Deutsche Bank Annual Report 2018

in € billions	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Assets:	1,925	2,202	1,501	1,906	2,164	2,012	1,611	1,709	1,629	1,591	1,475	1,348
Equity:	37.9	30.7	36.6	48.8	53.4	54.0	54.7	68.4	62.7	60.0	63.2	62.5
Net Inc:	6.5	(3.9)	5.0	2.3	4.3	0.3	0.7	1.7	(6.8)	(1.4)	(0.7)	0.3

Economic Capital

"Economic capital measures the amount of capital we need to absorb very severe unexpected losses arising from our exposures. "Very severe" in this context means that economic capital is set at a level to cover with a probability of 99.98% the aggregated unexpected losses within one year. We calculate economic capital for the default risk, transfer risk and settlement risk elements of credit risk, for market risk, for operational risk and for business risk."

(We use economic capital to show an aggregated view of our risk position from individual business lines up to our consolidated Group level. We also use economic capital (as well as goodwill and other nonamortizing intangibles) in order to allocate our book capital among our businesses. This enables us to assess each business unit's risk-adjusted profitability, which is a key metric in managing our financial resources.)

Business risk: Risk arising from changes in general business conditions, such as market environment, client behavior and technological progress. These factors can affect our earnings if we are unable to adjust quickly to changes in them.

Overall Risk Position (p.48)

The table below shows the overall risk position of the Group at year-end as measured by the economic capital calculated for credit, market, business and operational risk; it does not include liquidity risk.

in € m. (unless stated otherwise)	Dec 31, 2018	Dec 31, 2017
Credit risk	10,610	10,769
Market risk	10,341	10,428
Trading market risk	4,046	3,800
Nontrading market risk	6,295	6,628
Operational risk	7,359	7,329
Business risk	4,758	5,677
Diversification benefit[1]	(6,960)	(7,074)
Total economic capital usage	26,108	27,129

Regulatory Risk Capital (p.194)

in € m.	Dec 31, 2018 CRR/CRD 4 fully loaded	Dec 31, 2018 CRR/CRD 4[1]	Dec 31, 2017 CRR/CRD 4 fully loaded	Dec 31, 2017 CRR/CRD 4
Common Equity Tier 1 (CET 1) capital: instruments and reserves				
Capital instruments, related share premium accounts and other reserves[2]	45,515	45,515	45,195	45,195
Retained earnings	16,297	16,297	17,977	17,977
Accumulated other comprehensive income (loss), net of tax	382	382	696	660
Independently reviewed interim profits net of any foreseeable charge or dividend[3]	0	0	(751)	(751)
Other[2]	846	846	0	33
Common Equity Tier 1 (CET 1) capital before regulatory adjustments	63,041	63,041	63,116	63,114
. . .				
Tier 1 capital (T1 = CET 1 + AT1)	52,082	55,091	52,921	57,631
Tier 2 (T2) capital	9,211	6,202	10,329	6,384
Total capital (TC = T1 + T2)	61,292	61,292	63,250	64,016
Total risk-weighted assets	350,432	350,432	344,212	343,316
Capital ratios				
Common Equity Tier 1 capital ratio (as a percentage of risk-weighted assets)	13.6	13.6	14.0	14.8
Tier 1 capital ratio (as a percentage of risk-weighted assets)	14.9	15.7	15.4	16.8
Total capital ratio (as a percentage of risk-weighted assets)	17.5	17.5	18.4	18.6

The Group's Tier 1 and total capital ratios were 14.9% and 17.5% on Dec. 31, 2018, significantly higher than the 8% minimum required.
(CRR= EU's Capital Regulatory Requirements, CRD= Capital Regulatory Directive)
(Note: "fully-loaded" means as if Basel 3 had entered into force on 1 January 2013)

Market Risk (p.136)

Value-at-Risk of our Trading Units by Risk Type

in € m.	Total		Diversification effect		Interest rate risk		Credit spread risk		Equity price risk		Foreign exchange risk[1]		Commodity price risk	
	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017
Average	27.5	29.8	(25.5)	(28.1)	17.6	20.2	16.4	19.7	10.0	8.7	8.3	8.4	0.6	0.8
Maximum	40.9	38.4	(35.0)	(37.6)	32.6	26.0	24.0	25.1	14.5	12.5	13.0	16.5	1.3	3.0
Minimum	19.8	20.1	(20.2)	(21.4)	12.4	13.5	13.0	13.5	6.9	4.4	3.8	4.2	0.2	0.1
Period-end	32.1	29.1	(26.9)	(22.5)	14.1	21.4	22.3	14.4	13.0	10.1	9.2	4.9	0.3	0.7

"The average value-at-risk over 2018 was € 27.5 million, which is a decrease of € 2.3 million compared with the full year 2017 driven by reductions in credit spread and interest rate risk."

Value-at-risk is a quantitative measure of the potential loss (in value) of trading positions due to market movements that will not be exceeded in a defined period of time and with a defined confidence level.

Our value-at-risk for the trading businesses is based on our own internal value-at-risk model. In October 1998, the German Banking Supervisory Authority (now the BaFin) approved our internal value-at-risk model for calculating the regulatory market risk capital for our general and specific market risks. Since then the model has been periodically refined and approval has been maintained.
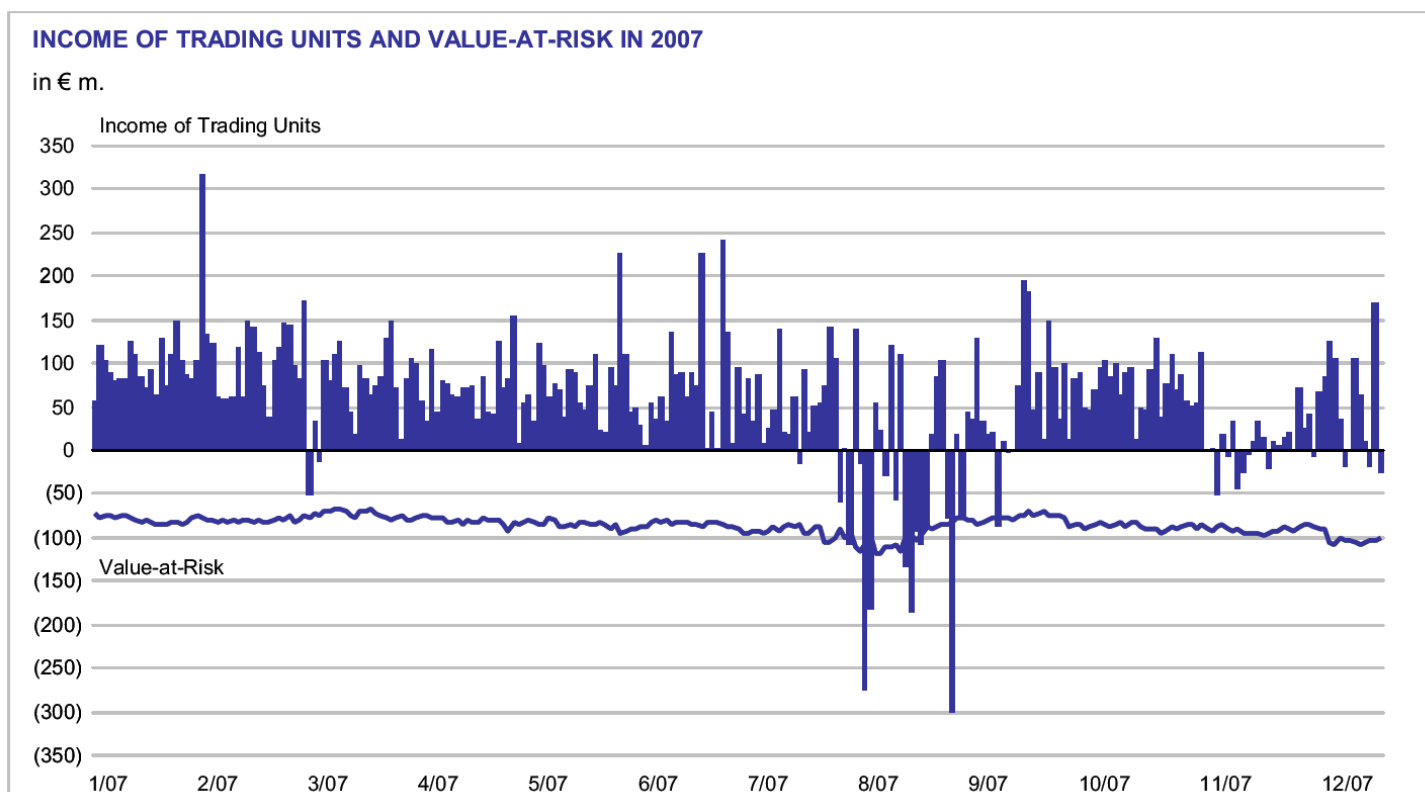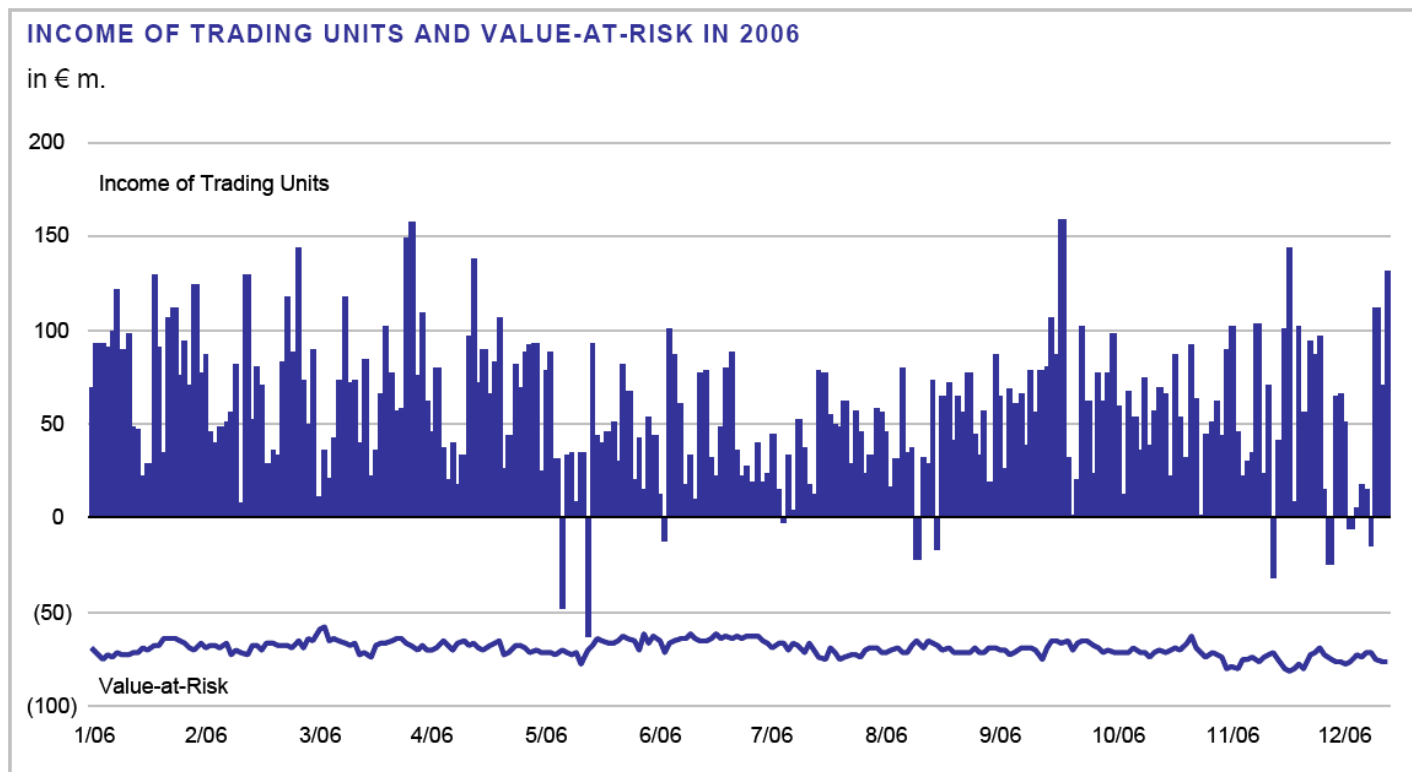
We calculate value-at-risk using a 99 % confidence level and a holding period of one day. This means we estimate there is a 1 in 100 chance that a mark-to-market loss from our trading positions will be at least as large as the reported value-at-risk. For regulatory reporting, the holding period is ten days.

We use historical market data to estimate value-at-risk, with an <u>equally-weighted 261 trading day history</u>. The calculation employs a <u>Monte Carlo simulation technique</u>, and we assume that changes in risk factors follow a certain distribution, e.g., normal or logarithmic normal distribution. To determine our aggregated value-at-risk, we use observed correlations between the risk factors during this 261 trading day period.

When using VaR estimates a number of considerations should be taken into account. These include:
– The use of historical market data may not be a good indicator of potential future events, particularly those that are extreme in nature. This "backward-looking" limitation can cause VaR to understate risk (as in 2008), but can also cause it to be overstated.
– Assumptions concerning the distribution of changes in risk factors, and the correlation between different risk factors, may not hold true, particularly during market events that are extreme in nature. The one day holding period does not fully capture the market risk arising during periods of illiquidity, when positions cannot be closed out or hedged within one day.
– VaR does not indicate the potential loss beyond the 99th quantile.
– Intra-day risk is not reflected in the end of day VaR calculation.
– There may be risks in the trading book that are partially or not captured by the VaR model.

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Results of Regulatory Backtesting of Trading Market Risk

INCOME OF TRADING UNITS AND VALUE-AT-RISK IN 2006

in € m.

INCOME OF TRADING UNITS AND VALUE-AT-RISK IN 2007

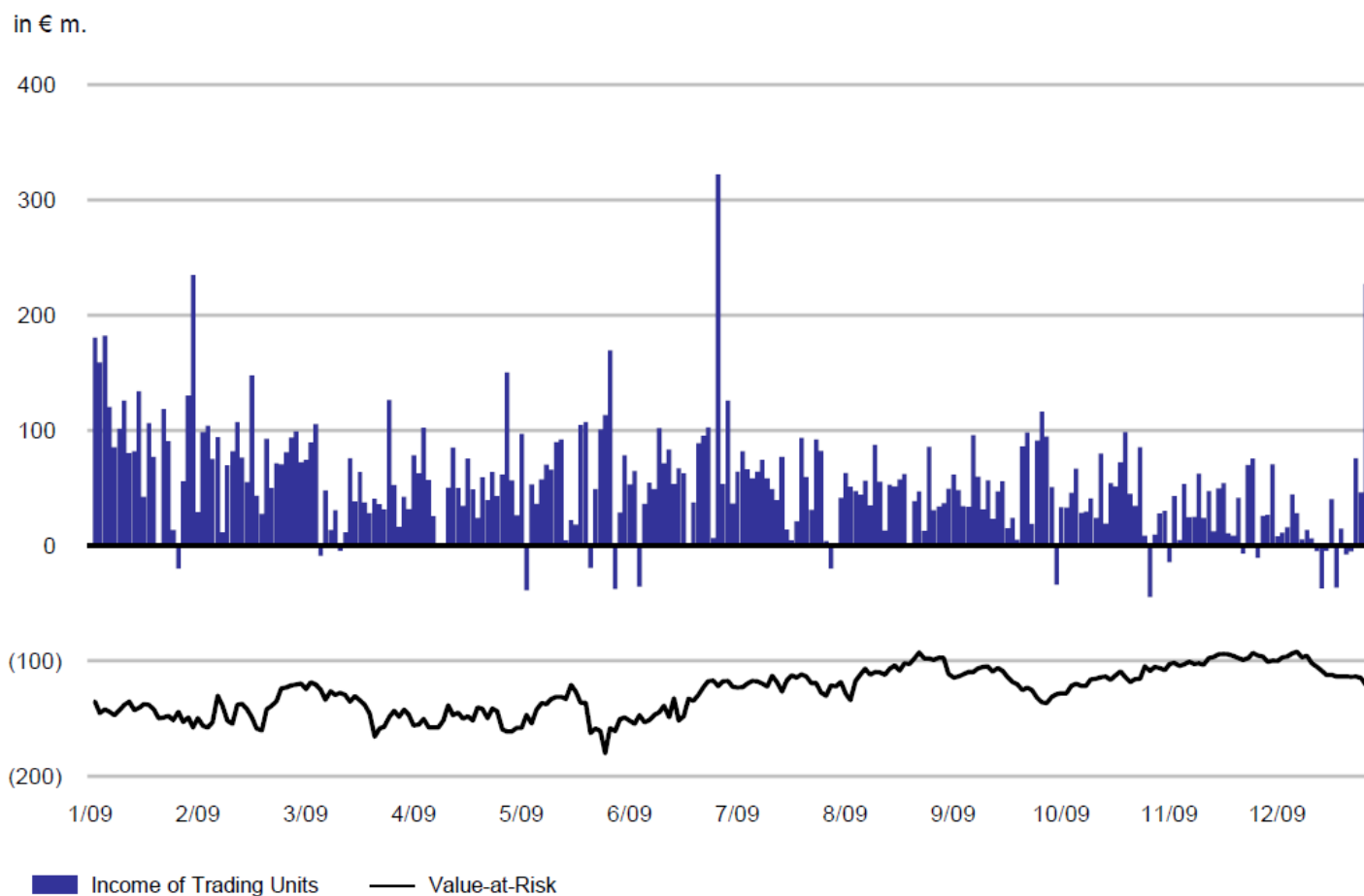in € m.

INCOME OF TRADING UNITS AND VALUE-AT-RISK IN 2008

in € m.
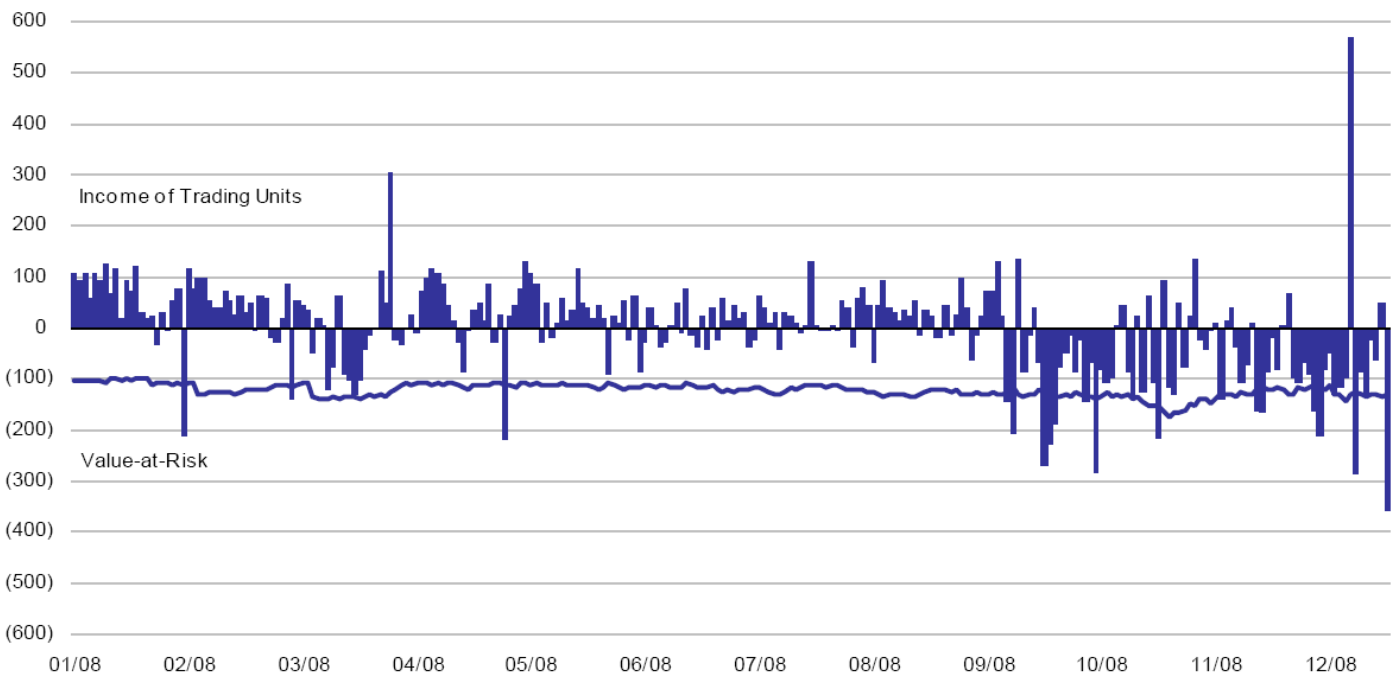
2008

Our trading units achieved a positive actual income for over 57 % of the trading days in 2008 (over 87 % in 2007).

In our regulatory back-testing in 2008, we observed 35 outliers (as compared to 12 in 2007), which are hypothetical buy-and-hold losses that exceeded our value-at-risk estimate for the trading units as a whole. While we believe that the majority of these outliers were related to extreme market events, we are also re-evaluating our modeling assumptions and parameters for potential improvements. We are also working on the improvement of the granularity of our risk measurement tools to better reflect some of the idiosyncratic nature of the exposures. We would expect a 99 percentile value-at-risk calculation to give rise to two to three outliers in any one year and, taking into account these extreme events, we continue to believe that our value-at-risk model will remain an appropriate measure for our trading market risk under normal market conditions.

2009

Our trading units achieved a positive actual income for over 91 % of the trading days in 2009 (over 57 % in 2008).

An outlier is a hypothetical buy-and-hold trading loss that exceeds our value-at-risk estimate. In our regulatory back-testing in 2009, we observed one outlier compared to 35 in 2008. We would expect a 99 percent confidence level to give rise to two to three outliers in any one year. This significant improvement in model performance reflects the developments carried out in 2008 and 2009 and the return of markets to more normal volatility and correlation patterns.
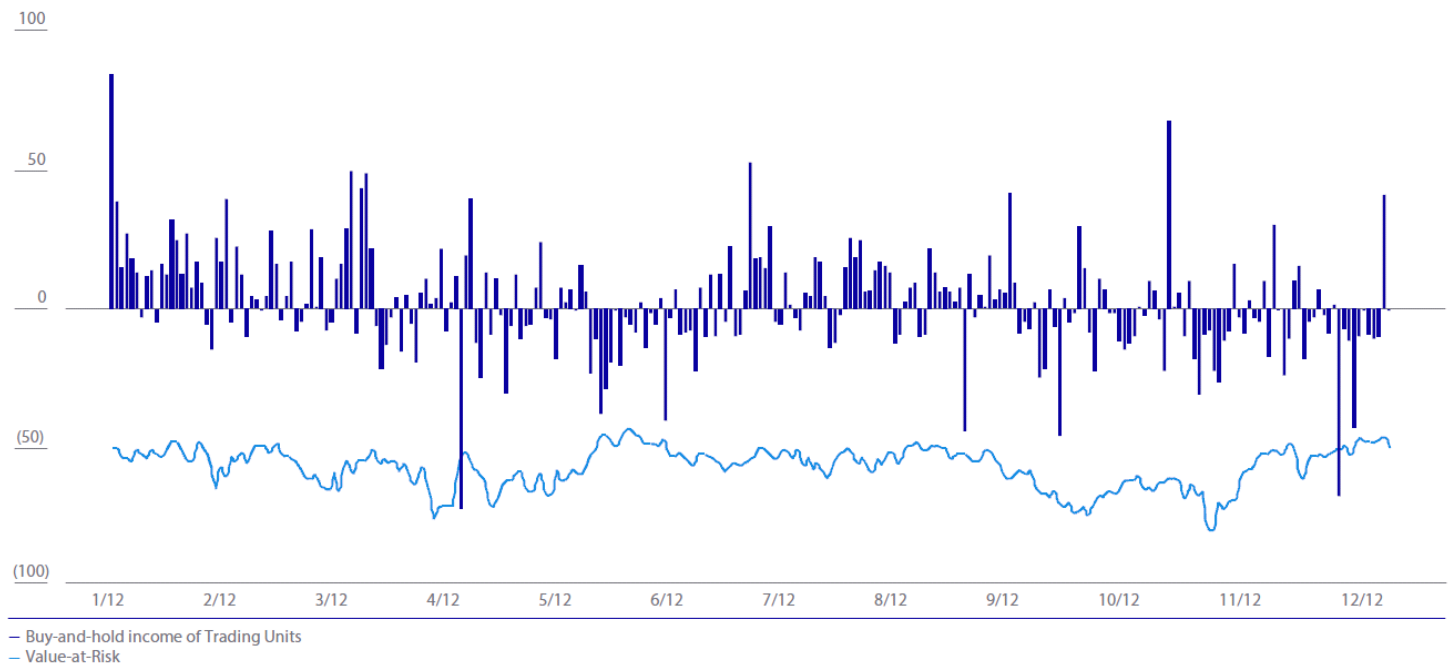
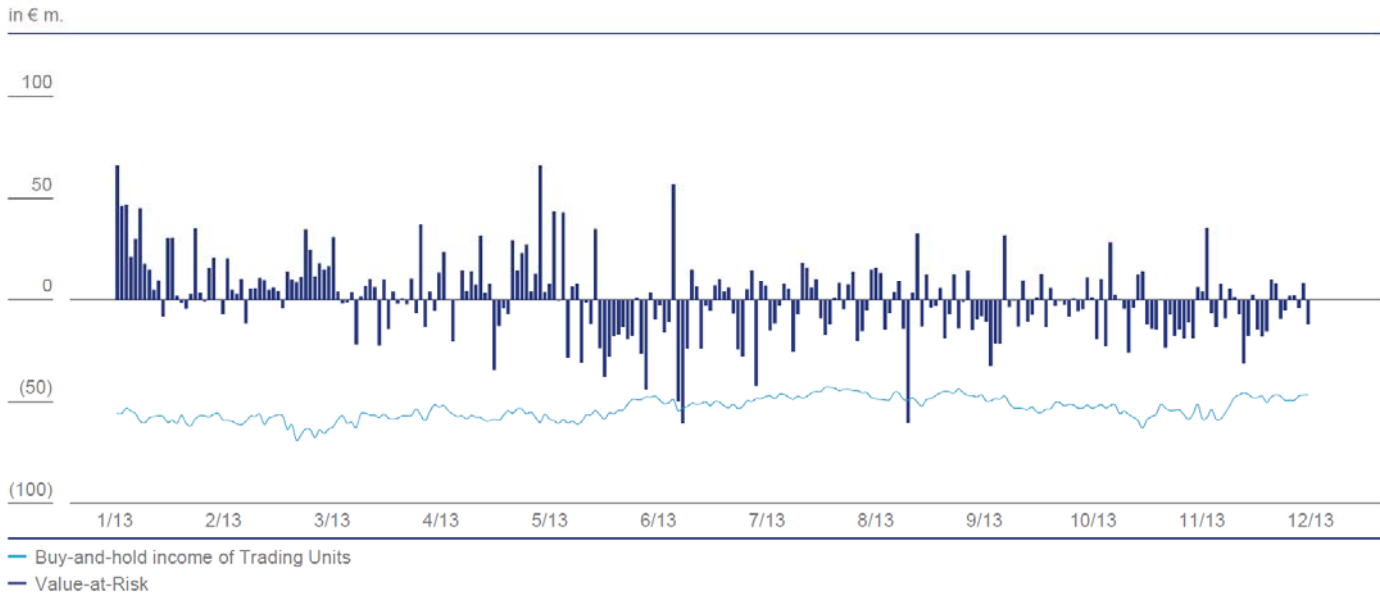## Buy-and-hold income of Trading Units and Value -at-Risk in 2011
in € m.

- Buy-and-hold income of Trading Units
- Value-at-Risk

Buy-and-hold income of Trading Units and Value-at-Risk in 2012
in € m.

— Buy-and-hold income of Trading Units
— Value-at-Risk

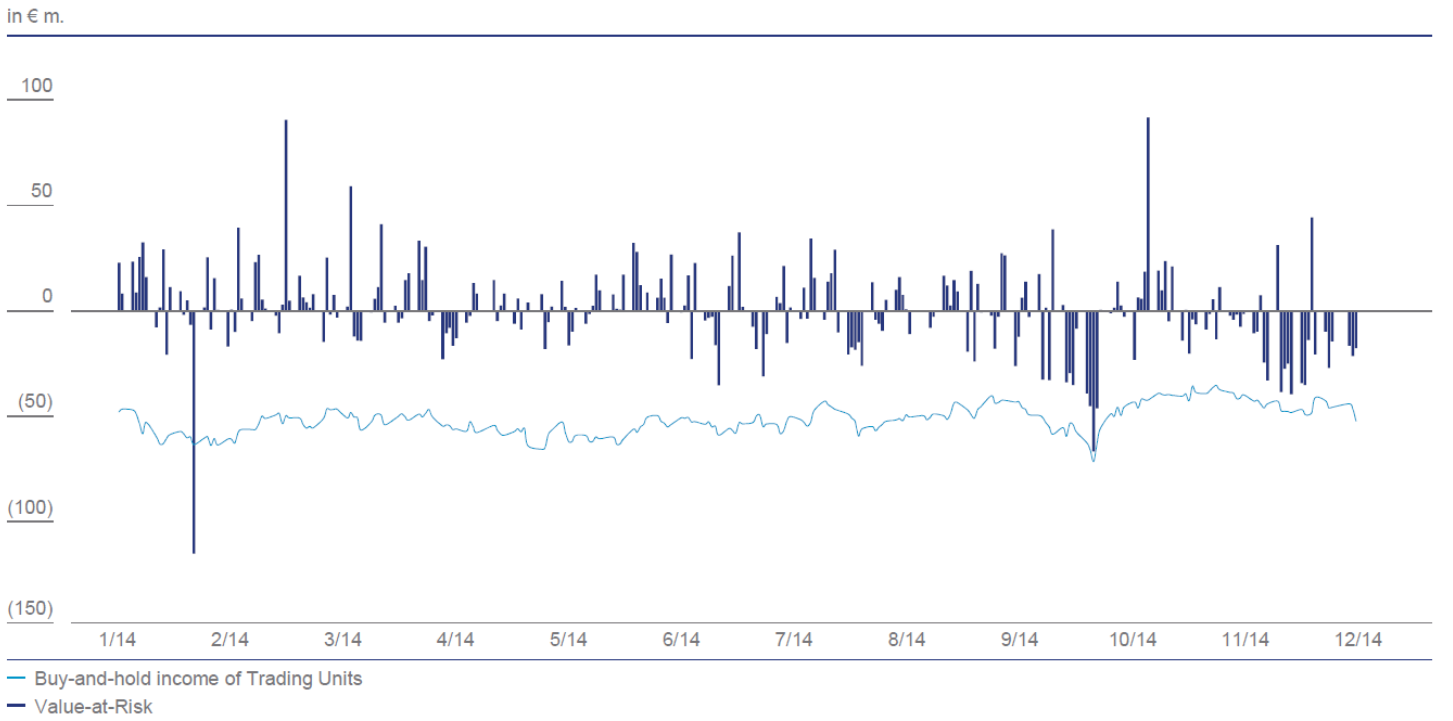D:\var\www\dbrisk-2018.doc
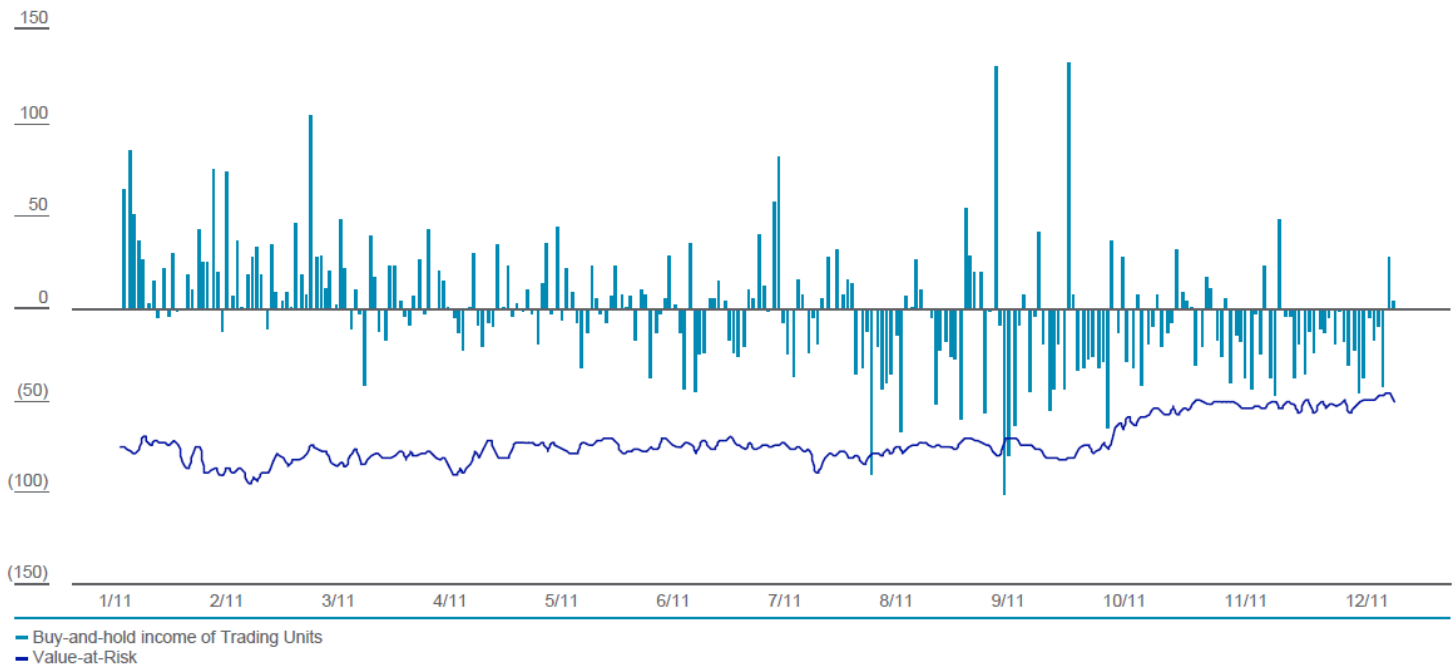
Comparison of daily buy-and-hold income of trading units trading results and value-at-risk in 2013
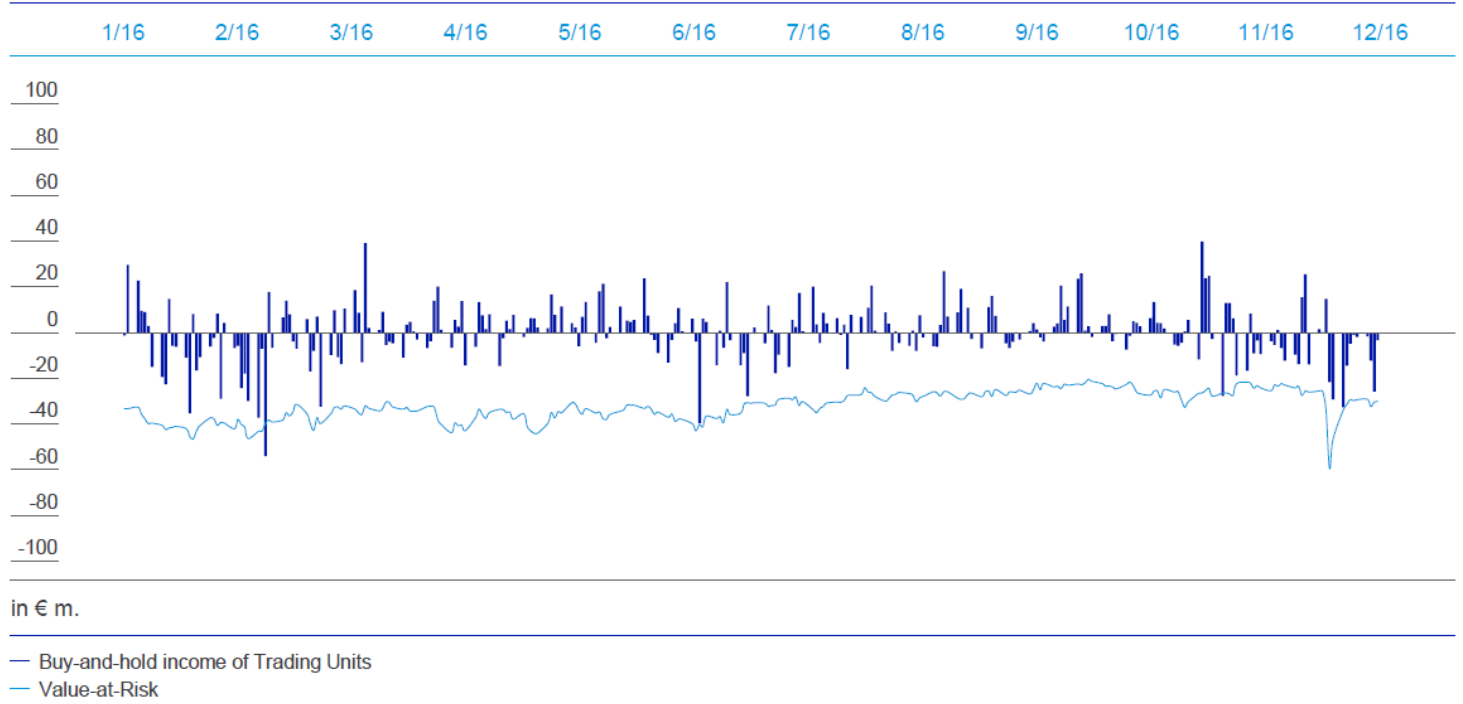
in € m.

— Buy-and-hold income of Trading Units
— Value-at-Risk

Comparison of trading units daily buy-and-hold income and value-at-risk in 2014

in € m.

— Buy-and-hold income of Trading Units
— Value-at-Risk

Comparison of trading units daily buy-and-hold income and value-at-risk in 2016

in € m.

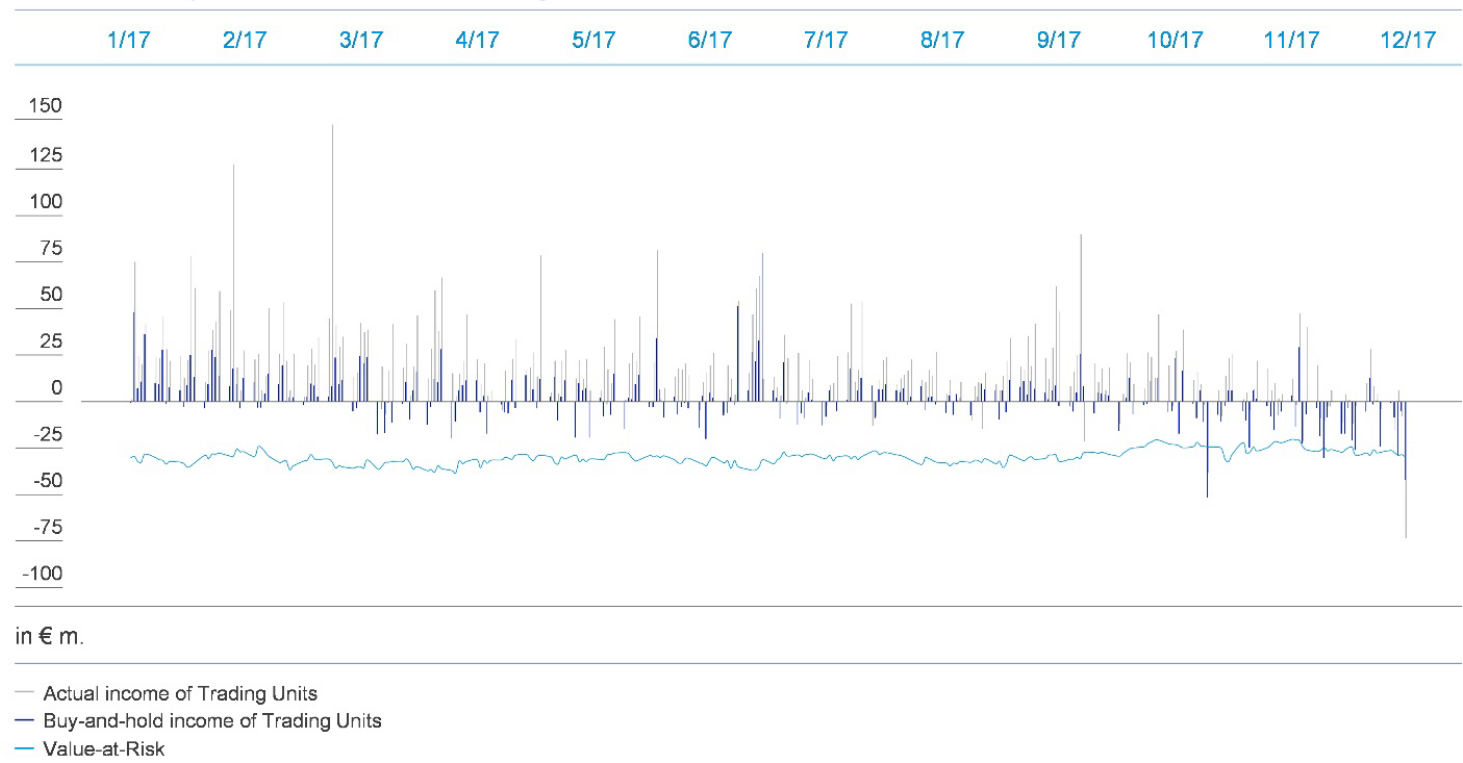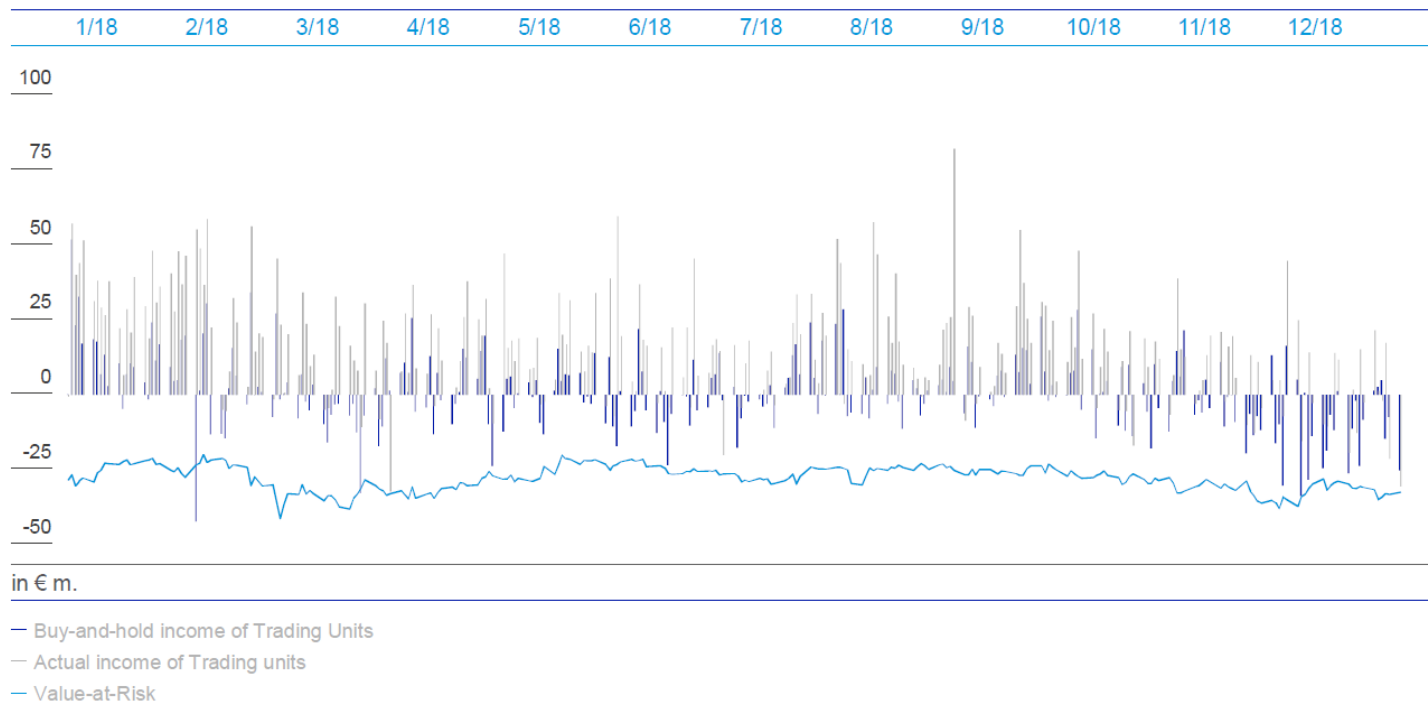— Buy-and-hold income of Trading Units
— Value-at-Risk

EU MR4 – Comparison of VAR estimates with gains/losses

in € m.

— Actual income of Trading Units
— Buy-and-hold income of Trading Units
— Value-at-Risk

EU MR4 – Comparison of VAR estimates with gains/losses

| 1/18 | 2/18 | 3/18 | 4/18 | 5/18 | 6/18 | 7/18 | 8/18 | 9/18 | 10/18 | 11/18 | 12/18 |

in € m.

— Buy-and-hold income of Trading Units
— Actual income of Trading units
— Value-at-Risk

2018 (p.138)

"In 2018 we observed one global outlier, where our loss on a buy-and-hold basis exceeded the value-at-risk… The outlier in 2018 occurred in February driven by losses coming from the Equities business line due to an increase in market volatility. There were no Actual Backtesting outliers, which compares the VaR to Total Income less Fees & Commissions, in 2018 compared to two in 2017."

Daily Income of our Trading Units

INCOME OF TRADING UNITS IN 2007
in € m.

INCOME OF TRADING UNITS IN 2008
in € m.
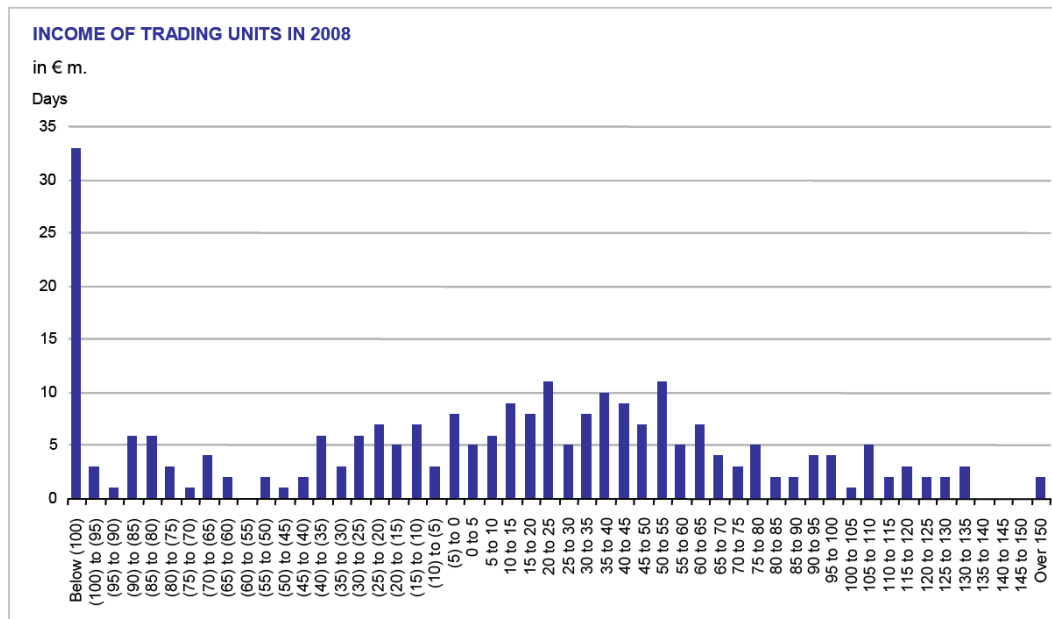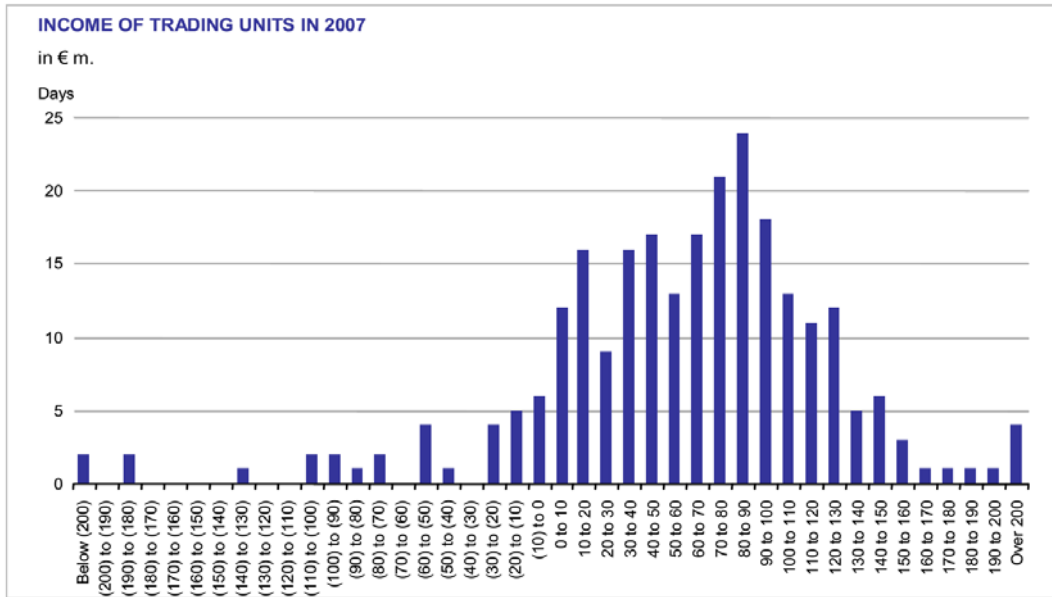
Income of Trading Units in 2009
in € m.

Income of Trading Units in 2010

Days

20

15

10

5

0

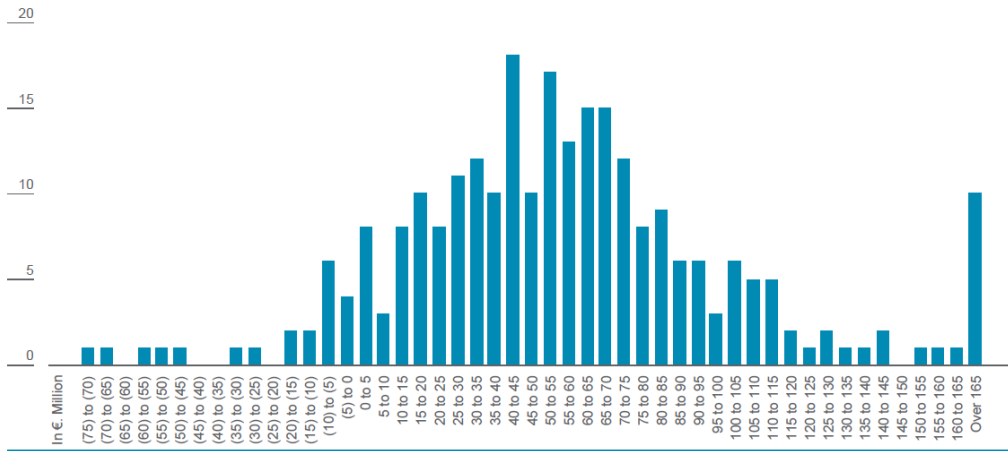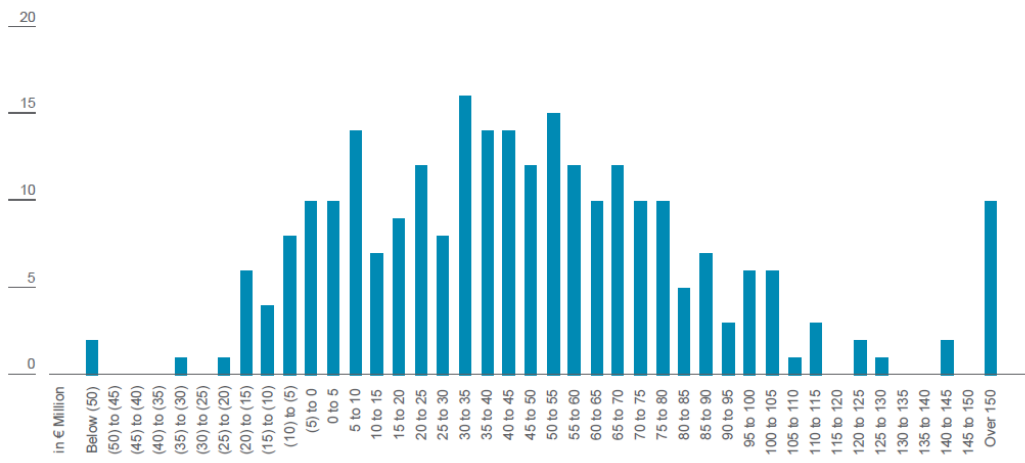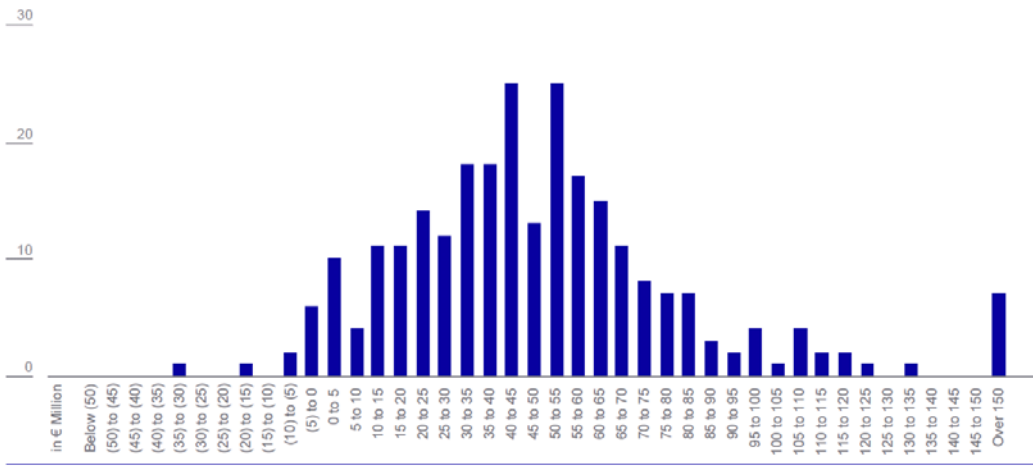In €. Million | (75) to (70) | (70) to (65) | (65) to (60) | (60) to (55) | (55) to (50) | (50) to (45) | (45) to (40) | (40) to (35) | (35) to (30) | (30) to (25) | (25) to (20) | (20) to (15) | (15) to (10) | (10) to (5) | (5) to 0 | 0 to 5 | 5 to 10 | 10 to 15 | 15 to 20 | 20 to 25 | 25 to 30 | 30 to 35 | 35 to 40 | 40 to 45 | 45 to 50 | 50 to 55 | 55 to 60 | 60 to 65 | 65 to 70 | 70 to 75 | 75 to 80 | 80 to 85 | 85 to 90 | 90 to 95 | 95 to 100 | 100 to 105 | 105 to 110 | 110 to 115 | 115 to 120 | 120 to 125 | 125 to 130 | 130 to 135 | 135 to 140 | 140 to 145 | 145 to 150 | 150 to 155 | 155 to 160 | 160 to 165 | Over 165

Income of Trading Units in 2011

Days

20

15

10

5

0

in € Million | Below (50) | (50) to (45) | (45) to (40) | (40) to (35) | (35) to (30) | (30) to (25) | (25) to (20) | (20) to (15) | (15) to (10) | (10) to (5) | (5) to 0 | 0 to 5 | 5 to 10 | 10 to 15 | 15 to 20 | 20 to 25 | 25 to 30 | 30 to 35 | 35 to 40 | 40 to 45 | 45 to 50 | 50 to 55 | 55 to 60 | 60 to 65 | 65 to 70 | 70 to 75 | 75 to 80 | 80 to 85 | 85 to 90 | 90 to 95 | 95 to 100 | 100 to 105 | 105 to 110 | 110 to 115 | 115 to 120 | 120 to 125 | 125 to 130 | 130 to 135 | 135 to 140 | 140 to 145 | 145 to 150 | Over 150

Income of Trading Units in 2012

Days

30

20

10

0

in € Million | Below (50) | (50) to (45) | (45) to (40) | (40) to (35) | (35) to (30) | (30) to (25) | (25) to (20) | (20) to (15) | (15) to (10) | (10) to (5) | (5) to 0 | 0 to 5 | 5 to 10 | 10 to 15 | 15 to 20 | 20 to 25 | 25 to 30 | 30 to 35 | 35 to 40 | 40 to 45 | 45 to 50 | 50 to 55 | 55 to 60 | 60 to 65 | 65 to 70 | 70 to 75 | 75 to 80 | 80 to 85 | 85 to 90 | 90 to 95 | 95 to 100 | 100 to 105 | 105 to 110 | 110 to 115 | 115 to 120 | 120 to 125 | 125 to 130 | 130 to 135 | 135 to 140 | 140 to 145 | 145 to 150 | Over 150

Distribution of daily income of our trading units in 2013
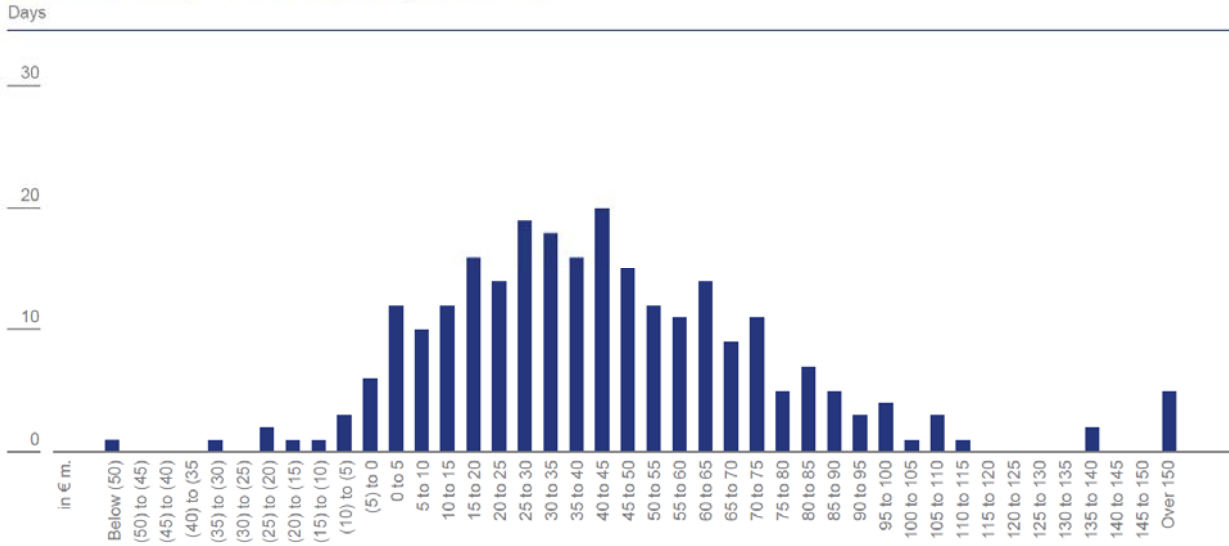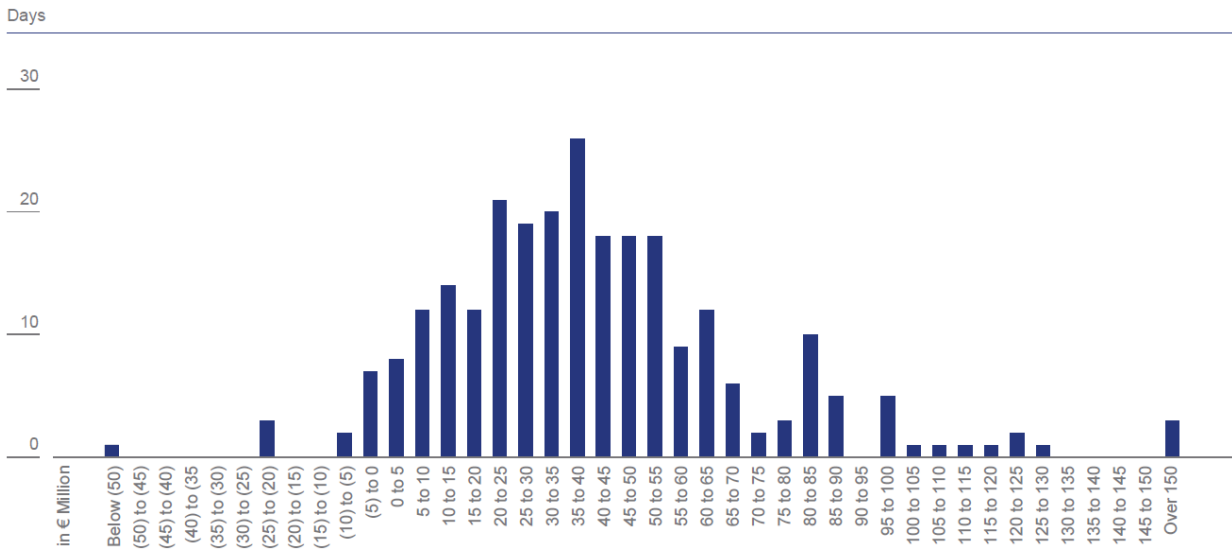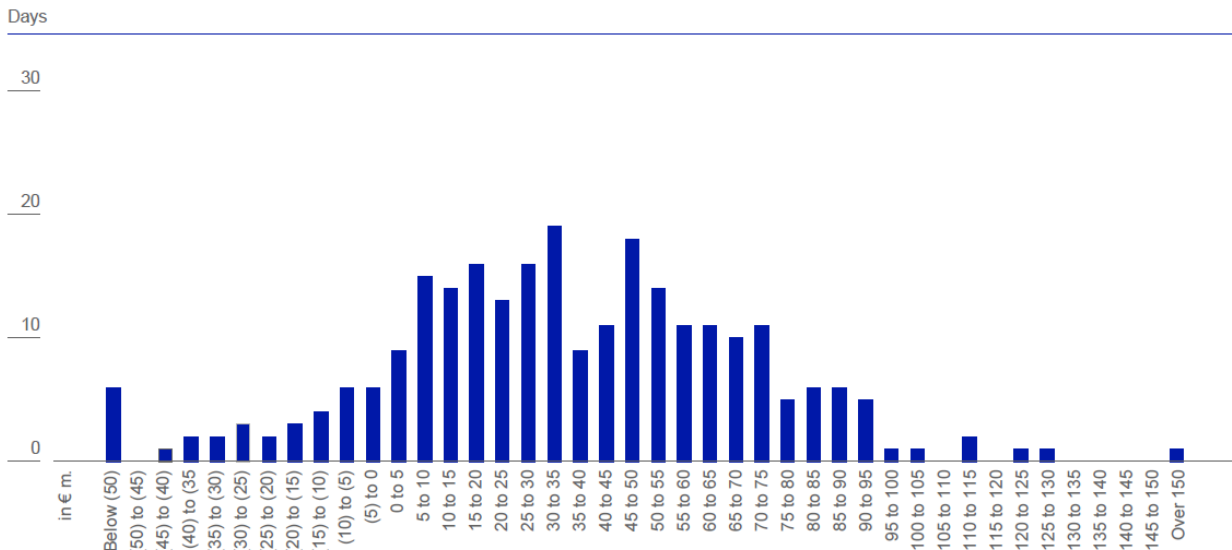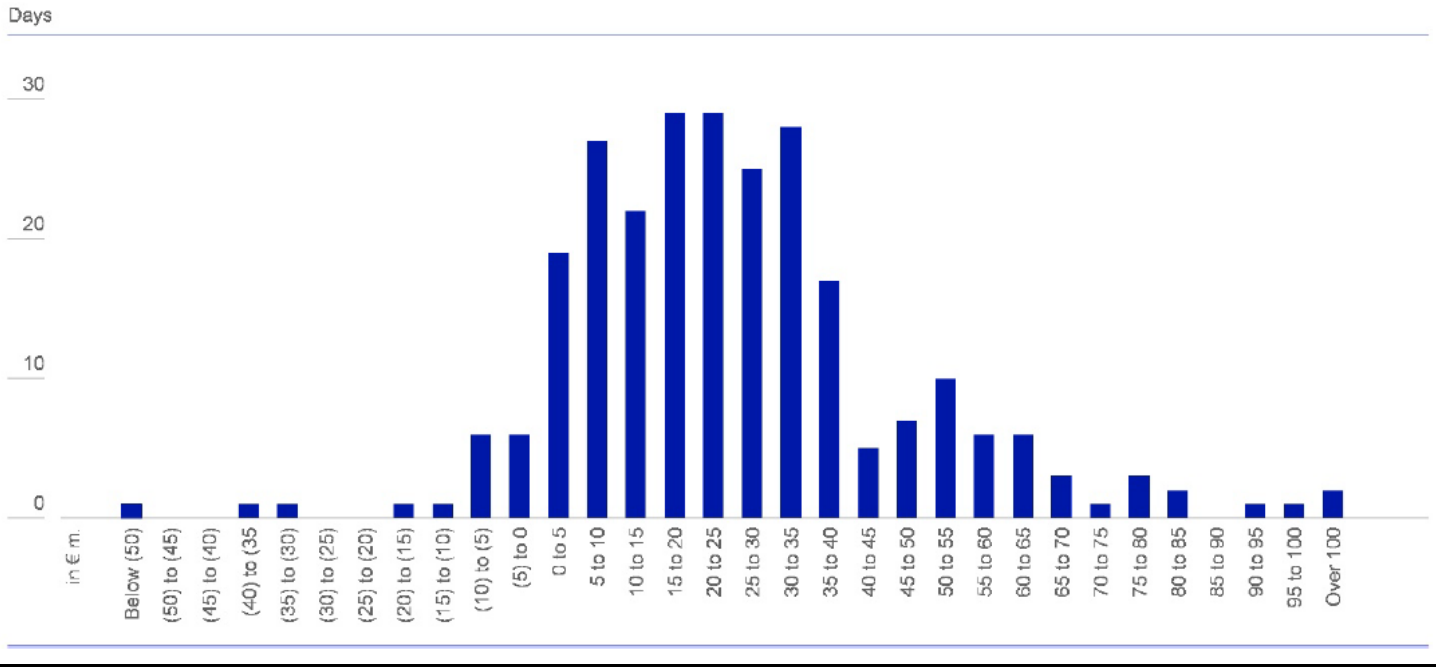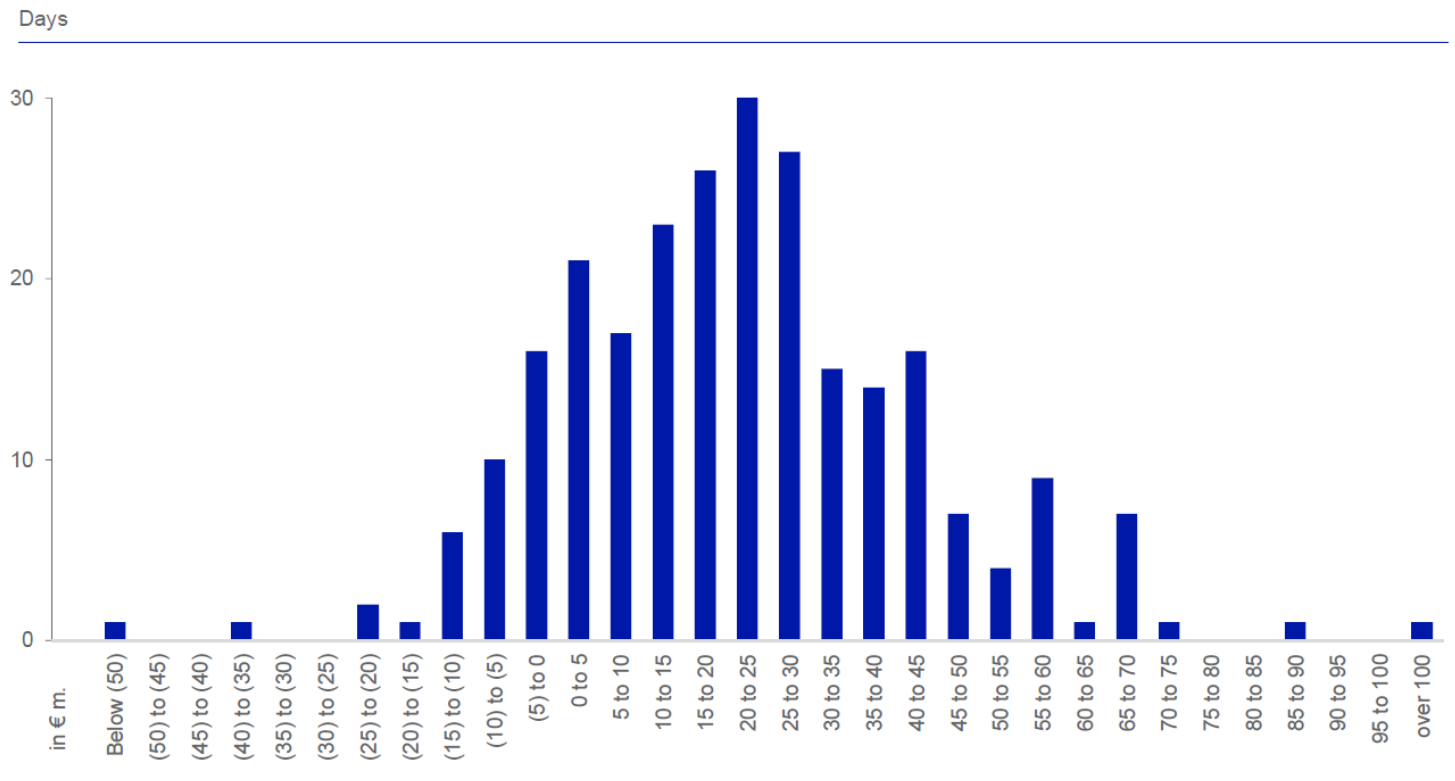
Days

Distribution of daily income of our trading units in 2014

Days

Distribution of daily income of our trading units in 2016

Days

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Distribution of daily income of our trading units in 2017

Days

Distribution of daily income of our trading units in 2018

Days

Liquidity risk (p.146)

"Our stress testing analysis assesses our ability to generate sufficient liquidity under extreme conditions and is a key input when defining our target liquidity risk position. The analysis is performed monthly. The following table shows, that under each of our defined and regularly reviewed scenarios we would maintain a positive net liquidity position, as the counterbalancing liquidity we could generate via different sources more than offsets our cumulative funding gap over an eight-week horizon after occurrence of the triggering event." (from 2013)

Global All Currency Daily Stress Testing Results

in € bn.	Dec 31, 2018			Dec 31, 2017		
	Funding Gap[1]	Gap Closure[2]	Net Liquidity Position	Funding Gap[1]	Gap Closure[2]	Net Liquidity Position
Systemic market risk	93	209	116	121	284	163
1 notch downgrade (DB specific)	63	193	131	79	252	173
Severe downgrade (DB specific)	222	278	57	287	331	43
Combined[3]	231	279	48	318	351	33

[1] Funding gap caused by impaired rollover of liabilities and other projected outflows.
[2] Based on liquidity generation through Liquidity Reserves and other countermeasures.
[3] Combined impact of systemic market risk and severe downgrade.

(As of Dec-2014, rated as   A3 by Moody's / A by S&P /   A+ by Fitch
         Dec-2016,   Baa2 /   BBB+ /   A-
         Dec-2017,   Baa2 /   BBB- /   BBB+
         Dec-2018,   Baa3 /   BBB- /   BBB+)

2008

Based on observations made during the financial crisis, we have reviewed our stress testing framework and amended it in various aspects: The market risk scenario has been redefined and now reflects the systemic knock-on effects seen since the fall of 2007. Across all scenarios, we have added liquidity risk drivers (e.g. FX-fungibility and secured funding) to cover sources of liquidity risk not accounted for by the previous methodology but which became apparent during the market disruptions. The downgrade scenarios have also been recalibrated to the most recent credit ratings of the Bank. The following table is illustrative of our stress testing results as of December 31, 2008 based on the new methodology, which will be reported going forward.

Stress Testing and Economic Capital (2008)

While value-at-risk, calculated on a daily basis, supplies forecasts for potential large losses under normal market conditions, it is not adequate to measure the tail risks of our portfolios. We therefore also perform regular stress tests in which we value our trading portfolios under severe market scenarios not covered by the confidence interval of our value-at-risk model.

These stress tests form the basis of our assessment of the economic capital that we estimate is needed to cover the market risk in our positions. The development of the economic capital methodology is governed by the Regulatory Capital Steering Committee, which is chaired by our Chief Risk Officer.

The quantification of economic capital, performed weekly, involves stressing underlying risk factors applicable to the different products across our portfolios under severe stress and liquidity assumptions, according to pre-defined scenarios. The resulting losses from these stress scenarios are then aggregated **using correlations that are meant to reflect stressed market conditions (rather than the normal market correlations used in the value-at-risk model).**

We derive the scenarios from historically observed severe shocks in those risk factors, augmented by subjective assessments where only limited historical data are available, or where market developments are viewed to make historical data a poor indicator of possible future market scenarios. During the course of 2008 these shocks were calibrated to reflect the market events experienced during 2007 and early 2008. Despite this recalibration, in several cases the scenarios used in our economic capital still underestimated the extreme market moves observed in the latter part of 2008 (for example the sharp moves in implied volatility observed in equity, interest rates and FX markets). Moreover, the liquidity assumption used did not adequately predict the rapid market developments of that period that severely impacted the ability to reduce risk by unwinding positions in the market or to dynamically hedge our derivative portfolios. For example, the scenario did not contemplate the severe illiquidity observed in convertible bond, loan and credit derivative markets.

As a result, the recalibration process is currently being repeated to capture the most recent market moves observed in late 2008.