closure of investment</td>
<td>Receive a 30% coupon and closure of investment</td>
<td>Receive a 40% coupon and closure of investment.</td>
<td>Capital guaranteed if FTSE under-performs.</td>
</tr>
<tr>
<td></td>
<td>Total Return 120%</td>
<td>Total Return 130%</td>
<td>Total Return 140%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investment continues if FTSE growth is less than 10%.</td>
<td>Investment continues if FTSE growth is less than 15%.</td>
<td>Investment continues if FTSE growth is less than 20%.</td>
<td></td>
</tr>
</tbody>
</table>

*FOR ILLUSTRATIVE PURPOSES ONLY*

*Capital guarantee is subjected to creditworthiness of the issuer.*
Stellar

Principles

Launch Background: Stellar was created in 2003 as an investment solution to allow investors to benefit optimally from moderate growth anticipated in the period following the growth and subsequent burst of the Dot-Com bubble. The payoff offers equity-linked annual coupons.

The Stellar is constructed to perform in markets which move forward together, even if the extent of this advance is moderate.

The Stellar structure is designed to boost long-term portfolio returns. It offers enhanced equity-linked annual coupons throughout the investment period. This structure may be used to ensure a minimum return via fixed annual coupons or floored variable coupons over a fixed period.

The variable equity-linked annual coupons are determined by the positive performance of a basket of underlyings. The annual coupons are calculated by applying a pre-determined cap to each underlying’s individual performance, these performances are then averaged and where necessary a pre-determined floor is also applied.

Typical Underlying: Basket of Shares

Benefits

- At each annual observation date, each underlying’s performance is measured against its initial level, without restriking.
- Assured minimum return via floored variable coupons.
- Potentially high variable coupons even in markets experiencing moderate growth.
- Capital guarantee at maturity.

Risks

- A drop in one or a few of the underlyings can dampen the overall performance.
- Any increase in the price of the underlying beyond the cap will not increase the annual return.
- Capital is guaranteed only if the product is held until maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

An investor buys a 5 year Stellar on a basket of 3 Blue chips (underlyings). The structure offers variable coupons equal to the basket average, where each share performance is individually capped at 7%. The coupon is floored at 2.5%.

Throughout the investment period, the investor receives annual coupons. At maturity, the investor receives the final 7% coupon in addition to their initial capital.

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share 1</td>
<td>5.80%</td>
<td>-5.80%</td>
<td>9.30% → 7.00%</td>
<td>+14.30% → 7.00%</td>
<td>16.80% → 7.00%</td>
</tr>
<tr>
<td>Share 2</td>
<td>+11.30% → 7.00%</td>
<td>-3.80%</td>
<td>3.80%</td>
<td>6.30%</td>
<td>14.00% → 7.00%</td>
</tr>
<tr>
<td>Share 3</td>
<td>2.30%</td>
<td>3.00%</td>
<td>5.00%</td>
<td>1.30%</td>
<td>8.80% → 7.00%</td>
</tr>
<tr>
<td>Average</td>
<td>5.03%</td>
<td>-2.20%</td>
<td>5.27%</td>
<td>4.87%</td>
<td>7.00%</td>
</tr>
<tr>
<td>Coupon</td>
<td>+5.03%</td>
<td>+2.5%</td>
<td>+5.27%</td>
<td>+4.87%</td>
<td>+7.00%</td>
</tr>
</tbody>
</table>

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Coupon Driver

Principles

Launch Background: The Coupon Driver was developed by BNP Paribas in 2004 to capitalise on high levels of volatility. It offers pre-defined returns on the majority of the underlyings.

The Coupon Driver structure pays a yearly coupon, linked to the performance of a basket of underlying assets, with full capital guarantee at maturity.

Yearly coupons are calculated as follows:

At each yearly anniversary date, the level of each share is compared to its initial level.

The X-best performing shares in the basket are set at a fixed performance, and the remaining ones are taken at their level of performance, with or without a cap, X being a number fixed in advance.

The annual coupon is the positive performance of the basket which may be floored at a pre-determined level

Typical Underlying: Basket of Shares

Benefits

- Coupons are floored at 0%.
- High returns, over-performing the basket performance, can be achieved in flat or moderately bearish markets.
- Capital guarantee at maturity.

Risks

- Investors might not benefit from the whole rise of the underlyings, due to the fixed performance for the best performing assets.
- Capital is guaranteed only if the product is held until maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

- An investor purchases a 5-year Coupon Driver, linked to a basket of 20 shares. The 17 best performing shares in the basket are set at +7.5% performance. The 3 remaining shares are taken at their level of performance and capped at +7.5%.
- The average of the share performance is floored at +1%.
- The investor receives the average of the recorded performance at the end of each year.

### Coupon Driver Performance

| Share 1 | Actual Performance in Year 1 | 16.0% | Coupon Driver Recorded Performance | 7.5% |
| Share 2 | 13.0% | 7.5% |
| Share 3 | 12.0% | 7.5% |
| Share 4 | 11.0% | 7.5% |
| Share 5 | 9.0% | 7.5% |
| Share 6 | 9.0% | 7.5% |
| Share 7 | 7.0% | 7.5% |
| Share 8 | 7.0% | 7.5% |
| Share 9 | 6.0% | 7.5% |
| Share 10 | 6.0% | 7.5% |
| Share 11 | 6.0% | 7.5% |
| Share 12 | 4.0% | 7.5% |
| Share 13 | 4.0% | 7.5% |
| Share 14 | 3.0% | 7.5% |
| Share 15 | 3.0% | 7.5% |
| Share 16 | 1.0% | 7.5% |
| Share 17 | -1.0% | 7.5% |
| Share 18 | -1.0% | -1.0% |
| Share 19 | -10.0% | -10.0% |
| Share 20 | -8.0% | -8.0% |
| **Average** | **4.85%** | **5.43%** |
Lookback

Principles

Launch Background: Lookback was designed in 2004 as a path dependent option that allows investors to benefit from the best entry point and / or the best exit point. It aims to protect investors from the risk of poor exit timing by recording the highest performance throughout the whole investment period.

The Lookback mechanism records the highest performance of an underlying over a part of or over the entire investment period. In general, the redemption at maturity is the highest recorded performance multiplied by a participation. Capital is fully guaranteed at maturity.

Typical Underlying: Single Index

Benefits

- Capital guarantee at maturity.
- Removes timing issues on the entry (lookback in) and on the exit of the investment (lookback out).
- Simple mechanism.

Risks

- Capital is guaranteed only if the product is held until maturity.
- Opportunity cost in a steady Bullish Market (max = final performance while lookback option is much more expensive than a simple call)

Capital guarantee is subjected to creditworthiness of the issuer.
Example

- An investor purchases a 6-year Lookback on an index, with monthly observations. At maturity, the investor receives 90% of the highest performance of the index over the investment period, with full capital guarantee.

**Performance Lookback Scenarios**

Highest Recorded Value = 208%

**Optimistic Scenario:** The investor receives $100\% + 90\% \times 108\% = 197.20\%$ of initial capital.

**Pessimistic Scenario:** The index does not perform above the initial level. At maturity, the investor receives 100% of the invested capital.

*Capital guarantee is subjected to creditworthiness of the issuer.*
Profiler

Principles

Launch Background: Profiler was created in 2004, in response to an investment scenario characterised by uncertain equity markets and low returns from bond markets. The payoff provides investors with the most performing of several diversified portfolios throughout the period.

With the Profiler structure, three alternately risk-profiled portfolios are composed from a set of diverse asset classes. At maturity, the investor gets full participation in the best performing portfolio, with full capital guarantee.

The 3 portfolio profiles are:

**Aggressive:** Largely composed of equities commodities with smaller allocations to low risk assets, such as bonds, rates, real estate, etc.

**Balanced:** Equal exposure to different kinds of assets.

**Defensive:** Emphasis on the low risk assets.

**Typical Underlying:** Basket of Indices

Asianing is generally applied.

Benefits

- Investors automatically benefit from the best performing strategy at maturity irrespective of market fluctuations.
- Capital guarantee at maturity.

Risks

- Investors may not benefit from the whole rise of the best performing asset, due to the averaging of performances.
- Capital is guaranteed only if the product is held until maturity.

Example

- An investor buys a 4-year Profiler indexed to the following 3 portfolios:

<table>
<thead>
<tr>
<th>Asset</th>
<th>Aggressive</th>
<th>Balanced</th>
<th>Defensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equities</td>
<td>50%</td>
<td>25%</td>
<td>15%</td>
</tr>
<tr>
<td>Commodities</td>
<td>25%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Real Estate</td>
<td>15%</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Bonds</td>
<td>10%</td>
<td>35%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Asianing is applied with semi-annual observation dates. The investor gets full participation in the best performing portfolio at maturity.

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*Capital guarantee is subjected to creditworthiness of the issuer.*
At maturity, the investor receives his initial capital plus the highest performing portfolio: **Aggressive = 59.25%**

<table>
<thead>
<tr>
<th>Observation Periods</th>
<th>Aggressive</th>
<th>Balanced</th>
<th>Defensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>19%</td>
<td>12%</td>
<td>8%</td>
</tr>
<tr>
<td>1</td>
<td>36%</td>
<td>23%</td>
<td>18%</td>
</tr>
<tr>
<td>1.5</td>
<td>61%</td>
<td>39%</td>
<td>29%</td>
</tr>
<tr>
<td>2</td>
<td>60%</td>
<td>40%</td>
<td>31%</td>
</tr>
<tr>
<td>2.5</td>
<td>72%</td>
<td>47%</td>
<td>35%</td>
</tr>
<tr>
<td>3</td>
<td>85%</td>
<td>54%</td>
<td>40%</td>
</tr>
<tr>
<td>3.5</td>
<td>82%</td>
<td>53%</td>
<td>40%</td>
</tr>
<tr>
<td>4</td>
<td>59%</td>
<td>44%</td>
<td>37%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>59.25%</strong></td>
<td><strong>39.00%</strong></td>
<td><strong>29.75%</strong></td>
</tr>
</tbody>
</table>

At maturity, the investor receives his initial capital plus the highest performing portfolio: **Balanced = 28.88%**

<table>
<thead>
<tr>
<th>Observation Periods</th>
<th>Aggressive</th>
<th>Balanced</th>
<th>Defensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>20%</td>
<td>12%</td>
<td>9%</td>
</tr>
<tr>
<td>1</td>
<td>36%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>1.5</td>
<td>40%</td>
<td>29%</td>
<td>23%</td>
</tr>
<tr>
<td>2</td>
<td>49%</td>
<td>42%</td>
<td>36%</td>
</tr>
<tr>
<td>2.5</td>
<td>35%</td>
<td>39%</td>
<td>37%</td>
</tr>
<tr>
<td>3</td>
<td>18%</td>
<td>33%</td>
<td>35%</td>
</tr>
<tr>
<td>3.5</td>
<td>5%</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>4</td>
<td>1%</td>
<td>26%</td>
<td>32%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>25.50%</strong></td>
<td><strong>28.88%</strong></td>
<td><strong>27.63%</strong></td>
</tr>
</tbody>
</table>

At maturity, the investor receives his initial capital plus the highest performing portfolio: **Defensive = 11.13%**

<table>
<thead>
<tr>
<th>Observation Periods</th>
<th>Aggressive</th>
<th>Balanced</th>
<th>Defensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>-3%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>1</td>
<td>-13%</td>
<td>-1%</td>
<td>4%</td>
</tr>
<tr>
<td>1.5</td>
<td>-21%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>2</td>
<td>-15%</td>
<td>5%</td>
<td>11%</td>
</tr>
<tr>
<td>2.5</td>
<td>-18%</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>-14%</td>
<td>14%</td>
<td>22%</td>
</tr>
<tr>
<td>3.5</td>
<td>-17%</td>
<td>10%</td>
<td>18%</td>
</tr>
<tr>
<td>4</td>
<td>-27%</td>
<td>-1%</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>-16.00%</strong></td>
<td><strong>4.63%</strong></td>
<td><strong>11.13%</strong></td>
</tr>
</tbody>
</table>
Talisman

Principles

Launch Background: Talisman was created in 2005 in an environment characterised by very low implicit dispersion according to historical standards. It was designed to take advantage of a future rise in market volatility and the bank’s appetite to provide aggressive pricing on dispersion due to its risk-reducing virtues.

The Talisman structure is designed to benefit from the dispersion of a basket of shares. Dispersion measures the tendency of the returns of shares comprising a basket to diverge from the average basket return.

Talisman offers 100% capital guarantee at maturity, as well as annual variable coupons depending on the level of dispersion. This structure may also offer a minimum return via floored coupons.

Typical Underlying: Basket of Shares

Benefits

■ Dispersion can be positive irrespective of the direction of market movements. Hence, the performance of a dispersion strategy is highly decorrelated with equity market trends.

■ This product is based on sophisticated techniques used only by hedge funds so far, and allows investors to benefit from them using a secured structure.

■ Capital guarantee at maturity.

Risks

■ In sluggish or bullish markets, the volatility tends to be lower.

■ High level of volatility.

■ Capital is guaranteed only if the product is held until maturity.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

- An investor purchases a 5-year Talisman on an Index with a strike level fixed at 8%.
- For each share, the absolute difference with the basket average is pro-rated and the excess difference over 8% is retained to calculate the average basket dispersion.
- From year 2 onwards, a variable floor on the coupon guarantees 50% of the previous coupon.

Absolute Difference
Number of Years = Strike = Retained Performance

Retained Performance for Share 1
\[
\frac{18.25}{1} - 8.00\% = 10.25\%
\]

Retained Performance for Share 2
\[
\frac{18.25}{1} - 8.00\% = 10.25\%
\]

After the first year of the investment, the investor receives a coupon worth the average of the two retained performances: 10.25%
Non-Capital Guaranteed Products

Reverse Convertible Principles

Launch Background: Reverse Convertible was relaunched by BNP Paribas in 2000, designed to take advantage of periods of high implied volatility through a high pre-defined coupon.

A Reverse Convertible is a short-term investment combining a high coupon with exposure to equity. It offers a guaranteed coupon and conditionally returns the principal, depending on the performance of the underlying. Generally the principal is 100% guaranteed down to a pre-determined barrier.

Typical Underlying: Single Stock or Single Index

Benefits

- Short term investment in which maturities range from three months to two years.
- The pay-off offers a high coupon, payable monthly, quarterly, semi-annually or annually.

Risks

- Capital guarantee subject to a predetermined barrier.
- Allows investors to benefit from the high implied volatility of a particular share or index.
- If the price of the underlying decreases below the predetermined barrier over the investment period, the return may be less than the original amount invested.
- Any increase in the price of the underlying will not increase the return of the Reverse Convertible.
- No dividends or ownership rights.

Example

An investor purchases a 9-month Reverse Convertible on a single share, with a 12% fixed coupon and a continuous down barrier at 70% of initial performance.

Capital guarantee is subjected to creditworthiness of the issuer.
Example

An investor purchases a 9-month Reverse Convertible on a single share, with a 12% fixed coupon and a continuous down barrier at 70% of initial performance.

**Optimistic Scenario** – The share does not breach the 70% barrier during the investment period, and is up by 6% at maturity. Investors receive a 12% coupon in addition to 100% of the principal invested.

**Pessimistic Scenario** – The share breaches the barrier during the investment period and is down by 40% at maturity. Investors receive a 12% coupon and 60% of the principal invested.
Certificate Plus

Principles

Launch Background: Certificate Plus was created in 2002, and was designed to capture the potential market rebound and high volatility in the period that followed the burst of the Dot-Com bubble.

The Certificate Plus structure offers 100% participation in the underlying performance with an ensured minimum return, provided the underlying never breaches the knock-out barrier during the investment period. Otherwise, Certificate Plus pays the underlying performance at maturity.

Typical Underlying: Single Index

Benefits

- Better performance than the index in all cases: Certificate Plus is designed to always at least track the underlying’s performance with a potential to outperform it due to the ensured minimum return.
- High potential redemption, even if the market does not perform.

Risks

- If the price of the underlying dips below the barrier at any time during the investment period, and finishes below its initial value at maturity, the redemption will be less than the original amount invested.
- The investor does not benefit from dividends or ownership rights.
Example

An investor buys a 3-year Certificate Plus on an Index with a 10% minimum return and a 70% down barrier.

**Optimistic Scenario** – The investor receives his initial capital in addition to the 38% underlying performance.

**Pessimistic Scenario** – The underlying breaches the knock-out barrier. The investor receives the performance of the underlying (-8%).

**Neutral Scenario** – The underlying does not perform but the knock-out barrier is never breached. At maturity the investor receives his initial capital and benefits from the 10% minimum return.
Tempo

Principles

Launch Background: Tempo was developed as a response to the market correction witnessed in mid-2002. It was designed as an investment solution for investors fearing a further decline in the short term and looking to optimise their market entry point.

The Tempo structure is designed for investors that are bullish over the medium to long-term on the underlyings’ markets, and provides them with the full upside of the performance. It allows investors to optimise their entry point in the market i.e. when the market is at its lowest level during the investment period.

Tempo periodically records the performance of the underlying compared to its initial level. At maturity, the recorded performance of the underlying is equal to the difference between its performance at maturity and the lowest performance recorded during the investment period.

If, however, the underlying closes below the barrier at any point, the investor receives the performance of the underlying from inception. The Initial Capital is no longer guaranteed and the entry level is no longer optimised.

Typical Underlying: Single Index

Benefits

■ Optimised market entry point.
■ Unlimited upside of the underlying’s performance.

Risks

■ Capital is not guaranteed if the underlying ever breaches the barrier.
Example

An investor buys a 3-year Tempo on a single index with a 50% barrier.

**Optimistic Scenario:** The investor receives a gain of 120% - 80% = 40% along with the initial capital at maturity.

**Pessimistic Scenario:** The 50% barrier is breached. The investor receives 70% of the initial capital at maturity.
Principles

Launch Background: Athena was created in 2003 as an investment solution designed for stable market conditions; anticipated in the period following the growth and subsequent burst of the dot-com bubble. The structure offers investors an early redemption at an attractive annual yield if the underlying breaches a pre-determined barrier at any observation date during the investment period.

The Athena structure offers a high coupon linked to the performance of the underlying. The performance of the underlying is compared to the strike price at each observation date. If the underlying overperforms a strike level at any observation point, the product terminates early, returning 100% of the capital and additionally paying a high coupon.

At maturity, as long as the value of the underlying is above a pre-determined barrier, capital is 100% guaranteed. Otherwise, the investor receives the performance of the underlying at maturity.

Typical Underlying: Index, share, basket of stocks

- Opportunity to earn a high coupon with a small increase in the price of the underlying.
- Possibility of collecting a coupon and receiving the initial capital after only 3 months.

Capital guarantee is subjected to creditworthiness of the issuer.

Risks

- Capital is not guaranteed.
- If the price of the underlying decreases below the pre-determined barrier at maturity, the redemption may be less than the original amount invested.
- Any increase in price of the underlying beyond the strike level will not increase the return.

Example

An investor buys a 1-year Athena on a basket of shares with quarterly observation points, a 3% quarterly coupon and a 70% barrier at maturity. The strike level is equal to the initial level (100%).

Example 1 – Early Exit

The basket average rises strongly in the first quarter. At the first observation point, the basket average is above the strike level. The product redeems early and the investor receives 100% of his initial capital plus a 3% (1 x 3%) coupon.

Early Exit

Performance

Capital guarantee is subjected to creditworthiness of the issuer.
Example 2 – High Coupon
The basket performance drops initially in the first three quarters however it recovers towards the end of the fourth quarter. No early redemption occurs. The basket average finishes above the strike level at maturity. The investor receives 100% of his initial capital plus a high 12% (4 x 3%) coupon.

Example 3 – Capital guarantee
The basket performance drops in the first two quarters and stays below the initial level for the entire investment period. No early redemption occurs and no coupons are paid out as the basket average does not reach the strike level on any of the observation dates. At maturity, the basket average is below the strike level but above the lower barrier, the investor receives 100% of his initial capital.

Capital guarantee is subjected to creditworthiness of the issuer.

Example 4 – Market Downturn
Markets drop significantly throughout the investment period. At maturity, the basket average finishes below the barrier. The investor receives the final performance of the basket i.e. in this case, 64% (64/100) of the initial investment.
Knock Out Forward

Principles

Launch Background: Knock Out Forward was launched by BNP Paribas in Hong Kong in 2003, designed to benefit from a potential market rebound in the period that followed the Dot-Com bubble burst offering investors the opportunity to purchase shares at a discount.

A Knock Out Forward structure is typically a 1 year product on a single equity underlying. With this structure, the investor accumulates a fixed number of shares of the underlying every day during the investment period at a substantial discount on the strike price. The accumulated shares are delivered on a monthly basis. The investor can also benefit from possible early redemption when the share reaches the pre-defined trigger (daily observation).

Typical Underlying: Single Share

Benefits

■ Opportunity to purchase shares of an underlying at a substantial discount.

■ Opportunity to redeem early on a daily basis to benefit from a market rebound (after trigger activation).

Risks

■ Capital is not guaranteed.

■ If the price of the underlying dips below the discounted price at any time during the investment period, the redemption at maturity may be less than the original amount invested.

Example

An investor buys a 1-year Knock Out Forward on a share with the following parameters:

■ Maturity: 1 Year

■ Notional Amount Invested: 10 million EUR

■ Underlying Spot at Time of Purchase: 50 EUR / Share

■ Buy Discount Level 20% →

■ Discounted Price: 40 EUR / Share

■ Early Redemption Trigger 110%: 55 EUR / Share

■ Number Of Shares Accumulated per Day: 794

Example 1 – Optimistic Scenario

The share gains 10% in 3 months (60 business days). The investor accumulates $60 \times 794 = 47,640$ shares at the pre-defined discounted price of 40 EUR / share. At the end of the 3rd month, the product redeems early since the share reaches the 110% trigger.

The investor can receive a profit of:

No. of Shares \times (Spot Price – Initial Discounted Price) = 47,640 \times (55 - 40) = 714,600 EUR
Example 2 – Neutral Scenario

The share does not reach the 110% barrier throughout the investment period (252 business days) and closes at 85% of its initial level at maturity i.e. 42.5 EUR / share.

The investor can receive a profit of:

\[
\text{No. of shares} \times (\text{Spot Price} - \text{Initial Discounted Price}) = (252 \times 794) \times (42.5 - 40) = 500,220 \text{ EUR}
\]

The payoff is positive despite the decrease in the price of the underlying due to the initial discounted price.

Example 3 – Pessimistic Scenario

The share does not reach the 110% barrier throughout the investment period (252 business days) and closes at 65% of its initial level after one year i.e. 32.5 EUR / share.

The investor will make a loss of:

\[
\text{No. of shares} \times (\text{Spot Price} - \text{Initial Discounted Price}) = (252 \times 794) \times (32.5 - 40) = -1,500,660 \text{ EUR}
\]

The investor loses 1,500,660 EUR (15% of his initial investment).
Appendix
Introduction to Options
Vanilla Options
Long / Short Position
Introduction to Forwards / Futures
Collar
Call Spread
Put Spread
Straddle
Strangle
Barrier
Asian
Binary
Lookback
Option Pricing
Black-Scholes Model
Grid Methods - Binomial Tree
Simulations - the Monte Carlo Methods
Efficient Frontier
Efficient Frontier with Lookback
Volatility Modelling - Local or Stochastic Volatility?
Fund-Linked Structured Products
An option is a contract that gives its holder the right, but not the obligation, to buy or sell an asset, at a fixed price (strike), on (for European options) or before (for American options) a given date.

Options allow investors to benefit from a leveraged participation in an asset without having to buy the asset itself.

There are various types of options, from the simplest, referred to as “plain vanilla” options, to the most complex “exotic” options.

A **European Option** is an option which the buyer can exercise only on a given date, i.e. the maturity date of the option.

An American Option is an option which the buyer can exercise at any time between the date of entering into the contract and the expiration date.

### Benefits
- Leveraged exposure and higher returns with respect to the money invested.
- Limited risk (for capital guarantee), as risk is limited to the premium paid for the option (if long the option).
- Possibility to make money whether the market goes up or down.
- Possibility of combining options to create bespoke investment solutions.

### Drawbacks
- Investments might result in loss of premium in a relatively short period of time.
- Option can expire worthless.
- Option holder must be right about both the direction and timing of the underlying’s anticipated price change.
- Selling an option can expose the seller to large losses.
Vanilla Options

A vanilla option is the most basic derivative. It has a specific expiry and strike price.

Call / Put

A Call Option is the right to buy a fixed number of underlyings (securities), at a fixed price, on a given date.

A Put Option is the right to sell a fixed number of underlyings (securities), at a fixed price, on a given date.

Option Terminology

Premium Option value

Intrinsic Value For a call, it is the difference between the spot price and the strike price of the underlying (if positive)

Time Value Premium – intrinsic value

At-the-money The underlying value currently equals the strike price

In-the-money Option has positive intrinsic value

Out-of-the-money Option has no intrinsic value

When an investor purchases an option, the net return is the difference between the intrinsic value realised from exercising the option less the option premium paid.
Long / Short Position

Long Position

Taking a long position in an asset means buying the asset. Any investor can take a long position on any underlying, option, etc. available on the market.

Short Position

Taking a short position in an asset means selling it. To take a short position, in securities an investor has to own / issue what he is selling (e.g. shares, etc.). There is one exception, which is short-selling.

Short-selling means borrowing a security and then selling it, hoping for the price to fall. The short-seller must eventually give back the borrowed security, by buying it back from the open market. The short-seller aims to buy the security at a cheaper price than that at which he / she sold it earlier to keep the difference as a profit.

In derivatives (future options), taking a short position does not include borrowing as derivatives are not securities, but contracts. However, when one buys or sells an option for a market-maker the market-maker might have to short sell the underlying security depending on the nature of the options.

Illustrated are the classical graphs of long / short positions in a call and a put, with K representing the strike price of the option.

Long Call (purchasing the right to buy an asset)

- Bullish view that share price will increase.
- Purchase the right (no obligation) to buy the share at a fixed price until or at maturity.
- If the share price rises above the strike price by more than the premium the investor will profit.
- If the share price is lower than the exercise price, the investor will let the call contract expire worthless, losing only the premium paid.
**Long Put** (purchasing the right to sell an asset)
- Bearish view that share price will decrease.
- Purchase the right (no obligation) to sell the share at a fixed price until or at maturity.
- If the share price is below the strike price by more than the premium paid, the investor will profit.
- If the share price is above the strike price, the investor can let the put contract expire worthless, losing only the premium paid.

**Short Call** (selling the right to buy an asset)
- Bearish view that share price will decrease.
- Sell, or “write” a call with the obligation to sell the share at a fixed price at the buyer’s option maturity.
- If the share price decreases, the short call position will make a profit in the amount of the premium.
- If the share price increases over the strike price by more than the amount of the premium, the short call will lose money, with the potential loss unlimited.

**Short Put** (selling the right to sell an asset)
- Bullish view that share price will increase.
- Sell, or “write” a put with the obligation to buy the share at a fixed price at the buyer’s option maturity.
- If the share price increases, the short put position will make a profit in the amount of the premium.
- If the share price decreases below the strike price by more than the amount of the premium, the short put will lose money, with the potential loss being up to the full value of the share.
Introduction to Forwards / Futures

A forward contact is an agreement to buy or sell an asset at a certain point in the future for a given price. It is traded in the over-the-counter market, usually between two financial institutions or between a financial institution and one of its clients.

Like a forward contract, a futures contract is an agreement to buy or sell an asset at a certain time in the future for a given price.

Unlike forward contracts, future contracts are normally traded on an exchange.

Forwards and futures are often substitutes. However, the relative costs, liquidity, and convenience of using one market versus the other differs at times.

Benefits

- Consistent tool to manage market and price risk.
- Cost efficiency due to low commission structure, and tight bid-offer.
- Easy to price.

Drawbacks

- No protection on the downside.

---

**Long Forward**

Profit

\[ \text{Profit of long forward} = S(T) - F(0,T) \]

_for illustrative purposes only_

**Short Forward**

Profit

\[ \text{Profit of short forward} = F(0,T) - S(T) \]

_for illustrative purposes only_
Collar

Principles

A collar (or tunnel) combines either a long call and a short put, or a short call and a long put, of the same maturity and different strikes.

For a zero-cost-collar, strikes can be customised so that the call premium exactly offsets the put premium. Strike prices are calculated so as to equate the value of both options and, hence, build a zero-cost strategy. At maturity, the investor is compensated for the drop of an underlying below the lower strike price, or abandons the rise of underlying above the higher strike price. If the underlying finishes between lower and higher strikes, the payoff is nil.

Benefits of a Long Collar (long put short call)

- Clients buy protection on the downside and take on upside risk.
- Portfolio protection – the lower the underlying price, the greater the return.
- No up front cost – the put purchase is financed by the sale of the call.
- Cheaper hedging solution.

Drawbacks of a Long Collar

- Upside is limited.
Call Spread

Principles

**Long Call Spread** BUY 1 call with a low strike price + SELL 1 call with a higher strike price

**Short Call Spread** BUY 1 call with a high strike price + SELL 1 call with a lower strike price

Calls are of identical maturities on the same underlying.

The potential upside is limited, but it is a cheaper alternative to buying a vanilla call because the income from selling the high-strike call offsets partly the cost of purchasing the low-strike call.

Benefits of a Long Call Spread

- Lower price than a plain vanilla call.
- Suited to moderately bullish markets.

Drawbacks of a Long Call Spread

- Limited profit potential.
Put Spread

Principles

**Long Put Spread** BUY 1 put with a high strike price + SELL 1 put with a lower strike price

**Short Put Spread** BUY 1 put with a low strike price + SELL 1 put with a higher strike price

Puts are of identical maturities on the same underlying.

The potential upside is limited. A put spread, however, is a cheaper alternative to buying a plain vanilla put, since the income from selling the low-strike put partly offsets the cost of purchasing the high-strike put.

Benefits of a Long Put Spread

- Lower price than a plain vanilla put.
- Suited to moderately bearish markets.

Drawbacks of a Long Put Spread

- Limited profit potential.
Straddle

Principles

A straddle combines a put and a call of same strike and maturity, usually at the money. The straddle buyer will make money if the underlying moves either significantly up or down. The price of a straddle is therefore quite sensitive to the price of implied volatility.

Benefits of a Long Straddle

- Unlimited potential upside.
- Returns in both bearish and bullish markets.

Drawbacks of a Long Straddle

- Expensive when volatility is high.
Strangle

Principles

A strangle is similar to a straddle (combining a put and a call of same maturity). A strangle has out-of-the-money options, as the put and call have different strikes.

Consequently, buying a strangle is cheaper than buying a straddle, but a strangle requires a greater movement of the underlying to be profitable.

Benefits of a Long Strangle

■ Unlimited potential upside.
■ Returns in both bearish and bullish markets.
■ Lower price than a straddle.

Drawbacks of a Long Strangle

■ Big move needed otherwise both the calls and puts will rapidly deteriorate in value.
Barrier

Principles

Barrier options are similar to vanilla options, except there is an element known as a “barrier”. The barrier can either knock-in the option, knock-out the option or, in some cases, do both.

A knock-in option is activated when the underlying’s price reaches a certain barrier.

A knock-out option is deactivated when the underlying’s price reaches a certain barrier.

The payoff depends on whether the underlying’s price reaches a certain level during a given period.

Due to the contingent nature of these options, barrier options’ premiums are lower than that of a corresponding vanilla option.

Benefits of a Long Barrier

■ Premium cost of a barrier option is less than that of a standard vanilla option.

Drawbacks of a Long Barrier

■ The payoff is path-dependent.

Example: Down-and-In Put

A Down-and-In Put is a contract that becomes a standard put option if the price of the underlying falls below a certain price level before maturity. The put is “knocked in” (activated) when the barrier is breached.

Barrier Example

FOR ILLUSTRATIVE PURPOSES ONLY
Asian

Principles

Asian options are options where the payoff depends on the average value of the underlying on a specific set of dates throughout the life of the option.

Since the distribution of the underlying asset value at maturity is wider than that of its average value over the investment period, Asian options enjoy a lower volatility, provide higher participation rate and are generally cheaper compared to equivalent vanilla options. The higher the number of observations, the cheaper the Asian option.

Average price option

The payoff is equal to the difference between the average value of the underlying throughout the life of the option and a fixed strike.

Asian options can be structured as puts or calls. They are generally exercised as European options.

Benefits of a Long Asian Option

- Lower premium than the plain vanilla option – the volatility of the average being lower than the volatility of the underlying price.
- Provide higher participation rate.
- In volatile environments, an Asian call smooths exceptional events – it enhances the underlying’s upside exposure, with no risk of the investor being penalised by a “bell shape” effect (market downturn at maturity).
- Avoid market timing issues.

Drawbacks of a Long Asian

- May not benefit from the whole rise of the underlying asset in the case of a strong bullish market.

Average Strike Option

Underlying Value

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Binary Principles

Binary options are options with discontinuous payoffs. A binary option pays a fixed amount if the underlying asset price is above the barrier level and pays nothing in the opposite case.

Cash-or-nothing options pay a fixed amount, or nothing at all, depending on the underlying’s price at maturity (i.e. when the option expires in-the-money).

These options are widely used in income products paying fixed coupons if the underlying asset is above, or below, a certain price.

Benefits of a Long Binary Option

■ Easy to understand
  ■ Only requires a sense of direction of the price movement of the underlying asset and target price, whereas vanilla options require a sense of direction and the magnitude of the price movement.
  ■ As long as the binary option settles in-the-money by even one percentage point, the option provides a full payout.
  ■ Low risk – known upside and downside assessment.

Drawbacks of a Long Binary Option

■ Unable to benefit from the full upside.
■ Need liquid market.

Example: Long Binary Call Option

The graph illustrates a binary call option that pays a fixed coupon of 25% if the underlying is above 120% of its initial level.

Long Binary Call Example

Payoff at maturity

FOR ILLUSTRATIVE PURPOSES ONLY
Lookback

Principles

Lookback options are options whose payoffs depend on the maximum or minimum asset price reached during the life of the option.

For a long call position, the payoff is the difference between the maximum asset price and the initial asset price (strike).

There are 2 types of Lookback options:

**Performance Lookback** – Strike is set at inception. At maturity, the buyer can “lookback” over the life of the option and choose the most favourable exercise point to maximise profit.

**Strike Lookback** – Strike is set at maturity. The buyer can choose the most favourable strike to maximise profit.

Since the buyer can always choose the highest profit, an important determinant of the option price is the underlying’s volatility. The higher the volatility, the higher the probability that the underlying will move enough for a significant profit, thus, the more expensive the lookback.

Benefits of a Long Lookback

- Lookback call owner can buy at the lowest observed price or sell at the highest observed price.
- Eliminates market entry and exit timing problems.

Drawbacks of a Long Lookback

- Expensive when volatility is high.
Option Pricing

Background

Numerous models have been created to price options, many based on the Black-Scholes (B&S) option pricing model of 1973.

The insight behind the B&S model was that the price of an option was the price of the dynamic trading strategy required to hedge it (in the absence of transaction costs). The work of Black and Scholes showed that, through hedging, the "real-world" assumption for the growth rate of the underlyings can be replaced by the risk-free interest rate in option pricing models. This is the famous and fundamental risk neutrality framework.

The Black-Scholes model was formulated to price European call and put options and takes into account several parameters: current asset price, option strike price, time to expiration, volatility of the underlying, risk-free interest rate and the value of dividends expected during the life of the option. As we will see, the current option price, interest rates and dividends are found in the B&S equation in a combination called the forward price.

We will look at the three methods currently in use to price options:

- Closed-Form Formulae (the Black-Scholes formula or its adaptations)
- Grid Methods (the best known being the binomial tree method)
- Simulations (Monte-Carlo method)

All of these depend on the risk neutrality framework.
Impact of Parameters on Vanilla Option Price

The table below illustrates the impact on option prices when each parameter is increased, *ceteris paribus.*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Call</th>
<th>Put</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Asset Price</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Strike Price</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Time to Maturity</td>
<td>+</td>
<td>?</td>
</tr>
<tr>
<td>Volatility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Dividend / Rebate</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

- Options are generally more valuable when the time to maturity increases. This always holds for American options, as the option holder has more opportunities to exercise. For European options, the present value of the exercise price falls and the volatility at maturity increases, thus increasing the value of call options. However, the present value of dividends can increase, having a negative effect on European call values.

- When volatility is higher, extreme values are more likely, making calls and puts more valuable as the expected payoff is higher.

- The forward price of the asset increases when interest rates rise. Consequently, the price of a call generally increases when interest rates rise and the price of a put decreases.

- The forward price of the underlying decreases when dividends rise. Hence, an increase in dividends has a negative (positive) effect on a call (put).

- Increasing the current asset price increases the expected asset price at maturity and therefore increases the value of a call while decreasing the value of a put.

- As a call gives the holder the right to buy an asset at the strike price, the call is more valuable when the strike price is lower while the opposite is true for a put.

*All other things being equal.
Black-Scholes Model

Background

Fischer Black and Myron Scholes proposed this option pricing model in 1973. The Black-Scholes (B&S) model, however, is not just about the famous formula. More important than the formula itself, the key contribution of Black and Scholes was to give a general and flexible framework to price many types of derivatives. Modified and extended versions of this model are still popular today.

Black-Scholes Option Pricing Formula

Value of a European Call (C)

\[
C = [F \times N(d_1) - K \times N(d_2)] \times B(T)
\]

where:

\[
d_1 = \frac{\ln \left( \frac{F}{K} \right) + \sigma^2 \times T}{\sigma \sqrt{T}}
\]

\[
d_2 = d_1 - \sigma \sqrt{T}
\]

and

\[
B(T) = e^{-rT}
\]

Log denotes the natural logarithm, and:

- \( F \) = the Forward price of the underlying share
- \( K \) = the strike price
- \( r \) = the continuous risk free interest rate
- \( T \) = the time in years until the expiration of the option
- \( \sigma \) = the implied volatility for the underlying share
- \( N \) = the standard normal cumulative distribution function
Consequences, Extensions and Limitations of the Black-Scholes Formula

One remarkable consequence of the Black-Scholes formula is that the price of a European Option (i.e. one that can be exercised only on maturity) is a function of only TWO parameters of the underlying asset – its Forward Price and its Implied Volatility. Once you have correct estimates for these, you can price a vanilla option. This has very general applications and allows various extensions to achieve at least an approximate pricing of some more complex options:

- Options on a dividend paying share can be priced by calculating the correct Forward Price of the share taking into account its dividends.

- Quanto options (i.e. options based on the performance of a foreign asset) can be priced with the same formula but adjusting the Forward Price by the so called quanto adjustment.

- Options on a share basket can be approximated by calculating the basket Forward Price from individual forward prices as well as the basket volatility from individual volatilities and correlations between shares.

- Etc.

However, the B&S formula has strong limitations:

- It cannot be used to price American Options.

- It cannot be used to price more complex payoff formulas such as barrier options, exotic multi-underlying options (Worst-Of, Best-Of options).

- It only takes into account a single number for the implied volatility which is independent of the strike level. This is fine for vanilla options but many types of simpleotics (for instance any kind of binary option) will be priced differently in the presence of volatility smile (i.e. different implied volatilities for different strikes).
Grid Methods – Binomial Tree

Background

The Cox-Ross-Rubinstein (1979) binomial option pricing model is a variation of the Black-Scholes model that can account for early exercise (American options pricing) and certain exotic payoffs (such as barrier options).

- The model uses a discrete time framework to trace the evolution of the underlying’s price via a simple, stationary binomial process. At each time interval (node), the price can either go up or down by a given percentage.

- Option valuation is calculated by applying the risk neutrality assumption over the life of the option. Option prices at each step of the tree are calculated working backwards from expiration to the present.

- The payoff specifics (payoff at maturity as well as early exercise conditions or barriers) are defined by appropriate boundary conditions.

Applications and Limitations of Grid Methods

With a careful implementation, grid methods are extremely powerful and versatile, allowing a large number of options on single underlyings to be priced. They also take into account a volatility which is not constant with strike or time (more on this later).

The main limitation of grid methods is that they are unable to price options on a large number of underlyings (in practice any number beyond two) such as complex options on baskets of indices or shares.
Simulations – the Monte Carlo Methods

Background

The use of repeated random simulations (called Monte Carlo methods) to solve problems in Theoretical Physics dates back to the 1930s. They were further used in the 1950s in military applications and, with the increase and wider availability of computational power, became increasingly common in the subsequent years. Over the last few decades use of Monte Carlo simulations in technical applications and in Finance has become widespread.

- The Monte Carlo engine draws a large number (usually more than 10,000) of random paths for the underlying asset in the risk neutral probability framework. This can also be done in a consistent manner for several assets that are correlated.
- For each path, the payoff is computed based on the final value and possibly some intermediary values (e.g. maximum value over the fixing dates to price a lookback option).
- The actual price of the option is the average of the simulated payoffs, discounted back from the payoff date to today.

Applications and Limitations of Monte Carlo Methods

Monte Carlo methods are extremely popular for pricing exotic equity options because:

- They are intuitive and relatively easy to implement.
- They allow various types of exotic options, including multi-underlying options (high dimension Monte-Carlo) to be priced.
- They allow different volatility models to be used (more on that very soon).

It is important to note that Monte Carlo methods work quite slowly, so they require high computational power to compute the result in a reasonable time frame. However, this is easily achievable using parallel computing power.

The major limitation of Monte Carlo methods is that they cannot normally be used to price American Options.
Efficient Frontier

Background

The objective of investing in a portfolio rather than taking a position in a single underlying is to diversify one’s investment and minimise risk. Some portfolios, however, are better than others, depending on the underlying assets and the portfolio allocation.

In the past, investment portfolios were typically selected according to an individual analysis of their constituent assets. Instead of selecting an overall portfolio, shares and bonds were individually selected based on their attractive risk-reward profiles.

In 1952, Harry Markowitz introduced the idea that a portfolio should be judged at the portfolio level, treating the assets as random variables. This approach enabled the calculation of expected values, standard deviations and correlations between the constituent assets, and provided the means to draw an efficient frontier – a way of optimising a portfolio’s overall risk and return.

What is an Efficient Frontier?

When analysing multiple portfolio combinations, there may be many portfolios that have the same volatility. Portfolio theory assumes that for a specified volatility, a rational investor would choose the portfolio with the highest return.

Similarly, there may be multiple portfolios that have the same return, and portfolio theory assumes that, for a specified level of return, a rational investor would choose the portfolio with the lowest volatility.

An efficient portfolio is the unique portfolio that has the highest expected return for a given volatility and, likewise, the lowest volatility for a given return. Point X for instance corresponds to the portfolio displaying the highest rate of return for a volatility of 10%.

Example - Efficient Frontier

1 H.M Markowitz, Journal of Finance, 1952
2 The efficient frontier is the collection of all efficient portfolios. Efficient frontier portfolio constituents: Eurobond, Eurostoxx and Emerging Equities.
Efficient Frontier with Lookback

Example: Adding a Structured Product - Lookback

The Lookback offers return at maturity based on the highest performance of an underlying asset on any observation date, with no cap on the upside and 100% capital guarantee.

The most obvious qualitative advantage of the Lookback is to solve market-timing issues, thus avoiding stop-loss selling if a market downturn occurs. From a quantitative point of view, the Lookback can improve the efficiency of a portfolio by delivering returns close to those of equities, while lowering risk (volatility).

*Capital guarantee is subjected to creditworthiness of the issuer.*

The inclusion of a Lookback in a portfolio of equities and bonds therefore alters the portfolio’s risk / return profile. Incorporating the Lookback as part of an efficient frontier analysis clearly increases return for a set level of risk by approximately 50bps. In other words, according to our model, an investment in a portfolio containing the Lookback may allow an investor to gain a return 50bps higher than an equivalent Lookback-free portfolio, for the same risk exposure.

BNP Paribas

Efficiency analysis provides a useful measure for determining the optimum allocation to an investor’s portfolio. The innovative employment of a structured product component as part of our efficient frontier calculations demonstrates the versatility and practicality of structured products as part of an optimised portfolio. BNP Paribas has developed unique models to conduct advanced portfolio analyses with structured products.
Volatility Modelling – Local or Stochastic Vol?

Background

As hinted at above, the price of some options will be affected by the fact that the implied volatility is different for different strike prices. This fact gave rise to the development of volatility modelling, with two main approaches being undertaken:

- Local volatility formalised by Bruno Dupire in 1994
- Stochastic volatility by Heston and other researchers

The local volatility replaces a single number with a range of values that depend on time and spot, namely a surface. Dupire showed that a local volatility surface could be created for any underlying that had a Black-Scholes implied volatility surface depending on maturity and strike, provided that this implied volatility responded to some basic consistency checks.

The local volatility model is very intuitive and can be implemented either in a Grid method or in a Monte Carlo method. It is very widely used, but fails to price correctly some particular types of options such as some cliquets.

The alternative is to consider that the volatility itself is a random quantity, correlated with the spot. This approach is the basis of a whole class of so called stochastic volatility models. They are feasibly implemented only in a Monte Carlo method. Quite often, stochastic volatility is complemented with “jumps” (i.e. large random moves of the underlying) to further improve the way the asset’s “dynamic” is simulated. Stochastic volatility models are notoriously difficult to implement and “calibrate” (i.e. it can be difficult to give prices consistent with those observed in the market for simple derivative products).
Fund-Linked
Structured Products

Sources of Return:
Alpha, Beta, Alternative Beta

**Alpha** ($\alpha$) is considered to be a measure of the added value that a manager contributes to a fund’s performance. While a portion of the performance can be explained by market movements, actively managed funds aim to improve on this through skillful investment.

Funds which target absolute returns may consider their alpha to be the returns delivered above the risk-free rate.

**Beta** ($\beta$) measures the portion of performance that is explained by market movements. For instance, a diversified portfolio of shares may perform similarly to broad market indices.

**Alternative Beta** ($\text{alt } \beta$) measures the portion of performance explained by the market exposure benefits of Hedge Funds, which have access to an increased range of asset classes and strategies.

![Diagram](image-url)
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