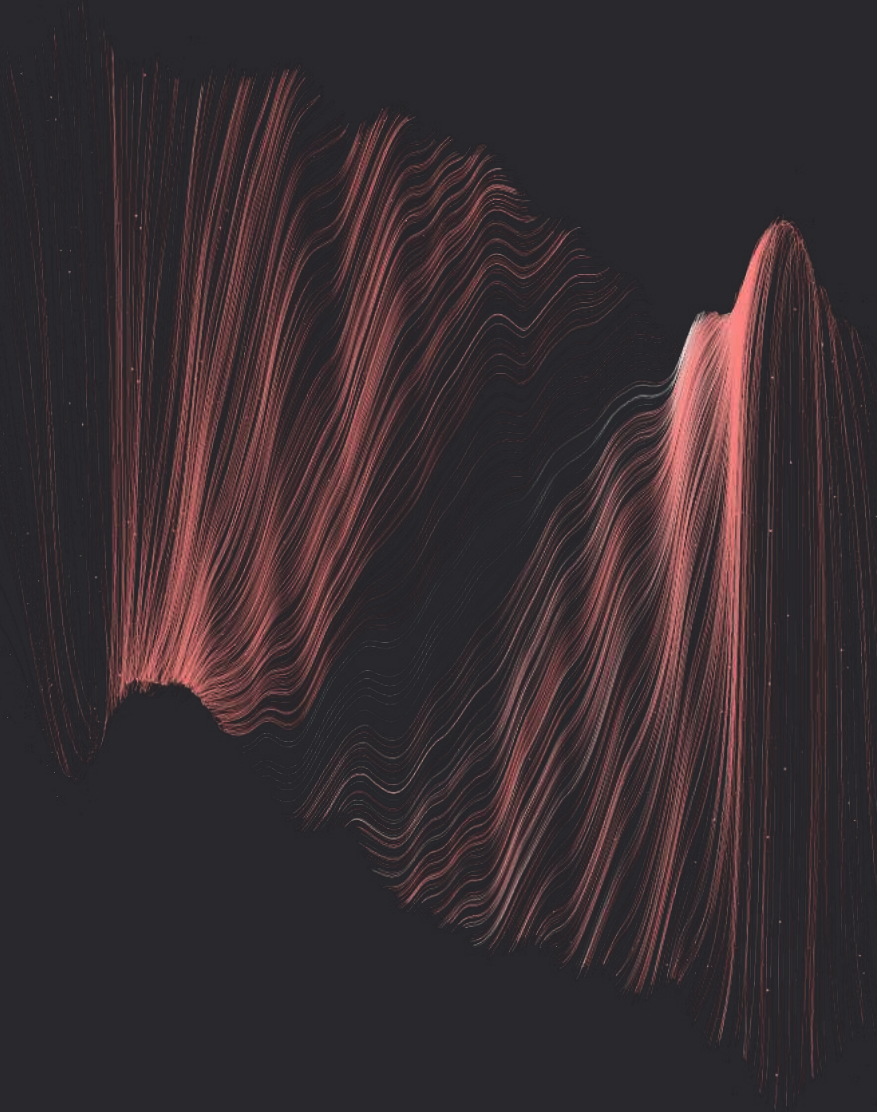


# Barrier-Hit-Risk Report First 3 Quarters - 2020

Bonus Certificates  
DAX<sup>®</sup> vs. NASDAQ 100<sup>®</sup>



## 01 Highlights

Bonus Certificates are mostly used as an alternative investment to a direct investment in the underlying stock or index. Investors who choose Bonus Classic Certificates as an alternative investment gain partial protection and usually benefit from markets that are moving sideways. As long as the price of the underlying asset never breaches the barrier, the owners of Bonus Certificates are entitled to a bonus payment. Once the barrier is touched (barrier hit event), the investors lose their entitlement to the bonus payment.

The performance of the Bonus Classic Certificates after the barrier hit event is equal to the performance of the underlying asset. In order to aid investors in better quantifying the probability of a future barrier breach, TTMzero computes the Barrier-Hit-Risk (BHR) for more than 150,000 Bonus Certificates. The Barrier-Hit-Risk is one of the most important risk management key figures. The computation of the BHR of a single Bonus Certificate requires Monte-Carlo-Simulation of 50,000 paths taking into account implied volatility, time to maturity and distance to the barrier (buffer).

For this research study, TTMzero analyzed 110,950 DAX Bonus Certificates and 8,250 NASDAQ Bonus Certificates listed at Börse Stuttgart in the first 3 quarters of 2020. Bonus Classic, Bonus Capped, Bonus Reverse and Bonus Reverse Capped Certificates are likewise included in this study.

- 31.12% of the DAX Bonus Certificates suffered from a Barrier Hit in between 01/JAN/2020 and 30/SEP/2020. The ratio for NASDAQ Bonus Certificates that experienced a barrier breach event was slightly lower (25.44%).
- During 01/JUL/2020 and 30/SEP/2020 the relative difference between barrier hit ratios for DAX and NASDAQ Bonus Certificates is more significant: Only 5.28% of DAX Bonus Certificates experienced barrier breaches whereas 12.49% of NASDAQ Bonus Certificates suffered from Barrier-Hit-Events. The higher ratio of barrier breaches for NASDAQ Bonus Certificates is due to substantial bullish movements in the NASDAQ 100® during the beginning of Q3 which led to a remarkable barrier breach ratio of 34.71% in Bonus Reverse and Bonus Reverse Capped products. At the same time the DAX® was moving mainly sideways. Therefore the ratio of DAX Bonus Reverse and DAX Bonus Reverse Capped products that experienced Barrier Hit Events was only 13.08% in Q3.
- The Barrier Hit Risk and more than 70 other important Key Figures are made available by Börse Stuttgart in cooperation with TTMzero.
- Investors can obtain the current BHR of Bonus Certificates across all categories at <https://tools.ttmzero.com/bhr> or on the websites of some issuers and independent web portals.

## 02 Subject of examination

- TTMzero analyzed 119,200 bonus certificates for the first three Quarters of 2020, of which 110,950 were DAX Bonus Certificates and 8,250 were NASDAQ Bonus Certificates. Only those bonus certificates which had at least one day of intact barrier during the respective quarter were analyzed.
- The considered Bonus certificates are all listed at Börse Stuttgart.

## 03 Analysis period and Methodology

For each bonus certificate, the performance of the certificate was compared with the performance of the DAX® index and NASDAQ 100® index in the respective time period. The individual observation period for a certificate starts with the first trading day of the certificate in the respective quarter and ends with the last trading day of the certificate in the same quarter. The following assumptions apply:

### Assumptions calculating the performance of the certificates

- ✓ The entry price is defined as the first ask price on the first trading day of the certificate in the respective quarter. For certificates issued after 1 January 2020 when analyzing all 3 Quarters, or after 1 July 2020 when analyzing only Q3, the first price on the first trading day is defined as the entry price.
- ✓ The last bid price on the last trading day in the respective quarter is defined as the exit price. If the certificate matures during this period, the exit price is the redemption amount.
- ✓ In the case a Bonus Certificate encounters a barrier hit during the analyzed period, its performance continues to be calculated in line with the movement of the DAX® and NASDAQ 100® respectively.

### Assumptions for calculating the performance of the DAX® and NASDAQ 100® in the observation period

- ✓ The performance of the DAX® and NASDAQ 100® are calculated from the opening prices of the indices on the first observation day of the corresponding certificate and the closing price of the indices on the last observation day of the corresponding certificate in the respective quarter.

### Calculation of the Barrier Hit Risk

- ✓ The BHR is being calculated continuously by TTMzero from the first trading day of the certificate until the day it encounters a barrier hit or matures.
- ✓ The computation of the BHR of a single Bonus Certificate requires a Monte-Carlo-Simulation of 50,000 paths taking into account implied volatility, time to maturity and distance to the barrier (buffer).

## 04 All 3 Quarters of 2020 in figures

- Average ratio for observed barrier breaches across all product categories is slightly higher in DAX® (31.12%) than NASDAQ 100® (25.44%). While 74.42% of barrier breaches were observed in DAX long products, only 24.96% of barrier breaches were observed in NASDAQ long products categories.

<b>DAX®</b>	Barrier hit events	Issued products in 3 Quarters of 2020	Products matured during 3 Quarters of 2020*	Number of products in the beginning of 2020*	Number of products by the end of Q3-2020*	Number of products with at least 1 day of intact barrier in 3 Quarters of 2020*	Percentage of products with barrier hits in 3 Quarters of 2020
<b>Bonus Certificates</b>	<b>34,524</b>	<b>76,184</b>	<b>26,986</b>	<b>36,023</b>	<b>46,107</b>	<b>110,950</b>	<b>31.12</b>
Bonus Classic	5,207	11,108	4,091	5,957	7,026	16,841	30.92
Bonus Capped	20,487	44,581	15,132	19,081	25,955	63,138	32.45
Bonus Reverse	1,873	2,683	881	1,833	1,584	4,471	41.89
Bonus Reverse Capped	6,957	17,812	6,882	9,152	11,542	26,500	26.25

<b>NASDAQ 100®</b>	Barrier hit events	Issued products in 3 Quarters of 2020	Products matured during 3 Quarters of 2020*	Number of products in the beginning of 2020*	Number of products by the end of Q3-2020*	Number of products with at least 1 day of intact barrier in 3 Quarters of 2020*	Percentage of products with barrier hits in 3 Quarters of 2020
<b>Bonus Certificates</b>	<b>2,099</b>	<b>5,737</b>	<b>1,853</b>	<b>2,541</b>	<b>4,247</b>	<b>8,250</b>	<b>25.44</b>
Bonus Classic	85	870	407	337	692	1,207	7.04
Bonus Capped	439	2,663	1,377	1,399	2,207	4,044	10.86
Bonus Reverse	48	65	-	-	7	55	87.27
Bonus Reverse Capped	1,527	2,139	69	805	1,341	2,944	51.87

\* Without barrier hit

- Within the long product categories (Bonus Classic and Bonus Capped) we observed a significantly higher ratio of barrier breaches for DAX® related products compared to NASDAQ 100® related products. 30.92% of DAX Bonus Classic and 32.45% of DAX Bonus Capped Certificates experienced Barrier Hits whereas only 7.04% of NASDAQ Bonus Classic and 10.84% of NASDAQ Bonus Capped suffered from barrier breaches.
- Within short product categories the picture seems reversed: 41.89% of DAX Bonus Reverse and 26.25% of DAX Bonus Reverse Capped products experienced barrier breaches. But 87.27% of NASDAQ Bonus Reverse and 51.87% of NASDAQ Bonus Reverse Capped suffered from Barrier Hit Events.

The much higher ratio of observed barrier breaches in the short products relating to the NASDAQ 100® can be explained with the strong outperformance of the NASDAQ 100® vs the DAX®. The chart below displays the historical time series of the TTMzero Evaluated Real-Time Prices for these indices where both time series are indexed to 100% on 1/Jan/2020.

**Development of DAX® vs. NASDAQ 100® in first 3 Quarters\***



\* Indexed to 100% on 1/Jan/2020

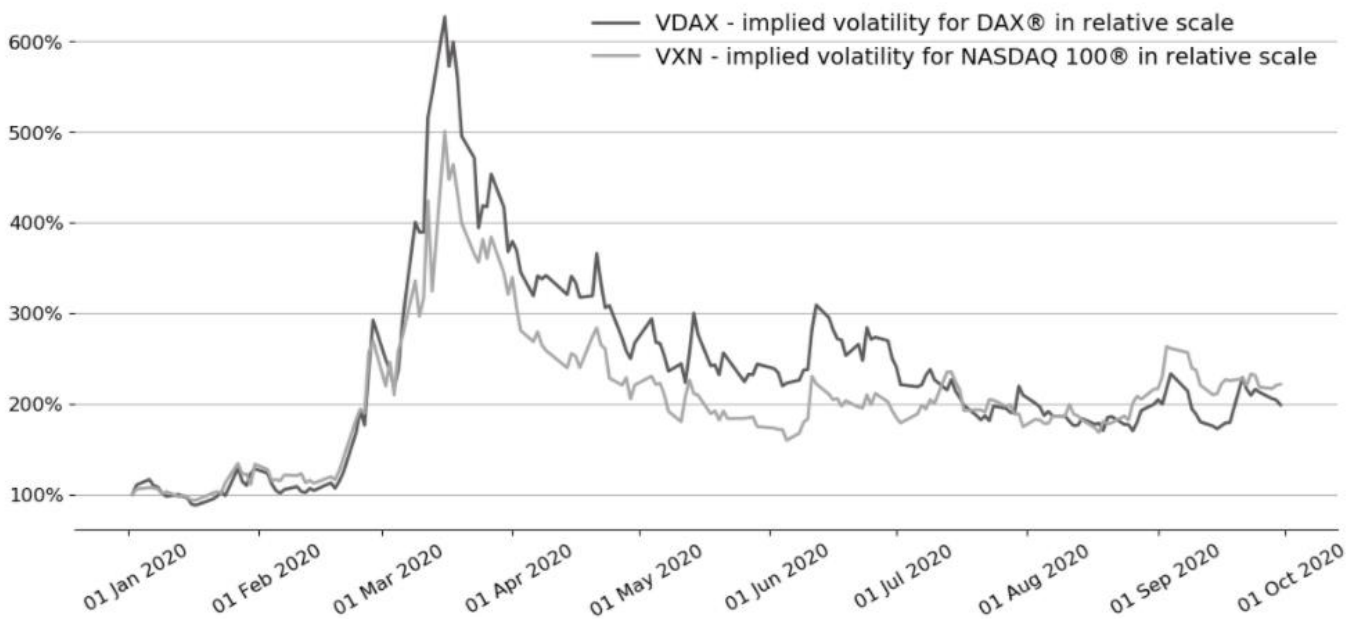
- DAX® seems to hold more balance between bullish and bearish movements throughout the 3 quarters. It has bounced back dramatically at high to 13,255 points on 16/Sep after the lowest on 18/Mar (8,441 points), almost back to the same level of DAX® all-time high on 19/Feb (13,789 points).
- Meanwhile, strong bullish movements dominated NASDAQ 100®, starting right after the deep crash in March. NASDAQ 100® has reflected the general market expectation that gave credibility to the tech industry with an impressive rebound that reached 12,468 points on 2/Sep, overcame its low on 20/March (6,994 points) and even significantly outperformed its all-time high in February (9,740 points).

Interestingly, when looking at VDAX and VXN respectively, which measure the implied volatility level on DAX options and NASDAQ 100 options, it could be easily spotted in the following chart that:

- In Q1: Prices on options on both indices (DAX® and NASDAQ 100®) were quite stable from January to mid-February. The respective volatility indices were moving during the pre-Covid period within a range of 20%. However, the implied volatility levels climbed dramatically for the options on both indices (increase of over 5 times for DAX, 4 times for NASDAQ 100) when comparing the level at the beginning of the year to the highest point in 18/Mar.
- In Q2: The implied volatility level for DAX options was slightly higher than for NASDAQ options. Both indices were generally bullish during Q2 and the absolute levels of implied volatilities have stabilized at levels higher than during the pre-Covid regime but also much lower than the peaks observed during March.
- In Q3: The NASDAQ 100® index climbed a steep slope during Q3 and its options were trading at higher volatility levels compared to DAX options.

*(Chart next page)*

## Implied volatility level of DAX® vs. NASDAQ 100® in first 3 Quarters\*



\* Indexed to 100% on 1/Jan/2020

**KEY TAKEAWAYS.**

- In general, there was a greater balance between bullish and bearish movements in DAX® throughout the whole 3 quarters. This resulted in a similar ratio of products with barrier hit events for each category of DAX Bonus Certificates (30.92% for Bonus Classic, 32.45% for Bonus Capped, 41.89% for Bonus Reverse and 26.25% for Bonus Reverse Capped).
- A strong bullish NASDAQ 100®, especially during Q2 and Q3, had caused Short products on NASDAQ to have a much higher ratio of barrier hit events (52.51%) than for Long products (9.97%).



- For the DAX®, throughout the first 3 quarters, the 3 days that DAX Bonus Certificates encountered the most barrier breaches were all in March, when the market witnessed the most dramatic crash. Additionally, 100% of products that suffered a barrier hit were Long products (ie. Bonus Classic and Bonus Capped). This is due to the fact that DAX® movements during March were the most dramatic along the whole period, and caused a great number of products to suffer.

DAX® most knock_out_date	No. of products with barrier breaches	% of Bonus Classic / Bonus Capped
12-Mar-2020	7,775	100
9-Mar-2020	5,358	100
16-Mar-2020	3,518	100

- As for NASDAQ 100®, for the same reason as with DAX®, 2 of the 3 days that NASDAQ Bonus Certificates suffered the most barrier breaches were also during the deep crash in March, in which 100% products that suffered a barrier hit were Long products.
- However, one of the 3 days with the most barrier breaches for NASDAQ Bonus Certificates was 09/JUN/2020 when the bull market accelerated on NASDAQ 100®. Therefore, in contrast to when the “big bear” took over in March, 100% of the products that got a barrier breach on 9/Jun were in Short categories.

NASDAQ 100® most knock_out_date	No. of products with barrier breaches	% of Bonus Classic / Bonus Capped	% of Bonus Reverse / Bonus Reverse Capped
16-Mar-2020	180	100	-
12-Mar-2020	135	100	-
09-Jun-2020	97	-	100

## 05 Q3-2020 in figures

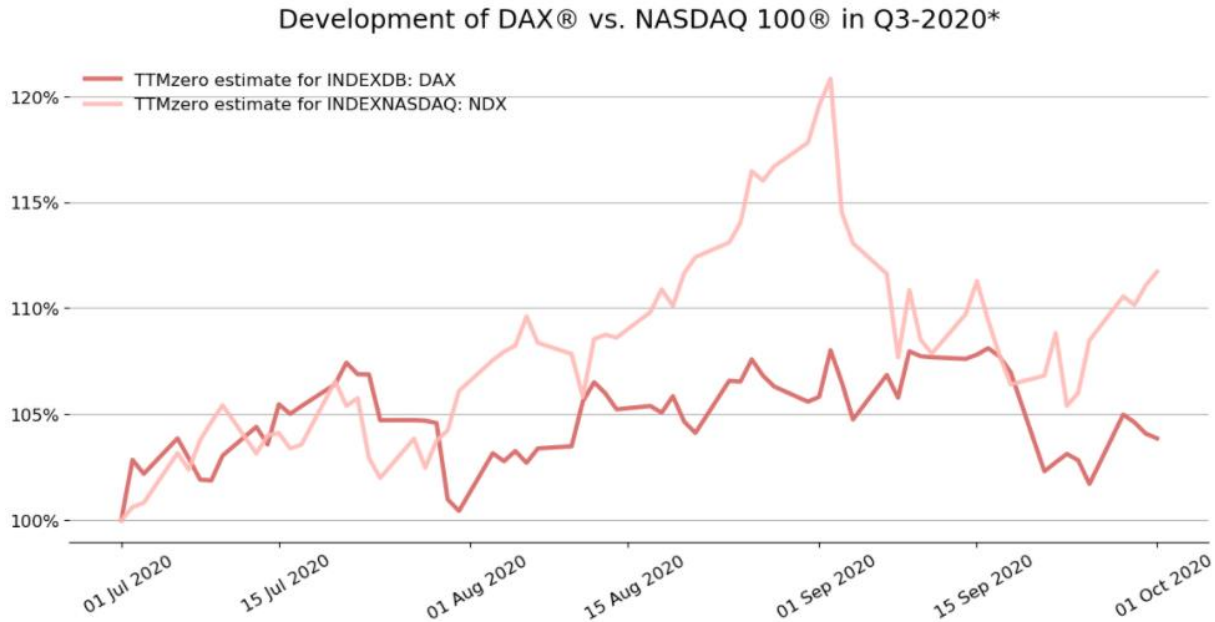
- The ratio of certificates with observed barrier breaches (across all DAX Bonus Certificate categories) for Q3 was remarkably low at only 5.28%.
- In Q3, only 1.83% of DAX Long products and 0.27% NASDAQ Long products breached the barrier.
- For DAX Bonus Certificates, 75% of barrier breaches in Q3 were observed with Short products. For NASDAQ Bonus Certificates, over 98.5% of the barrier breaches were observed with Short products.

<b>DAX®</b>	Barrier hit events	Issued products in Q3-2020	Products matured during Q3-2020*	Number of products in the beginning of Q3-2020*	Number of products by the end of Q3-2020*	Number of products with at least 1 day of intact barrier in Q3-2020*	Percentage of products with barrier hits in Q3-2020
<b>Bonus Certificates</b>	<b>3,295</b>	<b>19,570</b>	<b>13,010</b>	<b>42,964</b>	<b>46,689</b>	<b>62,408</b>	<b>5.28</b>
Bonus Classic	259	3,319	2,035	6,001	7,083	9,309	2.78
Bonus Capped	538	11,082	8,035	23,167	26,299	34,168	1.57
Bonus Reverse	365	729	350	1,721	1,640	2,416	15.11
Bonus Reverse Capped	2,133	4,440	2,590	12,075	11,667	16,515	12.92

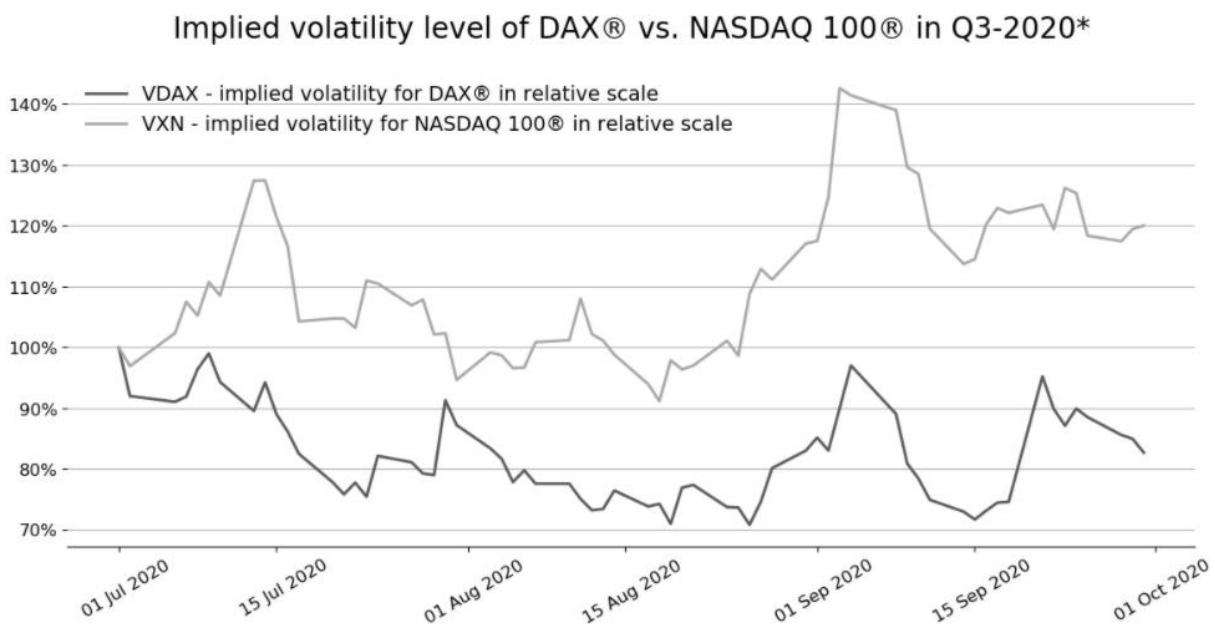
<b>NASDAQ 100®</b>	Barrier hit events	Issued products in Q3-2020	Products matured during Q3-2020*	Number of products in the beginning of Q3-2020*	Number of products by the end of Q3-2020*	Number of products with at least 1 day of intact barrier in Q3-2020*	Percentage of products with barrier hits in Q3-2020
<b>Bonus Certificates</b>	<b>712</b>	<b>3,278</b>	<b>854</b>	<b>2,449</b>	<b>4,269</b>	<b>5,699</b>	<b>12.49</b>
Bonus Classic	-	482	229	423	693	905	-
Bonus Capped	10	1,469	619	1,321	2,224	2,772	0.36
Bonus Reverse	45	62	-	-	7	52	86.54
Bonus Reverse Capped	657	1,265	6	705	1,345	1,970	33.35

\* Without barrier hit

- The chart displays the data from historical time series of TTMzero Evaluated Real-Time Prices for these indices where both time series prices are indexed to 100% on 1/Jul/2020.



- It clearly shows that the DAX® movement in Q3 is mainly sideways (range of 8.11% in relative scale).
- In comparison, the NASDAQ 100® movement range is 2.57 times that of the DAX® (a relative range of 20.83%).
- The observed differences in the directional trends of the two indices were also reflected in the levels of implied volatilities of the options which are visualized in the time series of the respective volatility indices in the chart below.



\* Indexed to 100% on 1/Jul/2020

- The numbers of bullish moves were generally more trending on the DAX® during Q3. Therefore, on the 3 days where DAX Bonus Certificates encountered the most barrier breaches in Q3, 100% were Short products (i.e. Bonus Reverse and Bonus Reverse Capped).

DAX® most knock_out_date	No. of products with barrier breaches	% of Bonus Reverse / Bonus Reverse Capped
21-Jul-2020	673	100
3-Sep-2020	528	100
20-Jul-2020	441	100

- The same is true for NASDAQ Bonus Certificates. As NASDAQ 100® went on a massive bullish journey in Q3, it is easily understandable that 100% NASDAQ Short products experienced a barrier hit on the 3 days with the most barrier breaches.

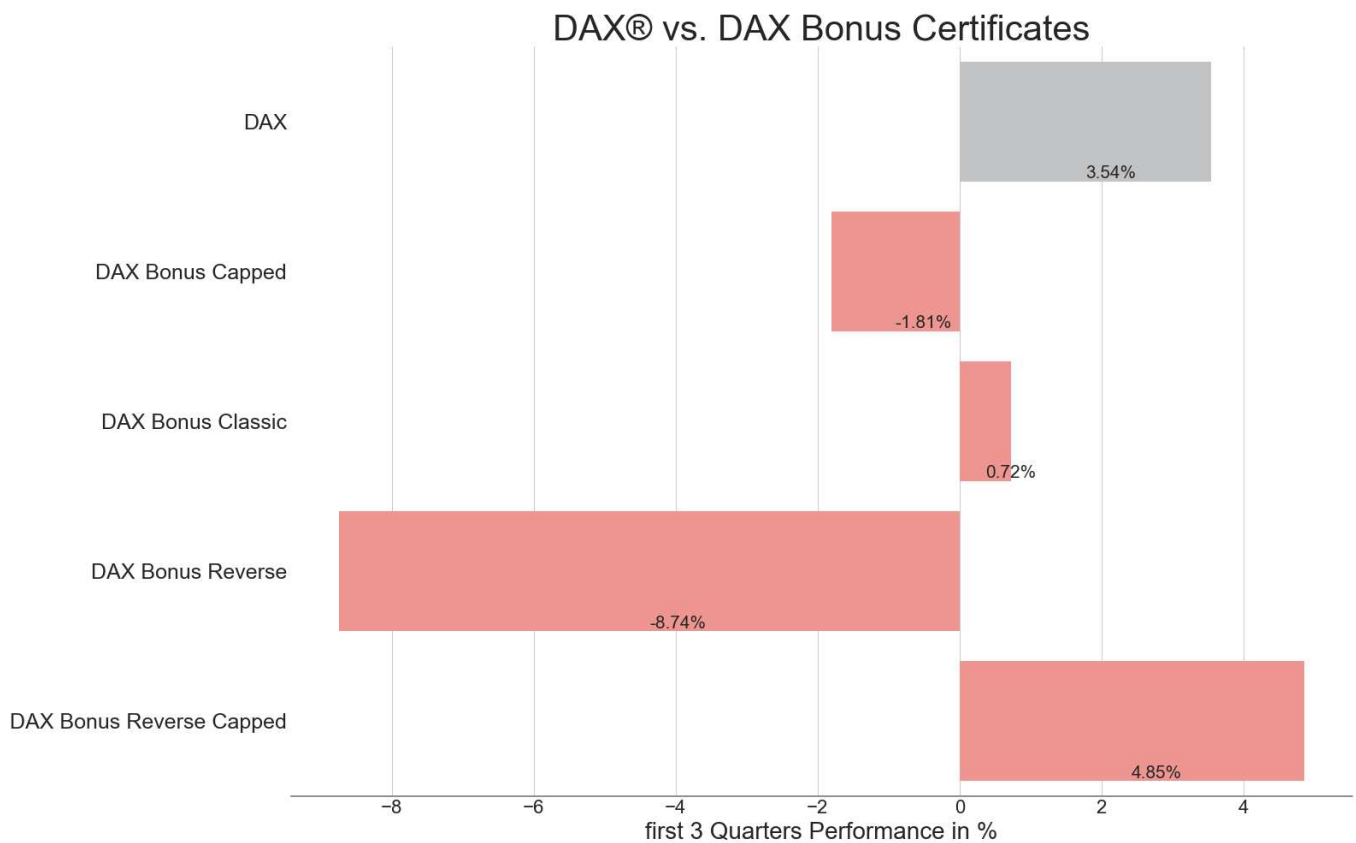
NASDAQ 100® most knock_out_date	No. of products with barrier breaches	% of Bonus Reverse / Bonus Reverse Capped
6-Jul-2020	90	100
18-Aug-2020	85	100
13-Jul-2020	75	100

#### KEY TAKEAWAYS

- DAX® witnessed a significantly lower ratio of products with barrier hit events (5.28%) due to the sideways trend during Q3.
- NASDAQ 100® experienced impressive bullish development in Q3. As a result, all barrier hit events observed for NASDAQ Bonus Certificates were Short products during this quarter.

## 06 First 3 Quarters: Performance of DAX® vs. Bonus Certificates

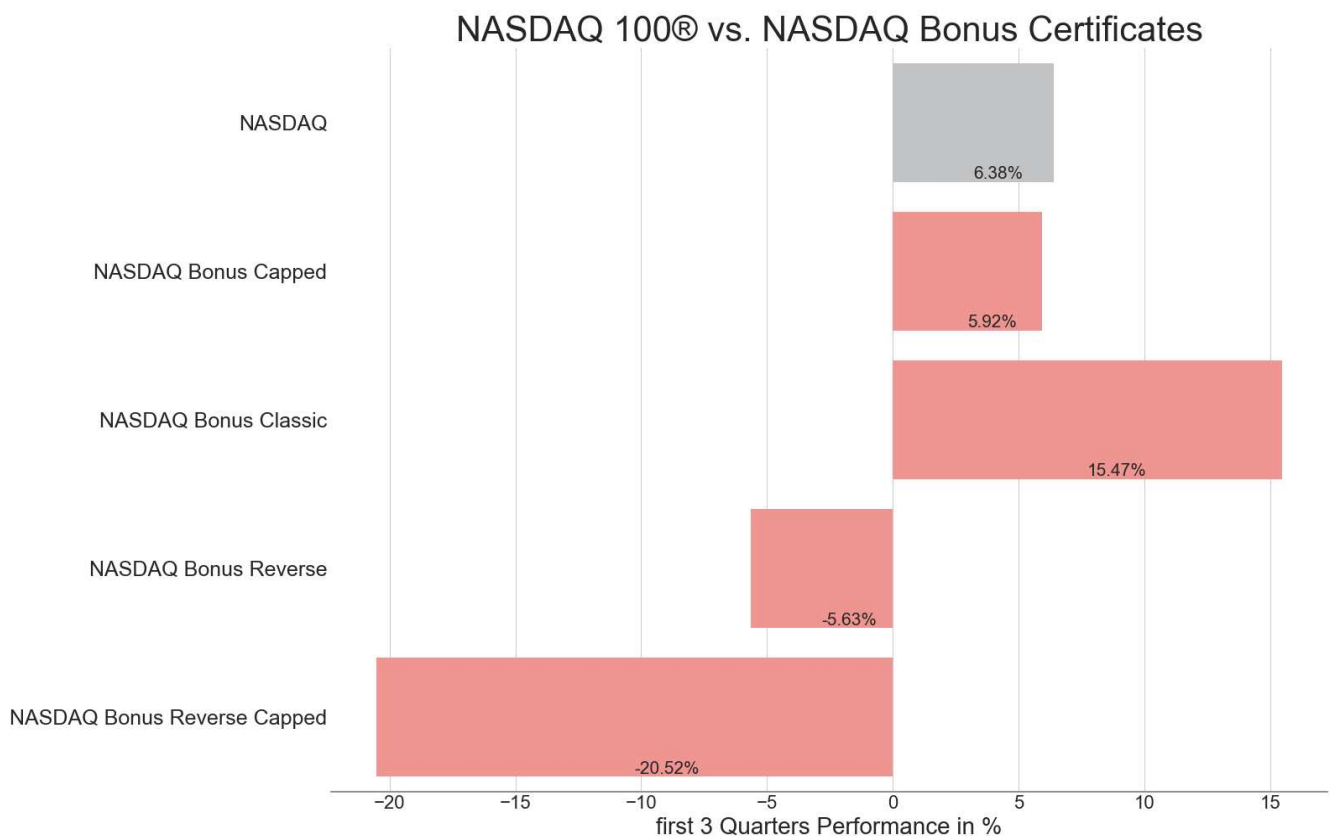
- Looking at the whole period between 1/Jan and 30/Sep, the strongest performing products were the DAX Bonus Reverse Capped product category. They achieved an average performance of 4.85% (compared to 3.54% performance in the DAX®).
- 43.54% of DAX Bonus Classic Certificates were able to outperform the DAX® during the first 3 Quarters.



	Number of Bonus Certificates that outperformed the DAX®	in %
<b>DAX Bonus Capped</b>	22,943	37.98
<b>DAX Bonus Classic</b>	7,205	43.54
<b>DAX Bonus Reverse</b>	1,505	36.14
<b>DAX Bonus Reverse Capped</b>	10,243	40.30

## 06 First 3 Quarters: Performance of NASDAQ 100® vs. Bonus Certificates

- On average, NASDAQ long products were performing quite well against NASDAQ 100® during the whole 3 Quarters. In particular, NASDAQ Bonus Classic product category with an average yield of 15.47% significantly outperformed NASDAQ 100® with an average performance of 6.38%.
- 65.74% of the NASDAQ Bonus Classic products performed better than NASDAQ 100®.



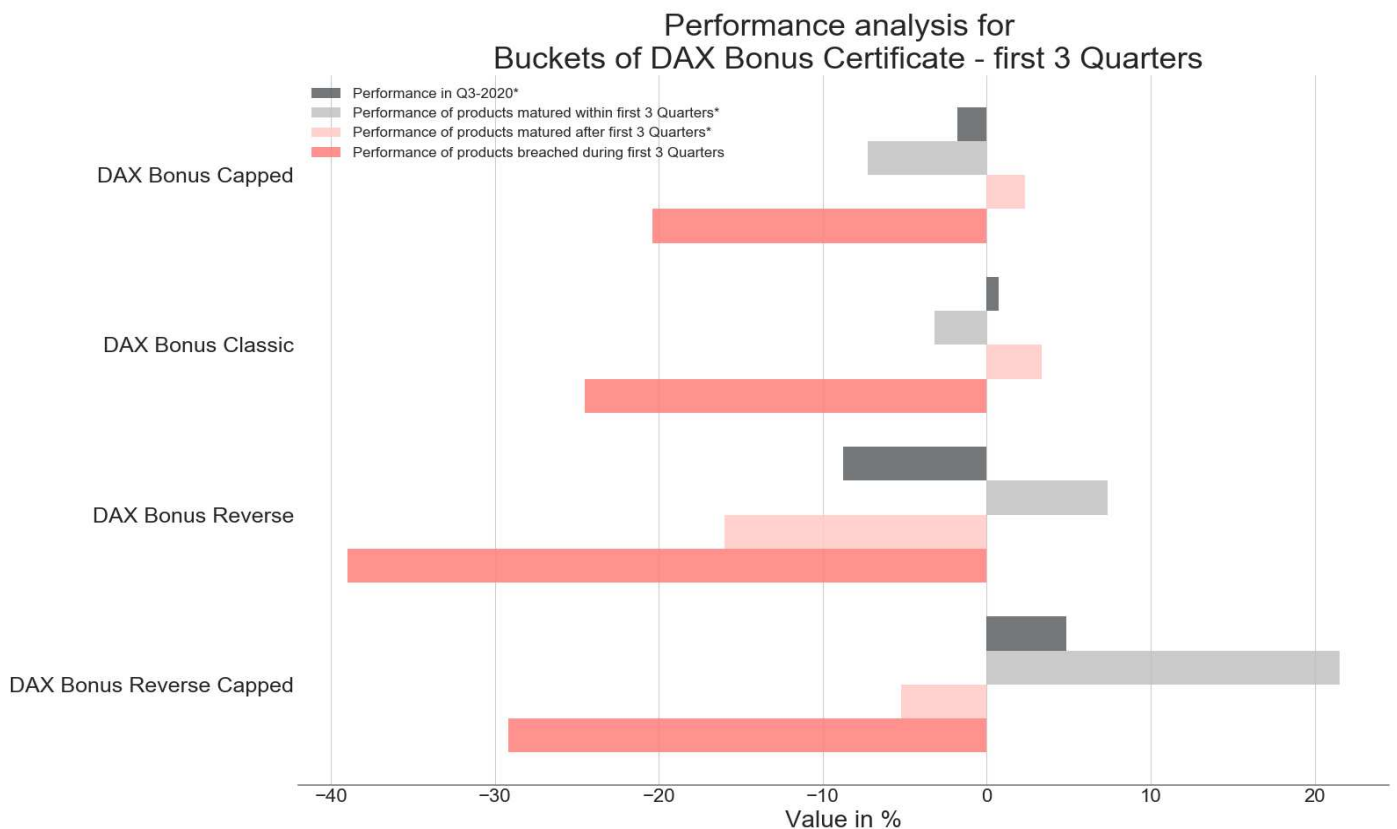
	Number of Bonus Certificates that outperformed the NASDAQ®	in %
<b>NASDAQ Bonus Capped</b>	1,447	36.65
<b>NASDAQ Bonus Classic</b>	660	65.74
<b>NASDAQ Bonus Reverse</b>	-	-
<b>NASDAQ Bonus Reverse Capped</b>	89	3.64

## 07 First 3 Quarters: Performance of Bonus Certificates

- In the first 3 Quarters, the DAX Long products that matured after Q3 generally performed better than the average performance of the Long categories.
- Meanwhile, DAX Short products that matured within the analyzed period (i.e. The first 3 Quarters) tend to significantly outperform the average performance of the Short categories.

	Performance in first 3 Quarters* (%)	Performance of products matured within first 3 Quarters* (%)	Performance of products matured after first 3 Quarters* (%)	Performance of products breached during first 3 Quarters (%)
<b>DAX Bonus Capped</b>	-1.81	-7.28	<b>2.35</b>	-20.37
<b>DAX Bonus Classic</b>	0.72	-3.18	<b>3.36</b>	-24.52
<b>DAX Bonus Reverse</b>	-8.74	<b>7.35</b>	-16.00	-38.98
<b>DAX Bonus Reverse Capped</b>	4.85	<b>21.50</b>	-5.20	-29.17

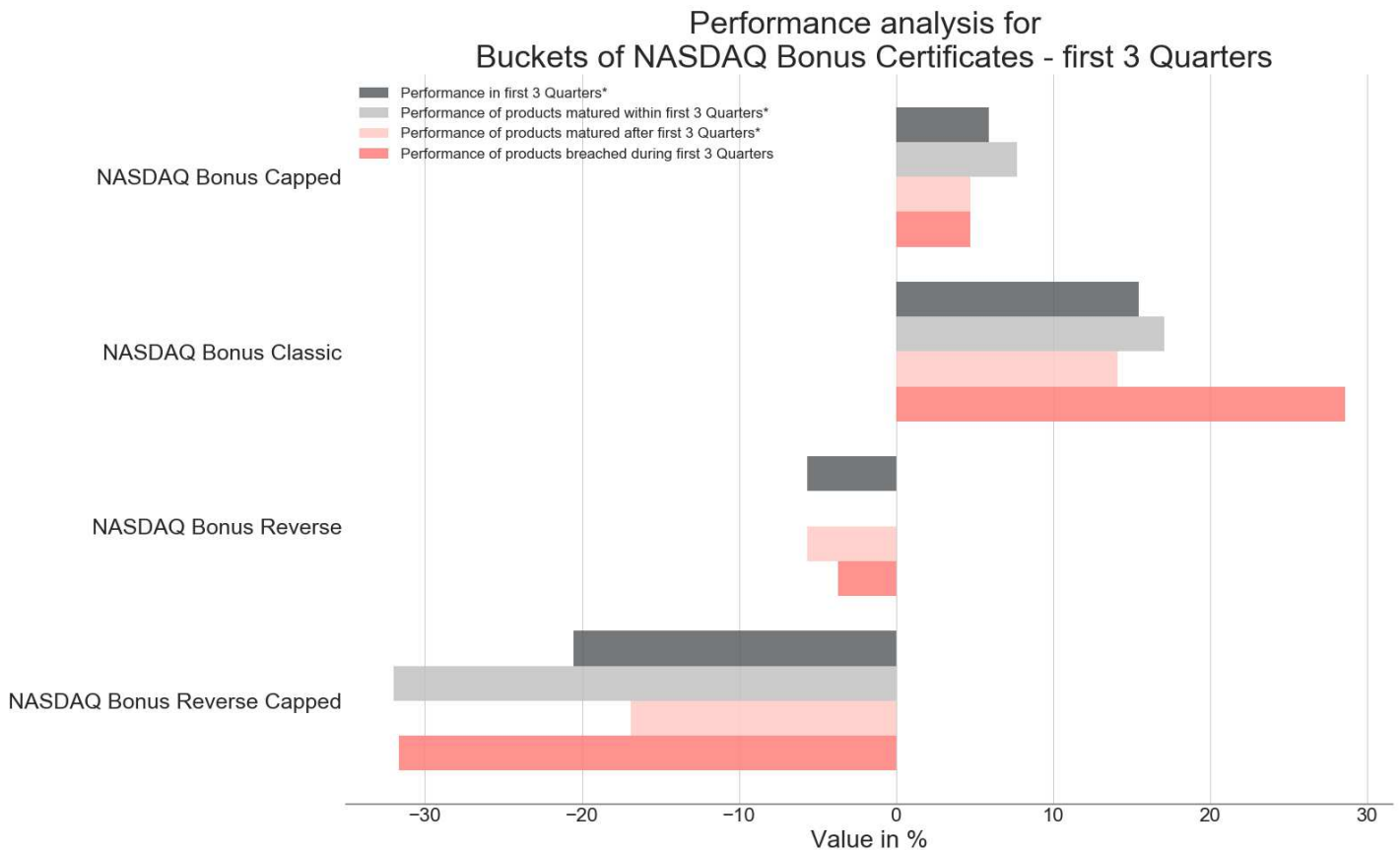
\* Without barrier hit



- Meanwhile for NASDAQ Bonus Certificates, Long products that matured within the first 3 Quarters performed better than its category’s average performance. Moreover, NASDAQ Bonus Classic Certificates that got breached during the first 3 quarters achieved a remarkable performance which is almost double the average yield of this category.
- Short products which matured after Q3 also yielded better than the average performance of the corresponding categories.

	Performance in first 3 Quarters* (%)	Performance of products matured within first 3 Quarters* (%)	Performance of products matured after first 3 Quarters* (%)	Performance of products breached during first 3 Quarters (%)
NASDAQ Bonus Capped	5.92	<b>7.7</b>	4.77	4.75
NASDAQ Bonus Classic	15.47	<b>17.08</b>	14.15	<b>28.62</b>
NASDAQ Bonus Reverse	-5.63	-	<b>-5.63</b>	-3.71
NASDAQ Bonus Reverse Capped	-20.52	-31.99	<b>-16.91</b>	-31.66

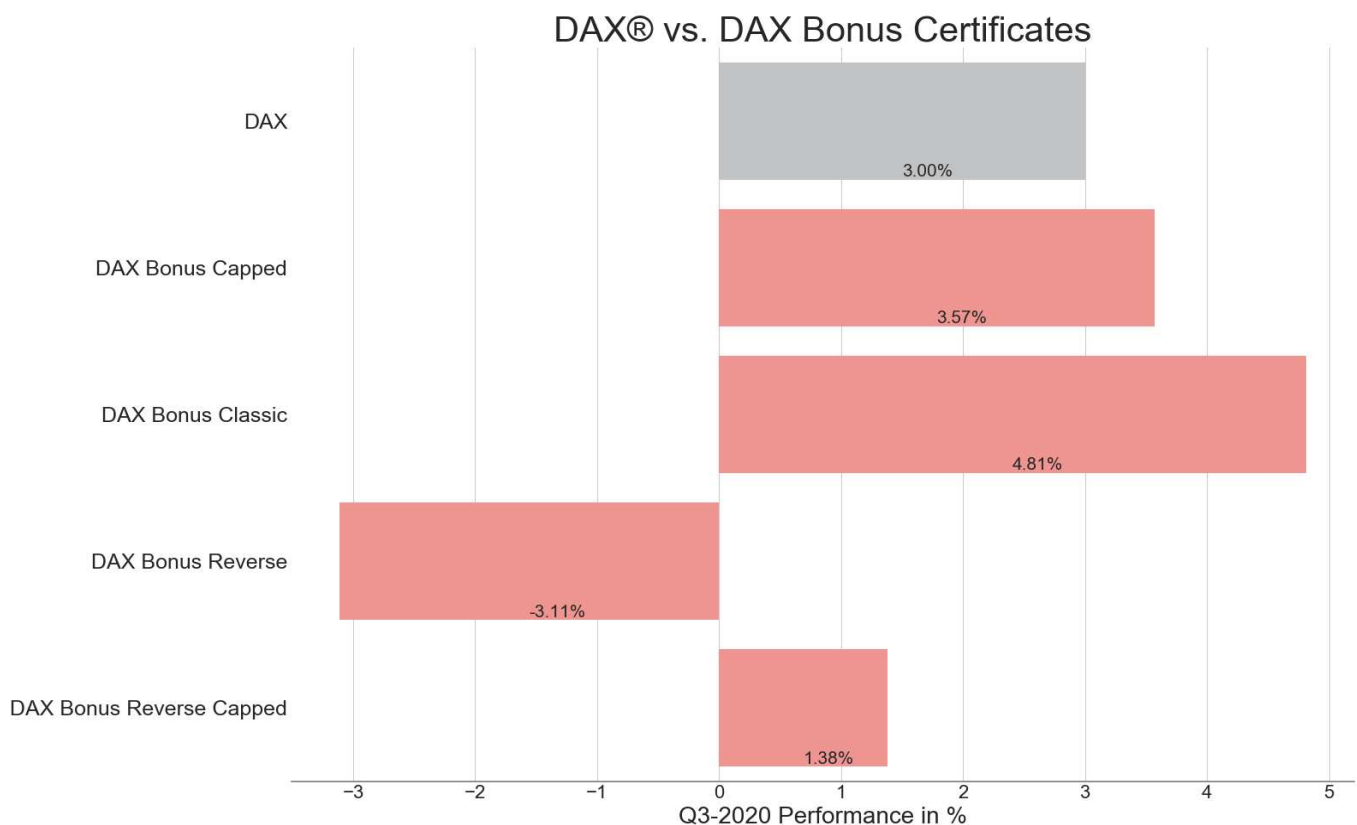
\* Without barrier hit





## 08 Q3-2020: Performance of DAX® vs. Bonus Certificates

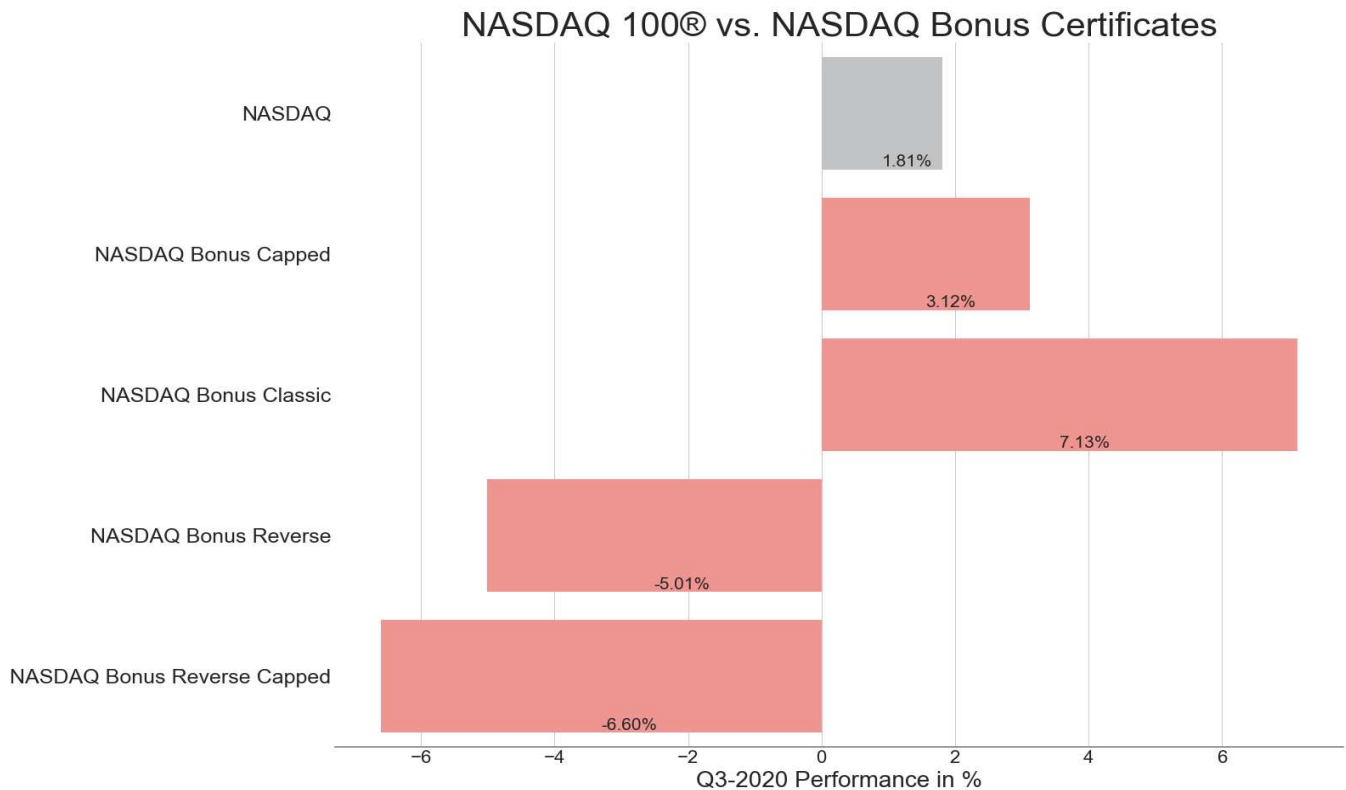
- DAX Long products easily outperformed the DAX® which mainly moved sideways and achieved an average yield of 3% during Q3.
- Of the Long categories, over 41% of DAX Bonus Classic Certificates outperformed the DAX® in Q3, while only 8.75% DAX Bonus Capped Certificates achieved outperformance against the DAX®.
- Proportions of DAX Short products that could outperform the DAX® are very low.



	Number of Bonus Certificates that outperformed the DAX®	in %
<b>DAX Bonus Capped</b>	2,136	8.75
<b>DAX Bonus Classic</b>	2,606	41.40
<b>DAX Bonus Reverse</b>	62	1.95
<b>DAX Bonus Reverse Capped</b>	515	3.02

## 08 Q3-2020: Performance of NASDAQ 100® vs. Bonus Certificates

- NASDAQ 100® impressively rallied up to its new all-time high, but with the crash on 2/Sep, it ended up performing at 1.81% by the end of Q3. Therefore, NASDAQ Long product categories still nicely outperformed NASDAQ 100®.



- Over 97% of NASDAQ Bonus Classic Certificates outperformed NASDAQ 100®, while 63.74% NASDAQ Bonus Capped Certificates achieved an outperformance during Q3.
- Interestingly, over 46% of NASDAQ Bonus Reverse Certificates still outperformed NASDAQ 100®, while only 12.21% of NASDAQ Bonus Reverse Capped Certificates could achieve outperformance against the index.

	Number of Bonus Certificates that outperformed the NASDAQ 100®	in %
<b>NASDAQ Bonus Capped</b>	1,772	63.74
<b>NASDAQ Bonus Classic</b>	707	97.52
<b>NASDAQ Bonus Reverse</b>	29	46.77
<b>NASDAQ Bonus Reverse Capped</b>	185	12.21

## 09 Q3-2020: Performance of Bonus Certificates

- In Q3, the DAX Bonus Certificates that matured within the Quarter generally performed better than the average performance across all categories.
- For NASDAQ Bonus Certificates, only Long products that matured within Q3 performed better than the respective categories' average performance. NASDAQ Short products that matured after Q3 attained a little bit better performance than the average of the categories.
- Meanwhile, NASDAQ Bonus Capped Certificates that got breached during Q3 could actually outperform the average performance of this category quite significantly.

	Performance in Q3-2020* (%)	Performance of products matured within Q3-2020* (%)	Performance of products matured after Q3-2020* (%)	Performance of products breached during Q3-2020 (%)
DAX Bonus Capped	3.57	<b>4.70</b>	3.26	-15.65
DAX Bonus Classic	4.81	<b>7.77</b>	4.13	-19.11
DAX Bonus Reverse	-3.11	<b>2.33</b>	-4.17	-14.18
DAX Bonus Reverse Capped	1.38	<b>9.05</b>	-0.11	-13.43

	Performance in Q3-2020* (%)	Performance of products matured within Q3-2020* (%)	Performance of products matured after Q3-2020* (%)	Performance of products breached during Q3-2020 (%)
NASDAQ Bonus Capped	3.12	<b>5.21</b>	2.60	<b>15.64</b>
NASDAQ Bonus Classic	7.13	<b>8.63</b>	6.50	-
NASDAQ Bonus Reverse	-5.01	-	<b>-5.01</b>	<b>-0.67</b>
NASDAQ Bonus Reverse Capped	-6.60	-32.14	<b>-4.85</b>	-12.02

\* Without barrier hit

## 10 Barrier-Hit-Risk as an early indicator

- The Barrier-Hit-Risk (BHR) is a key figure that continuously quantifies the probability of a barrier breach that a certain Bonus Certificate encounters. It is not static, but a dynamic parameter that is constantly changing.
- The BHR is being calculated continuously by TTMzero from the first trading day of the certificate until the day it encounters a barrier hit or matures.
- The computation of the BHR of a single Bonus Certificates requires a Monte-Carlo-Simulation of 50,000 paths taking into account implied volatility, time to maturity and distance to the barrier (buffer).

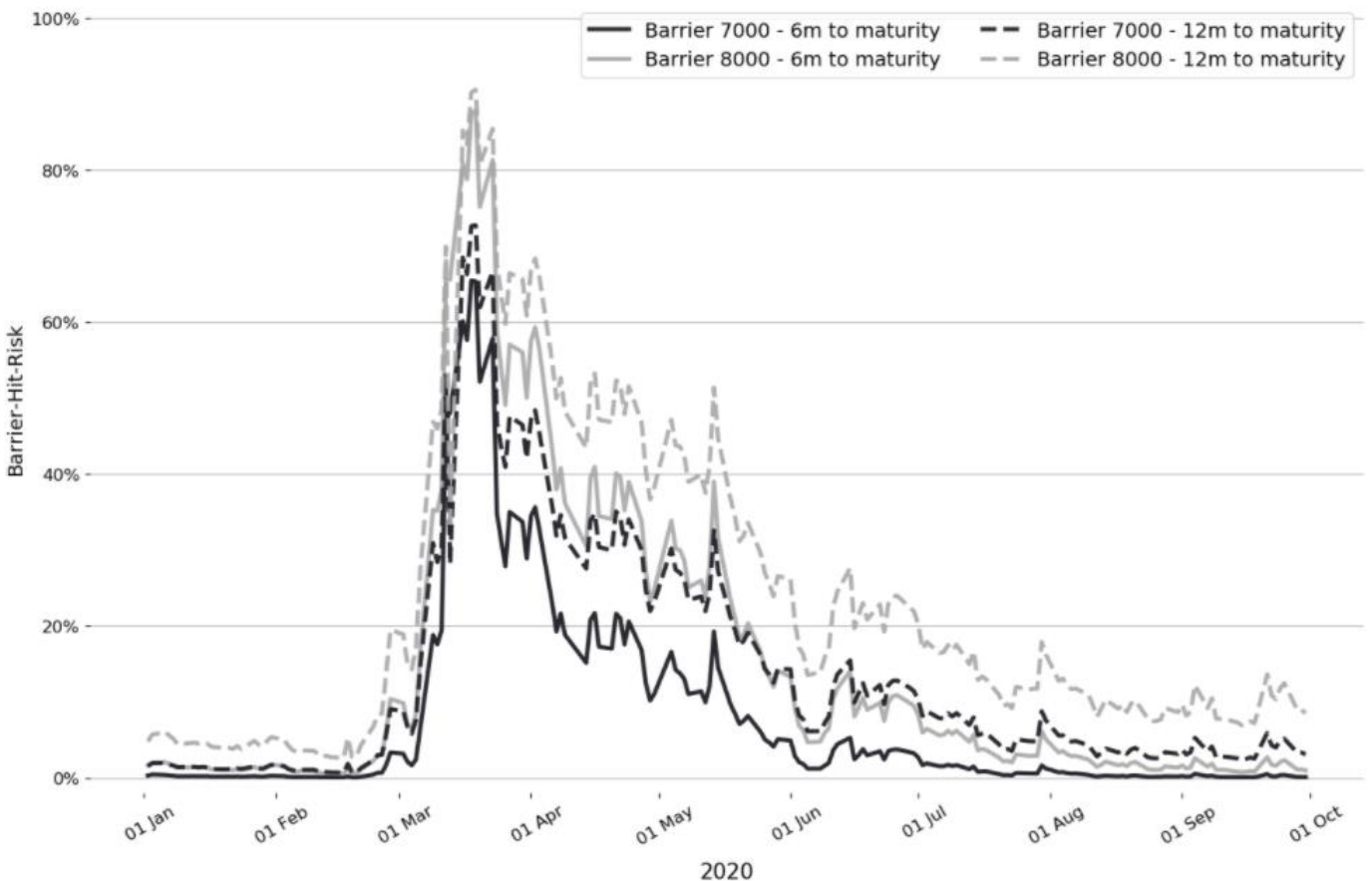
# 11 BHR and Time to Maturity – Bonus Classic Certificates

▪ Background:

The two following charts show the BHR development during the first 3 quarters for four fictional Bonus Classic Certificates of each index. The Time to Maturity is fixed to either 6 months or 12 months from the end of Q3.

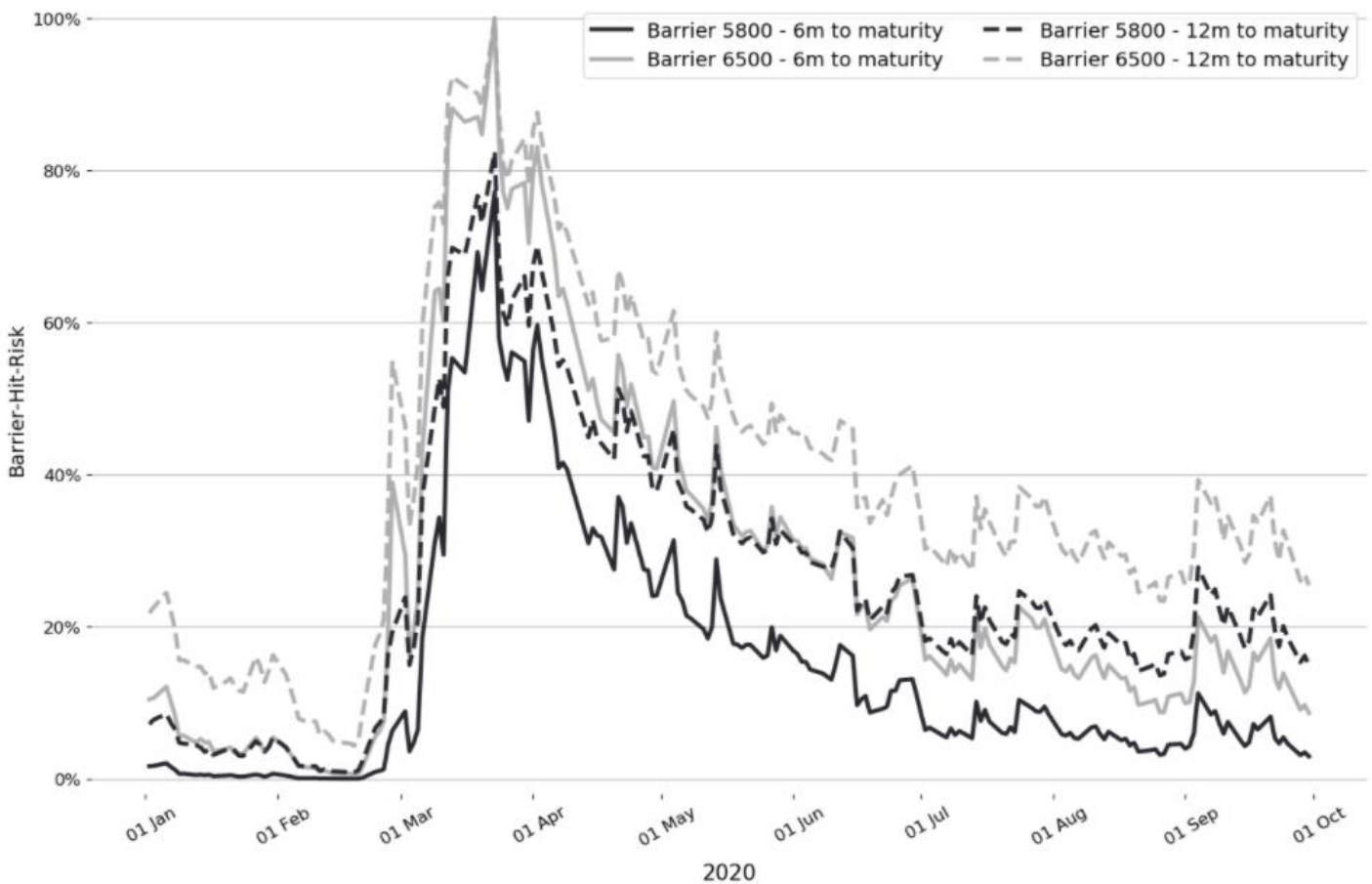
- For DAX Bonus Classic Certificates, the absolute barrier levels are 7,000 (in black) and 8,000 (in grey) respectively on every observation date during the 3 quarters. Note that products with barriers of 8,500 were breached during the plunge in March.

BHR Development for fictional DAX Bonus Classic Certificates with constant maturity (6 months vs 12 months) - first 3 Quarters



- Due to the fact that NASDAQ products with barrier level of 6,800 and above were breached during Q1, the upper barrier of 6,500 points are looked at for the BHR development of NASDAQ Bonus Classic Certificates.
- Therefore, the chart below displays the behaviour of four fictional Bonus Classic Certificates with absolute barrier levels of 5,800 (in black) and 6,500 (in grey) respectively on every observation date of the first 3 quarters.

BHR Development for fictional NASDAQ Bonus Classic Certificates with constant maturity (6 months vs 12 months) - first 3 Quarters



**KEY TAKEAWAYS**

- The higher the Time To Maturity, the higher the BHR.
- The smaller the difference between Spot Price and Barrier, the higher the BHR.
- The smaller the difference between Spot Price and Barrier, the heavier the reaction of the BHR to changing market conditions.

## 12 BHR and Distance to Barrier

- This table demonstrates the translation of Barrier-Hit-Risk into the buffer in DAX® points for DAX Bonus Classic Certificates with **1-year** remaining maturity.
- The Spot prices on 18/MAR when the DAX® was at YTD lowest (below 8,500), at the end of Q2 (DAX® close at 12,310) and at the end of Q3 (DAX® close at over 12,700) were taken for calculation.

BHR in %	Buffer in DAX® points as spotted on 18/MAR	Relative distance in %	Buffer in DAX® points at the end of Q2-2020	Relative distance in %	Buffer in DAX® points at the end of Q3-2020	Relative distance in %
10	3,358	39.65	3,399	27.73	3,236	25.19
20	2,756	32.54	2,711	22.12	2,569	20
30	2,291	27.06	2,208	18.01	2,087	16.24
40	1,903	22.47	1,805	14.73	1,701	13.24
50	1,541	18.20	1,439	11.74	1,352	10.52
60	1,204	14.21	1,108	9.04	1,038	8.08
70	868	10.25	785	6.40	733	5.71
80	524	6.18	462	3.77	431	3.35
90	157	1.85	125	1.02	114	0.89

- During Q1, investors needed to select DAX products with relative difference of 32.54% between spot and barrier to maintain a Barrier Hit Risk of 20%. A relative difference of 22.12% at the end of Q2, and 20% at the end of Q3 were sufficient to maintain the same level of BHR.

- The following table demonstrates the translation of Barrier-Hit-Risk into the buffer in NASDAQ 100® points for NASDAQ Bonus Classic Certificates with **1 year** remaining maturity.
- The Spot prices on 20/MAR when the NASDAQ® was at YTD lowest (below 6,800), at the end of Q2 (close at above 10,000) and at the end of Q3 (close at above 11,400) were taken for calculation.
- To maintain a BHR level of 20%, investors had to select NASDAQ products with relative distance of 27.75% between spot and barrier. However, a relative difference of 22.81% at the end of Q2, and 24.96% at the end of Q3 were sufficient to maintain the same level of BHR.

BHR in %	Buffer in NASDAQ 100® points as spotted on 20/MAR	Relative distance in %	Buffer in NASDAQ 100® points at the end of Q2-2020	Relative distance in %	Buffer in NASDAQ 100® points at the end of Q3-2020	Relative distance in %
10	2,578	34.73	2,875	28.62	3,561	31.16
20	2,060	27.75	2,292	22.81	2,852	24.96
30	1,682	22.66	1,865	18.57	2,330	20.38
40	1,377	18.55	1,523	15.16	1,908	16.70
50	1,099	14.81	1,211	12.06	1,523	13.32
60	847	11.42	931	9.27	1,173	10.26
70	603	8.12	658	6.55	832	7.28
80	356	4.80	386	3.84	490	4.28
90	100	1.34	100	1.00	131	1.15

### KEY TAKEAWAYS

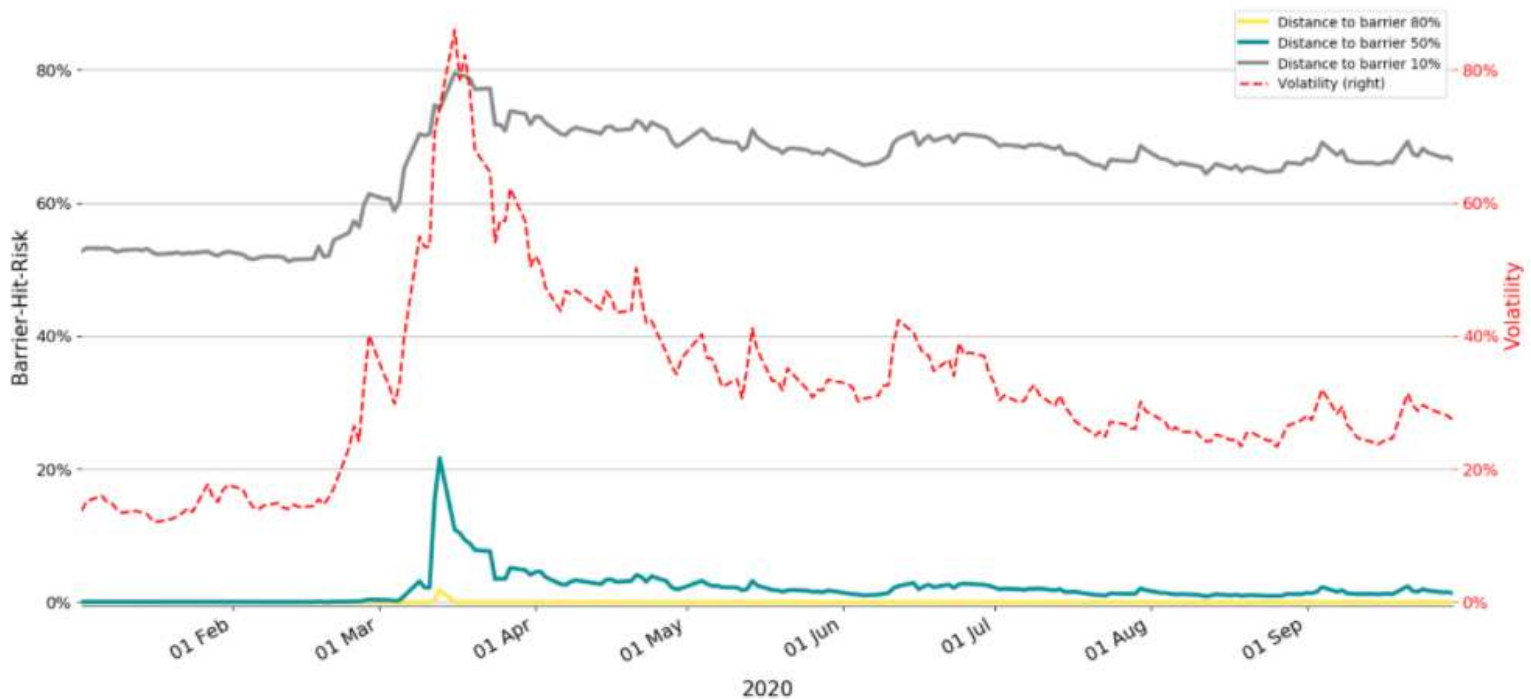
- The changes in the volatility regime have dramatic effects on the relative distance between Spot and Barrier that investors would have to choose to maintain a stable BHR.
- Relative distance between Spot and Barrier of a product is positively correlated with the volatility level of the index.



## 13 BHR and Implied Volatility

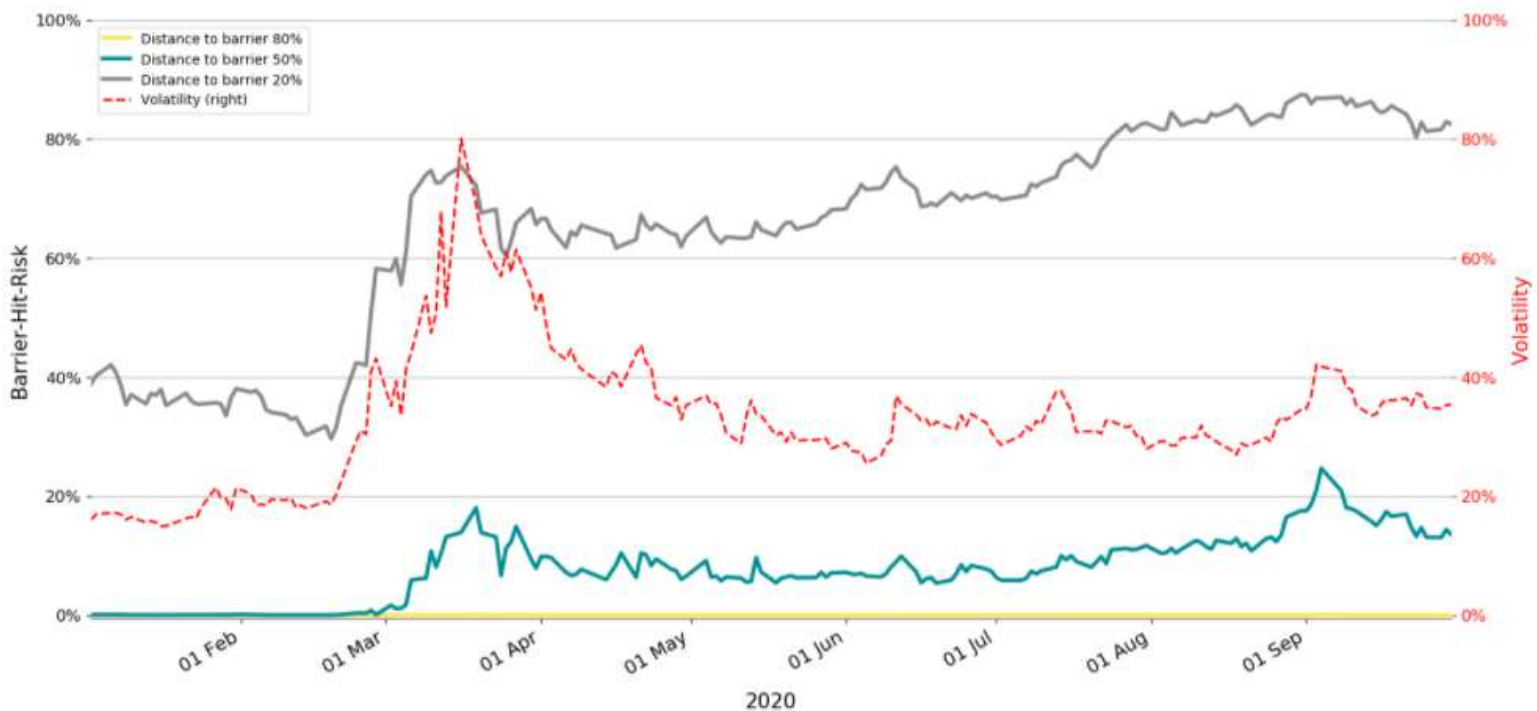
- All products considered for the demonstrated distance to barrier levels during the observed time between Jan2020-Sep2020 have a fixed maturity of **1 year**, which correspond to Jan2021-Sep2021.
- The chart below describes the impact of DAX options' implied volatility on DAX Bonus Classic Certificates for different levels of distance to barrier (as a percentage of spot levels: 10%, 50%, 80%).

Volatility impact on BHR Development for DAX Bonus Certificates first 3 Quarters (1-year maturity level)



- For NASDAQ Bonus Classic Certificates, the following levels of distance to barrier (as a percentage of spot levels: 20%, 50%, 80%) were chosen to be displayed in this chart below to describe the impact of NASDAQ options' implied volatility.

Volatility impact on BHR Development for NASDAQ Bonus Certificates  
first 3 Quarters (1-year maturity level)



### KEY TAKEAWAYS

- For products with relative differences of 80% or more between spot and barrier, the BHR remained below 5% during the whole 3 Quarters of 2020 despite the high range of volatilities that were observed.
- The smaller the differences between spot and barrier, the heavier the reactions of the BHR with respect to the changes in volatility.