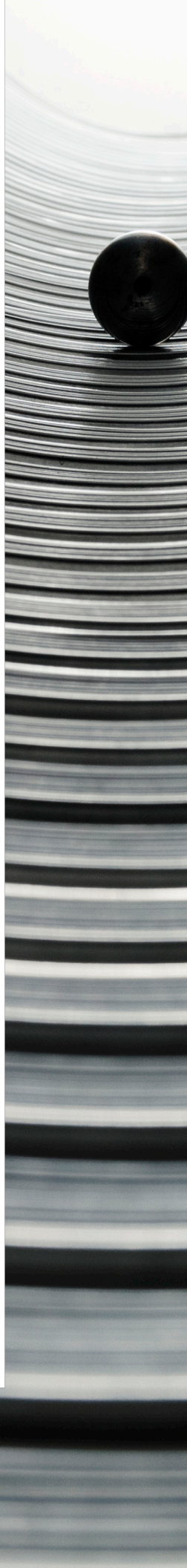
Morgan Stanley
INVESTMENT MANAGEMENT

Counterpoint Global Insights

Blockchain

EDGE | MAY 2018



WELCOME TO THE EDGE.
Morgan Stanley Investment Management's Counterpoint Global shares their proprietary views on a big idea that has the potential to trigger far-reaching consequences—ideas such as autonomous vehicles, machine learning and gene editing.

Counterpoint Global's long-term ownership mindset emphasizes perspective, insight and thinking across categories, while our investment process focuses on identifying unique companies with sustainable competitive advantages. Through The EDGE, we share our framework for thinking about change and our process for recognizing patterns that may drastically alter the investment landscape over the longer term.

This work complements our team's more traditional, fundamental research to create a framework for long-term investing that is grounded in intellectual curiosity and flexibility, perspective, self-awareness and partnership.

As the price of cryptocurrencies like bitcoin have fluctuated wildly over the last year, bitcoin, and blockchain, the underlying technology that powers it, have captured the popular imagination.

Blockchain at its heart is a distributed-ledger technology that employs cryptography to ensure the integrity of the data it stores. For all its hype, blockchain is basically just a novel approach to database architecture where control of the data is distributed among all the parties using it. This architecture is enabled by cryptography and the use of tokens (e.g. cryptocurrencies) as incentives for participants to perform the work to ensure the data's integrity. What makes blockchain so disruptive is its shared ledger eliminates the need for intermediaries to establish trust and authenticate identity between two untrusted parties who want to transact. As a result, blockchain has the potential to cut out the financial middleman.

How it works

Blockchain is a protocol for a shared ledger similar to the way that TCP/IP is a protocol enabling the internet. ▶

The views and opinions and/or analysis expressed herein are those of the investment team as of the date of preparation of this material, are subject to change at any time without notice due to market or economic conditions, and may not necessarily come to pass.

▶ Just as the internet has multiple websites, there are multiple blockchains including the most famous ones, bitcoin and ethereum. While each permissionless blockchain is slightly different in design, most share common features.

A permissionless blockchain is open to the public, meaning all the data is readable by every participant. The power of blockchain comes from this shared data, which can include anything from the ownership of a single bitcoin to property titles. Because the data is open to the public, care must be taken to ensure its integrity. Here, the key innovations of blockchain—using cryptography and proof of work to secure the contents of the shared ledger—come into play.

For example, take the bitcoin blockchain. Every ten minutes, a new block is added to the chain. Each block consists of three components: (1) the new transactions being added to the chain, (2) the previous block's "hash" (a fixed length output generated from an input string), and (3) a random number called a "nonce." Miners around the world compete to find a nonce that satisfies the requirements for the hash for the current block set forth by the bitcoin protocol. This protocol dynamically adjusts the difficulty of this task, depending on the amount of computing power currently dedicated to finding the next nonce, to ensure it always takes 10 minutes to find a nonce for each new block added to the chain *(Display 1)*. The first miner or team of miners to discover a valid nonce receives tokens (in this example, bitcoin) from the blockchain as a reward. Referred to as "proof of work," these token grants are the incentive that persuade miners to invest in and operate the infrastructure to confirm transactions.

What makes blockchain so disruptive is its potential to cut out the financial middleman.

Validation mechanisms vary among different blockchains, but they all work off the premise that people are rewarded for validating the transactions of the shared ledger. There are real costs to validating a transaction: time, computing power and electricity.

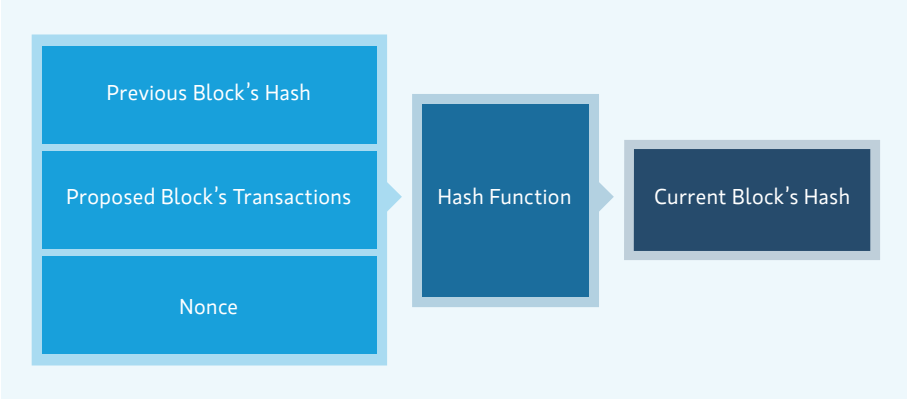
Because each prior block's hash is needed to generate the current block's hash, the system ensures that no one can go back and independently alter prior records in the blockchain (e.g. to give themselves more bitcoins). An altered record would immediately show discrepancies with other nodes in the blockchain and thus the protocol ignores the block that has a discrepancy from the rest of the blocks in the chain.

All told, blockchain is an open, shared technology that rewards hard work, and incorporates a system of security checks to ensure the integrity of the chain.

DISPLAY 1

Miners compete to be the first to find a nonce that satisfies the hash requirement

Each hash is designed to take 10 minutes to solve



Why It's Disruptive

What makes blockchain so disruptive is its decentralization of the ledger. All users of a given blockchain agree to the same set of facts, the ledger. This agreement eliminates the need for trust among participants and leads to new possibilities. For instance, titles to everything from property to securities to cryptocurrency can be written into blockchain. If two parties want to transact using the same blockchain, they can both verify that the other party has title to what they claim without the need for a financial intermediary facilitating the transaction. Blockchain effectively eliminates the clearing function in financial transactions and allows the parties to move almost immediately from execution to settlement. Hence, the time required for settlement collapses from multiple days to minutes. This change offers the potential to eliminate not only the back-office costs associated with clearing, but also the costs associated with putting up margin until a transaction closes.

While blockchain technology can be adopted by existing financial institutions to facilitate transactions, blockchain has the potential to enable a new set of payment rails that circumvents the existing financial establishment. In particular, cryptocurrencies are gaining traction as a form of payment for e-commerce transactions where there is a high risk of fraud and/or chargebacks. By accepting cryptocurrencies, merchants can bypass elevated credit card processing fees and lower their overall costs. Companies are also using blockchain in a range of other financial applications. For instance T0 is using blockchain to target the prime brokerage market.

In addition, blockchain has new capabilities such as the ability to deploy "smart contracts" that do not exist today. A smart contract is a self-executing contract that is written into the computer code. If the mutually agreed upon conditions of the transacting parties are met, the smart contract will execute automatically with transparency and no reversibility. The appeal of a smart contract lies in its potential to reduce transaction costs.

It is still unclear if bitcoin will become a lasting piece of the financial firmament or is just a passing fad. That said, at its heart, bitcoin provides the three key functions of a currency—it functions as a store of value, a mechanism of transaction, and a unit of account. Particularly in countries that have histories of financial instability, bitcoin could prove to be an attractive alternative to local currencies. It could potentially play a similar role to the one gold has historically, as a hedge against uncertainty. To put it in context, the bitcoin in circulation today is worth around $125 billion while the value of all gold ever mined is worth around $7.9 trillion. If bitcoin began to function more like gold on the world stage, those valuations could converge.

Challenges

We believe there are three key challenges that blockchain will need to overcome.

First, achieving critical mass. Blockchain-related technologies benefit from a network effect, meaning the addition of each person to the network increases the value of being on the network to everyone else. While a network effect is a strong competitive advantage in a mature

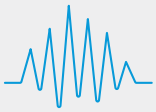
business, the downside is that they are very difficult to start, in part because small networks are not nearly as valuable as large networks to the end customer. It is possible that no blockchain will gain critical mass, which would prevent its advantages over traditional methods from materializing.

Second, regulatory uncertainty. Regulatory bodies across the globe have increased their focus on all aspects of blockchain related businesses. For instance, both China and South Korea have banned ICOs (initial coin offerings), a form of raising capital that has been gaining popularity. New regulations that limit what can be done with blockchain could reduce and/or eliminate its attractiveness versus traditional means of conducting financial transactions.

Third, high energy and storage demands. Challenges in scaling blockchains could prove insurmountable. Given that blockchains are distributed ledgers and that all the data stored on the blockchain is available at every node, the storage demands of such a system grow exponentially as more nodes/users are added to the overall system. The proof of work calculations needed to confirm bitcoin transactions also require a large amount of electricity. By some estimates, about as much electricity is used by the bitcoin proof of work calculations as by the entire country of Denmark.[1] In order to continue growing, changes to the protocols will need to be made to reduce their resource requirements.

Conclusions

Blockchain is still in the early innings of development. While it has the potential to become as ubiquitous as the internet over time, there are nevertheless many issues that need to be addressed. As with the internet, we will probably see a mixture of both blockchain native companies as well as companies adopting the technology to improve their existing business processes and to attack new market opportunities afforded by these new capabilities. We believe blockchain is a technology that will continue to garner increasing mindshare in the years ahead.



OTHER DISRUPTORS

Other themes the team is currently researching include

- Autonomous vehicles
- Machine learning
- Gene editing

Risk Considerations

There is no assurance that a Portfolio will achieve its investment objective. Portfolios are subject to **market risk**, which is the possibility that the market values of securities owned by the Portfolio will decline and that the value of Portfolio shares may therefore be less than what you paid for them. Market values can change daily due to economic and other events (e.g. natural disasters, health crises, terrorism, conflicts and social unrest) that affect markets, countries, companies or governments. It is difficult to predict the timing, duration, and potential adverse effects (e.g. portfolio liquidity) of events. Accordingly, you can lose money investing in this Portfolio. Please be aware that this Portfolio may be subject to certain additional risks. In general, **equities securities'** values also fluctuate in response to activities specific to a company. Investments in **foreign markets** entail special risks such as currency, political, economic, market and liquidity risks. The risks of investing in **emerging market countries** are greater than risks associated with investments in foreign developed countries. **Privately placed and restricted securities** may be subject to resale restrictions as well as a lack of publicly available information, which will increase their illiquidity and could adversely affect the ability to value and sell them (liquidity risk). **Derivative instruments** may disproportionately increase losses and have a significant impact on performance. They also may be subject to counterparty, liquidity, valuation, correlation and market risks. **Illiquid securities** may be more difficult to sell and value than public traded securities (liquidity risk). **Cryptocurrency** (notably, Bitcoin) operates as a decentralized, peer-to-peer financial exchange and value storage that is used like money. It is not backed by any government. Federal, state or foreign governments may restrict the use and exchange of cryptocurrency. Cryptocurrency may experience very high volatility.

[1] Ars Technica, "Bitcoin's insane energy consumption, explained", December 6, 2017.

DISTRIBUTION

This material is only intended for and will only be distributed to persons resident in jurisdictions where such distribution or availability would not be contrary to local laws or regulations.

MSIM, the asset management division of Morgan Stanley (NYSE: MS), and its affiliates have arrangements in place to market each other's products and services. Each MSIM affiliate is regulated as appropriate in the jurisdiction it operates. MSIM's affiliates are: Eaton Vance Management (International) Limited, Eaton Vance Advisers International Ltd, Calvert Research and Management, Eaton Vance Management, Parametric Portfolio Associates LLC, and Atlanta Capital Management LLC.

This material has been issued by any one or more of the following entities:

EMEA

This material is for Professional Clients/Accredited Investors only.

In the EU, MSIM and Eaton Vance materials are issued by MSIM Fund Management (Ireland) Limited ("FMIL"). FMIL is regulated by the Central Bank of Ireland and is incorporated in Ireland as a private company limited by shares with company registration number 616661 and has its registered address at 24-26 City Quay, Dublin 2, D02 NY19, Ireland.

Outside the EU, MSIM materials are issued by Morgan Stanley Investment Management Limited (MSIM Ltd) is authorised and regulated by the Financial Conduct Authority. Registered in England. Registered No. 1981121. Registered Office: 25 Cabot Square, Canary Wharf, London E14 4QA.

In Switzerland, MSIM materials are issued by Morgan Stanley & Co. International plc, London (Zurich Branch) Authorised and regulated by the Eidgenössische Finanzmarktaufsicht ("FINMA"). Registered Office: Beethovenstrasse 33, 8002 Zurich, Switzerland.

Outside the US and EU, Eaton Vance materials are issued by Eaton Vance Management (International) Limited ("EVMI") 125 Old Broad Street, London, EC2N 1AR, UK, which is authorised and regulated in the United Kingdom by the Financial Conduct Authority.

Italy: MSIM FMIL (Milan Branch), (Sede Secondaria di Milano) Palazzo Serbelloni Corso Venezia, 16 20121 Milano, Italy. The **Netherlands:** MSIM FMIL (Amsterdam Branch), Rembrandt Tower, 11th Floor Amstelplein 1 1096HA, Netherlands. **France:** MSIM FMIL (Paris Branch), 61 rue de Monceau 75008 Paris, France. **Spain:** MSIM FMIL (Madrid Branch), Calle Serrano 55, 28006, Madrid, Spain. **Germany:** MSIM FMIL Frankfurt Branch, Große Gallusstraße 18, 60312 Frankfurt am Main, Germany (Gattung: Zweigniederlassung (FDI) gem. § 53b KWG). **Denmark:** MSIM FMIL (Copenhagen Branch), Gorrissen Federspiel, Axel Towers, Axeltorv2, 1609 Copenhagen V, Denmark.

MIDDLE EAST

Dubai: MSIM Ltd (Representative Office, Unit Precinct 3-7th Floor-Unit 701 and 702, Level 7, Gate Precinct Building 3, Dubai International Financial Centre, Dubai, 506501, United Arab Emirates. Telephone: +97 (0)14 709 7158).

This document is distributed in the Dubai International Financial Centre by Morgan Stanley Investment Management Limited (Representative Office), an entity regulated by the Dubai Financial Services Authority ("DFSA"). It is intended for use by professional clients and market counterparties only. This document is not intended for distribution to retail clients, and retail clients should not act upon the information contained in this document.

This document relates to a financial product which is not subject to any form of regulation or approval by the DFSA. The DFSA has no responsibility for reviewing or verifying any documents in connection with this financial product. Accordingly, the DFSA has not approved this document or any other associated documents nor taken any steps to verify the information set out in this document, and has no responsibility for it. The financial product to which this document relates may be illiquid and/or subject to restrictions on its resale or transfer. Prospective purchasers should conduct their own due diligence on the financial product. If you do not understand the contents of this document, you should consult an authorised financial adviser.

U.S.

NOT FDIC INSURED. OFFER NO BANK GUARANTEE. MAY LOSE VALUE. NOT INSURED BY ANY FEDERAL GOVERNMENT AGENCY. NOT A DEPOSIT.

Latin America (Brazil, Chile Colombia, Mexico, Peru, and Uruguay)

This material is for use with an institutional investor or a qualified investor only. All information contained herein is confidential and is for the exclusive use and review of the intended addressee, and may not be passed on to any third party. This material is provided for informational purposes only and does not constitute a public offering, solicitation or recommendation to buy or sell for any product, service, security and/or strategy. A decision to invest should only be made after reading the strategy documentation and conducting in-depth and independent due diligence.

ASIA PACIFIC

Hong Kong: This material is disseminated by Morgan Stanley Asia Limited for use in Hong Kong and shall only be made available to "professional investors" as defined under the Securities and Futures Ordinance of Hong Kong (Cap 571). The contents of this material have not been reviewed nor approved by any regulatory authority including the Securities and Futures Commission in Hong Kong. Accordingly, save where an exemption is available under the relevant law, this material shall not be issued, circulated, distributed, directed at, or made available to, the public in Hong Kong. **Singapore:** This material is disseminated by Morgan Stanley Investment Management Company and should not be considered to be the subject of an invitation for subscription or purchase, whether directly or indirectly, to the public or any member of the public in Singapore other than (i) to an institutional investor under section 304 of the Securities and Futures Act, Chapter 289 of Singapore ("SFA"); (ii) to a "relevant person" (which includes an accredited investor) pursuant to section 305 of the SFA, and such distribution is in accordance with the conditions specified in section 305 of the SFA; or (iii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA. This publication has not been reviewed by the Monetary Authority of Singapore. **Australia:** This material is provided by Morgan Stanley Investment Management (Australia) Pty Ltd ABN 22122040037, AFSL No. 314182 and its affiliates and does not constitute an offer of interests. Morgan Stanley Investment Management (Australia) Pty Limited arranges for MSIM affiliates to provide financial services to Australian wholesale clients. Interests will only be offered in circumstances under which no disclosure is required under the Corporations Act 2001 (Cth) (the "Corporations Act"). Any offer of interests will not purport to be an offer of interests in circumstances under which disclosure is required under the Corporations Act and will only be made to persons who qualify as a "wholesale client" (as defined in the Corporations Act). This material will not be lodged with the Australian Securities and Investments Commission.
Japan: For professional investors, this material is circulated or distributed for informational purposes only. For those who are not professional investors, this material is provided in relation to Morgan Stanley Investment Management (Japan) Co., Ltd. ("MSIMJ")'s business with respect to discretionary investment management agreements ("IMA") and investment advisory agreements ("IAA"). This is not for the purpose of a recommendation or solicitation of transactions or offers any particular financial instruments. Under an IMA, with respect to management of assets of a client, the client prescribes basic management policies in advance and commissions MSIMJ to make all investment decisions based on an analysis of the value, etc. of the securities, and MSIMJ accepts such commission. The client shall delegate to MSIMJ the authorities necessary for making investment. MSIMJ exercises the delegated authorities based on investment decisions of MSIMJ, and the client shall not make individual instructions. All investment profits and losses belong to the clients; principal is not guaranteed. Please consider the investment objectives and nature of risks before investing. As an investment advisory fee for an IAA or an IMA, the amount of assets subject to the contract multiplied by a certain rate (the upper limit is 2.20% per annum (including tax)) shall be incurred in proportion to the contract period. For some strategies, a contingency fee may be incurred in addition to the fee mentioned above. Indirect charges also may be incurred, such as brokerage commissions for incorporated securities. Since these charges and expenses are different depending on a contract and other factors, MSIMJ cannot present the rates, upper limits, etc. in advance. All clients should read the Documents Provided Prior to the Conclusion of a Contract carefully before executing an agreement. This material is disseminated in Japan by MSIMJ, Registered No. 410 (Director of Kanto Local Finance Bureau (Financial Instruments Firms)), Membership: the Japan Securities Dealers Association, The Investment Trusts Association, Japan, the Japan Investment Advisers Association and the Type II Financial Instruments Firms Association.

IMPORTANT INFORMATION

There is no guarantee that any investment strategy will work under all market conditions, and each investor should evaluate their ability to invest for the long-term, especially during periods of downturn in the market.

A separately managed account may not be appropriate for all investors. Separate accounts managed according to the Strategy include a number of securities and will not necessarily track the performance of any index. Please consider the investment objectives, risks and fees of the Strategy carefully before investing. A minimum asset level is required.

For important information about the investment managers, please refer to Form ADV Part 2.

The views and opinions and/or analysis expressed are those of the author or the investment team as of the date of preparation of this material and are subject to change at any time without notice due to market or economic conditions and may not necessarily come to pass. Furthermore, the views will not be updated or otherwise revised to reflect information that subsequently becomes available or circumstances existing, or changes occurring, after the date of publication. The views expressed do not reflect the opinions of all investment personnel at Morgan Stanley Investment Management (MSIM) and its subsidiaries and affiliates (collectively "the Firm"), and may not be reflected in all the strategies and products that the Firm offers.

Forecasts and/or estimates provided herein are subject to change and may not actually come to pass. Information regarding expected market returns and market outlooks is based on the research, analysis and opinions of the authors or the investment team. These conclusions are speculative in nature, may not come to pass and are not intended to predict the future performance of any specific strategy or product the Firm offers. Future results may differ significantly depending on factors such as changes in securities or financial markets or general economic conditions.

This material has been prepared on the basis of publicly available information, internally developed data and other third-party sources believed to be reliable. However, no assurances are provided regarding the reliability of such information and the Firm has not sought to independently verify information taken from public and third-party sources.

This material is a general communication, which is not impartial and all information provided has been prepared solely for informational and educational purposes and does not constitute an offer or a recommendation to buy or sell any particular security or to adopt any specific investment strategy. The information herein has not been based on a consideration of any individual investor circumstances and is not investment advice, nor should it be construed in any way as tax, accounting, legal or regulatory advice. To that end, investors should seek independent legal and financial advice, including advice as to tax consequences, before making any investment decision.

Charts and graphs provided herein are for illustrative purposes only. **Past performance is no guarantee of future results.**

This material is not a product of Morgan Stanley's Research Department and should not be regarded as a research material or a recommendation.

The Firm has not authorised financial intermediaries to use and to distribute this material, unless such use and distribution is made in accordance with applicable law and regulation. Additionally, financial intermediaries are required to satisfy themselves that the information in this material is appropriate for any person to whom they provide this material in view of that person's circumstances and purpose. The Firm shall not be liable for, and accepts no liability for, the use or misuse of this material by any such financial intermediary.

This material may be translated into other languages. Where such a translation is made this English version remains definitive. If there are any discrepancies between the English version and any version of this material in another language, the English version shall prevail.

The whole or any part of this material may not be directly or indirectly reproduced, copied, modified, used to create a derivative work, performed, displayed, published, posted, licensed, framed, distributed or transmitted or any of its contents disclosed to third parties without the Firm's express written consent. This material may not be linked to unless such hyperlink is for personal and non-commercial use. All information contained herein is proprietary and is protected under copyright and other applicable law.

Morgan Stanley Investment Management is the asset management division of Morgan Stanley.

Explore our site at **www.morganstanley.com/im**

© 2026 Morgan Stanley. All rights reserved.

RO 5287566 Exp. 03/31/2028 10949216_CH_0326 Lit-Link: CNTRPTEDGE-0518