

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

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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

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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?

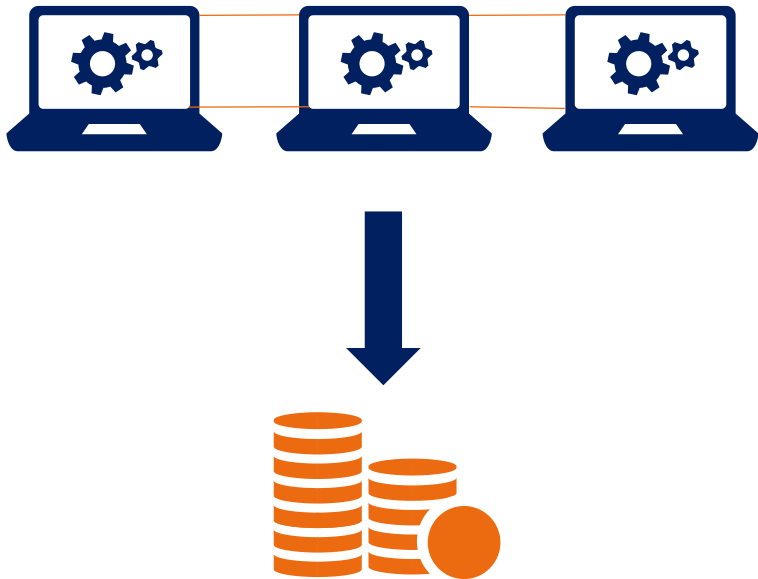


- Bitcoin was born in 2008. The revolutionary concept came from a scientist with the Japanese pseudonym of Satoshi Nakamoto. He published the concept of Bitcoin in a whitepaper called “Bitcoin: A Peer-to-Peer Electronic Cash System”.
- During its first few years Bitcoin had only a shadowy existence. 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

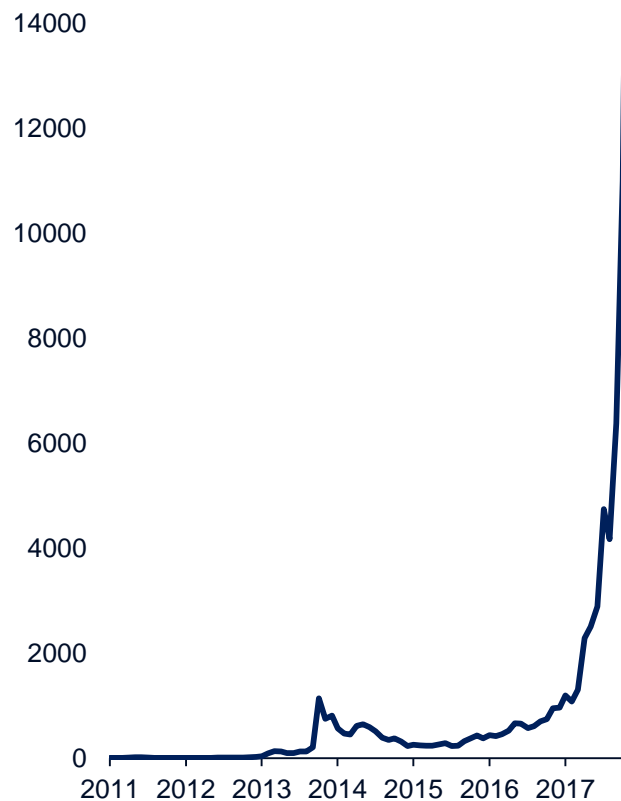


- To pay with Bitcoins a so-called **wallet** is needed. A Bitcoin Wallet is an app, which works like a **digital coin pocket**. It processes all historic transactions in a blockchain and enables accountancy for your own and foreign wallets.
- There are between 2.9 - 5.8 million **active cryptocurrency 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

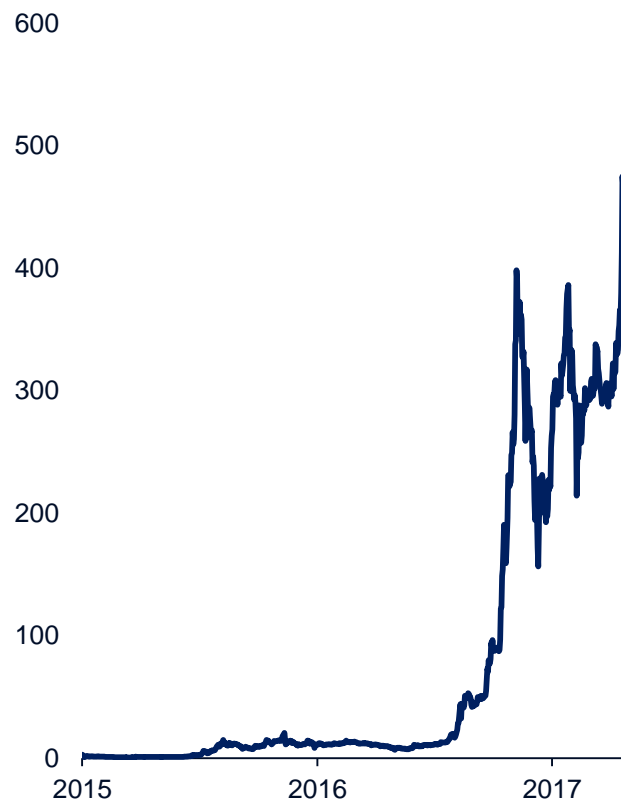


- The founder of Bitcoin, **Satoshi Nakamoto**, described the currency as a "**Peer-to-Peer Electronic Cash System**". Since 2009 Bitcoins have been traded publicly and it is also seen as in effect the first cryptocurrency. Furthermore, Bitcoin is the most traded cryptocurrency worldwide with a market 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

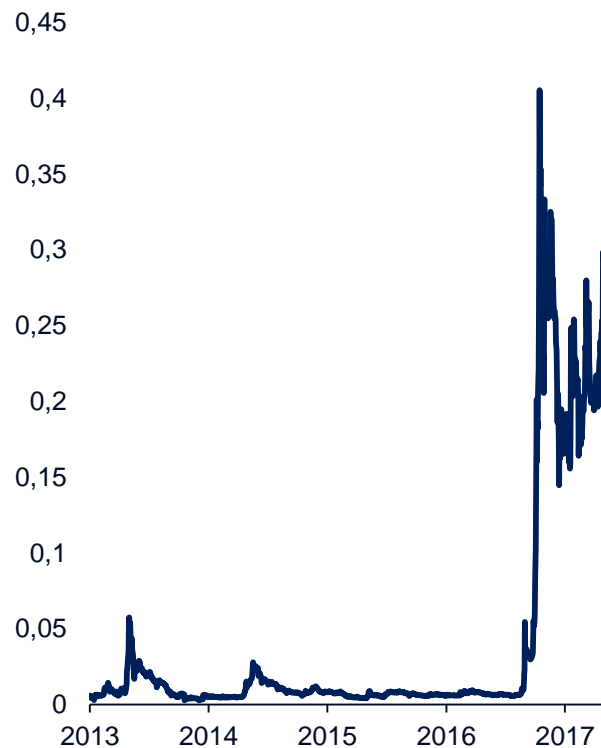


- Ethereum is a decentralized system, which allows investing, accounting and implementing of decentralized programs or smart contracts.
- It was found in 2013 by **Vitalik Butkerin** and uses a cryptocurrency called Ether, which is used as a payment method.
- Ethereum has a market share of 27 percent 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

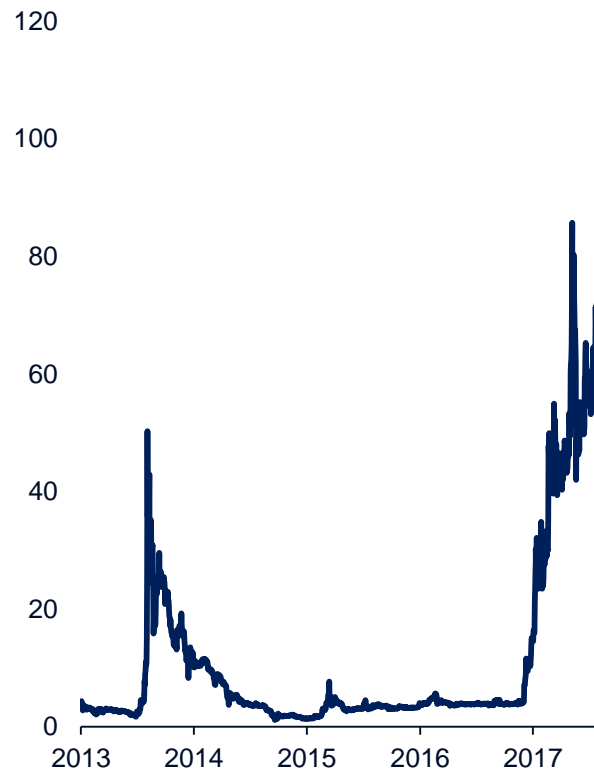


- Ripple was founded by **Jed McCaled** in 2012. The principle of Ripple is the verification of debentures. The account balances and also creditor-debtor relations are accessible for every user within the network.
- But, different from Bitcoin, the generation of Ripple coins is **not possible through 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, 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: 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, 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



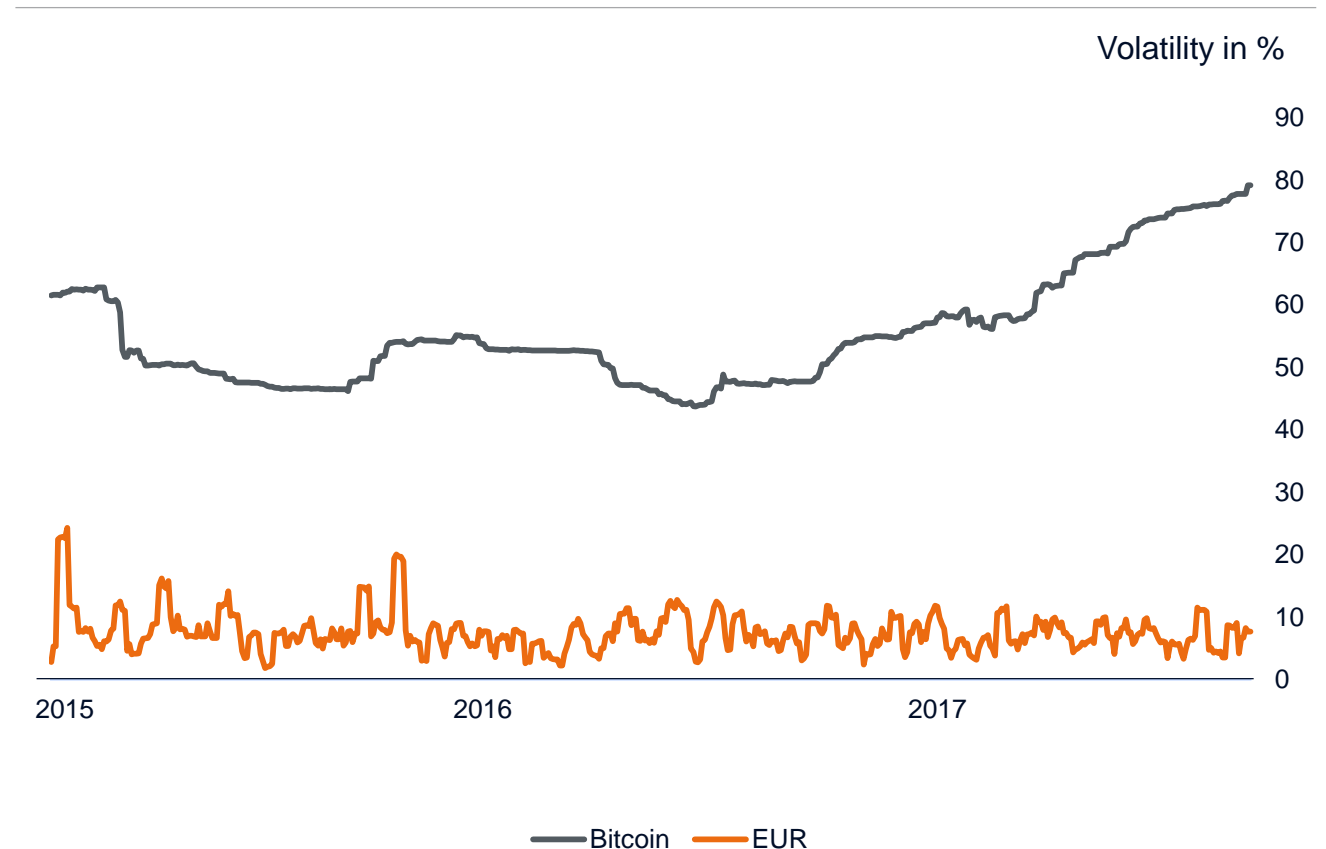
- Money provides a liquid store of value because it is so easy to spend and so easy to store. By acting as a store of value, money provides security to the individuals to meet unpredictable emergencies and to pay debts that are fixed in terms of money. It also provides assurance that attractive future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

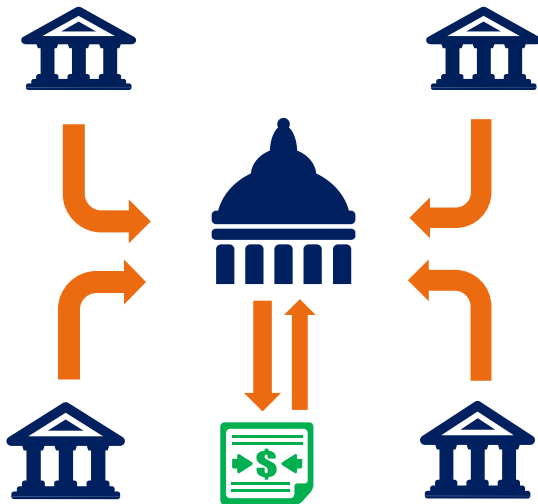
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Blockchain

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

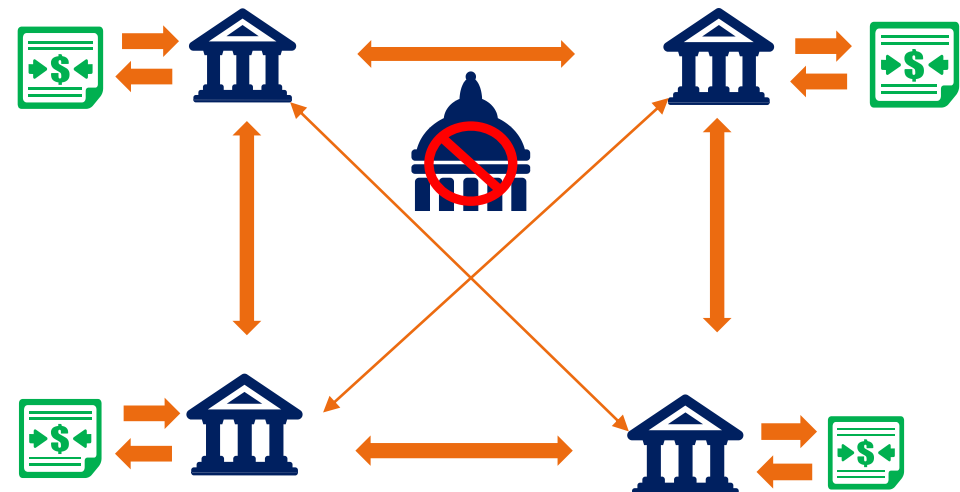
The blockchain as a central component

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.

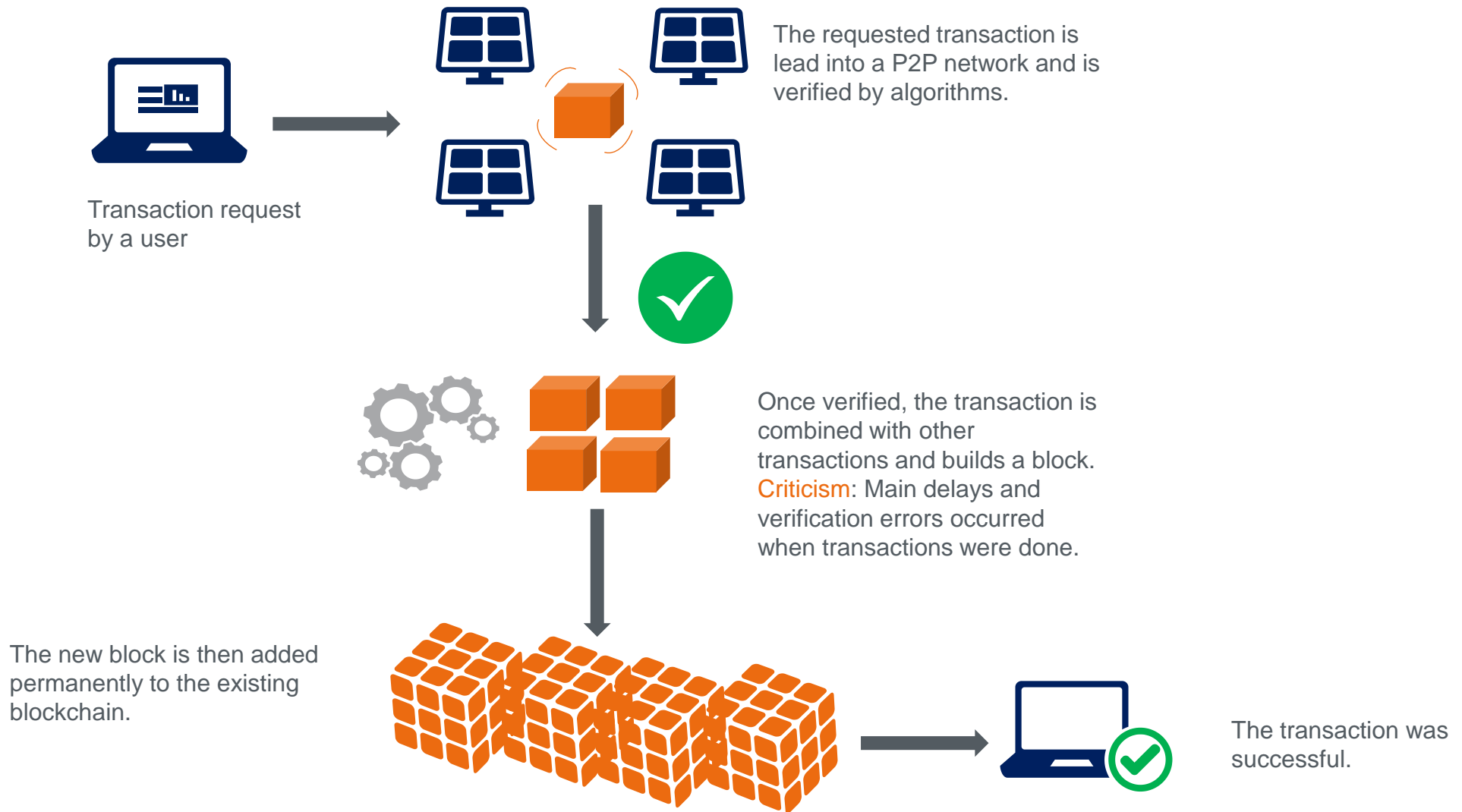
New model: The blockchain



- 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



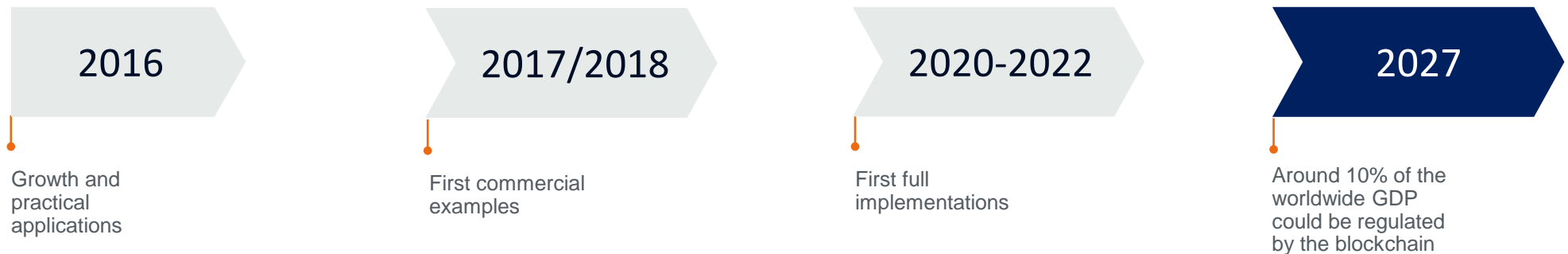
- Lower transaction costs
- Faster business processes
- Reduction of possible cyber attacks
- Reduction of IT infrastructure costs



- 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.

Source: Deutsche Bank Research, Deutsche Bank AG

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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.

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