Sarah Swammy/Richard Thompson/Marvin Loh

CRYPTO UNCOVERED

The Evolution of Bitcoin and the Crypto Currency Marketplace

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Foreword

Sovereign fiat currency may one day be considered pocket change and what is today's crypto currency may become the basis for tomorrow's sovereign digital currency. Regardless of how soon this happens, one thing is certain: blockchain is the technology that will provide the ubiquitous digital portal through which all financial transactions will occur. While the markets in crypto currencies have been roiled by huge swings in recent valuations and while there are clear and present dangers for investors in these currencies, this underlying technology and the driving forces for the emergence of stable digital currencies *are* here.

Many people think of crypto currency versus canonical fiat currency. But, this comparison misses a crucial point about the latter, which is that most of our money and our transactions are fully electronic already. When was the last time you went to the bank to check on your money in their vault? So, it will not be as huge a jump as some may think for consumers and governments to move from where they are today with electronic finance to purely digital currencies. Having a digital currency become a nation's sovereign currency and disintermediated by way of blockchain technology is very intriguing. Do we really need a bank between us and our money in the not too distant future? Crypto currencies may have a long road to travel if they are to ever *replace* the dollar or the euro but the transition to nationally denominated, sovereign digital currencies that are open, honest, and unconcealed, but secured by blockchain may happen sooner than many suggest or expect.

We are already seeing enormous investment in this new digital currency among the biggest and oldest financial institutions in the US. In July 2018, *Forbes* reported that Northern Trust has begun to integrate crypto currencies into several areas of business to create and more efficiently manage tradable digital assets.

"You can take anything today. You can take movie rights, you can take all sorts of entities, and you can create a token for those," Pete Cherecwich, president of Northern Trust's corporate and institutional services, told *Forbes*. "We have to be able to figure out how to hold those tokens, value those tokens, do those things."

Although Jamie Dimon, CEO of JP Morgan Chase, has professed no interest in crypto currencies, they are now attracting greater attention from many other traditional financial institutions and investors. In fact, KPMG reported in August 2018 that US investment in blockchain during the first six months exceeded all of 2017. The reason? Blockchain is no longer an experiment in crypto currency; it is the real deal with the potential to revolutionize the financial sector. But, just as assuredly, as digital currency gains momentum, we will see increased regulatory oversight from governments that seek to prevent market manipulation, reduce fraud, and minimize risk. China is a notable example of one nation that has recently and systematically cracked down on crypto currencies.

However, China is at the same time pushing forward with the underlying technology behind crypto currencies; the Chinese Ministry of Industry and Information Technology is looking to advance its adoption of blockchain to optimize its own financial industry and other sectors such as supply chain management. This is the "Jamie Dimon" approach and that of many financial institutions in the US and Europe, which is exemplified by a great interest in the underlying blockchain technology that fuels crypto currencies, while remaining skeptical about Bitcoin, Ethereum, Ripple, and other digital currencies themselves. Significantly, at the time of this writing, the Chinese Communist Party just announced that through its People's Daily Publishing House it has made available a book entitled *Blockchain—A Guide for Officials*, which is a primer on distributed ledger technology. This follows closely on the heels of an announcement by the Bank of China to invest more than 1% of its annual revenue in blockchain and other financial technologies.

Regardless of where the major players stand, one thing is clear: through crypto currencies, we are witnessing the promise of blockchain unfold in real time—the idea of massively distributed authentication and recordkeeping without the intermediary is incredibly disruptive in prospect. All of this may lead to financial ecosystems that are safer, more privatized, and more efficient.

The potential for blockchain to disrupt our world goes well beyond crypto currency, banking, and finance. It could come to the rescue of faulty science by authenticating and certifying published research data that surpasses peer review. In doing so, the scientific community could reduce errors (it is estimated that over two-thirds of experiments are unable to be replicated by other scientists).

As blockchain becomes more widely accepted as a first-rate credibility standard, researchers could post results online directly, thus enabling the scientific community to share information more quickly and more accurately.

The possibilities are unceasing: in higher education, blockchain can assess a person's competency by certifying skills, experience, and knowledge to future employers; in medicine, it can help reduce health care costs; and among government agencies, it may help reduce waste and overexpenditures.

The nascent yet intriguing realm of crypto currencies only ensures that blockchain technology will continue to attract investors, innovators, entrepreneurs, and educators. This last group will be essential in teaching the future generations of computer science and financial experts who will take us from today's "dial up" era of crypto currencies to a new era of stability, security, and sovereignty.

As the president of an academic institution focusing on technology writ large and more recently on blockchain technology in particular, I am proud that New York Institute of Technology (NYIT) alumna and co-author Sarah Swammy, as well as contributor and faculty member Steven J. Shapiro, have shared their expertise in this book to help readers better understand the past, present, and future potential of crypto currencies.

Blockchain technology will continue to evolve by building upon the technologies that led to its inception and innovation. Its evolution will accelerate at a faster pace. Perhaps, in contrast to how the internet and World Wide Web evolved, the unfolding of blockchain technology, crypto currencies, and their collective impact will follow a more managed and predictable evolutionary path course. Alternatively, they may evolve, adapt, and diversify spontaneously in new and very undirected ways. My Bitcoin is on the latter.

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Henry C. "Hank" Foley

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Dan Castro is the Founder of Robust Advisors, Inc., an independent consulting company focusing on structured finance markets, including Asset Backed Securities (ABS), Residential Mortgage Backed Securities (RMBS), Commercial Mortgage Backed Securities (CMBS), Collateralized Debt Obligations (CDOs), Asset Backed Commercial Paper (ABCP), Structured Investment Vehicles (SIVs), and other structured finance securities. Robust

Advisors provides due diligence, valuation, expert witness, litigation support, and general consulting services. Robust Advisors, Inc.'s clients include banks, broker-dealers, hedge funds, insurance companies, issuers, originators, rating agencies, and trustees.

Dan has been involved in the Fixed Income and Structure Finance Markets for over 30 years. His experience includes mortgage origination, underwriting, and servicing, mortgage banking, and broad knowledge of ABS, RMBS, CMBS, CDOs, Real Estate Investment Trusts (REITs), ABCP, SIVs, and other structured finance products. Dan has a particularly broad perspective on the market and has worked as a strategist, quantitative analyst, banker, rating agency analyst, research analyst, collateral manager, fund manager, Chief Investment Officer, Chief Credit Officer, Chief Risk Officer, salesman, and investor.

Dan has been on both the sell side and buy side of the market (buying and selling billions of dollars of ABS, RMBS, CMBS, and CDOs) and has a thorough understanding of both the big picture and nuances of the fixed income and structured finance markets. During the time Dan ran Merrill Lynch's Structured Finance Research Group (1991–2004), he was voted to the Institutional Investor All-America Fixed Income Research Team for 13 consecutive years, and was recognized for his expertise in ABS, RMBS, CDOs, and mortgage prepayments. He was the top-ranked analyst for ABS Strategy in the industry multiple times according to the Institutional Investor industry poll.

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From 2005 to 2008, Dan was Managing Director, Chief Credit Officer, and a portfolio manager for the Structured Finance Group at GSC Group, an investment management firm that also served as a CDO Fund Manager. While at GSC, Dan was also the Chief Investment Officer of an REIT named GSC Capital Corp. From 1991 to 2004, Dan was Head of the Structured Finance Research Department at Merrill Lynch. Before joining Merrill Lynch, Dan was a senior analyst at Moody's Investor Service from 1987 to 1991, and chaired ABS and RMBS rating committees from 1990 to 1991. From 1984 to 1987, Dan worked at Citicorp where he was an analyst and banker.

Dan holds an MBA in Finance from Washington University, preceded by a Bachelor of Arts degree (B.A.) in Government from the University of Notre Dame.

Marvin Loh has 30 years of experience in the financial service industry where he has been an analyst at various firms covering a multitude of asset classes. At present, he follows global macro themes for BNY Mellon, where he evaluates asset valuations by looking for intersections within the foreign exchange, fixed income and equity markets, both domestically and globally. Prior roles have included the director of research at W.R. Hambrecht and Fidelity Capital Markets. Marvin has also been active in identifying disruptive technologies and business models, having contributed to various white papers over his career.

Steven J. Shapiro, Ph.D. is Professor of Finance in the School of Management at New York Institute of Technology (NYIT), where he is also the Director of the Center for Risk Management. His research interests include cryptocurrency pricing, risk, and returns; assessment of the risk of the shares of closely held companies; finance event studies; and applications of economics and finance to issues in litigation. Professionally, Steven has testified on damages in personal injury, wrongful death, employment, intellectual property, antitrust, and commercial litigation. He has experience conducting statistical tests of employment discrimination and competitive analysis in antitrust litigation. He is also experienced in valuing the shares of private companies, stock-based compensation (including employee stock options), and pensions. Steven holds a BA in Economics from the University of Virginia and an MA and Ph.D. in Economics from Georgetown University.

Sarah Swammy is a Senior Vice President and Chief Operating Officer for the Portfolio Solutions businesses in both State Street Global Market, LLC, a registered broker-dealer subsidiary of State Street Bank and Trust, and State Street Bank and Trust. Sarah joined State Street from BNY Mellon where she held several leadership positions and has held compliance positions at Deutsche Bank Securities, Inc., CSFB, and Barclays Capital, Inc. Sarah is the executive editor and contributing author *of The Capital Markets: Evolution of the Financial Ecosystem* and author of *Governance Compliance and Supervision of the Capital Markets*. She is an adjunct instructor at New York University School of Professional Services and serves as a member of New York Institute of Technology Advisory Board in the School of Management. Sarah holds a BS in Business Administration, an MS in Human Resources Management and Labor Relations from New York Institute of Technology, an MA in

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Richard Thompson is the Chief Executive Officer at Digital AIR Technologies and Analytics, which he founded with the vision of marrying the immense power and scalability of modern cloud architecture with cutting-edge institutional business software to overcome technological challenges faced by enterprises today. With more than 20 years of experience directing the development of world-class institutional financial systems and pioneering the next generation of "cloud" technology, Richard is widely acknowledged as one of the foremost IT architects and technologists in the financial industry. Prior to Digital AIR Technology, Richard was Chief Information Officer and principal founder of Incapture Technologies, a director and front office systems designer/architect for Blackrock Solutions, and a director at Barclays Global Investors (BGI) for front office technologies. His many achievements include designing quantitative enterprise systems for Barclays Capital as head of the NY Derivatives Technologies and Trading Platforms, directing the development and implementation of BGI's fixed-income asset management system and creating front-office tools for BlackRock's Aladdin. Richard attended Cornell University for a program in Mathematics and Applied and Engineering Physics. He also attended NJIT for Master Programs in computer science and Carnegie Mellon University for a Master of Financial Engineering.

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History of Money

Sarah Swammy, Richard Thompson, and Marvin Loh

For the love of money is the root of all evil[1]
All money is a matter of belief[2]
Money makes the world go round[3]

As the above quotes indicate, money has been around for a long time, and some would argue since the beginning of time. Money is so common that everyone has experience with it and likely interacts with it on a daily basis. This familiarity does not, however, mean that money is universally understood. Therefore, we will begin by providing the following definition of money as described by the International Monetary Fund.

Money can be anything that serves as the following:

(1) Store of Value, which means people can save it and use it later
(2) Unit of Account, that is, it provides a common base for prices
(3) Medium of Exchange, something that enables people to buy and sell from one another

While crypto currencies do not necessarily meet all of the definitional requirements at the moment, they do represent a natural evolution of money. Additionally, many of the most appealing aspects of crypto currencies

[1] 1 Timothy 6:10, King James Version.
[2] Adam Smith (1776).
[3] From the musical Cabaret, 1966.

S. Swammy et al., *Crypto Uncovered*, https://doi.org/10.1007/978-3-030-00135-3_1

attempt to address many of the issues that have plagued money throughout history. From the perspective of these challenges, we will start by providing a brief history of money.

Barter

While one of the earliest forms of money is often considered barter, it actually falls short of the International Monetary Fund's definitional requirements for money. In a pre-currency society it is certainly easy to see how barter naturally evolves, with the baker looking to trade his bread for butchered meat as envisioned by Adam Smith in *The Wealth of Nations*. Of course, the limitations also become obvious as the baker has to first find a butcher interested in trading for bread before even determining the ratio of the two goods. These two parties also need to find farmers with wheat and ranchers with cattle that are interested in providing the baker and butcher with their inputs. While there are aspects of a medium of exchange, the requirements that bread (or meat) is a store of value and unit of account are not accomplished in this example.

These types of exchanges eventually gave way to a more standardized approach that facilitated a greater variety of transactions. Within each community, there were generally some agricultural products that were widely demanded by a large portion of that population, such as grain that could be ground or planted. In these instances, merchants of all kinds would be more willing to accept the broadly desired commodity if there was a general ability to exchange that product for something else. In our example above, while the butcher may not want bread, he would accept grain from the baker that could then be used to exchange for livestock from a farmer. The farmer in turn would be incented to accept grain as payment if it could be used to acquire tools from the blacksmith. These are broad examples of the development of commodity money, with salt, tea, and seeds widely accepted forms of "commodity money."

There are a few key points to take away from our example; firstly, grain has the potential to evolve into a unit of account and a medium of exchange, although its store of value is only as long as the grain does not spoil. An additional observation is that the success of grain as a currency is based on the broad-based belief in its convertibility into other goods and services. If that belief were suspended by enough of the community's population, the appeal of accepting grain would be hampered and only those that naturally needed it would continue to partake in this form of barter. This situation would then convert grain into just another bartered product that is limited by many of the