

STUDY ON DISCOUNT CERTIFICATES IN 2021

CONDUCTED BY TTMZERO AND BÖRSE STUTTGART
ON BEHALF OF THE GERMAN DERIVATIVES ASSOCIATION (DDV)

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2 2021 IN RETROSPECT

The past year was again a wild one, with old and new challenges facing the world:

A still-raging global Covid-19 pandemic with its Delta and Omicron variants, historically high inflation, supply chain disruptions, an oil price rally and an ongoing and much debated monetary policy. However, none of these events stopped stocks from climbing to one all-time high to the next:

In the US, the S&P 500 reached several all-time highs in 2021 and closed with a stunning 27% plus, the Nasdaq 100 gained close to 28% and the Dow Jones Industrial Average almost 19%. Tech stocks were again particularly strong, especially Alphabet, Tesla and Microsoft (68%, 51% and 50%), but also Apple (33%) and Facebook successor Meta (23%).*)

In Germany, the largest index DAX - which grew from 30 to 40 shares - climbed close to 16% by the end of the year, and its "little brothers" MDAX (which was reduced from 60 to 50 companies), SDAX and TecDAX showed increases of about 14%, 11% and 22%.*)

The challenging global issues as well as the positive developments at the stock markets also had a strong impact on discount certificates, a category of structured products that plays to its strengths mainly in sideways-moving or slightly falling markets.

In the present study, 152,898 discount certificates on 70 stocks and indices from Europe and the U.S. were examined, looking at a time span from 1 January to 31 December 2021. The study focused on the certificates' yield development and significant key figures.

83.12% of the examined discount certificates achieved a positive return in the given period despite the persistently challenging market environment, 41.04% even outperformed their underlying instruments. The average yield of the discount certificates under review in 2021 was 7.34% p.a., that of the underlyings in the same period 15.93% p.a.

But why this difference in annual yield?

Strong bullish markets are a good, but not the most favorable environment for discount certificates. While many underlyings are able to fully embrace a rise of the stock market, discount certificates are limited to a predefined level, the cap. On the upside, this restriction in an upwards market development comes with a cheaper purchase price - the discount - which in turn buffers losses and thus represents a lower overall risk. In 2021, the average relative discount of the examined certificates on the first observation day was 19.59%.

Besides the above mentioned numbers, there are further key figures for discount certificates that are relevant and should therefore be considered before investing in a discount certificate. One of the most significant ones is the Maximum Yield Probability, which gives the potential investor an indication of the likelihood of achieving the maximum possible yield at maturity.

In 2021, the average Maximum Yield Probability was 58.42%, which means that on the first observation day the certificate had an average probability of 58.42% of reaching its maximum yield at maturity.

Of the 67,118 certificates maturing in 2021 - i.e. 43.9% of all examined products - 80.99% reached their maximum yield.

*) based on TTMzero price indications on www.wallstreet-online.de

3 INTRODUCTION AND SUBJECT OF EXAMINATION

INTRODUCTION

For more than 25 years, discount certificates have enjoyed great popularity among private investors. This product category was one of the first structured investment products on the derivatives market.

Among investment products, discount certificates have a considerable market share, even exceeding that of bonus and index certificates. The reasons for the popularity of these products are their plain structure, the good risk-reward profile and the reduced risk of loss compared to a direct investment in the underlying asset.

The structure of a discount certificate is relatively simple: The investor purchases the certificate on the desired stock or index at a rebate - the discount - i.e. the price of the certificate is lower than the current price of the underlying. In return, the redemption is limited to a preset maximum amount, the cap.

Here, the following applies: the lower the cap, the greater the discount and the lower the risk (as well as the potential return). Conversely, the higher the cap, the lower the discount, however risk and potential returns are higher.

Discount certificates are particularly suitable for defensive investors who are expecting sideways-moving or slightly falling markets and want to be protected against minor price decreases. Offensive investors might also find this product category interesting, as they can control their risk and return opportunities through the choice of the cap.

In cooperation with the Stuttgart Stock Exchange ("Börse Stuttgart"), TTMzero analyzed 152,898 discount certificates for the year 2021. The certificates examined refer to the top 70 underlyings from Europe and the USA.

The objective of this study is to compare investments in discount certificates with direct investments in the corresponding underlying asset in terms of yield attractiveness. The returns realized on certificates

and those on underlyings during the period under review were compared for this purpose.

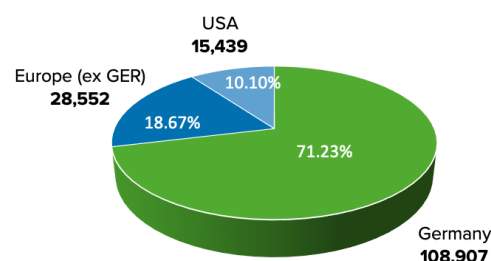
Furthermore, the study describes the large number of discount certificates in the German market and provides investors with a good overview of the opportunities and risks related to discount certificates.

In order to enable a comparison across issuers, the key figures Sideways Yield, Maximum Yield, Implied Volatility, Maximum Yield Probability, Relative Distance to Cap, Relative Discount and Delta were calculated and examined for all discount certificates.

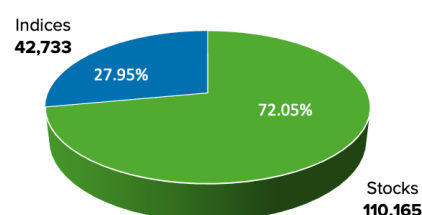
SUBJECT OF EXAMINATION

TTMzero analyzed 152,898 discount certificates, which are based on the 70 most popular underlyings from Germany (Top 40), Europe-ex-Germany (Top 20) and the USA (Top 10).

108,907 certificates were based on underlyings from Germany, 28,552 certificates were based on underlyings from Europe ex-Germany and 15,439 certificates were based on underlyings from the USA.



72.05% of the certificates were based on a stock as underlying and 27.95% of the certificates were based on an index.



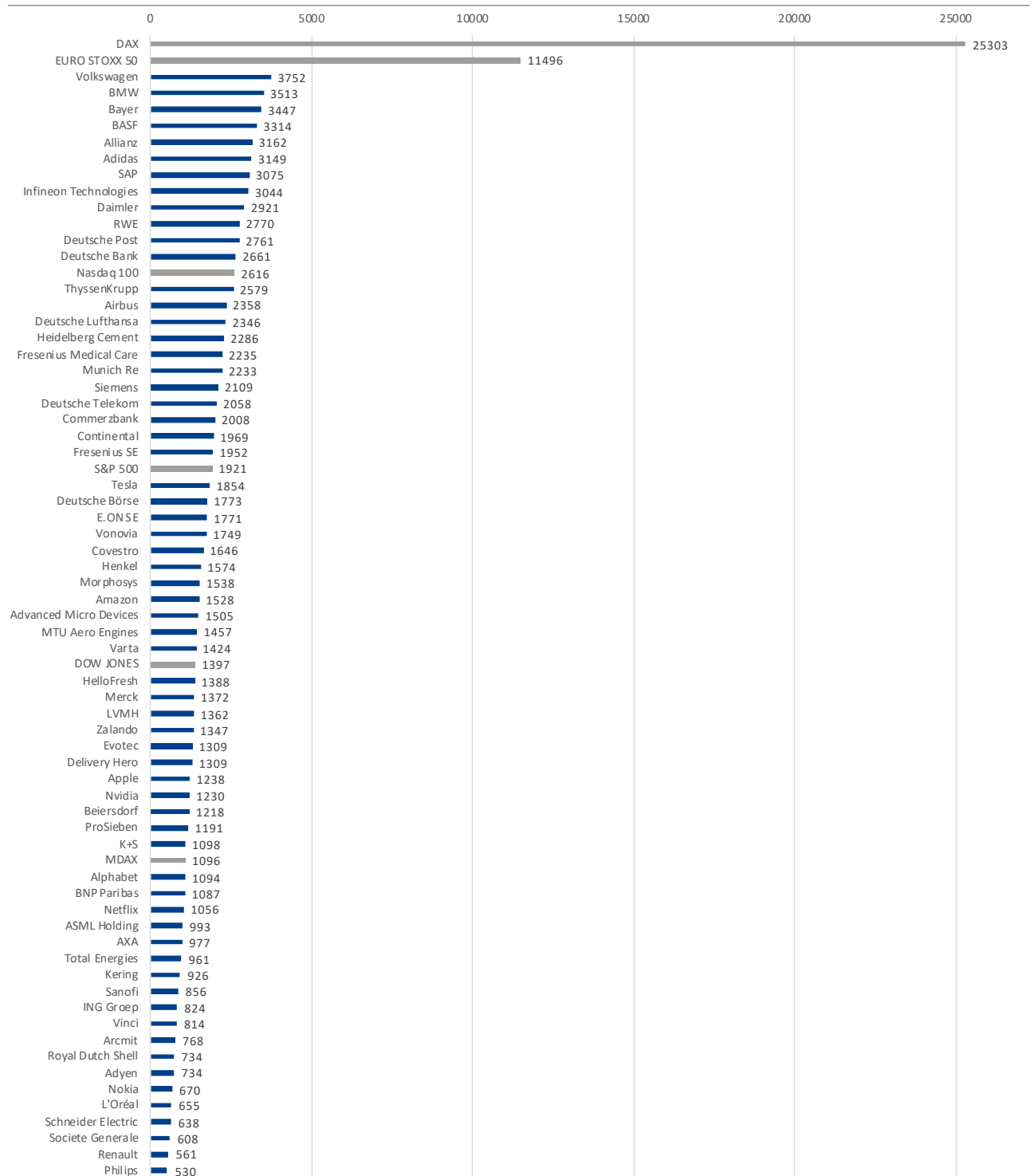
SUBJECT OF EXAMINATION

The top 40 underlyings from Germany consist of 38 shares and the two indices DAX® and MDAX® index. The top 20 underlyings from the rest of Europe consist of 19 equities and the EURO STOXX 50® Index. The American top 10 underlyings include

seven equities and the three indices NASDAQ 100®, S&P 500®, and Dow Jones Industrial Average®.

The underlyings are listed in the following overview.

Chart 1: Underlying assets and number of discount certificates examined based on these underlying assets



4 ANALYSIS PERIOD AND METHODOLOGY

ANALYSIS PERIOD

For each discount certificate, the certificate yield was compared with the underlying yield in the respective observation period. The individual observation period for a certificate starts with the first trading day of the certificate in 2021 and ends with the last trading day of the certificate in 2021. The following assumptions apply:

Assumptions calculating the certificate yield

The entry price is defined as the first ask price on the first trading day of the certificate. For certificates issued after 1 January 2021, the first price on the first trading day is defined as the entry price.

The last bid price on the last trading day in 2021 is defined as the exit price. If the certificate matures during the year 2021, the exit price is the redemption amount.

Calculation of key figures

The certificate key figures (sideways yield, maximum yield, implied volatility, delta, relative discount, relative distance to cap and maximum yield probability) are calculated on the first trading day of the discount certificate in 2021.

As a rule, the first ask price of the day was used to calculate the key figures. The mid-price between the first bid and ask price was used to calculate the delta and the implied volatility.

Assumptions for calculating the underlying yield in the observation period

The yield of the underlying asset is calculated from the opening price of the underlying asset on the first observation day of the certificate and the closing price of the underlying asset on the last observation day of the certificate in 2021.

When calculating the yield of the underlying instrument, prices are adjusted for corporate actions (dividends, stock splits, etc.).

For underlyings not denominated in Euro, the performance was adjusted for the exchange rates valid on the specific day.

5 RESULTS

1 Comparison of Yields: Discount Certificates vs. Underlyings

Overall, 83.12% of the discount certificates achieved a positive performance. For the respective underlyings, 71.28% achieved a positive performance.

13.86% of the discount certificates achieved a positive yield during the period under review, while the underlying asset performed negatively during the same period.

Of the discount certificates maturing in 2021, 80.99% achieved their maximum yield with an average maximum yield of 8.57% p.a. The average yield of all discount certificates maturing in 2021 was 7.91% p.a.

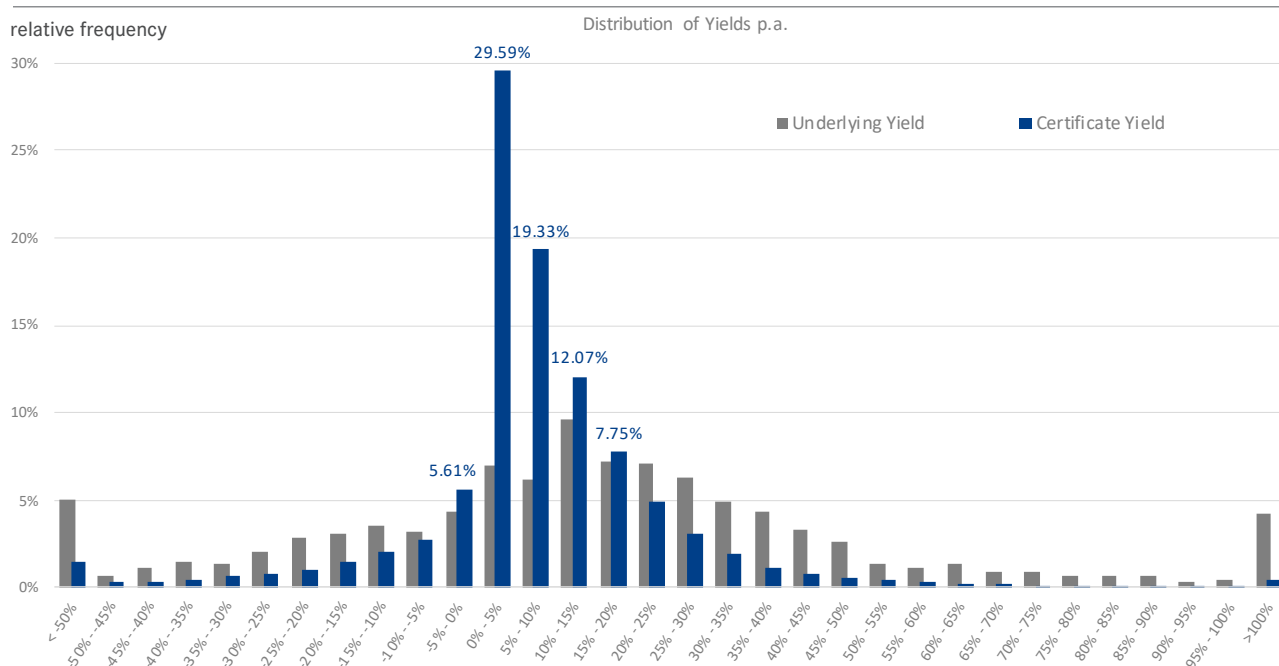
41.04% of the discount certificates generated a higher yield than a direct investment in the respective underlying asset would have generated in the same period.

The average yield of the underlyings in the period under review was 15.93% p.a., whereas that of discount certificates was 7.34% p.a.

Certificate yields in detail

- **29.59%** of discount certificates generated yields between **0% and 5% p.a.**
- **19.33%** between **5% and 10% p.a.**
- **12.07%** of the discount certificates had yields between **10% and 15% p.a.**
- **7.75%** of the certificates generated yields between **15% and 20% p.a.**
- **4.90%** between **20% and 25% p.a.**
- **9.49%** of the certificates generated yields of more than **25% p.a.**
- **16.87%** generated negative yields

Chart 2: Comparison of the distribution of yields of discount certificates and underlyings



Discount certificates performed well in 2021, with more than 83% attaining a positive performance and over 40% achieving a higher yield than the underlying. The average yield of the examined discount certificates in 2021 was 7.34% p.a., that of the underlyings 15.93%

RESULTS

2 Distributions and Averages of Certificate Key Figures

The following certificate key figures were calculated on the first trading day of each discount certificate.

2.1 Maturity

The discount certificates under review had an average remaining term of 328 days. 67,118 of the certificates under review, i.e. 43.90%, matured in 2021.

2.2 Relative Distance to Cap

The relative distance to the cap shows how far the price of the underlying asset is away from the cap on the first observation day and whether the price of

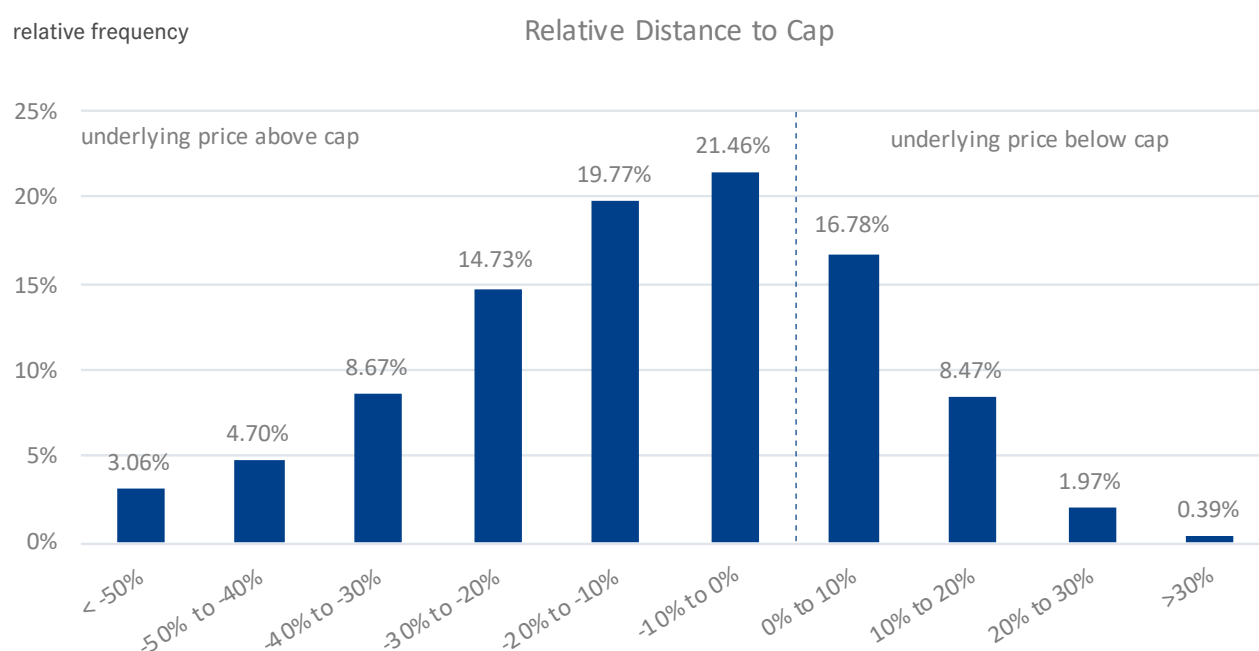
the underlying is above the cap (negative distance) or below (positive distance).

Since the cap determines the maximum possible yield that a discount certificate can achieve, the level of the cap is highly significant for investors.

The lower the cap, the bigger the discount compared to the current price of the underlying, the lower the risk as well as the potential return at the end of the certificate's term.

On the other hand, the higher the cap above the current price of the underlying, the lower the possible discount and the higher the risk. However, if the price of the underlying instrument climbs up to the cap, highly attractive yields are possible.

Chart 3: Distribution of the relative distance to the cap on the first trading day of each certificate



RESULTS

The average distance to the cap on the first observation day in 2021 was -11.94%.

In total, 72.39% of discount certificates had a negative distance to the cap on the first observation day. This implies that the price of the underlying instrument was above the cap and the certificates were in their maximum yield range when the observation period started.

Almost half of the certificates (47.53%) with a negative distance to the cap were issued before 2021, i.e. their first observation day was January 4, 2021; many of those certificates had reached their cap during the strong market at the end of 2020.

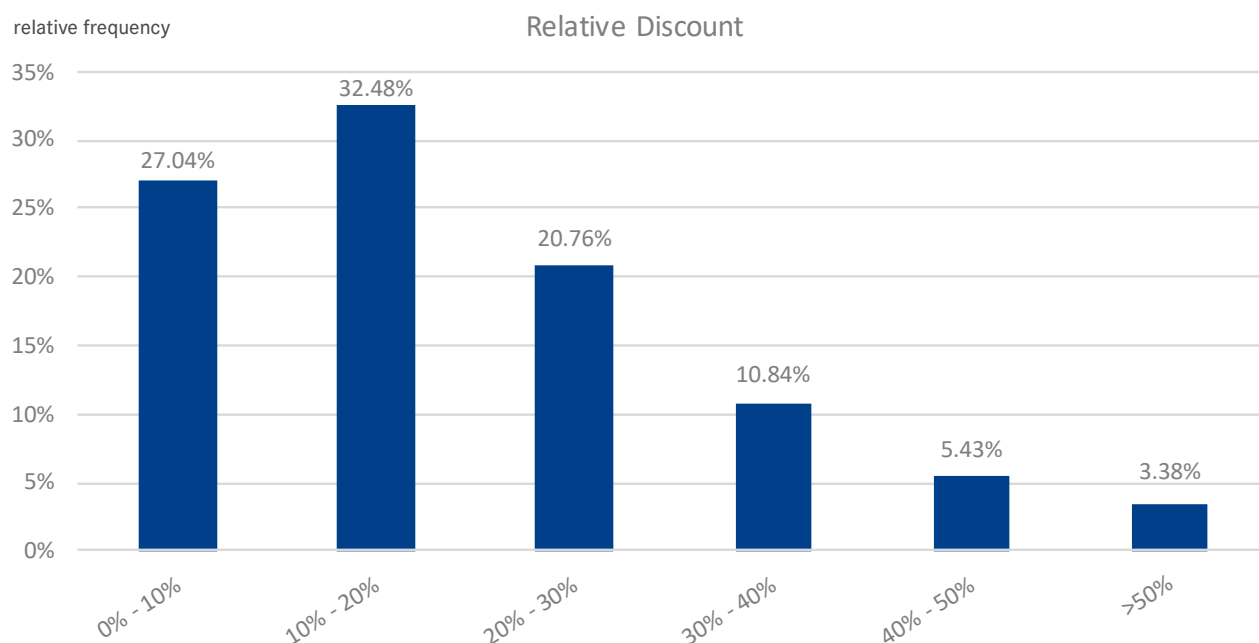
Of the 72.39% of certificates with a negative distance to the cap on the first observation day, 90.31% also had a negative distance to the cap on the last observation day, which means they maintained their maximum yield.

2.3 Relative Discount

The relative discount corresponds to the percentage discount of the certificate's price compared to a direct investment in the underlying instrument.

The granted discount of a certificate is higher the lower the cap is compared to the underlying price.

Chart 4: Distribution of the relative discount *)



*) 0.07% of the certificates under review had a negative relative discount

The discount certificates under review had an average discount of 19.59% on the first observation day. In total, 27.04% of the certificates had a discount between 0% and 10%, 32.48% between 10% and 20% and 20.76% of the certificates between 20% and 30%. 19.65% of the certificates had a discount of over 30%.

RESULTS

2.4 Maximum Yield p.a.

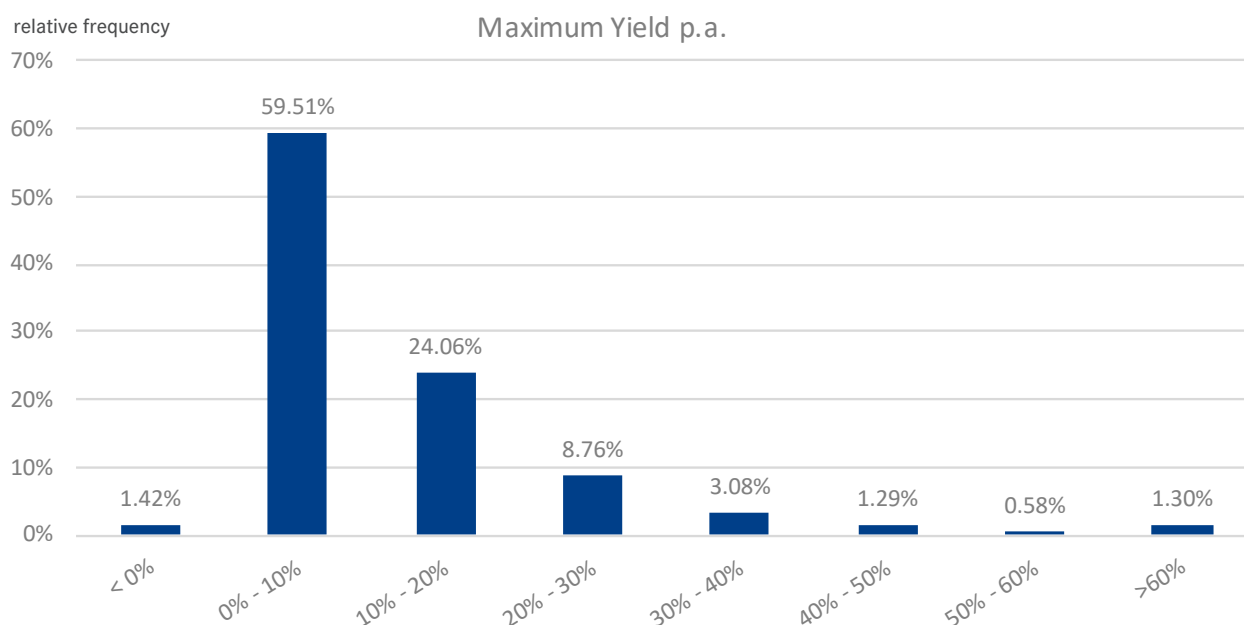
The maximum yield corresponds to the maximum possible yield of a discount certificate until maturity. By annualizing those yields, the maximum yield p.a. is obtained.

The maximum yield is determined by the level of the chosen cap. A cap high above the level of the underlying price implies a high possible maximum yield, but also a higher risk.

Looking at the possible maximum yield p.a. on the first observation day, the following picture emerges:

59.51% of the discount certificates had the chance of a maximum yield of 0% to 10% p.a., 24.06% of 10% to 20% p.a., and 15.01% of the certificates had the chance of a maximum annual yield of more than 20% p.a., thereof 1.3% of more than 60% p.a. 1.42% of the certificates had a negative possible maximum yield p.a.

Chart 5: Distribution of maximum yields p.a.



On the first observation day in 2021, possible maximum yields of up to 10% p.a. were by far the most frequent. The average possible maximum yield was 11.96% p.a. Of all certificates maturing in 2021, 80.99% reached their maximum yield.

RESULTS

2.5 Sideways Yield p.a.

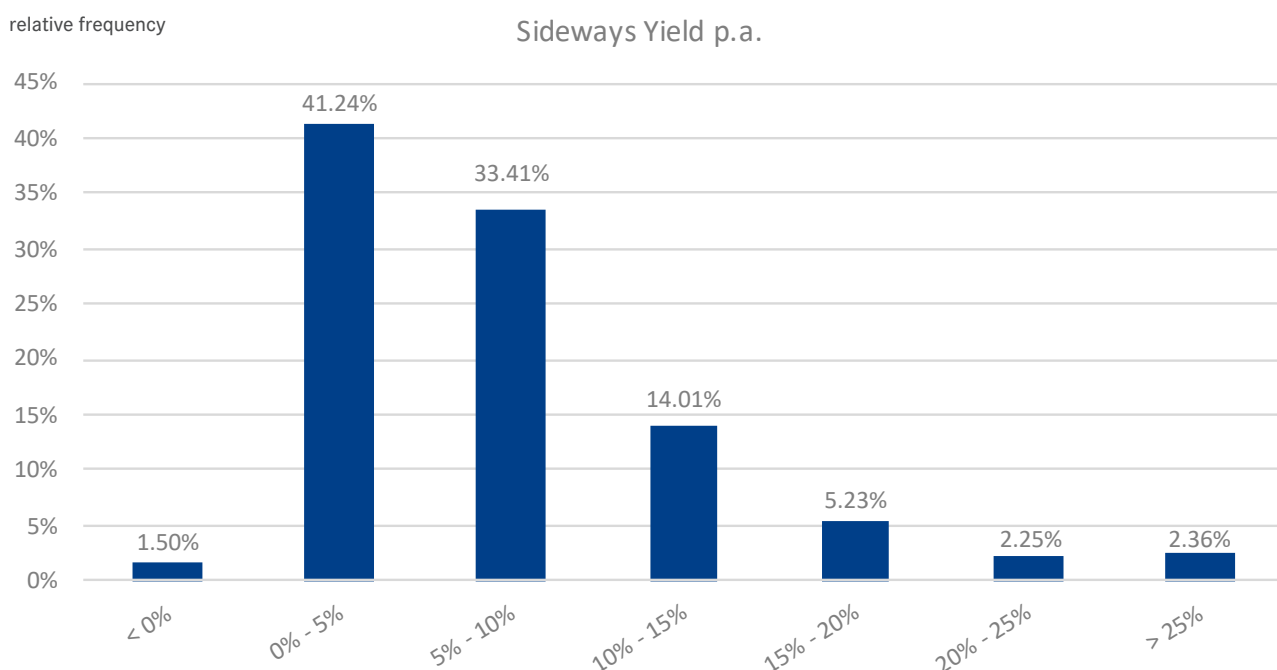
The sideways yield indicates the yield achieved by the discount certificate if the underlying asset is quoted at the same level at maturity as the level on the first observation day.

In our analysis, 41.24% of the discount certificates under review had a sideways yield between 0% to 5% p.a., 33.41% between 5% and 10% p.a., 14.01%

between 10% and 15% p.a. and 9.84% had a sideways yield of more than 15% p.a.

1.50% of certificates showed a negative sideways yield.

Chart 6: Distribution of annualized sideways yields



Discount certificates play to their strengths in sideways-moving or slightly falling markets. In 2021, they would have achieved an average sideways yield of 7.40% p.a.

RESULTS

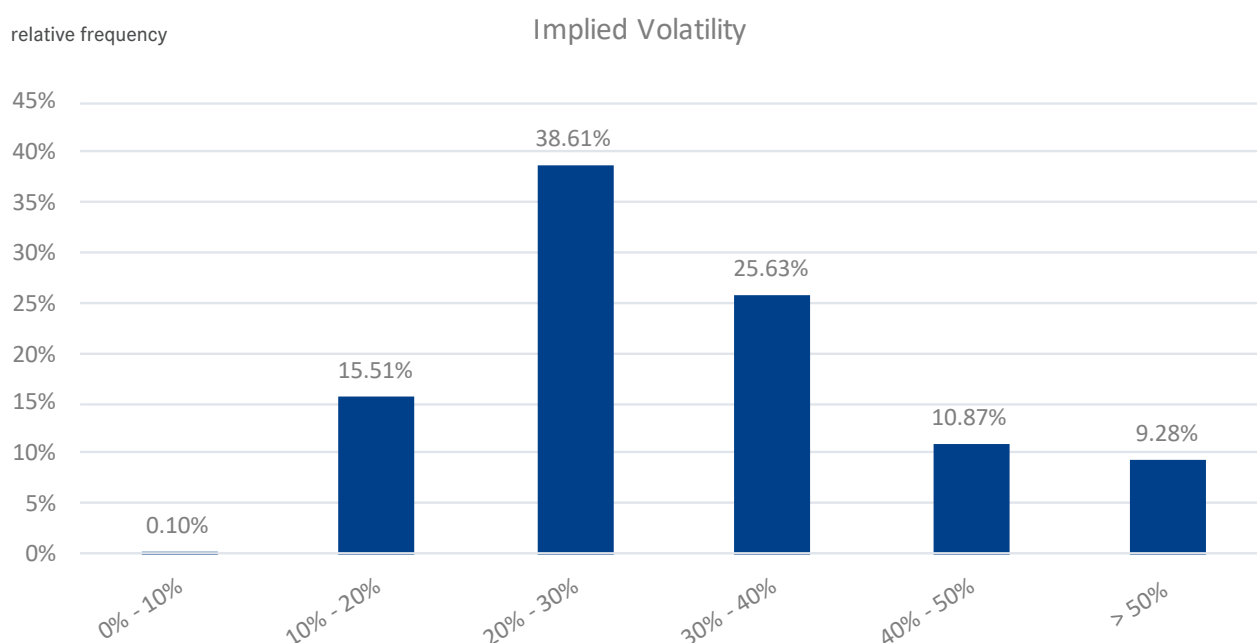
2.6 Implied Volatility

The implied volatility provides information about the expected fluctuations of the underlying. The higher this value is, the higher the price markdown for discount certificates.

Among the discount certificates examined, 0.10% of the discount certificates had an implied volatility of 0% to 10%, 15.51% from 10% to 20%, 38.61% between

20% and 30%, 25.63% from 30% to 40% and 10.87% from 40% to 50%. For 9.28% of the certificates the implied volatility was greater than 50%.

Chart 7: Distribution of implied volatilities



The average implied volatility in 2021 was 32.16% on the first observation day of the certificates.

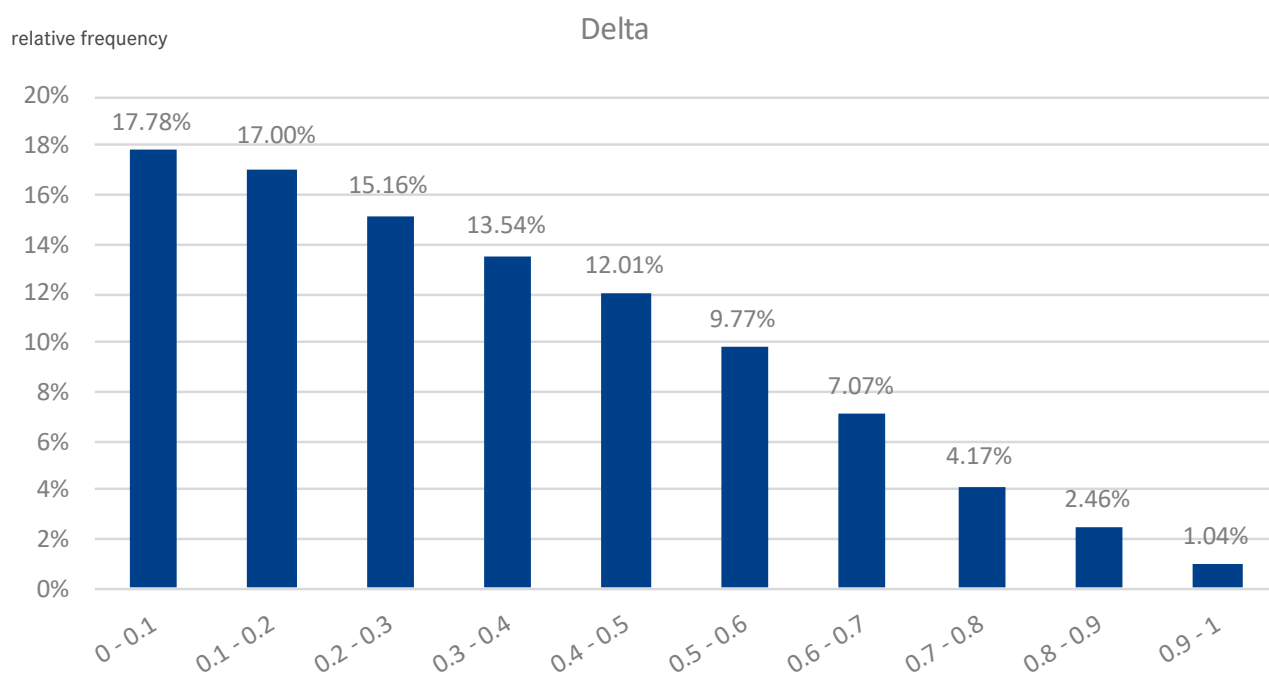
RESULTS

2.7 Delta

The delta indicates how the price of the discount certificate changes if the price of the underlying increases by one unit.

17.78% of the discount certificates under review had a delta of less than 0.1 on the first observation day and 57.71% had a delta between 0.1 and 0.5. 24.51% of the certificates had a delta between 0.5 and 1.

Chart 8: Distribution of the Delta *)



*) The study adjusted the delta for certificates based on underlyings in foreign currencies by the exchange rates (pure delta).

The average Delta of the examined discount certificates in 2021 was 0.33. In general, the lower the delta, the less impact a change in the underlying has on the certificate price.

RESULTS

2.8 Maximum Yield Probability

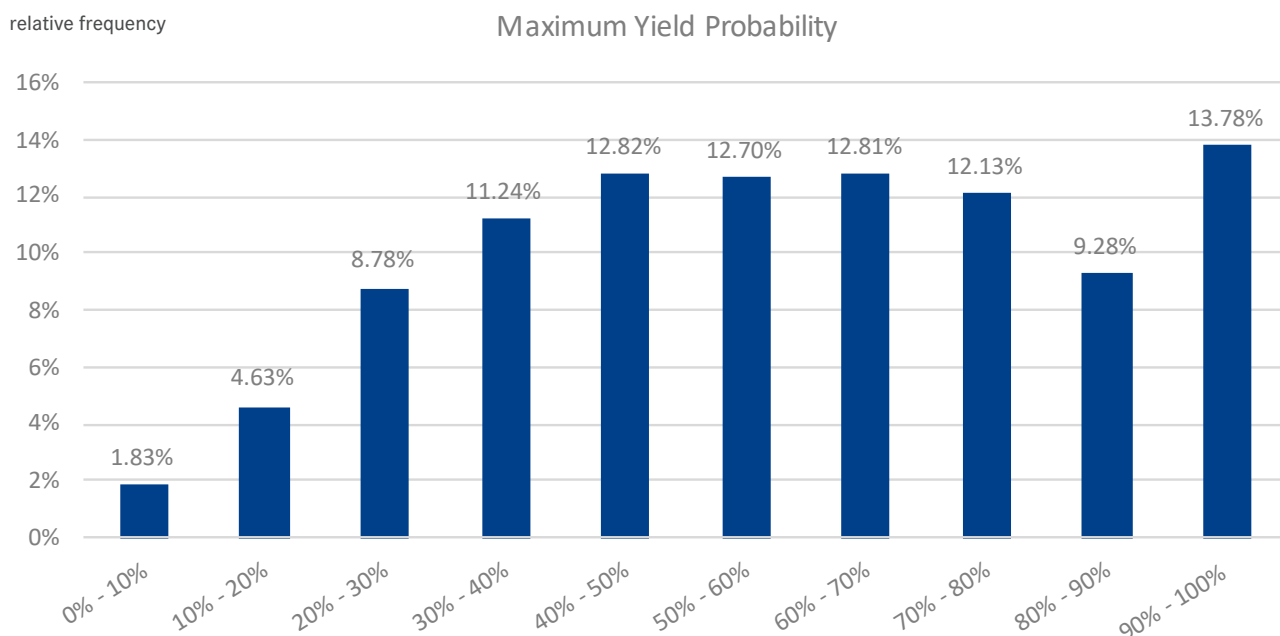
One of the most significant indicators for discount certificates is the Maximum Yield Probability.

It provides information about the probability of a discount certificate to achieve the maximum yield at maturity. In other words: The Maximum Yield Probability gives information about the probability that the price of the underlying asset will be at or above the cap on the valuation day of the discount certificate.

Usually, the underlying price of discount certificates with a high Maximum Yield Probability is either near or above the cap. Hence, yields to be achieved are generally lower than those for certificates with a lower Maximum Yield Probability.

Low Maximum Yield Probability in general goes along with an underlying price far below the cap, i.e. the chance for the underlying to reach the cap (=maximum amount), is smaller, which then in general results in higher maximum yields.

Chart 9: Distribution of Maximum Yield Probability



In 2021, the average maximum yield probability was 58.42%. 60.70% of the certificates had a maximum yield probability of over 50% and 23.06% of over 80%. Of the certificates with a maximum yield probability above 50% and maturing in 2021, 93.03% attained their maximum yield. Of the maturing certificates with a maximum yield probability of above 80%, 98.45% reached their maximum yield.

RESULTS

3 Key Messages

- 83.12%** of the discount certificates achieved a positive yield over the period considered.
- 41.04%** of the discount certificates outperformed their underlying assets in the relevant period.
- 13.86%** of the discount certificates achieved a positive yield in the period under review, while the underlying developed negatively.
- 7.34%** was the average yield p.a. of the discount certificates under review.
- 80.99%** of all certificates expiring in 2021 attained their maximum yield.
- 98.45%** of the certificates maturing in 2021 with a Maximum Yield Probability above 80% on their first observation day reached their maximum yield.

6

DESCRIPTION OF THE MARKET AND LICENCE INFORMATION

DESCRIPTION OF THE MARKET

In Germany, the volume invested in structured products amounted to around 73.9 billion euros at the end of 2021. Discount certificates accounted for approximately 5.8% of this total. (Source: www.derivateverband.de; based on information from the exchanges).

At the Stuttgart and Frankfurt stock exchanges, the volume traded in investment products amounted to 16.156 billion euros in 2021. Discount certificates accounted for 5.926 billion euros of this total. This corresponds to a share of 36.68%.

A total of 516,896 investment products were listed in Stuttgart as of 31 December 2021, of which 176,166 were discount certificates.

The relatively high share of discount certificates in the total investment products reflects the high attractiveness of this product category in Germany.

LICENCE INFORMATION

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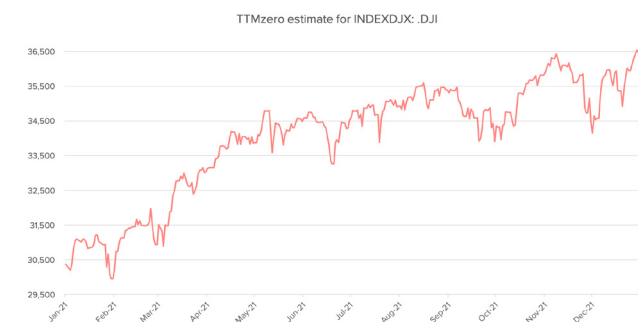
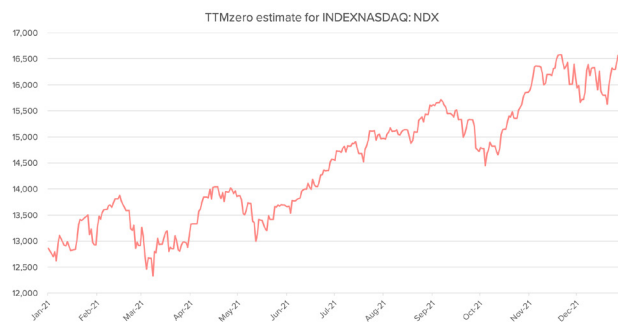
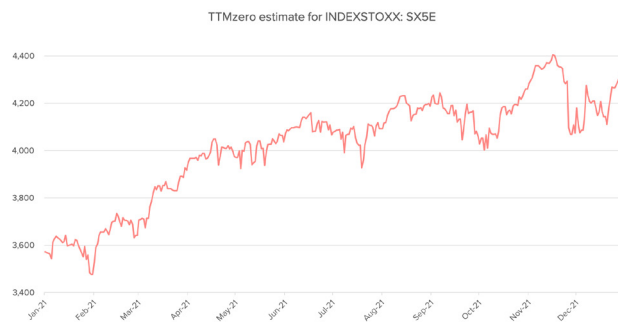
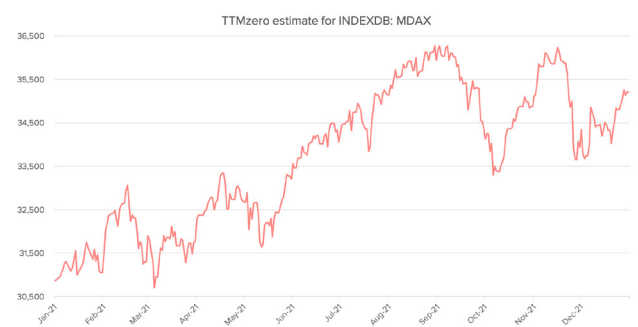
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7

PERFORMANCE OF THE 6 INDICES

PERFORMANCE OF THE 6 INDICES

The 6 indices that are part of the examined underlyings all show a similar performance for 2021.



The charts are based on real-time estimates calculated by TTMzero.

TTMzero provides real-time prices for a large number of financial instruments such as all major indices, stocks, currencies, crypto currencies, futures, commodities and FX pairs.



TTMZERO, BÖRSE STUTTGART AND ABOUT DDV

The study was conducted by TTMzero together with the Stuttgart Stock Exchange on behalf of the German Derivatives Association (DDV).

TTMzero

TTMzero offers data products and software solutions in the area of RegTech and Capital Markets Tech. It is part of United Fintech Ltd. The organization maintains offices in New York (US), London (UK), Copenhagen (DK), Berlin (DE), Madrid (ES) and Craiova (RO).

TTMzero's expertise lies in the independent valuation of financial instruments. Its product range includes a variety of real-time data products such as valuations for structured products and other financial instruments as well as Software-as-a-Service solutions which support financial institutions and capital markets participants in the automation of pre- and post-trade processes.

TTMzero calculates the key figures presented in the study in real-time for all discount certificates. The real time data is published by some of the leading issuers and also on some of the most important broker platforms and finance portals such as traderepublic.com and wallstreet-online.de.

The Stuttgart Stock Exchange (Börse Stuttgart)

The Stuttgart Stock Exchange (Börse Stuttgart) is the private investor exchange and the leading floor trading place in Germany. Private investors can trade shares, securitized derivatives, bonds, ETFs, funds and participation certificates in Stuttgart.

Stuttgart is the market leader in Germany for exchange trading in corporate bonds and the European market leader in securitized derivatives. In the hybrid market model of the Stuttgart stock exchange, trading experts ensure reliable and fast order execution.

All regulatory and control mechanisms of a public stock exchange are in place to ensure investor protection and transparency. With a trading volume of around 106.8 billion euros in all asset classes in 2021, the Stuttgart Stock Exchange again ranks eighth in Europe.

ABOUT DDV

Deutscher Derivate Verband (DDV), the German Derivatives Association, is the industry representative body for the leading issuers of structured products in Germany: BNP Paribas, Citigroup, DekaBank, Deutsche Bank, DZ BANK, Goldman Sachs, HSBC Trinkaus, HypoVereinsbank, J.P. Morgan, LBBW, Morgan Stanley, Société Générale, UBS, and Vontobel. Furthermore, the Association's work is supported by more than 20 sponsoring members, which include the stock exchanges in Stuttgart and Frankfurt, gettex (which belongs to the Bavarian Stock Exchange in Munich), Baader Bank, and the direct banks comdirect bank, Consorsbank, DKB, flatexDEGIRO, ING-DiBa, maxblue, S Broker and Trade Republic, as well as the finance portals finanzen.net, onvista, and wallstreet:online, and various other service providers.

DDV's aim is to improve the general political and regulatory conditions for structured products in Germany and at European level, and to encourage increasing numbers of private investors to choose certificates and warrants. The objectives of DDV therefore include making the products more understandable and transparent. To this end, DDV provides a wide range of training and educational opportunities. This includes regular publications such as this „Discount Study“. The intention is to provide private investors - professionals and those who want to become professionals - with useful facts in order to make well informed and self-responsible investment decisions. It is therefore targeted to self-decision-makers as well as investors who seek advice.

The Discount Study was commissioned by DDV for the third time this year.

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IMPORTANT NOTES

IMPORTANT NOTES

For the above information, the sources available and considered reliable have been used. Statements based on these sources represent a non-binding estimate at the time this document was prepared.

The authors of the study make no representations or warranties with regard to the results. In no way are the securities discussed in the study recommended or advertised. The information contained herein does not constitute investment advice.

The complete information as well as the risks relating to the discount certificates examined can be found in the respective base prospectus and any supplements thereto, as well as in the respective Final Terms.

The investment products considered in this document are not suitable for every investor, as they may also result in substantial losses. Individual clarification by an investment advisor is recommended.