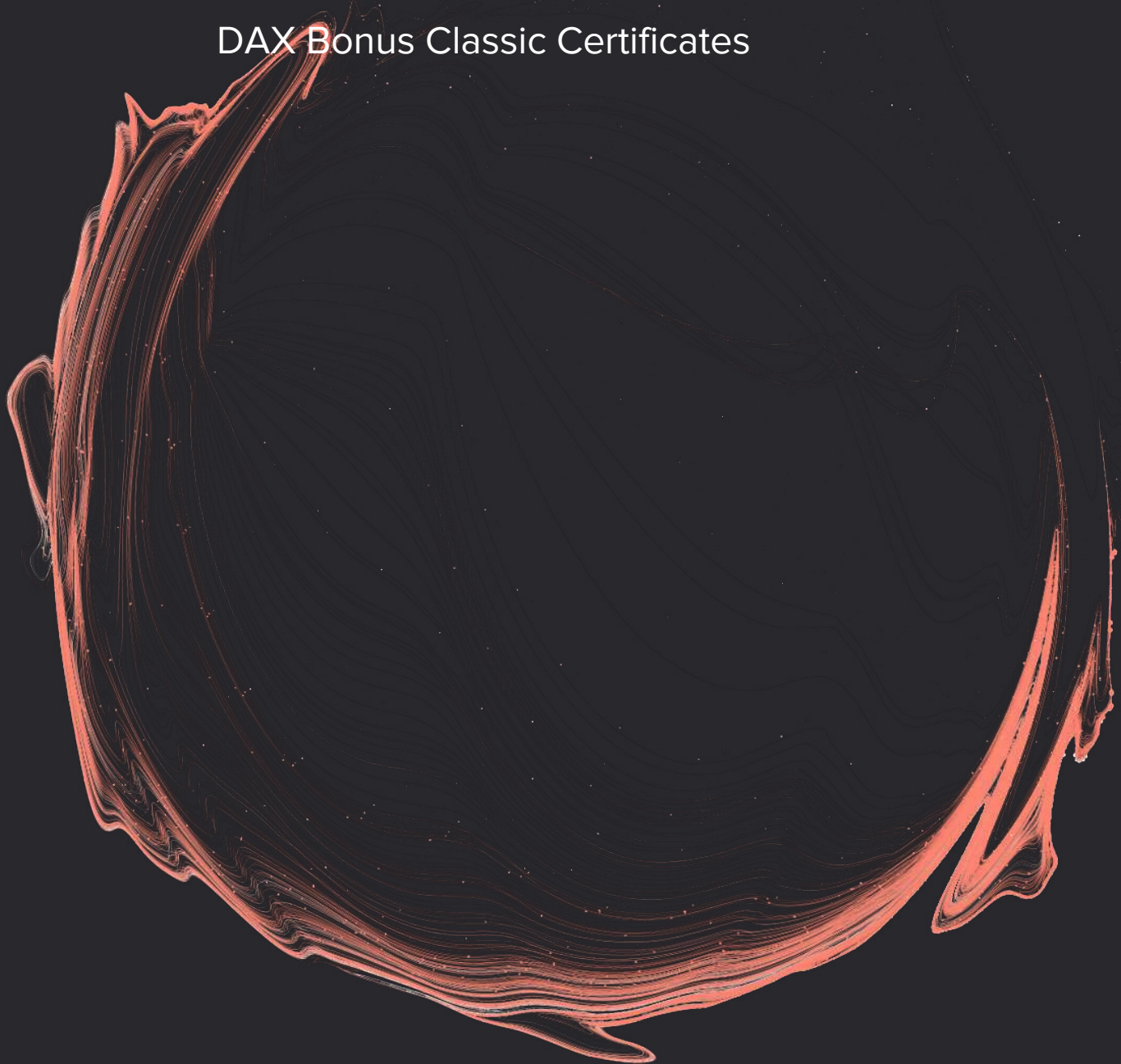# Barrier-Hit-Risk Analysis

Q1-2020

DAX Bonus Classic Certificates

01 Key Takeaways

For Bonus Certificates, a barrier hit event has a significant effect on investment performance. In order to aid investors in better quantifying the probability of a barrier breach, TTMzero computes the Barrier-Hit-Risk (BHR) key figures, taking into account the most important factors which are distance to the barrier (buffer) and implied volatility.

TTMzero analyzed the barrier hit events for over 20,000 DAX Bonus Classic Certificates listed at Börse Stuttgart in the full year of 2019 and first quarter of 2020 (Q1-2020).

- For the whole full year of 2019, only 3.53% of considered Bonus Certificates had a barrier hit event. However, this rate for Q1-2020 alone is 60.37%.

- The three days in Q1-2020 with the most barrier breaches in DAX bonus certificates were 9/MAR, 12/MAR and 16/MAR.

- The average BHR for the affected products was over 80% on the trading day before the actual barrier breach occurred.

- The BHR key figure is made available to professional market participants in real-time via an API that is maintained by Börse Stuttgart in cooperation with TTMzero.

- Private 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 (ie. https://de.citifirst.com/) and financial information portals (https://www.wallstreet-online.de/).

02 Overview figures for DAX Bonus Classic Certificates

- In 2019, more than 12,000 products were available to investors. Only 3.53% of those had a barrier hit event, which means that almost 96.5% of the products remained with intact barrier and either received the bonus payment in 2019 or kept the chance of bonus payment beyond 31/DEC/2019.

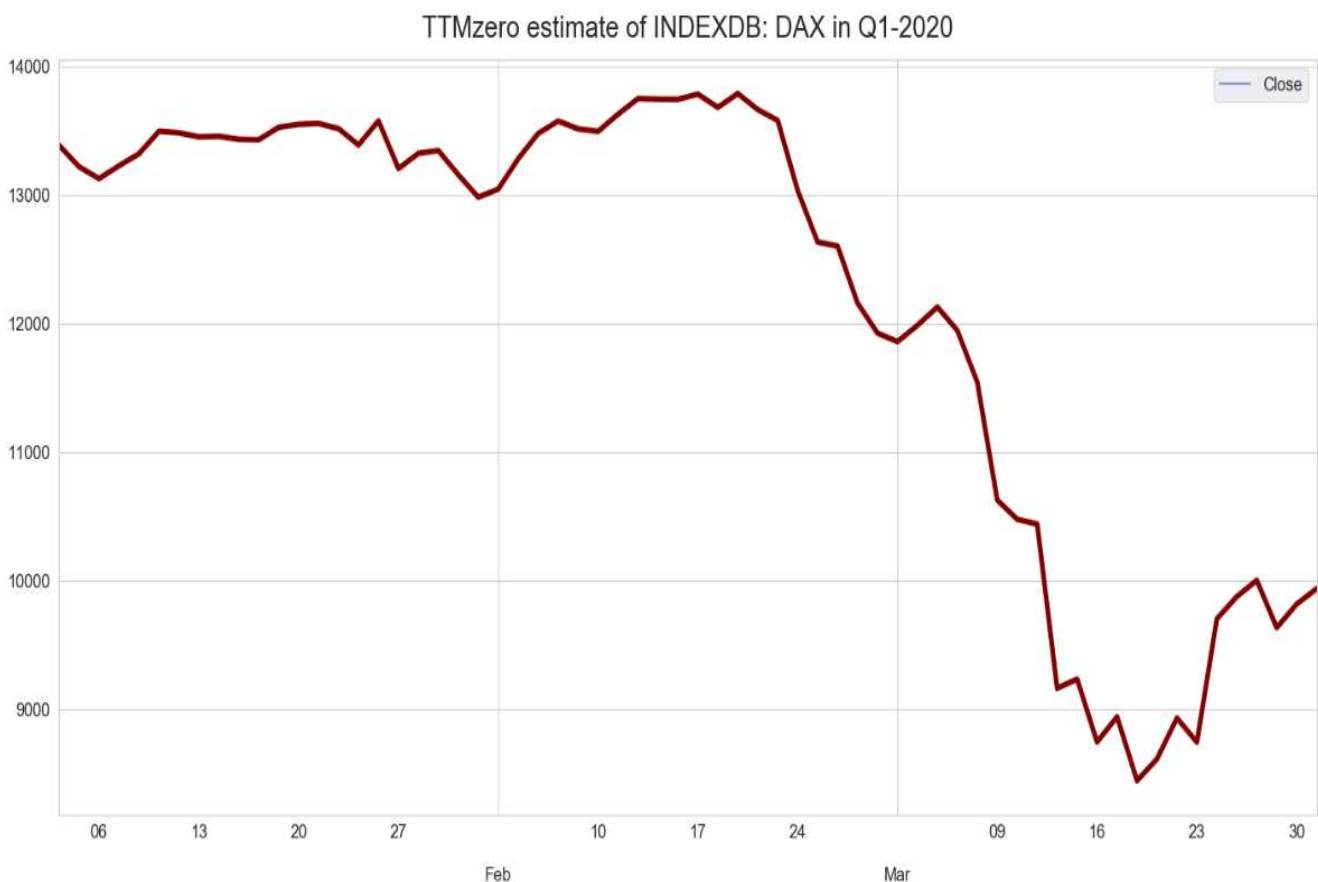|	DAX Bonus Classic Certificates
Barrier hit events in 2019	440
Issued products in 2019	8,025
Products matured in 2019*	5,558
Number of products in the beginning of 2019*	4,443
Number of products by the end of 2019*	5,958
Number of products with at least 1 day of intact barrier in 2019	12,457
BHR Ratio in % for 2019	3.53

*** Without barrier hit**

- Meanwhile, there were over 8,000 available Bonus Classic Certificates products in Q1-2020. In contrast to the previous barrier hit rate for 2019, 60.37% of considered products encountered a barrier hit event within the first 3 months of 2020. Therefore, less than 40% DAX bonus classic certificates remained with intact barrier in Q1-2020.

|	DAX Bonus Classic Certificates
Barrier hit events in Q1 2020	4,846
Issued products in Q1-2020	2,135
Products matured in Q1-2020*	1,905
Number of products in the beginning of Q1-2020*	5,957
Number of products by the end of Q1-2020*	1,235
Number of products with at least 1 day of intact barrier in Q1-2020	8,027
BHR Ratio in % for Q1-2020	60.37

Without barrier hit

03 Most barrier hits for DAX Bonus Classic Certificates in Q1-2020

- As stock markets all over the world began crashing from late February, with more deep plunges into March, the DAX performance was completely in line and at its lowest on 18/MAR , as portrayed in the chart below:

TTMzero estimate of INDEXDB: DAX in Q1-2020

- As a result, the 3 days in Q1-2020 on which most barrier hits were observed for the analyzed DAX Bonus Classic Certificates were the following ones:

➢ 9/MAR: 1063 barrier hits

➢ 12/MAR: 1450 barrier hits

➢ 16/MAR: 589 barrier hits
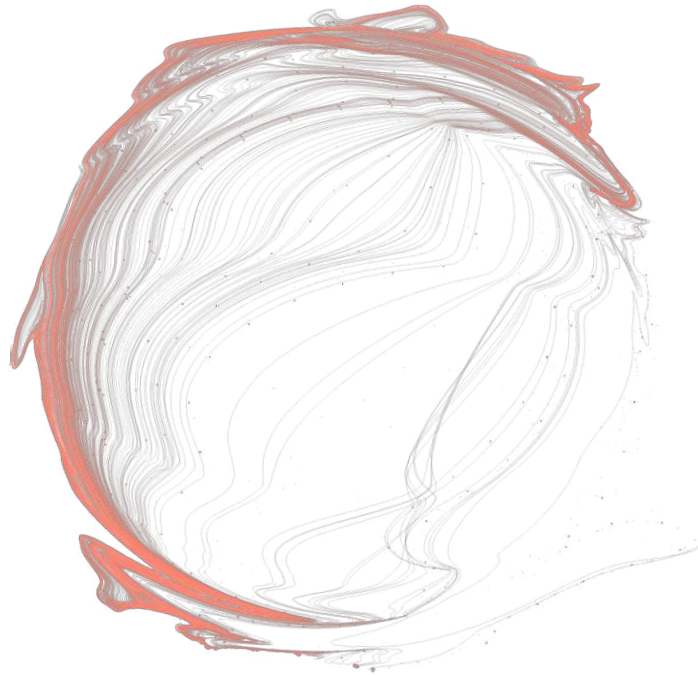
04 Development of BHR figures

▪ It is noteworthy that the average BHR for the affected certificates was
as low as 10.24% on 02/JAN.

knock_out_date	No. of products with barrier hits	No. of affected products with BHR on 02. Jan	Average BHR on 02. Jan in %
12-Mar-2020	1,450	1,283	7.55
9-Mar-2020	1,063	864	17.99
16-Mar-2020	589	516	2.86

▪ On the third day prior to the day of barrier hits, the BHR key figure calculated by TTMzero had already predicted an average of 62% chance of barrier hit for the affected products. This rate for the second day prior to the day of barrier hits surged close to 73%. Eventually, the average BHR for those products climbed to over 81% on the trading day before the actual barrier breach occurred.

knock_out_date	No. of products with barrier hits	3rd day* prior	No. of products with BHR 3rd day* prior to barrier hit	Average BHR 3rd day* prior to KO in %
12-Mar-2020	1,450	9-Mar-2020	1,403	71.61
9-Mar-2020	1,063	4-Mar-2020	1,063	56.28
16-Mar-2020	589	11-Mar-2020	570	48.62

knock_out_date	No. of products with barrier hits	2nd day* prior	No. of products with BHR 2nd day* prior to barrier hit	Average BHR 2nd day* prior to KO in %
12-Mar-2020	1,450	10-Mar-2020	1,431	75.13
9-Mar-2020	1,063	5-Mar-2020	1,063	64
16-Mar-2020	589	12-Mar-2020	589	82.43

knock_out_date	No. of products with barrier hits	Previous day*	No. of products with BHR on previous day*	Average BHR on previous day* in %
12-Mar-2020	1,450	11-Mar-2020	1,450	80.46
9-Mar-2020	1,063	6-Mar-2020	1,063	80.57
16-Mar-2020	589	13-Mar-2020	589	85.04

Trading day

- TTMzero calculated the percentage of DAX Bonus Classic Certificates with BHR figures of over 50%, over 75% and over 90% respectively on the previous trading day of barrier hits.

- The results: In terms of the total number of available DAX Bonus Classic Certificates on a particular day, the number of products with the above mentioned BHR figures of 50% / 75% / 90% were a little lower on 6/MAR (the previous trading day of 9/MAR) in comparison to 11/MAR (the previous trading day of 12/MAR) and 13/MAR (the previous trading day of 16/MAR).

knock_out_date	No. of products with barrier hits	Total number of Bonus Classic Certificates on previous day*	Percentage of products with BHR on previous day over 50%*	Percentage of products with BHR on previous day over 75%*	Percentage of products with BHR on previous day over 90%*
12-Mar-2020	1,450	2,829	49.77	37.68	13.5
9-Mar-2020	1,063	4,136	25.19	19.1	4.84
16-Mar-2020	589	1,252	45.85	41.45	19.89

Trading day

- The previous findings can be explained without a doubt. TTMzero implied volatility increased even before 9/MAR. Therefore, TTMzero BHR key figures were indicating rising probabilities of barrier hits before the market started to drop significantly in March.

- Furthermore, with continuous deep market freefalls starting in early March, the steep escalation in market volatility could be observed progressively. In consequence, the BHR key figures generally soared as it went forward during March. *(See Appendix 1 for further details).*

- For example: the volatility movement of DAX in Q1-2020.

05 Appendix 1

The average BHR was 80.57% on 6/MAR for all products with a barrier hit on 9/MAR.

The following charts show the development of the BHR key figure for three DAX Bonus Classic Certificates with a BHR close to the average from 2/JAN until 6/MAR.

- Product ISIN: DE000GB1SSM7. Issuer: Goldman Sachs & Co. Wertpapier GmbH.

Barrier-Hit-Risk for DE000GB1SSM7
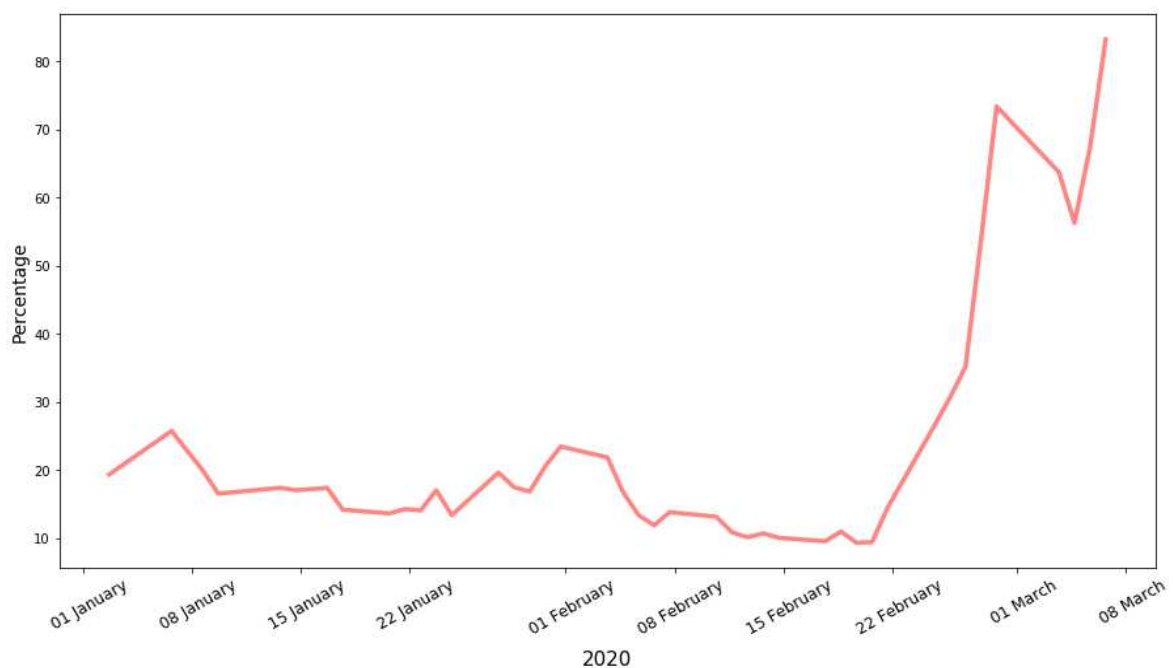from 02Jan to 06Mar (before barrier hit on 09Mar)
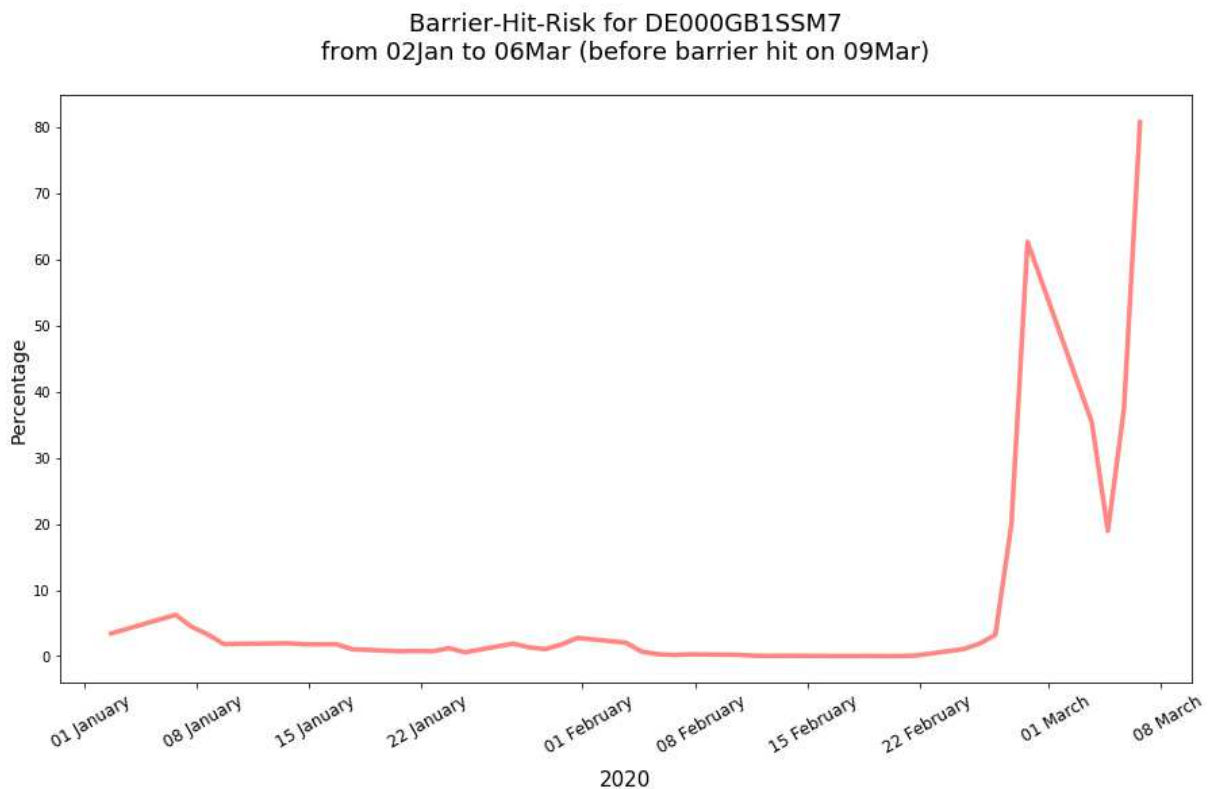
- Product ISIN: DE000PX6KU92. Issuer: BNP Paribas Emissions- und Handelsgesellschaft.

Barrier-Hit-Risk for DE000PX6KU92
from 02Jan to 06Mar (before barrier breach on 09Mar)
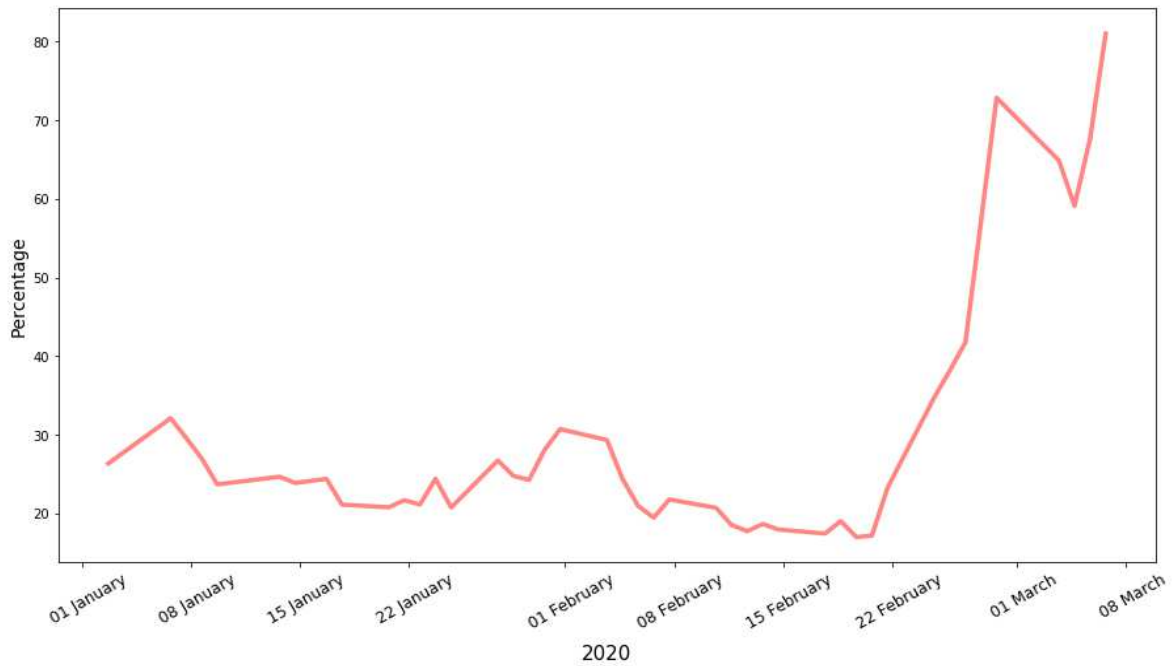
- Product ISIN: DE000CU3T0R8. Issuer: Commerzbank AG.

Barrier-Hit-Probability for DE000CU3T0R8
from 02Jan to 06Mar (before barrier breach on 09Mar)

06 Appendix 2

Overview figures for DAX Bonus Certificates across 4 main categories

▪ Full year 2019

	Barrier hit events	Issued products in 2019	Products matured in 2019*	Number of products in the beginning of 2019*	Number of products by the end of 2019*	Number of products with at least 1 day of intact barrier in 2019	Ratio of BHR in 2019 in %
Bonus Certificates	**10,667**	**54,129**	**45,226**	**37,847**	**36,045**	**91,856**	**11.61**
Bonus Classic	440	8,025	5,558	4,443	5,958	12,457	3.53
Bonus Cap	1,341	27,168	17,836	12,517	19,082	39,652	3.38
Bonus Reverse	909	2,537	3,082	3,115	1,833	5,640	16.12
Bonus Reverse Cap	7,977	16,399	18,750	17,772	9,172	34,107	23.39

▪ Q1-2020

	Barrier hit events	Issued products in Q1-2020	Products matured in Q1-2020*	Number of products in the beginning of Q1-2020*	Number of products by the end of Q1-2020*	Number of products with at least 1 day of intact barrier in Q1-2020	Ratio of BHR in Q1-2020 in %
Bonus Certificates	**25,863**	**24,679**	**10,506**	**36,048**	**23,549**	**60,255**	**42.92**
Bonus Classic	4,846	2,135	1,905	5,957	1,235	8,027	60.37
Bonus Cap	19,688	13,694	5,942	19,083	6,319	32,608	60.38
Bonus Reverse	223	1,259	382	1,833	2,610	3,092	7.21
Bonus Reverse Cap	1,106	7,591	2,277	9,175	13,385	16,528	6.69

*** Without barrier hit**