Blockchain: Measuring its evolution and development via open-source collaboration
The Dbriefs Financial Services series

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Agenda

• What is blockchain?
• Recent developments in the blockchain space
• Open source and blockchain
• Analyzing blockchain projects on GitHub
• Q&A
Polling question #1

How familiar are you with blockchain technology?

• I have never heard of blockchain
• I have heard of blockchain but don’t know what it really means
• I am quite familiar with blockchain but I am personally not involved with the technology
• I am quite involved with blockchain technology
• Don’t know/Not applicable
What is blockchain?
What is blockchain?

- The ledger is distributed across multiple computers.
- Transactions are verified with cryptography.
- Every transaction is recorded in a block.
- Network of computers validates transactions.
- Once transactions are validated, they become part of the blockchain.
- Decentralized ledger that records transactions.
- Transactions recorded are immutable and do not depend on a single entity.
Origins of blockchain technology

In 2008 Satoshi Nakamoto published a paper describing the application of blockchain technology into a virtual currency known as Bitcoin.

In 2009 the core code behind Bitcoin was released and hosted on GitHub.

In 2010 the first commercial transaction using Bitcoin was registered (10,000 Bitcoins for $25 worth of pizza).

In 2013 Bitcoin market capitalization reached a billion dollars.*

In 2014 Ethereum, a blockchain-based platform for smart contracts is launched.

Blockchain is the engine for Bitcoin

The model for a growing market of cryptocurrencies, Bitcoin continues to grow and expand on the infrastructure of blockchain

USD/Bitcoin, September 13, 2017*: $3,858


*Open price as of September 13, 2017
Multiple uses: A highly disruptive technology

Blockchain has multiple use cases and new applications are being developed rapidly.

**Potential benefits for firms—**
- Improved security
- Lower transaction costs
- Infrastructure efficiencies

**Potential benefits for consumers—**
- Transparency and security
- Immutable records
- Increased accountability
- Lower transaction costs
- Enabling new business models
Polling question #2

What is your understanding of ICOs (Initial Coin Offerings)?

• I have never heard of an ICO
• I am aware of them, but don’t know exactly how they work
• I understand what an ICO is and how it works
• I understand how ICOs work, and I have invested in an ICO
• I understand how ICOs work and my firm has issued an ICO
• Don’t know/Not applicable
Recent developments in the blockchain space
ICOs in the news
What is all the fuss?

**Digital Coins Are So Hot, Startups Are Selling Them Like an IPO**
- *Bloomberg Business Week June 14, 2017*

**Forget an IPO, Coin Offerings Are New Road to Startup Riches**
New, unregulated fundraising method is based in world of cryptocurrencies
- *Wall Street Journal, July 7, 2017*

**Initial coin offerings have raised $1.2 billion and now surpass early stage VC funding**
- *CNBC, August 9, 2017*

**ICOs: Foolish Mania or Market Discovery? (They Might Be Both)**
- *Coindesk, July 26, 2017*

**ICOs Take Centre Stage, But Current Crop of ICO Platforms Unsuitable**
- *The Cointelegraph, August 20, 2017*
But what are ICOs?
ICO is a hybrid of an IPO and crowdfunding, used for funding blockchain projects

- ICO is a crowdfunding event to raise money for a new cryptocurrency asset, company, or venture.
- An ICO trades future cryptocurrencies in exchange for cryptocurrencies of immediate, liquid value.
- The new currencies may have their own blockchain or may be built on top of existing ones (e.g. on top of Ethereum).
- Investors own “tokens” that can be traded on exchanges, like a stock, and whose value will rise or fall depending on the success of the venture.
Comparison - IPO, Crowdfunding, VC, and ICO
ICO is a hybrid of an IPO and crowdfunding, used for funding blockchain projects

<table>
<thead>
<tr>
<th>Categories</th>
<th>IPO</th>
<th>Crowdfunding</th>
<th>VC</th>
<th>ICO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investor Type</strong></td>
<td>Retail and institutional investors</td>
<td>Retail investors</td>
<td>Accredited investors</td>
<td>Blockchain professionals and retail investors</td>
</tr>
<tr>
<td><strong>Type of project / ventures</strong></td>
<td>All real-world and online businesses</td>
<td>Mostly small artistic, travel, social ventures</td>
<td>All real-world and online businesses</td>
<td>Mostly blockchain projects</td>
</tr>
<tr>
<td><strong>Company stage</strong></td>
<td>All – Plan to mature</td>
<td>Business Plan</td>
<td>Business plan to early stage</td>
<td>Technical paper</td>
</tr>
<tr>
<td><strong>Ownership</strong></td>
<td>Equity shares</td>
<td>Reward, equity, token, donation</td>
<td>GP and LP</td>
<td>Tokens</td>
</tr>
<tr>
<td><strong>Holding period</strong></td>
<td>Immediate to long-term</td>
<td>Till project completion</td>
<td>5 – 10 years</td>
<td>Immediate to long-term</td>
</tr>
</tbody>
</table>
What kind of projects can raise money from ICOs?

Projects have moved from blockchain protocols to online applications and real-world projects.

**Protocols**
New blockchain protocols similar to Ethereum, Bitcoin

**Decentralized applications**
Decentralized applications running on blockchain platforms such as:
- Database storage
- Gaming platforms
- Communication and social networks

**Autonomous organization**
Decentralized organization for managing enterprises and other types of associations (e.g., elections)

**Real-world**
Real-world projects (real estate investment, film financing, medical devices, virtual-reality, etc.)
Risks of ICOs

The SEC has warned investors of a limited recovery in case of an ICO fraud or theft.

1. **Regulatory grey zone**
   ICOs seem to currently lie in a regulatory grey area, as the tokens are, according to a recent SEC case, subject to securities laws when certain conditions are met.

2. **Lack of investor control**
   Investors cannot control any strategic, operational, or financial actions of promoters, who do not have any legal or fiduciary obligations.

3. **Founder knowledge**
   Founders are usually blockchain enthusiasts, specializing in technical knowledge, but may lack business and management acumen often required to grow and sustain a business.

Source: Securities and Exchange Commission
Bitcoin hard fork – setting a precedent, or a unique occurrence?

The whole of Bitcoin (BTC) was copied to start Bitcoin Cash (BCH)

Why?

To more quickly scale the size of blocks of transactions on the blockchain (20 transactions per second vs 5).

What was done?

The code AND the entire blockchain of BTC was copied to create BCH, and “enhanced” with 8 times the block transaction capacity.

What does it mean practically?

After the fork, an owner of BTC is now an owner of BCH without having to do anything... if their wallet providers allow it.

Source: CoinDesk
Polling question #3

Which of the following statements best represents your view on open source software?

- I think open source software is helpful, but it has many downsides, such as the lack of a company’s guarantee
- I think using and contributing to open source software increases innovation
- I think open source software limits innovation
- Open source software has a long way to go before being taken seriously by commercial entities
- I do not have a view
- Don’t know/Not applicable
Open source and blockchain
Open source software has a long history

Evolution of OSS

1950’s
First computers developed and adopted

1960’s
Universities develop and share software improvements

1970’s
Operating systems limited the number of modifications to software

1980’s
OSS development led by programmers at a small scale. Launch of GNU project.

1990’s
OSS is boosted by development of Linux, adoption of internet, and by development of web tools.

2000’s
OSS is actively embraced by large tech companies and powered by new tools and platforms.

Today
OSS developed by firms, organizations and individuals and permeate multiple industries.

Open software is rapidly evolving

OSS involvement of commercial entities greatly reduced in 80’s-90’s due to patenting, fees, and bundled business model (hardware-software). Commercial entities increased their participation in OSS as tech development moved faster, patenting became too expansive, and new business models and tools for software development arose.


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Open Source Software helps in the development, diffusion and adoption of new technologies

OSS has helped created the right conditions for the development of new technologies

- OSS licenses can provide flexibility to adapt and modify software according to business needs, thus creating incentives to develop tailored tools.

- Software development platforms such as GitHub, GitLab, BitBucket, etc. offer multiple tools to developers interested in contributing to OSS projects, increasing collaboration and productivity.

- Once a project is developed and adopted, new applications are often built based on the original.

- Many large firms are evolving their business models to provide additional services on top of OSS solving scalability issues and promoting more innovation.
Blockchain technology evolution is highly intertwined with flourishing OSS ecosystem.

Since its inception blockchain technology has been tied to open source.

Core code of Bitcoin is Hosted in GitHub
In April of 2009 the core code behind Bitcoin is published on GitHub. It gains traction and multiple users contribute to its development.

Bitcoin interfaces developed for multiple languages
Programmers develop Bitcoin interfaces in multiple languages so they could create applications in their favorite language.

Ethereum is launched in GitHub in 2014
Project Ethereum is launched to facilitate the creation of applications around blockchain.

GitHub primary platform to discuss changes and the future of Blockchain
Recent modifications to Bitcoin were discussed thoroughly by developers on GitHub before adapting them (BIP 91, BIP 148, Segwit, etc.)

As technology matures multiple actors develop applications for Ethereum and Bitcoin
Many firms, startups, organizations, etc. are actively developing new applications and hosting their projects on GitHub.

Bitcoin Paper Published in 2008
Published under pseudonym Satoshi Nakamoto in cryptography newsletter for developers.

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What can open source teach us about Blockchain?

Financial institutions interested in developing blockchain solutions can understand the full, comprehensive, holistic blockchain ecosystem as it unfolds.

These insights can help FIs make the right decisions and avoid pitfalls (e.g., scalability issues, security protocols).

It enables financial institutions to understand the technical developments and identify nascent trends.

Provides new metrics to decide which platforms to use when building Blockchain technology in financial services.

Assess how different solutions are connected to each other and also determine how technologies in the ecosystem are developing (e.g., digital payments, cryptography, digital identity, smart contracts, database management).

Understand/predict what languages are gaining/losing traction for what types of applications, and invest accordingly.

Determine where talent exists and how best to leverage the geographic distribution of talent and projects.
What is GitHub

GitHub is an open source software platform

GitHub is one of the largest software development collaboration platforms in the world, particularly popular in the open software community.

It has a large base of users and projects with more than:

• 18 million GitHub users\(^1\)
• 57 million repositories\(^1\)
• 337 different languages represented\(^2\)

Some of the most relevant projects for the Blockchain ecosystem are hosted, developed and discussed on GitHub. Further, discussions improvements and prototypes for new projects are first developed there.

Polling question #4

What is your view of GitHub?

• I have never heard of GitHub
• That GitHub is an open source platform for software development
• That GitHub is a private proprietary platform where commercial entities develop software
• That GitHub is an academic institution to promote innovation in software development
• Don’t know/Not applicable
Analyzing blockchain projects on GitHub
Understanding the Blockchain ecosystem

How many projects are in the network?

~85,900 projects

9,800+ projects by companies, research institutions, and startups

Finding: projects of organizations are 5 times more likely to be forked (copied).

How fast is it growing?

Averaging 8,904 per year but with 27,000+ in 2016

Finding: Projects developed by orgs register fastest adoption rate: 30% CAGR

Project survival?

Only 7-8% of projects are actively maintained

Finding: Only 5% of forked projects survive

Projects have average lifespan of 1.03 years

Finding: There are very few projects with high longevity


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Growth of blockchain projects 2009-2017

As blockchain technology matures more organizations are developing projects.

Software foundations, research institutions, and firms are central for the development of blockchain.

Despite accounting for 11% of total projects, organizations produced 30% of code. **18 of the 20 most central projects in the network are maintained by organizations.**

Commercially backed blockchain applications are flourishing on open source

<table>
<thead>
<tr>
<th>Blockchain applications</th>
<th>Commercial grade</th>
<th>Non Commercial</th>
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<tbody>
<tr>
<td><strong>Wallets</strong></td>
<td>bitaddress</td>
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<td>eth-lightwallet</td>
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<td>breadwallet</td>
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<td>electrum</td>
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<td>coinbase</td>
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<td><strong>Exchanges</strong></td>
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<td>txbits</td>
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<td>bitfinex-api-go</td>
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<td><strong>Cryptocurrencies</strong></td>
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<td><strong>Investment, payment, and lending</strong></td>
<td>Dapp-fund</td>
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<td><strong>platforms</strong></td>
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<td><strong>Smart Contracts</strong></td>
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<td>and ledgers</td>
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<td>fabric, etc.)</td>
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<td>Azure-blockchain</td>
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High performance languages are the backbone of blockchain technologies

Understanding the demand of skills for blockchain

• The resource intensive and technical sophistication of Blockchain requires high performing languages, similar to the ones used in traditional finance.

• C++ accounts for almost one third of all the content created for Blockchain.
  – For the most central repositories C++ accounts for almost half of all the content.

• However new languages are becoming more prevalent
  – Go, the programming language developed by Google is becoming more central for the Blockchain technology.

Language pick can be critical scalability of projects

Rapid prototyping of Blockchain projects can be impacted by choice of language

- Projects written in C#, C and C++ are updated more frequently than those developed in other languages.

- These languages are more common in organizations and in the most watched repositories.

- The C language family is important for the development of high-performance software.
  - C++ is often used on Wall Street.

- They also serve as a natural selection mechanism for collaborators in the network given their complexity.

Organizations, particularly startups, face tradeoff between rapid prototyping and scalability

**Disadvantages**

- C family suite presents high entry barrier
  - Prototyping requires good understanding of compiled languages.
  - Sophisticated languages harder to debug.

**Benefits**

- Code that can be scaled
  - Particularly relevant for projects that look to rapidly grow user base.
    - Usually higher levels of security, critical for financial applications.
Blockchain projects are clustered around communities

Communities of projects show several different specializations

- The Bitcoin network of projects can be divided into 765 communities.
  - The average community has 21 projects with some of the largest ones boasting hundreds of members.
- Every community encompasses projects and authors that collaborate in the development of the Blockchain ecosystem.
  - The communities indicate the degree of development of Blockchain technologies.
  - Communities also highlight prevailing technologies

The largest community is comprised of **Ethereum applications**

The second largest community is comprised of **Bitcoin applications**

Factors that are associated to projects becoming stalled

Projects not developed by organizations tend to stall

- Our analysis shows **two factors as the most significantly correlated with the mortality of a repository**:
  - Share of total collaborations in a project conducted by the highest contributor (**top author of code**).
    - On average the top author accounts for 80 percent of all collaborations.
    - This relationship holds for users and organizations.
    - Surprisingly, the number of authors does not seem to be a statistically significant indicator of project mortality.
  - **Number of copies** (forks) made of a repository.

Development of projects is concentrated in the US and Europe
Fintech hubs concentrate talent, projects and capital

- About 38 percent of the projects we study have geographic information.

- San Francisco has the largest amount of projects (1,212) followed by London (576) and New York (547).

- There are 196 different cities collaborating in the creation of knowledge.
  - USA cities account for the majority of the network with 79 locations, followed by Canada (13), Germany (8), China (8) and the UK (8).

- In terms of centrality of collaboration across cities, Atlanta, Portland, Campina Grande (Brazil), and San Francisco are the most central cities in the network.
  - Collaboration between European and American cities accounts for a significant part of the network connections.

Question and answer
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