Quarterly Investment Perspective

The Hype and Hope of Bitcoin and Blockchain

BESSEMER TRUST

Rebecca Patterson
Chief Investment Officer

Executive Summary

- **2017's meteoric price rise put cryptocurrency bitcoin and its underlying technology, blockchain, under a financial-market spotlight**
- **We find investors sharply divided on cryptocurrencies in particular: Some see the future, and others see fraud**
- **We are not convinced cryptocurrencies belong in Bessemer portfolios today; however, we think they will evolve and become more mainstream in the years ahead**
- **More and more Bessemer equity holdings are using blockchain in some way; we expect this to only grow going forward**

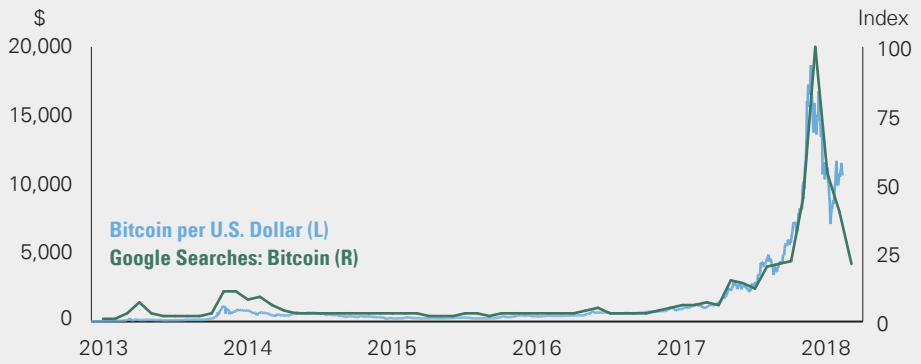
The last year saw bitcoin, a cryptocurrency, and blockchain, its technological foundation, move from curiosities to financial-market phenomenon, with the price of bitcoin skyrocketing by 1800% during 2017 to its mid-December peak (Exhibit 1). Yet as with politics, global trade, climate change, and other issues these days, cryptocurrencies and blockchain have proven exceptionally divisive, with die-hard believers facing off against staunch skeptics.

Who's right? Will we all be happily and profitably using blockchain's technology and cryptocurrencies in the future, or are one or both of these market focal points born out of a desperate search for investment returns, an abundance of cash looking for the next technology "unicorn," and some part of the population that wants an alternative currency?

In this *Quarterly Investment Perspective,* we dig into bitcoin (and other cryptocurrencies) and blockchain, endeavoring to separate hype from reality. In a nutshell, we are wary of cryptocurrencies today and have no interest in holding them in Bessemer portfolios, yet we can envisage a future where cryptocurrencies evolve and even become part of countries' formal money supply. Blockchain, meanwhile, already has shown its usefulness across a number of processes. Bessemer portfolios, in different ways, have exposure to this technology now and will likely see that grow over time.

Exhibit 1: The Price of Bitcoin and Worldwide Google Searches for Bitcoin

Key Takeaway: Investor interest in bitcoin skyrocketed through 2017 until hitting a peak in mid-December; a dramatic sell-off ensued.



As of March 7, 2018. Google search numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there was not enough data for this term.

Source: Bloomberg, Google

Bitcoin is generated through a computer process called mining and relies on peer-to-peer blockchain technology.

Back to Basics of Bitcoin and Blockchain

Before we get into the weeds, and to ensure our readers are on the same page, we want to quickly define bitcoin and blockchain. Bitcoin, launched in 2009 by an unknown programmer using the pseudonym Satoshi Nakamoto, is now the most widely used of some 1,400 cryptocurrencies. There are currently three main types of cryptocurrencies: monetary instruments, such as bitcoin; utility tokens, such as filecoin; and security tokens (used in "initial coin offerings," or ICOs; see page 8, "What is an ICO?," for a brief ICO primer).

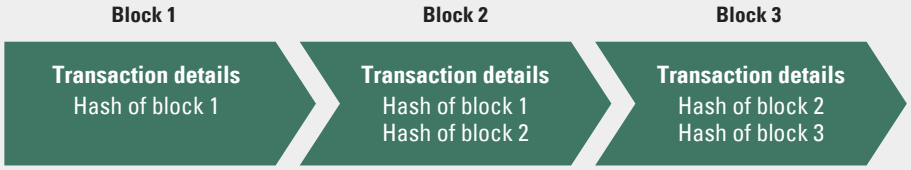
Bitcoin and other crypto, or digital, currencies are traded through online exchanges, including the U.S.-based Coinbase and Gemini. In contrast, fiat currencies (the paper money and coins in your wallet) are traded on the foreign exchange market, the world's largest financial market by volume, via participants such as investment banks, central banks, and retail traders.

Unlike fiat currencies issued by governments and overseen by central banks, bitcoin is generated through a computer process called mining and relies on peer-to-peer blockchain technology. Each individual who successfully adds a new block to the virtual chain is rewarded with bitcoins once the members of the blockchain network collectively validate the transaction. No public authority, such as a central bank or government, monitors these transactions. Bitcoin is self-governed.

In essence, blockchain technology is a sequential transaction database that is consensually shared and synchronized across a network of users. The first block is the initial, or genesis, transaction. Once a transaction occurs, a new block is added that contains a unique code linked to the prior transaction. New blocks are added through mining, also called the securing process. For instance, if Michael gives $15 to Claire and $20 to Steven, a block would list these transactions and contain the code that would tell all members of the blockchain that Michael started with $100 and had two subsequent transactions with Claire and Steven; the members of the network must validate the transactions before a subsequent block can be added.

Each block is encrypted with a unique code, called a hash, and includes the common transaction details and unique signatures of the parties involved in the transaction (Exhibit 2). Securing occurs when the members of the blockchain compete to solve for the unique hash using software specifically designed for this.

Exhibit 2: Blockchain Technology: Simplified Example



The first to confirm that a transaction is valid via the correct code is rewarded with cryptocurrency and a fee. All new blocks are linked to older blocks in chronological order, so all members of the network can see the transaction history and must approve of each new block added to the chain.

If a member of the blockchain attempts to make a fraudulent change to one of the blocks that has already been completed, all the subsequent blocks need to be changed as well. This is because the hash has been altered, and all the following transactions are based on the now-obsolete hash. The person who changed the hash must then recode all the invalid transactions via securing before any new blocks can be added to the network. This takes a tremendous amount of time and computing power. Additionally, all the members of the blockchain would know that a change has been made to one of the blocks. This provides a sense of security to all content within the network and is a comparative advantage of blockchain technology.

Additionally, blockchain technology can be split into two forms: public and private. Public blockchain simply means that anyone who takes part in the transaction can also read and write within the entire database. Cryptocurrencies are examples of these public ledgers and are ideal for their functionality because the individual members of the blockchain do not know each other. Meanwhile, private blockchains require each user to be approved via a market ID. This second type of blockchain, with transaction privacy, has captured the attention of a growing number of businesses.

The lack of formal public oversight and general anonymity of cryptocurrencies are what make them attractive to many users, but equally are what produce the most anxiety.

Luddites or Sound Skeptics?

While some doubt whether blockchain can live up to its hype and become an internet-like game changer, the more serious charges of "fraud" and "Ponzi scheme" (at times voiced by credible business people, policymakers, and academics) have targeted cryptocurrencies. The doubts center on at least three main issues.

- **Regulatory oversight and transparency**. The lack of formal public oversight and general anonymity of cryptocurrencies are what make them attractive to many users, but equally are what produce the most anxiety. If you deposit your money in a U.S. bank, the Federal Deposit Insurance Corporation (FDIC), among other institutions and rules, protects you at least in part from theft or fraud. If you sign up to invest in a cryptocurrency and your data and/or account is hacked, you usually have little recourse. Consider just three (of many) recent examples:
  - In February 2014, the then-largest bitcoin exchange, Mt. Gox, went bankrupt after hackers stole some 850,000 bitcoins that at the time were worth roughly $450 million.
  - In August 2016, the exchange Bitfinex said that hackers had stolen about $77 million worth of coins; customers had their deposits cut by 36% as a result.

Without credible data, investors can't be sure that the crypto playing field is actually fair.

– In January this year, Japanese exchange Coincheck had coins worth around $500 million stolen from some 260,000 users. As of March, customers did not know if they would receive any compensation.

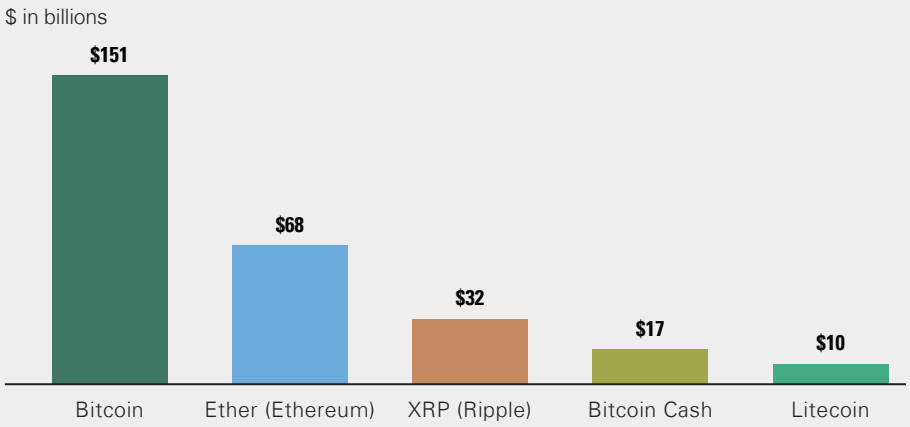
With very limited rules and guidelines for the cryptocurrency industry, firms often do not feel compelled to share much data with the public. And with minimal risk of recourse, crypto data is not as credible as information from a firm with multiple regulators. That becomes critical to anyone trying to research crypto-related businesses or coin valuations. For now, it is difficult to know with confidence who is buying these digital currencies (unless they reveal their public key) or whether or not a currency presents an attractive investment opportunity. One recent article provided a scary example of this: It suggested that about 40% of bitcoin is held by around 1,000 users and that large cryptocurrency holders could communicate with each other on buying or selling — effectively driving the broader market in their interest. Without credible data, investors can't be sure that the crypto playing field is actually fair. In the case of fiat money, valuations can be established, the integrity of the money is backed by the government and/or central bank in question, and market manipulators are punished.

The general lack of rules around cryptocurrencies also makes it relatively easy for someone to start a new one. One of the early attractions of bitcoin when it launched in 2009 — a time when the Federal Reserve was rapidly expanding its balance sheet and fueling fears of a dollar devaluation — was limited supply. Bitcoin's founder said that total supply would never exceed 21 million coins. For investors worried about central banks and traditional money, bitcoin, like gold, appealed from this perspective.

Today, bitcoin has a market capitalization around $220 billion, with roughly 80% of supply already mined. However, if one thinks about supply not in terms of bitcoin alone but cryptocurrencies in aggregate, the limited-supply argument loses authority. (There is also the issue of limited supply relying on the word of an unregulated, anonymous founder.) Crypto platforms Ethereum, Ripple, and Bitcoin Cash, for instance, have an additional market cap around $300 billion (Exhibit 3). After that, there are another 1,000-or-so currencies, albeit with very limited volumes. (Note that these tiny cryptos can be potentially more volatile than bitcoin, the latter falling more than 20% in a single day in mid-January.)

On a separate but related note, many of the digital currencies seem questionable in and of themselves. The founders of Dogecoin publicly state their currency was created as a joke (it now has a market capitalization of nearly $500 million). Kanye West created Coinye that proved short-lived, and there is now a "UET," a Useless Ethereum Token with the tagline "no value, no security, no product." The bottom line here is that limited supply seems questionable, as do a meaningful number of the actual currencies.

Exhibit 3: Top Five Cryptocurrencies by Market Capitalization



As of March 9, 2018.

Source: Coinmarketcap.com

Only a handful of large companies will take cryptocurrency as payment.

- **User experience.** While transacting in cryptocurrencies has become more efficient in recent years, it remains a relatively slow and expensive way to trade. On average, a bitcoin transaction can take 10 minutes. Another digital currency, Ripple's XRP, which touts itself as being the "fast money transfer network," claims a transaction takes only four seconds and that the platform can manage 1,500 transactions per second overall. While significantly better, compare it with another, more traditional electronic payment system: Visa. Visa claims it can handle more than 24,000 transactions per second.

  And while Visa, other credit cards, and cash are widely accepted around the world, cryptocurrencies still have limited use. Only a handful of large companies will take cryptocurrency as payment (often just limited to bitcoin). Most others are wary of the cryptocurrencies' volatility, the lack of regulation, and possibly the lack of clarity around taxation.

- **Cost to "mine."** As noted earlier, creating a blockchain requires people to perform large numbers of calculations to track and confirm transactions and earn bitcoins. As bitcoin values rise, mining, or securing, calculations become more difficult, in turn requiring more computing power and more energy along the way. Electric supply firm Elite Fixtures tallied electricity costs in different cities and countries to gauge how much it would cost to secure one bitcoin in different places. As of January 2018, a bitcoin secured in the U.S. would cost roughly $4,700. In South Korea, that cost would rise to more than $26,000 per coin. For context, the World Gold Council estimates that the all-in cost to mine an ounce of gold is around $1,000. A U.S. dollar bill, meanwhile, costs less than six cents to produce.

Cryptocurrency firms are working to identify and implement more efficient means to mine, possibly including making those validating the ledger to put capital at risk, or show "proof of stake." For the foreseeable future, though, cryptocurrencies will face cost and environmental perceptions as another challenge to broad-based acceptance.

The Other Side of the Crypto Coin

If there is so much wrong with bitcoin and other cryptocurrencies, why have they multiplied and (often) prospered? We can think of at least three reasons, all of which inspire crypto enthusiasts.

First, bitcoin was launched at a moment in time when a large number of investors were expecting that exceptionally easy U.S. monetary policy would undermine the dollar, and more Americans were becoming frustrated by politicians. Bitcoin and other cryptocurrencies, like gold, were seen as an alternate currency, divorced from dysfunctional governments and uncertain monetary policies (Exhibit 4).

Second, the last years' outperformance by technology firms and excitement around new applications for technology attracted people to cryptocurrencies and blockchain — in part because they truly believed in the transformational potential of the technology, and in part because they saw it as a path to quick profits. Consider Eastman Kodak as one example: In January, the 130-year-old company launched a digital currency (a "utility token") called KodakCoin to help photographers and agencies have greater control over image rights. A photographer should now be able to upload images to a platform called KodakOne, create a blockchain-based license for each image, and have clients pay with crypto KodakCoins. The underlying blockchain would create permanent records of image ownership and hopefully reduce the risk of copyright violators. Between the January announcement and early March, Kodak's share price was up by more than 70%, largely on this development.

A third driver of cryptocurrency interest is the anonymity and general lack of public-sector oversight — either to hide illegal activities or to move money out of countries (the latter sometimes to get around local country restrictions). It's not surprising that available data show that many cryptocurrency buyers are in countries either with capital controls or with what one could describe as questionable governments.

Looking Ahead: What's in Your Digital Wallet?

For the moment, there is no global consensus on how to define, monitor, or oversee cryptocurrencies. However, the growing interest in and success of these instruments, despite their myriad challenges, is quickly garnering the attention of more regulators, central banks, and governments — both to fight fraudulent use and to create industry best practices (Exhibit 5). In the U.S. this March, a federal judge upheld that cryptocurrencies, such as

Exhibit 4: Cryptocurrencies of Note

Bitcoin	XRP	Ether	ADA	Filecoin	Litecoin
Original cryptocurrency; currently most widely used	Ripple coin launched 2012; rapid digital payments	Launched 2015; electronic contracts and decentralized applications	Cardano coin launched 2017; similar to ether	Launched 2017; electronic data storage and retrieval	Launched 2011; similar to bitcoin but faster transactions

Source: Bessemer Trust

Exhibit 5: Cryptocurrency Regulations by Country

Key Takeaway: There is no global consensus on cryptocurrency rules and regulations … at least yet.

Australia	Crypto considered legal tender
China	Not considered legal tender; banned ICOs as of September 2017
Eurozone	ECB rejected Estonia's plans to launch digital currency
India	Created committee to study regulation of cryptocurrencies
Japan	Crypto classified as legal payment method; exchanges regulated
Russia	Exploring how to regulate cryptocurrencies
South Korea	Tougher restrictions announced in December 2017; now under review
Switzerland	Regulators supporting ICOs; trying to better define market
U.S.	CFTC allowed CME and CBOE to launch bitcoin futures

CME is Chicago Mercantile Exchange; CBOE is Chicago Board Options Exchange.
Source: Bessemer Trust, Bloomberg, Reuters

bitcoin, are commodities, and can therefore be regulated by the U.S. Commodity Futures Trading Commission, or CFTC. The CFTC, for its part, allowed for a bitcoin futures market to launch in December last year. (There remains an intellectual debate if cryptocurrencies should be considered currencies, commodities, or even equity-like securities.) The Securities and Exchange Commission (SEC) so far has stated that it sees cryptocurrencies as securities; it also has established a "cyber unit" to scout for fraudulent initial coin offerings, or ICOs (see page 8, "What is an ICO?," for a brief ICO primer).

Developing local and ultimately global rules and regulations around cryptocurrencies seems likely to take years. But we know from history to keep an open mind in terms of what cryptocurrencies could become. Recall that what is now the iconic Post-it sticky note started out as an attempt by a scientist at the firm 3M to create a super-strong adhesive. The glue resulting from the failed experiment languished for a dozen years before finding its ultimate success.

In the case of cryptocurrencies, one outcome we think is very possible, even within the next few years, is a central bank cryptocurrency, or CBCC. In this form, cryptocurrencies would lose their anonymity but would gain a level of oversight that, in most cases, should increase credibility and trust among owners, increase volumes to reduce volatility, allow for better related data, and reduce risk of market manipulation. Interestingly, about a dozen central banks around the world are already well into CBCC research projects. China is in the lead, reportedly starting research into a sovereign cryptocurrency in 2014, and last year conducting CBCC experiments between the central bank and local commercial banks. In January of this year, China took a next step and announced formal plans to issue its own cryptocurrency. It will be centrally controlled and used to replace cash (but not bank deposits); the central bank has stated it does not want to disintermediate banks through this effort.

China is a special case, both in terms of policy and technology. China has long held a policy of limiting the population's ability to take their money out of the country (also known as capital controls). Specifically, Chinese residents have an annual purchase limit of $50,000 worth of foreign currency. With few investment options at home, though, and frequent worries that the local currency (renminbi) could be devalued, many Chinese seek ways of getting around these controls. Cryptocurrencies clearly present one such avenue to evade controls. Perhaps not surprisingly, then, China's government closed several bitcoin and other cryptocurrency exchanges in 2017 and banned ICOs. Before the news, Chinese renminbi buyers had accounted for around 80% of total bitcoin transactions.

Banning crypto trading but launching a CBCC would give the government and central bank much greater control over capital movements and real-time information on what local households were spending their money on. In addition, a Chinese CBCC might be an easier transition compared with other countries given how many Chinese households today

What Is an ICO?

An ICO, or initial coin offering, is like an initial public offering (IPO) in that it provides a means by which a new venture can source funds from a broad investor community. However, an ICO eliminates the need for intermediaries, such as banks, and is not always regulated by the SEC. Where an IPO leads to an investor receiving shares in the now-publicly traded company in return for funding, an ICO rewards an investor with a cryptocurrency, or token, tied to that company or network. If an ICO does not raise enough money to move the project forward, funds should be returned to investors. ICO buyers will hope the network or firm thrives, which in turn would boost the value of the related tokens.

As an example, in 2014, the Ethereum project was announced, and its ICO raised $18 million in bitcoins, or $0.40 per token (named ether). The project itself was then launched in 2015, and by 2016, ether's value had risen, as high as $14 (and as of March 2018, ether was trading around $588). Thus far, the U.S. and Switzerland are dominating ICO activity, with Swiss Economics Minister Johann Schneider-Ammann telling reporters in January that Switzerland wanted to be"the crypto-nation" as a way to support the country's banking and finance sector.

already use digital payment methods (and the relative lack of alternative payment options). In 2016, China's mobile payments (computers and mobile devices) reached $5.5 trillion, about 50 times the size of the U.S. $112 billion market, according to consulting firm iResearch.

Even if China has specific reasons to move quickly on a sovereign cryptocurrency, others seem likely to follow. Canada's central bank introduced a concept "CAD-coin" in 2016 and is working with partners both on the digital currency as well as blockchain applications for the financial sector; Singapore's central bank has a similar "Project Ubin." Sweden, Japan, Saudi Arabia, India, and others have all disclosed different CBCC research efforts, some including prototypes. Even the U.S. Federal Reserve has suggested it is "thinking about" applications for cryptocurrencies and blockchain. Beyond data collection and transparency of money use, CBCCs could, at least in theory, reduce inefficiencies in the financial system. Not surprisingly, the banking sector is focused on how to stay relevant if sovereign cryptos create the ability of end-users to deal directly with central banks.

The Beauty of Blockchain

While we see a potentially broad-based, global future for cryptocurrencies, for now we believe bitcoin and its brethren do not meet our criteria as attractive portfolio investments. Our view toward blockchain, meanwhile, is quite different: We are believers, although not yet convinced this is the "next internet" as some enthusiasts predict. Blockchain technology, creating distributed ledgers, is being adopted across industries and around the world as different companies see applications that often go well beyond cryptocurrencies. (Along with publicly traded securities, Bessemer clients who invest in private equity also get exposure in these funds to blockchain and cryptocurrency-related ventures.)

Consider just four very different companies held in Bessemer portfolios at the start of 2018 that are meaningfully using blockchain:

- Lockheed Martin. This U.S. aerospace and defense firm announced in May last year that it would integrate blockchain technology into its supply chain risk-management systems as a way to improve data integrity.
- Mastercard. This financial services firm developed its own blockchain and announced last October that it would allow certain banks and merchants (locally and overseas) access to it as an alternative payment method for goods and services. Interestingly, it operates without a cryptocurrency, instead accepting payment in traditional local money.
- Microsoft. This technology company launched an initiative in late 2015 to provide blockchain as a service via the company's Azure cloud. Several partnerships have subsequently emerged, including one with Accenture that uses blockchain to support a public-private partnership focused on solving challenges of identity for deprived people, including refugees (it is estimated that one-sixth of the world's population is denied basic rights due to lack of documented proof of their existence).
- Cognizant. This U.S. technology services and consulting firm has been working on blockchain projects with a number of clients to provide secure communications and document exchange, support fund transfers, and accelerate digital identity assurance.

Beyond impacting our views on specific firms and securities, blockchain warrants macro consideration. As with many technological innovations today, this distributed ledger will have benefits and costs. Benefits should include making a number of processes more efficient and, for many people around the globe, providing enhanced safety around contracts (home ownership, identity, etc.). More efficiency at the margin may reduce the need for certain types of labor, however, which in turn may depress wages and, if broad-based enough, overall inflation rates. We do not expect these risks to materialize any time soon, but should blockchain continue to be adopted globally and across industries, we could see it alongside forces like online shopping that are now clearly having broader economic impacts.

Final Thought: First-Quarter Performance and Positioning

Bitcoin is not the only financial asset that has seen recent ups and downs; the first quarter of 2018 saw market volatility return with a bang. Equities had the strongest calendar-year start since 1987, with the S&P 500 up approximately 7% in the first three weeks of the year, before experiencing a 10% pullback in February and subsequently recouping some of the lost performance, though March ended on a down note.

While structured products tied to volatility exacerbated the market moves in February, fundamental drivers were also to note, particularly U.S. inflation. While the pull of resilient, synchronized global growth and robust company earnings continued to support cyclical assets at the start of 2018, the push of higher inflation expectations, concerns about subsequent Federal Reserve monetary tightening, and political uncertainty (including relatively aggressive action on trade and personnel shifts) weighed on market sentiment in the first quarter.

Our base case is for the underlying positive economic growth dynamics to outweigh other risk factors in the coming months. We remain constructive on equities and expect a positive return over 2018, albeit with elevated volatility; Bessemer mandates maintain equity exposure at neutral relative to benchmarks across risk profiles. Strong stock selection in the Large Cap Core, Large Cap – Global, and Small and Mid Cap Core equity mandates has benefited performance for Bessemer mandates year to date, as have defensive elements within equities, and solid performance from certain external managers (Exhibit 6).

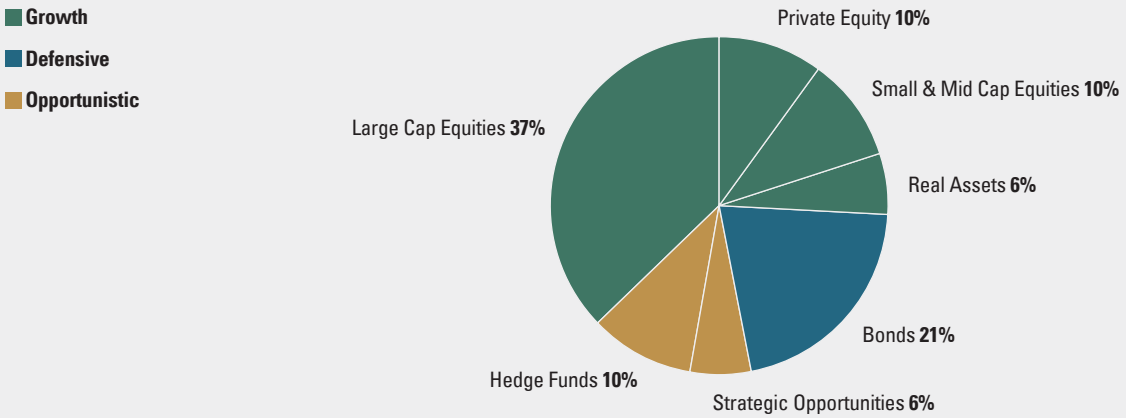
Overall, on a preliminary basis, the first quarter saw a 70/30 "Balanced Growth" portfolio return of -0.1%, ahead of the benchmark return of -0.9%. Looking ahead, portfolio managers will continue to seek opportunities — though not for now in bitcoin — to benefit from late economic cycle dynamics with the goal of optimizing long-term, risk-adjusted performance.

Exhibit 6: Portfolio Positioning and Key Views

Key Views for 2018	Portfolio Implications
Steady, broad-based global growth; only modest Chinese slowing	Neutral equities versus strategic benchmarks
U.S. fiscal stimulus boosting buybacks, corporate activity	Modest U.S. overweight within equity exposure
Central banks starting to tighten, albeit very gradually	Modest fixed income underweight
Dollar steady to slightly weaker despite rising interest rates	Dollar exposure reduced over recent months
Growing support for commodity prices	Adding to hard commodity and related equity exposure

Source: Bessemer Trust

Bessemer's Positioning (70/30 Risk Profile with Alternatives)



Positioning as of April 2, 2018. This model displays Bessemer's Balanced Growth with Hedge Funds and Private Assets target portfolio allocation guidelines. Each client situation is unique and may be subject to special circumstances, including but not limited to greater or less risk tolerance, classes, and concentrations of assets not managed by Bessemer, and investment limitations imposed under applicable governing documents and other limitations that may require adjustments to the suggested allocations. Model asset allocation guidelines may be adjusted from time to time on the basis of the foregoing or other factors. Alternative investments, including Bessemer private equity, real assets, and hedge funds of funds, are not suitable for all clients and are available only to qualified investors.

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