

# CIO Insights Reflections: Cryptocurrencies and blockchains – their importance in the future

Christian Nolting, Global Chief Investment Officer and Global Head of Wealth Discretionary

Markus Müller, Global Head of CIO Office

December 2017



# Cryptocurrencies and blockchains

- **Blockchains** and connected **cryptocurrencies** are probably the inventions with the most **disruptive character** for the finance sector and the public since the invention of the internet.
- Blockchains have the potential to revolutionize industries from the bottom-up and also to create new business models up to a peer-to-peer community.
- Bitcoin, Ethereum et al are only the **first pioneer projects**, whose success or failure depends on several factors like technical security, regulations and also their political impact.
- As a **new asset class**, which gets a lot of attention nowadays, cryptocurrencies could be an interesting alternative to diversify portfolios. But there is an appreciable risk of major losses. Cryptocurrencies are in our opinion a highly speculative investment.
- Economists have long been interested in **the origins and uses of money**, from Adam Smith, through Ludwig von Mises and on to the present day: they will now need to explore new aspects of it.
- If blockchain can create **trust** in the public sector, than it could sharply reduce the need for lawyers, accountants and so on in these public or private sector functions: in other words, artificial intelligence is not the only threat to white-collar jobs.

Source: Deutsche Bank AG

# 1

---

## Cryptocurrencies

- What are cryptocurrencies?
- Who found cryptocurrencies?
- How does mining work?
- Acceptance and Token
- Potential and risks
- Conclusion

# What are cryptocurrencies?



“Digital money” with artificial **limitations**, without coins and notes. With the help of **cryptography**\* and a collective booking system called Blockchain, cryptocurrencies build a distributed, safe and decentralized payment system, which does not need banks, intermediates, an organization or a central technical infrastructure to work.



The main difference to the **current types of money** we know is that an intermediate, which is responsible for production (e.g. central bank) or exchange (banks) is not needed. Exchanges of digital values and goods are made directly between two individuals.



Known cryptocurrencies are Bitcoin, Ethereum, Ripple, Litecoin and IOTA. In a sense they are scarce commodities as the amount of available currency units is in this case limited by mathematical algorithms. After every digital currency unit is issued there is no way to generate additional currency units from it (e.g. Bitcoin is limited to 21 million units). Furthermore every cryptocurrency has their **own currency generating process**.



The **market cap** of cryptocurrencies went **up to over \$200bn** in 2017 and received the attention of the global central banks. Main factors likely to affect the future **development** of cryptocurrencies are, in our opinion, interventions by the **government and central banks** and questions on how the **sector will be regulated**. Also keep an eye on the growing competition between cryptocurrencies.

Footnote: \*Cryptography is the science of encrypting information, \*\*Blockchain see p.14  
Source: Deutsche Bank Research, Deutsche Oppenheim, Deutsche Bank AG

# Who found cryptocurrencies?



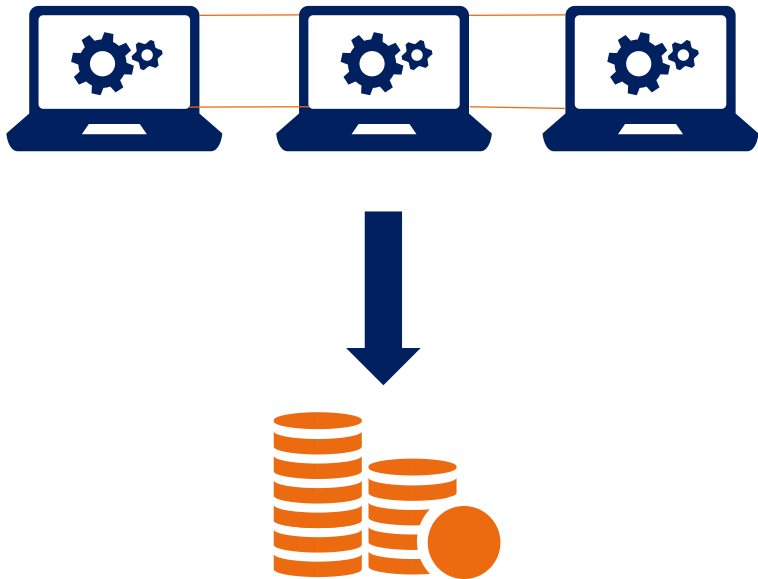
- Bitcoin was born in 2008. The revolutionary concept came from a scientist with the Japanese pseudonym of Satoshi Nakamoto. He published the concept of Bitcoin in a whitepaper called “Bitcoin: A Peer-to-Peer Electronic Cash System”.
- During its first few years Bitcoin had only a shadowy existence. The breakthrough happened in 2013, after the number of Bitcoin users grew and the theme was picked up by the media. The number of Bitcoin acceptances increased constantly.
- Because of its success, and the hype and innovation around the blockchain technology, many firms started to focus on cryptocurrencies and developed different business models:  
It will continue to impact payment services, account services, producers of bank ATMs and specialized hardware to mine bitcoins, news portals, investment funds and many other areas.

Source: Deutsche Bank Research, Deutsche Bank AG



# How does “Mining” work?

- There are transactions happening around the clock worldwide which are paid with digital money. The blockchain network adds an unconfirmed transaction into a list – the so called block. A confirmed block is then added to the blockchain. This process is called mining.
- The **function of mining** is the confirmation, synchronisation and digital booking of these transactions like Bitcoin. The participants in this process compete with each other, because the confirmation of one block is rewarded with a fraction of transaction costs and new bitcoins. To make this process fair, every participant has to solve a **cryptographic puzzle**. A hash with a unique structure must be created, like a combination of figures and letters. There is no possible way to know the structure of this hash before it is created. The participant who solves this puzzle first is able to generate a new block and gets the reward.
- Mining demands very powerful hardware – a very powerful graphic board or a special miner is needed. While it was worthwhile for someone to mine alone a few years ago, this is because of high hardware and energy costs not profitable anymore. Of course this depends on the price of the cryptocurrency. In fact mining is organized by so called “**Mining pools**”.
- There are some alternatives to mining in development. Cloud mining for example is possible without owning any hardware, because it is possible to buy shares of the mining power.



Source: Deutsche Bank Research, Deutsche Bank AG

# Acceptance of cryptocurrencies

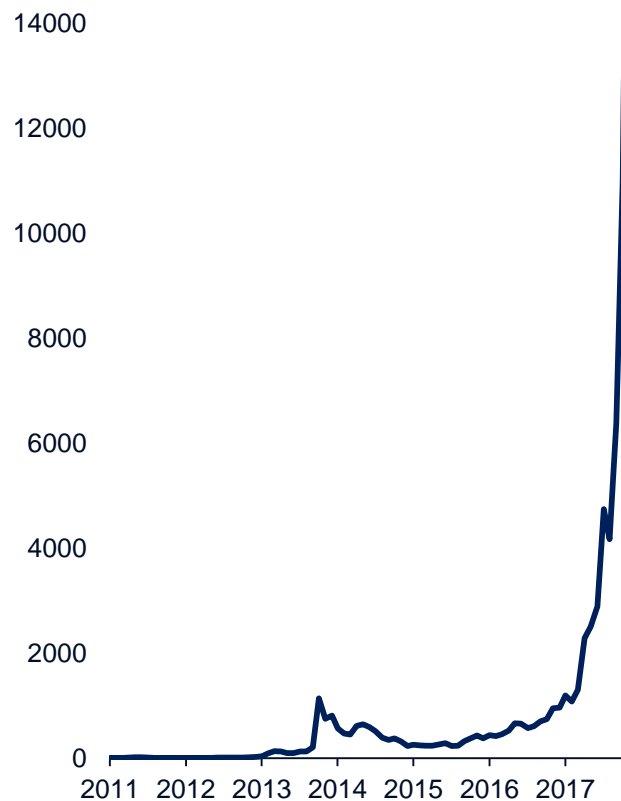


- To pay with Bitcoins a so-called **wallet** is needed. A Bitcoin Wallet is an app, which works like a **digital coin pocket**. It processes all historic transactions in a blockchain and enables accountancy for your own and foreign wallets.
- There are between 2.9 - 5.8 million **active cryptocurrency wallet users**, according to a study by Cambridge University.\*
- The number of companies that accept cryptocurrencies as a payment method rises daily. Around 180 companies accepted Bitcoin as a payment method in Germany as of July 2017. The value of cryptocurrencies rises, on the one hand, if they are more widely accepted as a payment method and, on the other hand, if rising demand causes higher valuations, because of supply limitations.
- Because of cheap transaction costs (currently 0.0001 BTC for a transaction between Bitcoin users) and a fast payment process, cryptocurrencies have become more and more interesting to retail businesses. But the transaction costs are set to change, because of rising demand working in favor of the miners.
- Since the beginning of cryptocurrency payment methods in 2011 opportunities have increased, but cryptocurrencies are still a long way away from getting global acceptance. This is why cryptocurrencies cannot be seen as a universal currency.

\*Global Cryptocurrency Benchmarking Study  
Source: Deutsche Bank Research, Deutsche Bank AG

# Bitcoin

Bitcoin chart BTC/USD



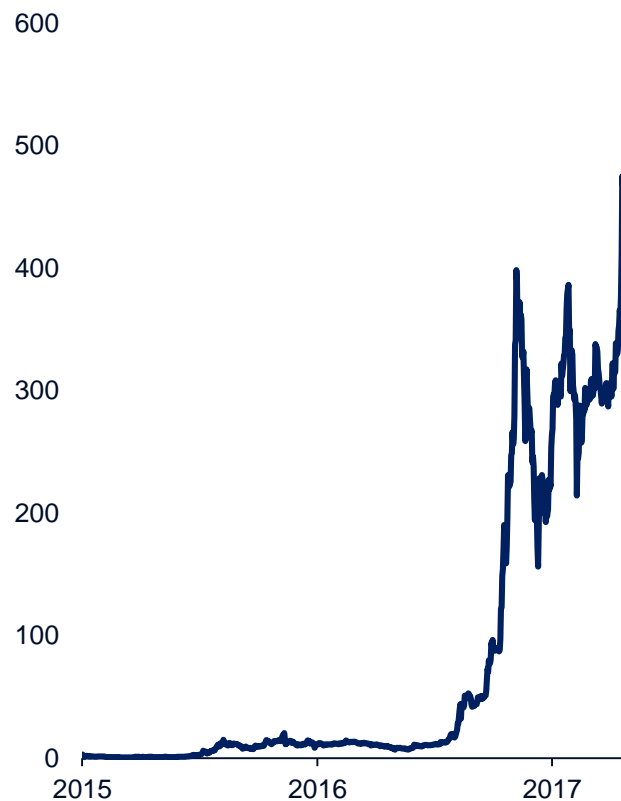
- The founder of Bitcoin, **Satoshi Nakamoto**, described the currency as a "**Peer-to-Peer Electronic Cash System**". Since 2009 Bitcoins have been traded publicly and it is also seen as in effect the first cryptocurrency. Furthermore, Bitcoin is the most traded cryptocurrency worldwide with a market share of over 40 percent.
- Transactions are made via the blockchain technology. A fundamental system of Bitcoins is the so-called **bitcoin block reward halving**. That means, that the reward per block is halved over the years. Currently the Block reward is 12.5 Bitcoins but the amount of rewarded Bitcoins per block halves after each 210.000 blocks generated. There are about 144 new blocks generated each day because of the transaction volume, which sums up at a block reward of 12.5 Bitcoins to a total amount of 1,800 Bitcoins per day. The next block reward halving is expected in 2020 and the daily reward is set to decrease to 870-900 Bitcoins.
- Bitcoin.com has limited the maximum amount on issued Bitcoins to **21 million**. This amount of Bitcoins is expected to be reached in 2140 and after that **there will be no more new Bitcoins generated**.
- To participate in a Bitcoin network an app called Bitcoin Wallet is needed. This app enables sending and receiving the cryptocurrency and works like PayPal.

Source: Bloomberg Finance L.P., Deutsche Bank AG, data as of December 2017



# Ethereum

## Ethereum chart ETH/USD

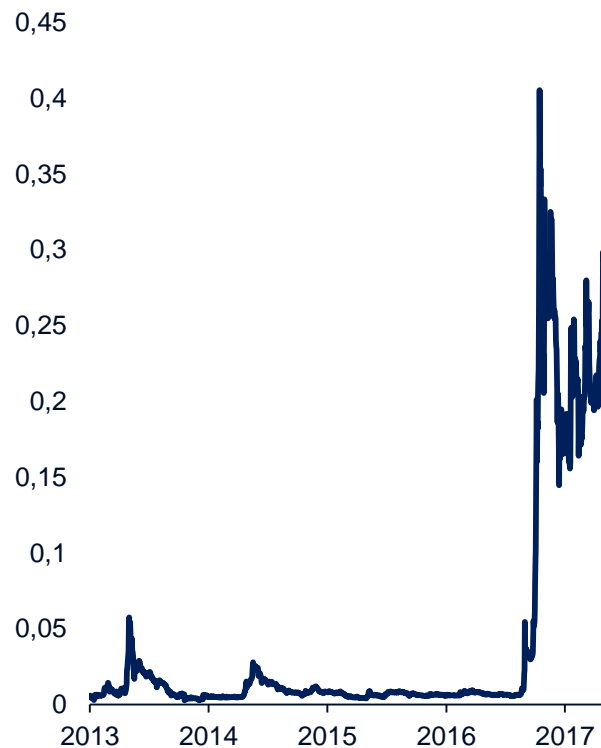


- Ethereum is a decentralized system, which allows investing, accounting and implementing of decentralized programs or smart contracts.
- It was found in 2013 by **Vitalik Buterin** and uses a cryptocurrency called Ether, which is used as a payment method.
- Ethereum has a market share of 27 percent and has been traded publicly since 2016. The issuance of Ether is limited to 18 million per year. Because the absolute issuance of Ether is limited, the relative inflation rate should decrease every year with rising demand.
- **Smart contracts** are transaction protocols or programs, which check the terms of a contract automatically and run as demanded by clauses in the contract.

Source: ethereum.org, Deutsche Bank AG, data as of December 2017

# Ripple

## Ripple chart XRP/USD

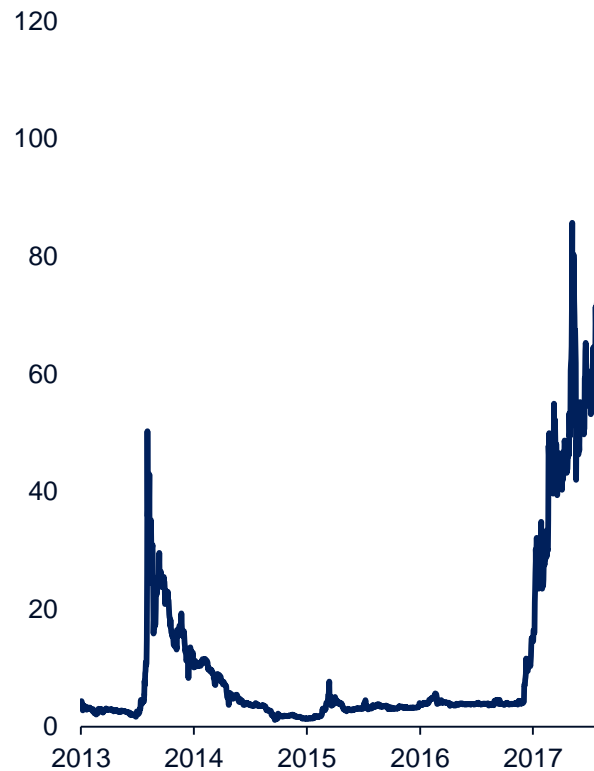


- Ripple was founded by **Jed McCaled** in 2012. The principle of Ripple is the verification of debentures. The account balances and also creditor-debtor relations are accessible for every user within the network.
- But, different from Bitcoin, the generation of Ripple coins is **not possible through mining**. The currency is only issued by Ripple Labs itself. To avoid inflation the amount of Ripple units is limited to 100 billion, with 99 billion already generated and around 55 billion distributed to the users. Seen from this angle, Ripple Labs is only a digital bank. Power and control lies here with the company, not the users.

Footnote: XRP\* is the labeling of Ripple's currency  
Source: ripple.com, Deutsche Bank AG, data as of December 2017

# Litecoin

## Litecoin chart LTC/USD



- Litecoin was founded by **Charles Lee** in 2011 and is limited to 84 million units.
- Litecoin is very similar to Bitcoin in its technical implementation. Generating new Litecoins is possible through mining as well. Litecoins can be traded for every other real currency or Bitcoins.
- Litecoin has an advantage in processing speed. Its 4x faster than Bitcoin – a block is generated in 2.5 minutes. This keeps transaction costs low as they arise for faster confirmation of a transaction. Litecoin is also based on an uncomplex algorithm, which allows miners to use less computing capacity for confirming a block.

Source: [litecoin.org](http://litecoin.org), Deutsche Bank AG, data as of December 2017

# IOTA

- The **IOTA foundation**, located in Berlin has **revolutionised IoT**\*. IOTA represents a third generation of Blockchain after the development of Bitcoin and Ethereum were developed. It actually isn't a simple blockchain anymore, but rather a completely new concept.
- The scale problem is solved through a **new developed structure**. Instead of a chain the blocks are processed in **parallel strands**. A transaction is processed after being confirmed by several participants (not miners like Bitcoin). There are basically three steps during a transaction:
  1. I have to confirm a minimum of two transactions (the software does this automatically, unlike miners for Bitcoin).
  2. These two transactions must be verified and checked (also done by the software).
  3. The authentication is processed through a **nonce (number used once)**\*. This guarantees spam protection.
- In conclusion: IOTA has solved the **fundamental problems of blockchain**, because it is scalable and does not cause any costs. The problem is, that this payment system only works if cryptocurrencies are compatible with each other, because IOTA does not have blocks and chains.

Footnote: \*IoT is the currency of IOTA, \*\*A nonce is a numerical order, which is replaced by a new order after short time.  
Source: [iotafoundation.com](https://iota.foundation), Deutsche Bank AG

# Cryptocurrency tokens

Cryptocurrencies can be divided in three groups – utility tokens, equity tokens and hybrid tokens\*:

- **Utility token:** Utility tokens, often called app coins or user tokens, provide users with future access to a product or service. Around 95% of all cryptocurrencies are utility tokens and the value of these tokens is determined by limitation, the digital service and the acceptance of the token. They are designed to function as a payment method. Bitcoin is an example of a utility token.
- **Equity token:** With an equity token you receive a share of the company. These tokens have an intrinsic value, which is composed from revenue, investments and resources of the company. These tokens increase in value if the earnings of the company rise.
- **Hybrid token:** Hybrid token consist of utility and equity tokens. They are designed to combine the advantages of both tokens but aren't widespread currently. One example of a hybrid token are PressCoins which promise, to serve as a payment method and simultaneously hold a stake in the company.

→ **That means that investors not only have the chance to use cryptocurrencies as a payment method, but also use them as an equity stake in the company. Hybrid versions could combine the advantages of both tokens in the future.**

Footnote: \*Token describes the characteristics of a cryptocurrency  
Source: [presscoi.com](http://presscoi.com), Deutsche Bank AG

# Excursion: Functions of money

Money has to fulfil three functions – the better a good can fulfil these functions, the more it is seen as money

## Medium of exchange



- The most important function of money is to serve as a medium of exchange or as a means of payment. Money is also used to grant credits and extinguish debt. To be a successful medium of exchange, money must be commonly accepted by people in exchange for goods and services.

## Measure of value



- Money serves as a common measure of value in terms of which the value of all goods and services is measured, expressed and can be compared. Money also acts as a unit of account. As a unit of account, it helps in developing an efficient accounting system because the values of a variety of goods and services which are physically measured in different units can be added up.

## Store of value



- Money provides a liquid store of value because it is so easy to spend and so easy to store. By acting as a store of value, money provides security to the individuals to meet unpredictable emergencies and to pay debts that are fixed in terms of money. It also provides assurance that attractive future buying opportunities can be exploited.

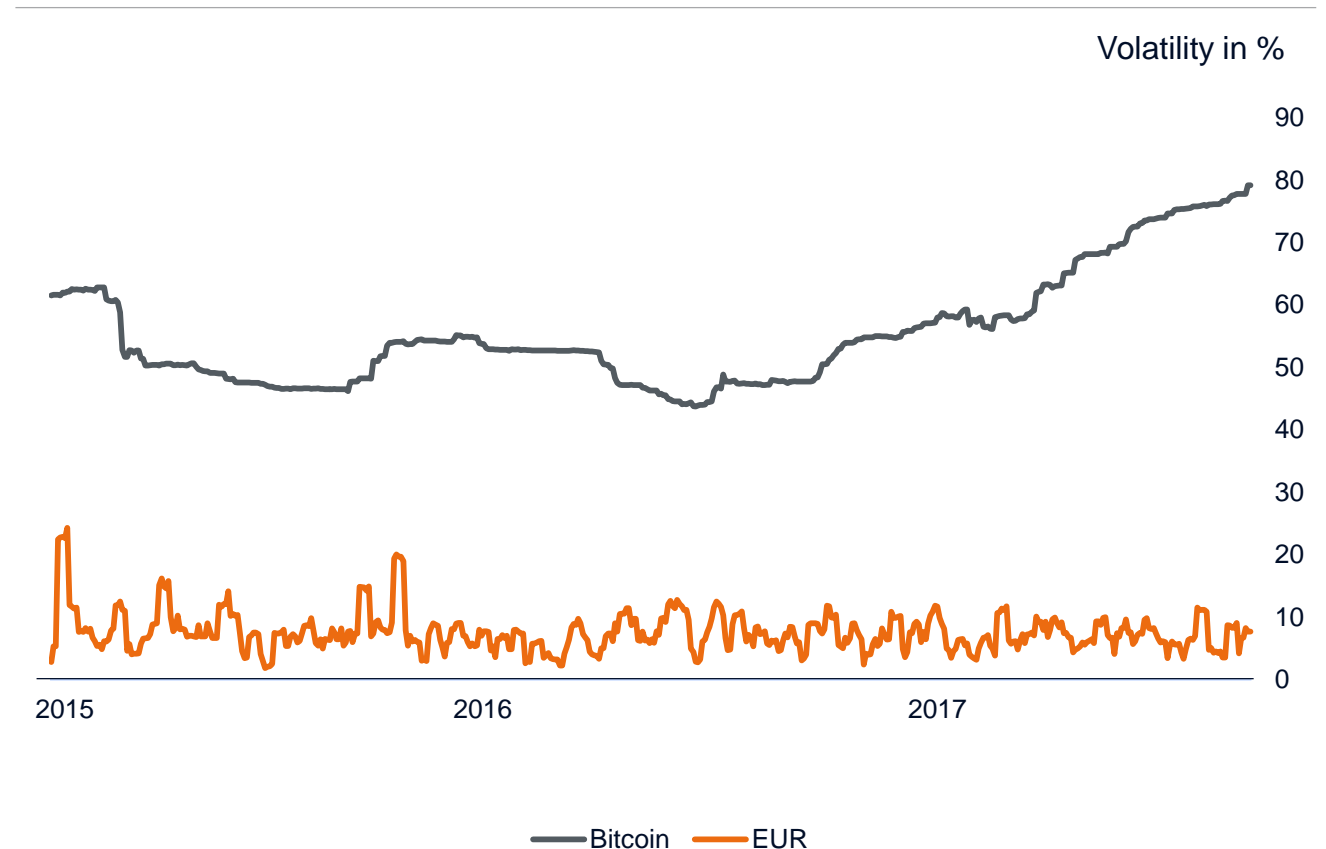
Source: bundesbank.de, Deutsche Bank AG



# What potential do cryptocurrencies have?

- Analysis of the development of money shows that every historical currency has needed the support of a central authority, to guarantee its value and deliver securities to investors. To gain **trust** in the value of cryptocurrencies, changes like more regulation and believable securities are likely to be necessary.
- In particular, the criterion of **general acceptance** is **not fulfilled** by cryptocurrencies, so that central banks (as well as the relevant literature) will not vouch for their quality. This is also our view.
- Because most cryptocurrencies are **limited** the **inflation risk is low**. But reproductions and splittings could have an impact on the inflation rate as this could increase the number of available currency units. One example is the splitting of Bitcoin and Bitcoin Cash.
- Cryptocurrencies could in fact represent a form of **protection against inflation** in **crisis countries**. Venezuela had an inflation rate of 250% in 2016 and the IMF expects a rate of 700% in 2017.

Volatility\* Bitcoin vs. USD/EUR



\* The volatility is based on the exchange rate to the USD.  
Source: bundesbank.de, Bloomberg Finance L.P., Deutsche Bank AG, data as of December 2017

# What risks do cryptocurrencies face?

## Theft and technical progress

---

- As the transactions are based on cryptography, stealing or loss of the private key to an account is possible by bugs, Trojans or viruses. To avoid losing it, wallet apps provide different opportunities to secure the key: it can either be kept in a “wallet file” on the main drive, on external hardware or on paper. Quantum computers\*, which are expected to be finally develop and available for purchase in 10 years at the earliest, can decrypt the algorithms that encrypt cryptocurrencies because of their enormous computing power. However, we expect new encryption methods that are protected against quantum computers.

## Political risks and regulation

---

- Another risk is that large economic powers prohibit trading and payment with cryptocurrencies. Central banks could also introduce their own cryptocurrencies to drive private crypto currencies out of the market. For example, in September 2017, China's Central Bank banned all Initial Coin Offerings\*\*, which companies use to create their own crypto-money and sell it to the public, with immediate effect.

## Reproduction and sustainability

---

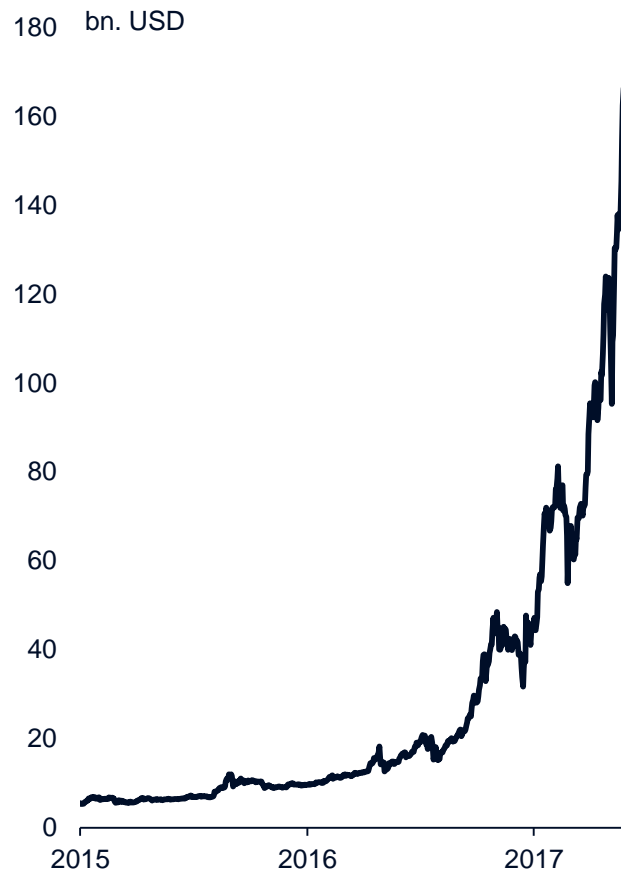
- Various cryptocurrency replicas or splits, so called forks\*\*\*, are likely to occur in the future as most cryptocurrencies are based on an "open-source" blockchain, a protocol freely available to everyone. These forks are forcing investors to assimilate to a cryptocurrency because transaction costs, value, and competition can change dramatically. It is possible that after a fork only one currency of the spin-offs prevails. Power consumption for bitcoin mining worldwide now amounts to 24.52 terawatt hours annually. This roughly corresponds to the annual energy needs of Nigeria. Based on the data of a Bitcoin mining operation, the resulting environmental impact for a transaction corresponds to a 200 km journey in an SUV.

Footnote: \*Quantum computers are high-performance computers whose functions are based on the laws of quantum mechanics. \*\*ICOs are an unregulated method of raising capital used by companies whose business model is based on cryptocurrencies. \*\*\*Forks are splits in the jargon of cryptocurrencies.

Source: Deutsche Bank Research, Deutsche Bank AG

# A new asset class?

## Market cap of Bitcoin in USD



- We rank cryptocurrencies as a **risky investment**, because recent price increases are in part based on speculation. Volatility is very high and reached 80% and the whole sector is generally unregulated.
- A benefit only arises because of their use as a medium of exchange for transactions. On the one hand their value rises as their use as a medium of exchange becomes more popular; on the other hand, cryptocurrencies are supported by their issue limitation compared to rising demand.
- In some countries, the first **certificates and funds** based on cryptocurrencies have been launched. Also CME Group plans to introduce future contracts.
- The government in Dubai officially announced their own cryptocurrency called **emCash**, which is used for government transactions but also for daily payments. After Japan allowed Bitcoins as a legal payment method, they also allowed eleven companies to trade Bitcoins.

Source: Deutsche Bank Research, Deutsche Bank AG, data as of December 2017

# Conclusion cryptocurrencies



Cryptocurrencies currently represent a **highly speculative** and unregulated risk investment. Because of **missing money functions and scalability problems** we would not assume that real currencies are replaced by cryptocurrencies.



Cryptocurrencies could develop into a **new asset class in the future**. But for this purpose **more regulation and some degree of security needs** to be implemented, to provide more **trust, transparency and security** to investors.



**Main factors** affecting the **future development** of cryptocurrencies are likely to be **government intervention** and **competition** between cryptocurrencies. In addition central banks could develop their own cryptocurrencies and replace the private ones in the market.



**Cryptocurrencies will raise further attention**. Especially in crisis countries they could represent an alternative to inflation threatened currencies. It will be very interesting how the blockchain technology evolves beyond cryptocurrencies in the public and financial sector.



Paying cashless, always and everywhere? Around 40% of purchases made in Germany are paid by card already. In Sweden almost every transaction is made without cash already. Cash can not be replaced that easily, but the number of cashless transactions will for sure rise further in the future.

Source: Deutsche Bank AG

# 2

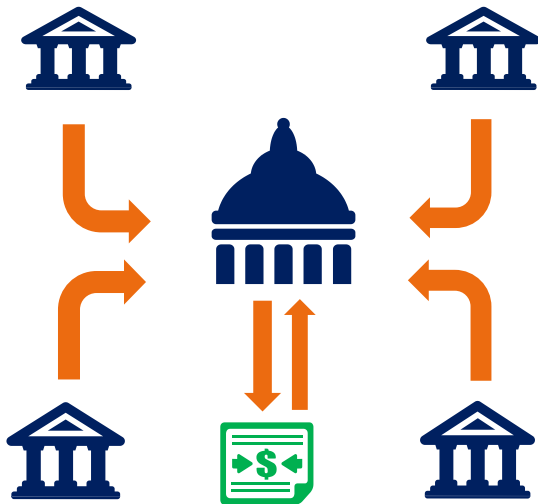
---

## Blockchain

- How do Blockchains work?
- SWOT Analyse
- What does the future bring ?
- Challenges
- Conclusion

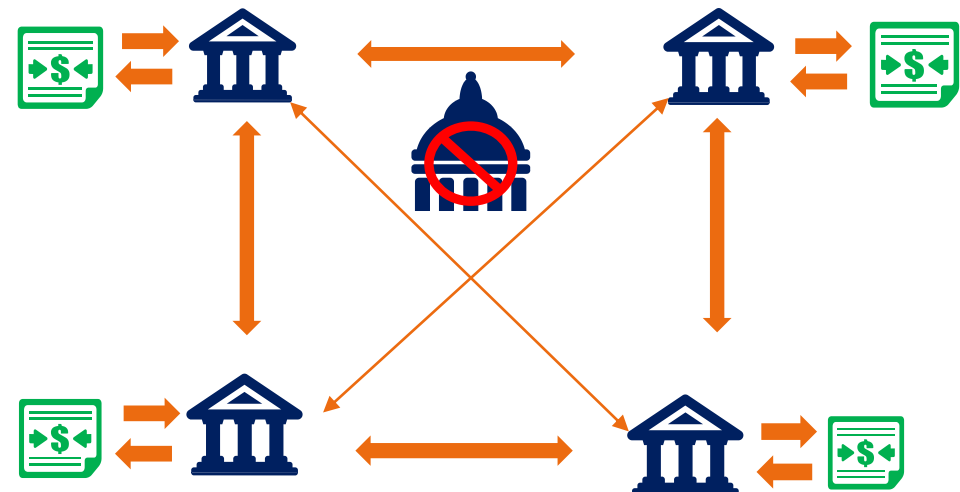
# The blockchain as a central component

## Current model: Central register



- Protocols, Transactions and data is saved in a central register. An intermediate watches and verifies the data exchange.
- **For example**, behind central bank money stands the **central bank**. Every Euro that is issued by the Bundesbank is booked as a liability in the balance. Seen that way, central bank money is a claim on the central bank. With trust in the central bank, the value of money decreases and increases.

## New model: The blockchain

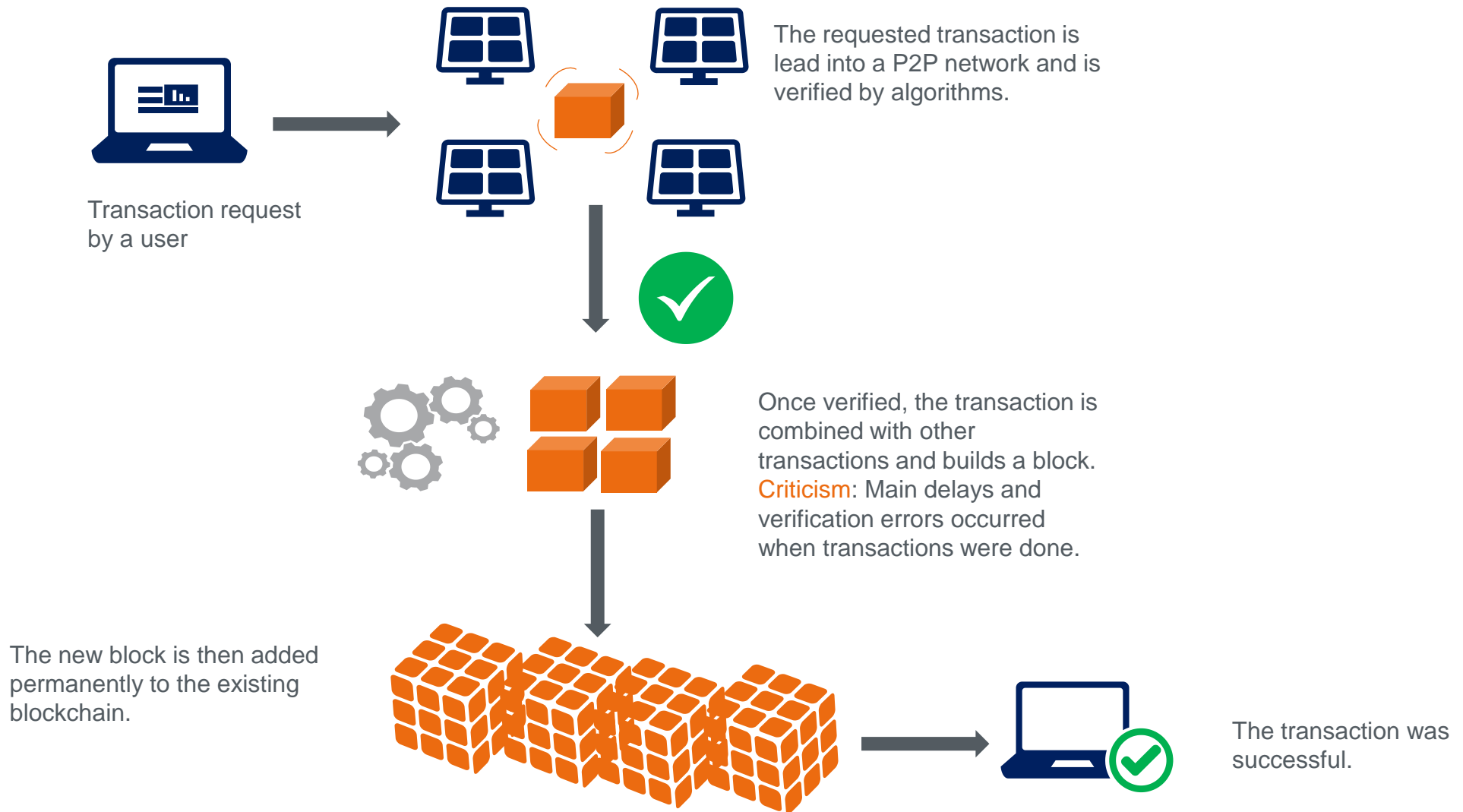


- A blockchain is a decentralized database, which includes a steadily rising list of transactions. It enables the worldwide exchange of data – without a central party – through a P2P network\*. Due to decentralization, transaction costs are lower and business can be done faster.
- **Digital Money has no claim on anyone**. No one needs to accept your currency as a payment method.

Footnote: \*Peer-to-peer (P2P) is a decentralized communications model in which each party has the same capabilities and either party can initiate a communication session  
Source: Deutsche Bank Research, Deutsche Bank AG



# How does the blockchain work?



Source: pwc.de, Deutsche Bank AG

# SWOT analysis of a blockchain



- Decentralized network
- Protection of large amount of data using encryption and data management
- High transparency
- Versatile application



- Limited memory capacity
- Access permissions
- Scalability
- Trust in new technologies



- Lower transaction costs
- Faster business processes
- Reduction of possible cyber attacks
- Reduction of IT infrastructure costs



- Regulatory barriers
- Technological failures
- Political opponents
- Institutional barriers
- Crime

Source: Deutsche Bank Research, Deutsche Bank AG

# What will the future bring for blockchains?



- We expect that the **blockchain will change the business model of companies in a sustained way.**
- The blockchain technology enables a faster and cheaper exchange of assets and financial products between individuals without an intermediate, which reduces the asymmetry of information between the individuals.
- Energy supplier **RWE** develops the usage of blockchains for charging station of electro cars. The **NASDAQ** trading floor introduced the service LINQ, which is mainly used for authentications and certification of solar energy based on blockchains.
- 63% of the managers from German banks expect a change in their business model in the next 10 years because of blockchain technologies. 29% of the respondents expect financial advantages, while 50% of the respondents stayed neutral towards blockchains.\*
- But 76% of the respondents will plan to implement the blockchain in their business model, after they have seen a successful implementation by other market participants.\*

Footnote: \* Data based on a study by pwc  
Source: pwc.de, Deutsche Bank AG

# Possible implementations in the future



**Bond markets:** First successful tests based on smart contracts. After Daimler issued the first blockchain debt certificate, the Japanese financial information supplier Fisco followed with the first Bitcoin bond.



**Virtual/ digital currencies:** Digital currency by central banks could change the business model of banks fundamentally. Deutsche Bank, UBS, Santander and BNY Mellon are designing a cryptocurrency called “**Utility Settlement Coin**”, which should help bankers, making stock broking faster and cheaper.



**Public administration:** General administration and elections could become tamper-proof because of the blockchain technology.



**Music industry/ copyright infringement:** Publication of and payment for music in a digital format.

Source: Deutsche Bank Research, Deutsche Bank AG

# Conclusion blockchain



The opportunities associated with blockchain technologies are **huge**. Bigger banks are likely start to implement the technology in their systems.



The blockchain has the potential to change the financial sector in a **sustained way**, because of its disruptive potential. We see major opportunities for stock markets and trading.



**Elections** could be protected from hacking via blockchains. **Agreements with employers, governments or companies** directly and the registration of rights on ideas, inventions or digital goods are also possible with the technology.



Distinguished by **high transparency and a decentralized system**, we see in the blockchain one of the most innovative developments in recent years.

3

---

Summary



# Overview important questions

## Is inflation a threat for cryptocurrencies?

---

Inflation in each cryptocurrency depends on production rate, demand and limitation. If new units of a cryptocurrency are generated there is some degree of automatic inflation as the supply rises. Bitcoin for example has a yearly expansion rate (in terms of supply) of 4%. But the demand for Bitcoins is rising faster than the amount of new Bitcoins generated. Also the amount of rewarded Bitcoins per block decreases over time. But there is a possibility of so-called reproduction and splitting because most cryptocurrencies are based on an open-source Blockchain, which is a publicly open protocol. This has inflationary potential.

## Does technological development threaten the security of cryptocurrencies?

---

Malware, viruses or trojans represent threats, as they are designed to hack the private key and access the digital account. It remains to be seen how fast quantum computers are developed and become market ready, as their computing capacity is capable of encrypting the coding of transactions. This is ultimately a race against time: The cryptographers of cryptocurrencies have to make their systems safer to be protected against all kind of external attacks.

## Are cryptocurrencies scalable and sustainable?

---

For a few cryptocurrencies the scalability decreases drastically. Rising demand and the size of the blocks (1 Mbyte for Bitcoin) are increasing the time to confirm transactions and also the transaction costs. The lower the transaction costs, the longer it takes to confirm transactions. But there are cryptocurrencies like IOTA, which have apparently solved this problem with a new blockchain structure. Sustainability depends on the mining process of each cryptocurrency. While Bitcoin mining demands high amounts of energy, others consume almost no energy as mining is not possible.

Source: Deutsche Bank Research, Deutsche Bank AG

# Overview important questions

## Is it possible to hack the blockchain technology?

---

The security of blockchains is guaranteed by a decentralized system without a central data base. The blockchain is also protected by cryptography which cannot be hacked through today's computing capacity. Each block which is added to the blockchain has its own encrypted identity and is visible for each user after it has been confirmed. As each block has its own visible encryption, this makes it impossible for hackers to gain access and alter the hashcode in one block, as each alteration is easily visible.

## Are there alternatives to the blockchain?

---

The blockchain technology is currently in its development process. One weakness is represented by the scalability of each block. But there are developments of new blockchains, which appear to have solved this problem. (IOTA)

## Why are smart contracts important?

---

Smart contracts could account and overwatch the conditions of a contract. The advantage of computers only knowing yes and no comes in handy: Every condition in a contract leads to a decision. Because of that contracts can be checked automatically with smart contracts. Equipped with the right content and algorithms the encrypted data blocks guarantee the observance of these contracts. Human mistakes during composition and execution are prevented.

Source: Deutsche Bank Research, Deutsche Bank AG

# Glossary

**Bitcoin** is the most popular cryptocurrency, which was found in 2008 by a scientist with the Japanese synonym Satoshi Nakamoto.

**Cryptocurrencies** are currencies in digital form, without a central authority behind them.

The **Eurozone** is formed of 19 European Union member states that have adopted the euro as their common currency and sole legal tender.

**USD** is the currency code for the U.S. Dollar.

**Valuation** attempts to quantify the attractiveness of an asset, for example through looking at a firm's stock price in relation to its earnings.

**Volatility** is the degree of variation of a trading-price series over time.

# Contacts CIO Wealth Management



**Christian Nolting<sup>1</sup>**  
*Global Chief Investment Officer (CIO)*  
*Global Head Wealth Discretionary*

## Strategy Group

**Larry V. Adam<sup>4</sup>**  
*Global Chief Strategist*

Matt Barry  
 Moshe Levin

**Dr. Helmut Kaiser<sup>1</sup>**  
*Chief Strategist Germany*

**Daniel Kunz<sup>7</sup>**  
*Strategist EMEA*

## Regional Heads Wealth Discretionary

**Stéphane Junod<sup>8</sup>**  
*Head WD EMEA*  
*CIO EMEA*

**Deepak Puri<sup>3</sup>**  
*Head WD Americas*

**Tuan Huynh<sup>5</sup>**  
*Head WD APAC*  
*CIO Asia*

**Marcel Hoffmann<sup>1</sup>**  
*Head WD Germany*

## Chief Investment Office

**Markus Müller<sup>1</sup>**  
*Global Head CIO Office*

**Graham Richardson<sup>2</sup>**  
*Financial Writer, CIO Office*

**Sebastian Janker<sup>1</sup>**  
*Head CIO Office Germany*

Konrad Aigner  
 Gundula Helsper  
 Ursula Morbach  
 Alisa Spital  
 Thomas Teufel

## Regional CIOs

**Larry V. Adam<sup>4</sup>**  
*CIO Americas*

**Tuan Huynh<sup>5</sup>**  
*CIO Asia*

**Stéphane Junod<sup>8</sup>**  
*CIO EMEA*

**Johannes Mueller<sup>1</sup>**  
*CIO Germany*

## International Locations

1. Deutsche Bank AG  
 Mainzer Landstrasse 11-17  
 60329 Frankfurt am Main  
 Germany
2. Deutsche Bank AG, London  
 105/108 Old Broad St (Pinners Hall)  
 EC2N 1EN London  
 UK
3. Deutsche Bank Trust Company  
 345 Park Avenue  
 10154-0004 New York, NY  
 United States
4. Deutsche Bank Securities  
 1 South Street  
 21202-3298 Baltimore, MD  
 United States
5. Deutsche Bank AG, Singapore  
 One Raffles Quay, South Tower  
 048583 Singapore
6. Deutsche Bank AG, Hong Kong  
 1 Austin Road West  
 Hong Kong  
 Hong Kong
7. Deutsche Bank (Switzerland) Ltd.  
 Hardstrasse 201  
 8005 Zurich  
 Switzerland
8. Deutsche Bank (Switzerland) Ltd.  
 Place des Bergues 3  
 1211 Geneva 1  
 Switzerland

# Important Note (1) – EMEA

Deutsche Bank Wealth Management offers wealth management solutions for wealthy individuals, their families and select institutions worldwide. Deutsche Bank Wealth Management, through Deutsche Bank AG, its affiliated companies and its officers and employees (collectively “Deutsche Bank”) are communicating this document in good faith and on the following basis.

Deutsche Bank Wealth Management is the brand name of the Wealth Management business unit of Deutsche Bank Group, offering high net worth client a broad range of traditional and alternative investment solutions, providing a holistic service for all aspects of Wealth Management”

This document has been prepared without consideration of the investment needs, objectives or financial circumstances of any investor. Before making an investment decision, investors need to consider, with or without the assistance of an investment adviser, whether the investments and strategies described or provided by Deutsche Bank, are appropriate, in light of their particular investment needs, objectives and financial circumstances. Furthermore, this document is for information/discussion purposes only and does not constitute an offer, recommendation or solicitation to conclude a transaction and should not be treated as giving investment advice.

Deutsche Bank does not give tax or legal advice. Investors should seek advice from their own tax experts and lawyers, in considering investments and strategies suggested by Deutsche Bank. Investments with Deutsche Bank are not guaranteed, unless specified. Unless notified to the contrary in a particular case, investment instruments are not insured by the Federal Deposit Insurance Corporation (“FDIC”) or any other governmental entity, and are not guaranteed by or obligations of Deutsche Bank AG or its affiliates.

Investments are subject to various risks, including market fluctuations, regulatory change, counterparty risk, possible delays in repayment and loss of income and principal invested. The value of investments can fall as well as rise and you may not recover the amount originally invested at any point in time. Furthermore, substantial fluctuations of the value of the investment are possible even over short periods of time.

This publication contains forward looking statements. Forward looking statements include, but are not limited to assumptions, estimates, projections, opinions, models and hypothetical performance analysis. The forward looking statements expressed constitute the author’s judgment as of the date of this material. Forward looking statements involve significant elements of subjective judgments and analyses and changes thereto and/or consideration of different or additional factors could have a material impact on the results indicated. Therefore, actual results may vary, perhaps materially, from the results contained herein. No representation or warranty is made by Deutsche Bank as to the reasonableness or completeness of such forward looking statements or to any other financial information contained herein. The terms of any investment will be exclusively subject to the detailed provisions, including risk considerations, contained in the Offering Documents. When making an investment decision, you should rely on the final documentation relating to the transaction and not the summary contained herein.

The terms of any investment will be exclusively subject to the detailed provisions, including risk considerations, contained in the Offering Documents. When making an investment decision, you should rely on the final documentation relating to the transaction and not the summary contained herein”

This document may not be reproduced or circulated without our written authority. The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries, including the United States. This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction, including the United States, where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Deutsche Bank to any registration or licensing requirement within such jurisdiction not currently met within such jurisdiction. Persons into whose possession this document may come are required to inform themselves of, and to observe, such restrictions.

Past performance is no guarantee of future results; nothing contained herein shall constitute any representation or warranty as to future performance. Further information is available upon investor’s request.

This document may not be distributed in Canada, Japan, the United States of America, or to any U.S. person.

# Important Note (2) – EMEA

## Kingdom of Bahrain

For Residents of the Kingdom of Bahrain: This document does not constitute an offer for sale of, or participation in, securities, derivatives or funds marketed in Bahrain within the meaning of Bahrain Monetary Agency Regulations. All applications for investment should be received and any allotments should be made, in each case from outside of Bahrain. This document has been prepared for private information purposes of intended investors only who will be institutions. No invitation shall be made to the public in the Kingdom of Bahrain and this document will not be issued, passed to, or made available to the public generally. The Central Bank (CBB) has not reviewed, nor has it approved, this document or the marketing of such securities, derivatives or funds in the Kingdom of Bahrain. Accordingly, the securities, derivatives or funds may not be offered or sold in Bahrain or to residents thereof except as permitted by Bahrain law. The CBB is not responsible for performance of the securities, derivatives or funds.

## State of Kuwait

This document has been sent to you at your own request. This presentation is not for general circulation to the public in Kuwait. The Interests have not been licensed for offering in Kuwait by the Kuwait Capital Markets Authority or any other relevant Kuwaiti government agency. The offering of the Interests in Kuwait on the basis a private placement or public offering is, therefore, restricted in accordance with Decree Law No. 31 of 1990 and the implementing regulations thereto (as amended) and Law No. 7 of 2010 and the bylaws thereto (as amended). No private or public offering of the Interests is being made in Kuwait, and no agreement relating to the sale of the Interests will be concluded in Kuwait. No marketing or solicitation or inducement activities are being used to offer or market the Interests in Kuwait.

## United Arab Emirates

Deutsche Bank AG in the Dubai International Financial Centre (registered no. 00045) is regulated by the Dubai Financial Services Authority. Deutsche Bank AG - DIFC Branch may only undertake the financial services activities that fall within the scope of its existing DFSA license. Principal place of business in the DIFC: Dubai International Financial Centre, The Gate Village, Building 5, PO Box 504902, Dubai, U.A.E. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

## State of Qatar

Deutsche Bank AG in the Qatar Financial Centre (registered no. 00032) is regulated by the Qatar Financial Centre Regulatory Authority. Deutsche Bank AG - QFC Branch may only undertake the financial services activities that fall within the scope of its existing QFCRA license. Principal place of business in the QFC: Qatar Financial Centre, Tower, West Bay, Level 5, PO Box 14928, Doha, Qatar. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Business Customers, as defined by the Qatar Financial Centre Regulatory Authority.

## Kingdom of Saudi Arabia

Deutsche Securities Saudi Arabia LLC Company, (registered no. 07073-37) is regulated by the Capital Market Authority. Deutsche Securities Saudi Arabia may only undertake the financial services activities that fall within the scope of its existing CMA license. Principal place of business in Saudi Arabia: King Fahad Road, Al Olaya District, P.O. Box 301809, Faisaliah Tower - 17th Floor, 11372 Riyadh, Saudi Arabia.

## United Arab Emirates

Deutsche Bank AG in the Dubai International Financial Centre (registered no. 00045) is regulated by the Dubai Financial Services Authority. Deutsche Bank AG - DIFC Branch may only undertake the financial services activities that fall within the scope of its existing DFSA license. Principal place of business in the DIFC: Dubai International Financial Centre, The Gate Village, Building 5, PO Box 504902, Dubai, U.A.E. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

# Important Note – UK

In the UK this publication is considered a financial promotion and is approved by Deutsche Asset Management (UK) Limited on behalf of all entities trading as Deutsche Bank Wealth Management in the UK. Deutsche Bank Wealth Management (DBWM) offers wealth management solutions for wealthy individuals, their families and select institutions worldwide and is part of the Deutsche Bank Group. DBWM is communicating this document in good faith and on the following basis. This document is a financial promotion and is for general information purposes only and consequently may not be complete or accurate for your specific purposes. It is not intended to be an offer or solicitation, advice or recommendation, or the basis for any contract to purchase or sell any security, or other instrument, or for Deutsche Bank to enter into or arrange any type of transaction as a consequence of any information contained herein. It has been prepared without consideration of the investment needs, objectives or financial circumstances of any investor. This document does not identify all the risks (direct and indirect) or other considerations which might be material to you when entering into a transaction. Before making an investment decision, investors need to consider, with or without the assistance of an investment adviser, whether the investments and strategies described or provided by Deutsche Bank, are suitability and appropriate, in light of their particular investment needs, objectives and financial circumstances. We assume no responsibility to advise the recipients of this document with regard to changes in our views. Past performance is no guarantee of future results. The products mentioned in this document may be subject to investment risk including market fluctuations, regulatory change, counterparty risk, possible delays in repayment and loss of income and principal invested. Additionally, investments denominated in an alternative currency will be subject to currency risk, changes in exchange rates which may have an adverse effect on the value, price or income of the investment. The value of an investment can fall as well as rise and you might not get back the amount originally invested at any point in time. We have gathered the information contained in this document from sources we believe to be reliable; but we do not guarantee the accuracy, completeness or fairness of such information and it should not be relied on as such. Deutsche Bank has no obligation to update, modify or amend this document or to otherwise notify the recipient in the event that any matter stated herein, or any opinion, projection, forecast or estimate set forth herein, changes or subsequently becomes inaccurate.

Deutsche Bank does not give taxation or legal advice. Prospective investors should seek advice from their own taxation agents and lawyers regarding the tax consequences on the purchase, ownership, disposal, redemption or transfer of the investments and strategies suggested by Deutsche Bank. The relevant tax laws or regulations of the tax authorities may change at any time. Deutsche Bank is not responsible for and has no obligation with respect to any tax implications on the investment suggested. This document may not be reproduced or circulated without our written authority. The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries, including the United States. This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction, including the United States, where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Deutsche Bank to any registration or licensing requirement within such jurisdiction not currently met within such jurisdiction. Persons into whose possession this document may come are required to inform themselves of, and to observe, such restrictions. This document contains forward looking statements. Forward looking statements include, but are not limited to assumptions, estimates, projections, opinions, models and hypothetical performance analysis. The forward looking statements expressed constitute the author's judgement as of the date of this material. Forward looking statements involve significant elements of subjective judgements and analyses and changes thereto and/or consideration of different or additional factors could have a material impact on the results indicated. Therefore, actual results may vary, perhaps materially, from the results contained herein. No representation or warranty is made by Deutsche Bank as to the reasonableness or completeness of such forward looking statements or to any other financial information contained in this document. Deutsche Bank conducts its business according to the principle that it must manage conflicts of interest fairly, both between itself and its clients and between one client and another. As a global financial services provider, Deutsche Bank faces actual and potential Conflicts of Interest periodically. The Bank's policy is to take all reasonable steps to maintain and operate effective organisational and administrative arrangements to identify and manage relevant conflicts. Senior management within the Bank are responsible for ensuring that the Bank's systems, controls and procedures are adequate to identify and manage Conflicts of Interest. This information is communicated by Deutsche Bank Wealth Management. Deutsche Bank Wealth Management is a trading name of Deutsche Asset Management (UK) Limited. Registered in England & Wales No 5233891. Registered Office: Winchester House, 1 Great Winchester Street, London EC2N 2DB. Deutsche Asset Management (UK) Limited is authorised and regulated by the Financial Conduct Authority. Financial Services Registration Number 429806. This document may not be distributed in Canada, Japan, the United States of America, or to any U.S. person. © 2017 Deutsche Bank AG