



LISBON
SCHOOL OF
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UNIVERSIDADE DE LISBOA

Case Studies in Financial Engineering

CASE 6

EXPRESS CERTIFICATE S&P 500

Sept. 2019

Express Certificate S&P 500

Deutsche Bank AG, Frankfurt has just offered the structured product described in the attached document. Considering the information provided, please answer to the following questions:

- 1) Characterize the structured product, namely by identifying the options embedded and the risks faced by investors.
- 2) Estimate the volatility you would use for the pricing of this product, by employing at least two different methodologies.
- 3) Present the valuation of those options embedded.
- 4) What is the probability of an investor to lose more than 20% of the investment, estimated at the issuance date?
- 5) What is the minimum and maximum potential return? Please explain your calculations.
- 6) Detail a risk hedging strategy from the buyer and seller perspectives.
- 7) Assess the adequacy of the risk information and the performance scenarios provided by the issuer.
- 8) Why should an investor be interested in this product? What should be the risk profile of the targeted investor?
- 9) What would be your investment advice?



Key Information Document

Purpose

This document provides you with key information about this investment product. It is not marketing material. The information is required by law to help you understand the nature, risks, costs, potential gains and losses of this product and to help you compare it with other products.

Product

Product name	Express Certificate linked to S&P 500® Index (Price Index)
Product identifiers	ISIN: DE000DB9UZQ5 WKN: DB9UZQ
PRIIP manufacturer	Deutsche Bank AG. The product issuer is Deutsche Bank AG, Frankfurt.
Website	www.db.com
Telephone number	Call +49-69-910-00 for more information.
Competent authority of the PRIIP manufacturer	German Federal Financial Supervisory Authority (BaFin)
Date of production	5 September 2019

You are about to purchase a product that is not simple and may be difficult to understand.

1. What is this product?

Type German law governed certificates

Objectives

(Terms that appear in bold in this section are described in more detail in the table(s) below.)

The product is designed to provide a return in the form of a cash payment on termination of the product. The timing and amount of this payment will depend on the performance of the **underlying**.

Early termination following an autocall: The product will terminate prior to the **maturity date** if, on any **autocall observation date**, the **reference level** is at or above the relevant **autocall barrier level**. On any such early termination, you will on the immediately following **autocall payment date** receive a cash payment equal to the applicable **autocall payment**. The relevant dates, **autocall barrier levels** and **autocall payments** are shown in the table(s) below.

Autocall observation dates	Autocall barrier levels	Autocall payment dates	Autocall payments
23 September 2020	100.00%*	28 September 2020	USD 105.70
22 September 2021	95.00%*	27 September 2021	USD 111.40
21 September 2022	90.00%*	26 September 2022	USD 117.10
21 September 2023	85.00%*	26 September 2023	USD 122.80

* of the **initial reference level**.

Termination on the maturity date: If the product has not terminated early, on the **maturity date** you will receive:

- if the **final reference level** is at or above 80.00% of the **initial reference level**, a cash payment equal to USD 128.50;
- if the **final reference level** is at or above 65.00% of the **initial reference level** and below 80.00% of the **initial reference level**, a cash payment equal to USD 100; or
- if the **final reference level** is below 65.00% of the **initial reference level**, a cash payment directly linked to the performance of the **underlying**. The cash payment will equal (i) the **product notional amount** multiplied by (ii) (A) the **final reference level** divided by (B) the **initial reference level**.

Under the product terms, certain dates specified above and below will be adjusted if the respective date is either not a business day or not a trading day (as applicable). Any adjustments may affect the return, if any, you receive.

Underlying	S&P 500 (Price return index) (ISIN: US78378X1072)	Initial reference level	The reference level on the initial valuation date
Underlying market	Equity	Reference level	The closing level of the underlying as per the reference source
Product notional amount	USD 100	Reference source	New York Stock Exchange, New York
Issue price	USD 100	Final reference level	The reference level on the final valuation date
Product currency	U.S. Dollar (USD)	Initial valuation date	24 September 2019
Underlying currency	U.S. Dollar (USD)	Final valuation date	23 September 2024
Subscription period	• Germany, Austria and Luxembourg: 11 September 2019 (inclusive) to 24 September 2019 (inclusive)	Maturity date / term	26 September 2024
Issue date	24 September 2019		

The issuer may terminate the product with immediate effect in the event of obvious written or mathematical errors in the terms and conditions or if certain extraordinary events provided in the terms and conditions occur. Examples of extraordinary events include (1) material changes, particularly in connection with the **underlying**, including where an index ceases to be calculated, and (2) events, in particular due to changes in certain external conditions that hinder the issuer in meeting its obligations in connection with the product or – depending on the terms and conditions of the security – otherwise affect the product and/or the issuer. In case of immediate termination, the return (if any) may be significantly lower than the purchase price, but will reflect the product's market value and, if higher, any minimum redemption (alternatively, in some cases the corresponding compounded amount may be paid out at the product's scheduled maturity). Instead of immediate termination, the issuer may also amend the terms and conditions.

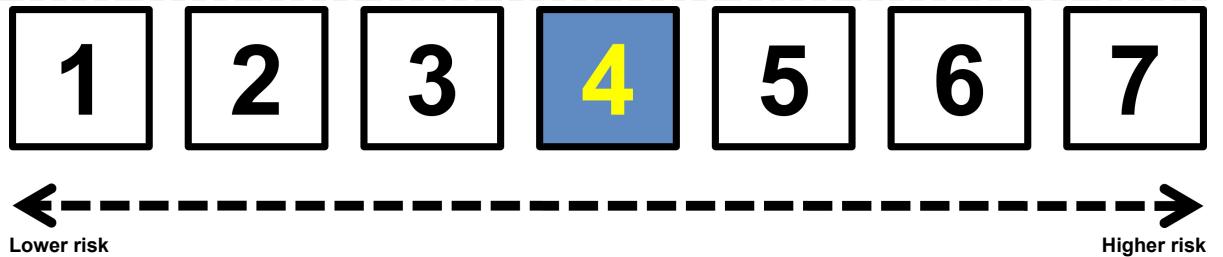
Provided that in the event of any inconsistency and/or conflict between the foregoing paragraph and any applicable law, order, rule or other legal requirement of any governmental or regulatory authority in a territory in which this product is offered, such national requirements shall prevail.

Intended retail investor

The product is intended for private clients who pursue the objective of general capital formation/asset optimization and have a medium-term investment horizon. This product is a product for clients who have sufficient knowledge and / or experience to make an informed investment decision. The investor can bear losses up to the total loss of the capital invested and attaches no importance to capital protection.

2. What are the risks and what could I get in return?

Risk indicator



The risk indicator assumes you keep the product for 5 years. The actual risk can vary significantly if you cash in at an early stage and you may get back less.

The summary risk indicator is a guide to the level of risk of this product compared to other products. It shows how likely it is that the product will lose money because of movements in the markets or because we are not able to pay you.

We have classified this product as 4 out of 7, which is a medium risk class. This rates the potential losses from future performance at a medium level, and poor market conditions are very unlikely to impact our capacity to pay you.

To the extent the currency of the country in which you purchase this product differs from the product currency, please be aware of currency risk. You will receive payments in a different currency so the final return you will get depends on the exchange rate between the two currencies. This risk is not considered in the indicator shown above.

This product does not include any protection from future market performance so you could lose some or all of your investment.

If we are not able to pay you what is owed, you could lose your entire investment.

Market developments in the future cannot be accurately predicted. The scenarios shown are only an indication of some of the possible outcomes based on recent returns. Actual returns could be lower.

Performance scenarios

Investment: USD 10,000

Scenarios		1 year	3 years	5 years (Recommended holding period)
Stress scenario	What you might get back after costs	USD 7,711.82	USD 6,557.86	USD 4,760.67
	Average return each year	-22.88%	-13.12%	-13.78%
Unfavourable scenario	What you might get back after costs	USD 10,232.79	USD 9,807.25	USD 10,000.00
	Average return each year	2.33%	-0.65%	0.00%
Moderate scenario	What you might get back after costs	USD 10,518.75	USD 10,809.40	USD 10,570.00
	Average return each year	5.19%	2.63%	1.11%
Favourable scenario	What you might get back after costs	USD 10,788.89	USD 11,055.32	USD 11,710.00
	Average return each year	7.89%	3.40%	3.20%

This table shows the money you could get back over the next 5 years under different scenarios, assuming that you invest USD 10,000.

The scenarios shown illustrate how your investment could perform. You can compare them with the scenarios of other products. The scenarios presented are an estimate of future performance based on evidence from the past on how the value of this investment varies, and are not an exact indicator. What you get will vary depending on how the market performs and how long you keep the product. The stress scenario shows what you might get back in extreme market circumstances, and it does not take into account the situation where we are not able to pay you.

The figures shown include all the costs of the product itself, but may not include all the costs that you pay to your advisor or distributor. The figures do not take into account your personal tax situation, which may also affect how much you get back.

3. What happens if Deutsche Bank AG, Frankfurt is unable to pay out?

You are exposed to the risk that the issuer might be unable to fulfil its obligations in respect of the product – e.g. in the event of insolvency (inability to pay / over-indebtedness) or an administrative order of resolution measures. In case of a crisis of the issuer such an order can also be issued by a resolution authority in the run-up of an insolvency proceeding. In doing so, the resolution authority has extensive intervention powers. Among other things, it can reduce rights of the investors to zero, terminate the product or convert it into shares of the issuer and suspend rights of the investors. With regard to the basic ranking of the issuer's obligations in the event of action by the resolution authority, please see www.bafin.de and search for the keyword "Haftungskaskade". A total loss of your capital invested is possible. The product is a debt instrument and as such is not covered by any deposit protection scheme.

4. What are the costs?

The Reduction in Yield (RIY) shows what impact the total costs you pay will have on the investment return you might get. The total costs take into account one-off, ongoing and incidental costs.

The amounts shown here are the cumulative costs of the product itself, for three different holding periods. They include potential early exit penalties. The figures assume you invest USD 10,000. The figures are estimates and may change in the future.

Costs over time

Investment: USD 10,000

Scenarios	If you cash in after 1 year	If you cash in after 3 years	If you cash in at the end of the recommended holding period
Total costs	USD 402.76	USD 360.80	USD 352.81
Impact on return (RIY) per year	4.02765%	1.12937%	0.66542%

The costs shown in the table above represent how much the expected costs of the product would affect your return, assuming the product performs in line with the moderate performance scenario.

The person selling you or advising you about this product may charge you other costs. If so, this person will provide you with information about these costs, and show you the impact that all costs will have on your investment over time.

The table below shows:

- The impact each year of the different types of costs - The investment return you might get at the end of the recommended holding period.
- The meaning of the different cost categories.

The table shows the impact on return per year.

One-off costs	<i>Entry costs</i>	0.66542%	The impact of the costs already included in the price.
	<i>Exit costs</i>	0.00%	The impact of the costs of exiting your investment when it matures.
Ongoing costs	<i>Portfolio transaction costs per year</i>	0.00%	The impact of the costs of us buying and selling underlying investments for the product.
	<i>Other ongoing costs</i>	0.00%	The impact of the costs that we take each year for managing your investments.

Composition of costs

5. How long should I hold it and can I take money out early?

Recommended holding period: 5 years

The product aims to provide you with the return described under "1. What is this product?" above. However, this only applies if the product is held to maturity. It is therefore recommended that the product is held until 26 September 2024 (maturity).

The product does not guarantee the possibility to disinvest other than by selling the product off-exchange. No fees or penalties will be charged by the issuer for any such transaction. However if you sell the product in the secondary market you will incur a bid/offer spread. By selling the product before its maturity, you may receive back less than you would have received if you had kept the product until maturity.

Exchange listing	Luxembourg Stock Exchange (Main Segment)	Last exchange trading day	20 September 2024
Smallest tradable unit	1 unit	Price quotation	Units

In volatile or unusual market conditions, or in the event of technical faults/disruptions, the purchase and/or sale of the product can be temporarily hindered and/or suspended and may not be possible at all.

6. How can I complain?

Any complaint regarding the conduct of the person advising on, or selling, the product can be submitted directly to that person.

Any complaint regarding the product or the conduct of the manufacturer of this product can be submitted in writing at:

Jurisdiction	Postal address	Email address	Website
Germany	Deutsche Bank AG, X-markets, Mainzer Landstrasse 11-17, 60329 Frankfurt am Main, Germany	x-markets.team@db.com	www.xmarkets.db.com
Austria	Deutsche Bank AG, X-markets, Mainzer Landstrasse 11-17, 60329 Frankfurt am Main, Germany	x-markets.team@db.com	www.xmarkets.db.com
Luxembourg	Deutsche Bank AG, X-markets, Mainzer Landstrasse 11-17, 60329 Frankfurt am Main, Germany	x-markets.team@db.com	www.xmarkets.db.com

7. Other relevant information

Any additional documentation in relation to the product and in particular the prospectus, any supplements thereto and the final terms are published on the manufacturer's website (www.xmarkets.db.com/DocumentSearch ; after entering of the respective ISIN or WKN), all in accordance with legal requirements. In order to obtain more detailed information - and in particular details of the structure and risks associated with an investment in the product - you should read these documents. These documents are also available free of charge from Deutsche Bank AG, Mainzer Landstrasse 11-17, 60329 Frankfurt am Main, Germany, in accordance with legal requirements.