Alternative Investment Analyst Review

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Initial Coin Offerings

Introduction

In the late 1940s, W.J. Howey company owned a hotel and large tracts of orange groves in Florida. It devised a plan to sell portions of the groves to the public, whereby buyers would receive ownership of a piece of land for a set price with the option to lease the property back to Howey. The lease agreement entitled the owners to a share of profits generated by Howey through its management of the orange groves. The US Securities and Exchange Commission sued Howey, claiming that the sale contracts were in fact securities that were being offered to the public, and, therefore, should have been registered with the SEC. The US Supreme Court sided with the SEC, and since then firms that wish to raise funds from the public have had to register their offerings with the SEC if the sales met the standards set by the Supreme Court. However, technology has finally caught up with the Supreme Court ruling, creating a vehicle through which a variety of for-profit and not-for-profit entities can raise substantial amounts of funds from the public without violating the SEC regulations. Initial coin offerings (ICOs), or more precisely, blockchain-based tokens, represent this vehicle.

In the following pages, first, I will give a very brief introduction to blockchain. Next, I will explain the differences between cryptocurrencies and tokens followed by an introduction to ICOs and the process of issuing ICOs. Finally, I will briefly discuss the relationship between ICOs and VC investing.

Blockchain

Blockchain is a ledger that can contain various types of information. In this essay, we use the term blockchain to refer to public ledgers that can be accessed without permission from a central authority. The Bitcoin blockchain is such a ledger.

A blockchain can contain information about ownership of assets, instructions about performing specific tasks in response to a certain signal, rights and privileges of asset owners and asset issuers, and so on. Given that it is a permission-less public ledger, there must be a mechanism to prevent unauthorized changes to the ledger. The mechanism is to give a group of volunteers (i.e., miners) the incentive so that through a consensus process they verify that only legitimate changes are recorded on the ledger. The key is the incentive mechanism, which creates the conditions such that a large group of people are willing to spend time and money to verify the changes. The mechanism has a built-in incentive so that fraudulent entries into the blockchain are not approved by the majority of the volunteers.

One major advantage of blockchain is that the history of the system and all transactions completed through that system are saved securely, and no change can take place unless 51% of the miners agree with that change. Most blockchains use a form of encryption discussed below to secure and verify the authenticity of the changes that enter the blockchain. The following is an example of how encryption can be used to secure a blockchain:

- Go to this website https://passwordsgenerator.net/sha256-hash-generator/
- Type "CAIA Association owns 10 bitcoins" in the window and hit enter.
- Below the window, you will see "SHA256 Hash of your string:" The string shown will be

191561C5ECA2B17FE6D8430BC6B001B59EB12E21E80F172D4DDE200B554102BC

- Hit the enter key and copy and paste this string into the original window below "CAIA Association owns 10 bitcoins" and then type below it the phrase "CAIA Association paid Hossein 2 bitcoins." and hit the enter key. Now the encrypted string should read:

01A9647724B73D89956A4A49B41F1ABD4BA217EF27156B2948D5865F9852B31E

We have now created a very crude blockchain. Going forward, this last string can be used as a check on the integrity of the blockchain.

The key to the encryption method used here (SHA256) is that, no matter how long or how short the text in the window, the string (i.e., "hash") will be 64 characters long. In other words, one can upload all the books in the local library or the entire history of all bitcoin transactions into that window and the "hash" of each one would be a unique string of 64 characters. More importantly, even if one letter in one of those books is changed or just a zero is added to one of the transactions that took place years ago, the entire hash will change unpredictably. Therefore, if we have the hash of the verified history of all bitcoin transactions up to now and someone presents us with a copy of the public ledger, it will take us just a few seconds to determine whether that ledger has been altered or not. All we need to do is to compare the hash that we have with the hash of the ledger being presented.

In our example, if someone tries to change the original statement to "CAIA Association owns 9 bitcoins" the resulting string will change as the string is a unique representation of the input. No other input would generate the same string. Therefore, the public will realize that someone has made an unauthorized change to the previous version of the blockchain. The role of the miners is to find a set of characters called a "nonce" such that when added to the above blockchain, the resulting hash will have some pre-determined property (e.g., the first *n* characters must be zeros). For their efforts, the miners are rewarded with cryptocurrencies. There is no known formula for finding the nonce, and only brute force can be used to find the right nonce.

Since the ledger is public, everyone can see who owns what. As a result, blockchain and the internet allow global transfers of digital assets like bitcoin. Similar to sending an email, you can send a digital asset to another party by letting the network that monitors and secures the blockchain know that you have transferred the ownership of the asset to someone else. Of course, you need a password (i.e., a private key) to initiate the transfer of the ownership to someone else. The blockchain maintains a record of who owns these digital assets at any point in time without the need for a centralized authority, like a central bank or a centralized exchange. In theory, the blockchain technology can be used to trade stocks and bonds too, but the efficiency gains are not yet there to implement this technology on a large scale. Below we discuss one particular application of the blockchain technology: issuing and tracking of tokens.

As I discuss below, tokens have been around for a long time (almost as long as capitalism has existed), and entities have used various forms of tokens to raise funds. What has changed in recent years is the use of blockchain technology in creating, tracking, and trading of tokens.

Tokens and Cryptocurrencies

Tokens and cryptocurrencies are different. Both could be based on a particular blockchain (i.e., a given ledger), but they serve different functions. First, every blockchain has its own cryptocurrency. This is needed to reward the miners who verify and secure changes in the blockchain. The most famous blockchain is the Bitcoin blockchain and its bitcoin cryptocurrency. Ethereum is another blockchain with its own currency called ether.

Cryptocurrencies have limited use. You can use them as a means of payment and a store of value. Once you have obtained a cryptocurrency, you can do three things: (a) hold it, (b) spend it to purchase an item or (c) use it to gain access to the underlying blockchain system. Bitcoin and ether are cryptocurrencies.

Tokens may not have anything in common with cryptocurrencies. In fact, a token does not need to be based on a blockchain. For example, a casino chip is a token. It allows you to participate in a game. You can trade it, but there is no point in holding it because its value will not appreciate. A ticket to a movie is also a token, which can be traded and may appreciate in value if the movie is popular. Stock certificates are also tokens and so are the tickets to enter Disney World.

We can see that tokens can serve a variety of functions and may possess several features not shared by cryptocurrencies. The primary contribution of the blockchain technology is that it has allowed a variety of entities to issue and track their tokens on a very large scale. The blockchain of choice for issuing tokens is Ethereum.

Ethereum Blockchain

It is hard to believe, but the Bitcoin blockchain is already becoming obsolete as it has limited uses beyond supporting bitcoin. On the other hand, Ethereum is a more advanced blockchain, which not only has its own currency – ether – but can hold and execute computer programs called "smart contracts."

Smart contracts are software programs embedded in a blockchain that can receive or send assets and information if certain conditions are met. The transmission of information and assets by the smart contract is entirely predefined in the code and is autonomously triggered if certain conditions are met. For example, suppose an insurance company decides to sell flight insurance where the payments are made through the Ethereum blockchain. A customer will use a wallet on Ethereum to pay for flight insurance. The information is stored on the blockchain with a smart contract receiving information from a flight traffic database. If there is a delay, the smart contract will automatically execute some predefined instructions and send the amount of insurance to the customer's wallet. The insurance company AXA has already introduced such a contract.

There was no token associated with the flight insurance example provided above. In most cases, a firm may create its own token to facilitate the sale of its products or services to the public. For example, suppose a group of movie theaters decide to pre-sell tickets to Marvel Studio's next movie by issuing the tickets through the Ethereum blockchain. A simple, smart contract is placed on the blockchain. Every time a payment is received by a designated account that is on the blockchain, the program is executed, sending the correct number of digital tickets to the buyer's account on the blockchain. The owners of these digital tickets may decide to trade them for other tickets or to sell them to people looking to buy tickets. All these transactions are recorded on the blockchain. Of course, this will not be a smart way of issuing tickets as the issuers will need to compensate the miners for securing the history of transactions and the digital tokens have limited life. Besides, there are more efficient ways of implementing this pre-sale.

Issuing a new token on Ethereum blockchain is exceedingly simple and can be implemented in less than an hour! Getting people to buy your token is another matter. However, interesting and promising projects can use Ethereum tokens to raise a substantial amount of funds in a short period of time. According to Coindesk, the total amount of ICOs issued in the first quarter of 2018 was $6.3 billion. This is slightly less than half the size of the US IPO market and about one-third of the venture capital funds allocated during the same period. In short, the ICO market is becoming very large.

Initial Coin Offerings

Despite their name, ICOs are different from IPOs. In case of an IPO, shares of a startup company are sold to the public. These shares will represent claims on the firm's assets, and investors are considered owners of the firm with certain rights and privileges. Furthermore, once the

IPO is completed and necessary funds are raised, the firm will not directly benefit from a rise in the value of its shares unless it decides to do a secondary offering and issue additional shares.

Most ICOs are similar to crowdfunding done on Kickstarter for example. The firm issues its own digital currency, which can be used to access the services offered by the firm. Not only can the firm raise cash to fund its operations, but it will benefit if the value of its currency increases through time. For example, suppose a firm creates a new social networking platform similar to Facebook. It issues its own digital currency and stipulates that anyone who wishes to join the platform must pay a small fee using the digital currency that the firm has issued. Suppose each token is worth $0.01 at the beginning and its costs one token to join the network. Every time someone joins the network, the firm will receive a token which it can then sell for cash or use it to pay for its employees' salary. If the network becomes popular, the value of the token may increase to, say, $0.1. While the firm still requires one token for joining its network, those tokens are worth ten times more.

Similar to other commodities, the price of a token issued through an ICO will depend on its demand and supply. The issuing firm can undertake certain actions to affect both and thus increase the value of the token. Policies or actions that directly affect the supply of the tokens are referred to as monetary policies while those that directly affect the demand for the tokens are referred to fiscal policies.

ICO Monetary Policy: This refers to the management of the supply of the tokens. Continuing with our social networking example, we need to determine the volume of the coins to be sold and whether the entire supply is going to be offered to the public or a portion will be kept at the firm. For instance, in 2017 Gnosis, a prediction market platform, used an ICO to raise $12 million in less than 15 minutes. However, the coins sold to the public constituted only 5% of the entire supply. The remaining 95% was held by Gnosis, which implies a market cap of $300 million for the ICO. The monetary policy of a token should clearly communicate to outsiders the issuer's policy regarding current and future supplies of the tokens. If only a fraction of the tokens is offered to the public, the remaining tokens are typically stored in an escrow account with the future sales of these token normally tied to operating expenses of the issuer.

ICO Fiscal Policy. While the monetary policy deals with the supply of the tokens, the fiscal policy deals with the benefits received by token holders. These policies are meant to increase the attractiveness of the tokens. For instance, the firm may decide to accept other currencies in exchange for its service but to offer a discount to those who use its token to purchase the service. Of course, improving the efficiency of the underlying project will be the most important benefit that the firm can provide for its token holders, and here lies one of the fundamental aspects of the token economics. As the firm works to improve its product (e.g., our social network project offers new features), demand for its tokens will increase leading to a rise in the price of its token. This will benefit both the firm and the token holders. In other words, there is strong alignment of incentives in this tokenized economy.

Life-Cycle of an ICO

Let's consider the steps typically taken to issue a token on Ethereum's blockchain. Throughout, we assume that the developers have already ensured that the ICO does not violate local rules and regulations regarding the issuance of securities to the public. For instance, in the US, the crucial step is to apply the Howey Test to ensure that the project's token does not fall under the legal definition of a security, and is, therefore, subject to securities regulation. The four main parts of the Howey Test are (i) there is investment of money, (ii) profits are expected, (iii) money investment is a common enterprise, and (iv) any profits come from the efforts of a promoter or third party. The feature that most projects exploit to pass the Howey Test is that they make a decentralized cryptocurrency that is equivalent to a currency (or simply cash) with no central owner. Assuming that the project complies with local rules and regulations, let's consider the next steps.

Project: The very first step is to have a project that is worth funding. Let's assume that our project is to develop an open source web browser where all advertisements are removed from websites that one visits while using this browser. To use this web browser, users will have to pay the developers one token, which is then used to pay the owners of the websites. In other words, we believe that people are willing to pay a very small fee to use a browser that filters out all advertisements. Notice that our entity could be a not-for-profit organization. Of course, some initial funding from angel investors or founders is needed to kickstart the project.

Whitepaper: The developers write and distribute a whitepaper describing the project. The whitepaper also describes the rights of token-buyers and the responsibilities of the entity. For example, the paper will state whether the supply of the token to be issued will be fixed or not. If not, a precise schedule regarding the future issuance of new tokens should be presented. Most tokens benefit from a network effect. That is, the value of the network and its associated token will increase in value the more people use the network. In our case, as more people use this web browser, more websites are likely to agree to remove their advertisements in exchange for receiving a token every time one of our users accesses their website.

Roadshow: The developer team will go on the road to present the idea to potential buyers. Facebook, Twitter, Reddit, and other social networks will be used to promote the idea and get people excited about the project.

Pre-ICO: Most projects implement a Pre-ICO. During a Pre-ICO, a fraction of the funds needed to support the project is raised. More importantly, the early adopters and influential people in the industry are provided with cheaper tokens to increase the chance of success. The funds raised through Pre-ICO might be enough to pay for the cost of the initial development, the road show, and the promotion. Some argue that the Pre-ICO also provides the developer team with information about the potential fair price of the token that will be issued to the public.

ICO: As mentioned above, the most popular platform for issuing tokens is Ethereum. Using the Ethereum network to issue tokens is very

simple, and a tech-savvy person can complete the entire process in about 30 minutes! First, we must create a digital wallet on Ethereum (see www.ethereum.org/). Second, we download the code for smart contracts on Ethereum (the code is about 100 lines). The technical name for the code is Ethereum Request for Comment 20 or ERC20. Third, we make some small edits in the program's parameters so that it will contain the information about our token (e.g., name, size, deadlines, etc.). We need to have some ether coins to pay Ethereum for the privilege of using the network. Finally, the revised code is uploaded to Ethereum. We are ready to sell our coins! The mechanics of the actual ICO are almost as easy as sending an email. The project creates an address to which the funds (in the form of other cryptocurrencies) will be sent. Investors will then send funds to the address and receive the equivalent amount of the tokens.

Listing: A critical ingredient for making the ICO a success is its listing on one of the cryptocurrency exchanges (e.g., Coinbase or Kraken). The listing ensures that investors can trade their tokens with varying degrees of liquidity. The listing also contributes to the price discovery process. Increased liquidity will encourage others to use the token to purchase the services provided by the original project, contributing to the network effect.

ICOs and the VC Industry

ICOs have emerged as a popular funding tool for startups in the technology sector. They offer advantages to digital projects that traditional venture capital firms cannot. In particular, ICOs help attract developers and users of the product even when the project still is in its infancy. Furthermore, as we have seen, ICOs are low-cost options that do not dilute ownership, require no intermediaries, and can be completed very quickly compared to the time it takes to raise traditional venture capital.

ICOs are not viable fund-raising options for most startups. Firms that sell their services through online sites and benefit from a network effect appear to be prime candidates for ICOs. Of course, several firms have attempted to get on the bandwagon and take advantage of the hype surrounding ICOs. For instance, recently, ARAMCO, the state-owned oil company of Saudi Arabia, conducted an ICO where the tokens representing a claim to oil extracted by ARAMCO were issued. It is hard to see why ARAMCO Coins should be successful. Why would one need to purchase a token representing a claim to a barrel of oil when such investments can be done through available securities? Further, there is no incentive on the part of token holders to increase their use of the token and the network as it will have no impact on the value of the tokens – there is no network effect. Finally, ARAMCO has to maintain the blockchain, which defeats the whole purpose of having a decentralized ledger. If a public ledger is to be used, then someone must pay the miners to secure the ledger.

Pros and Cons of ICOs: ICOs make it easy for the right startup to raise funds on a large scale in a short period of time. Almost every person on the Earth can become an investor in a project funded through an ICO. The size threshold for conducting an ICO is extremely low. Even the smallest startups may have the opportunity to raise funds through an ICO. Of course, the potential network effect will be small if the firm plans to remain small and therefore coins may have to be sold at deep discounts.

Transparency and security are the primary disadvantages of ICOs. Many projects are nothing but a vague idea presented as a whitepaper. The ease with which ICOs can be implemented has attracted many fraudulent activities. This may lead to severe adverse selection problem such that investors will reduce the average price they are willing to pay for tokens, making the ICO an inefficient mechanism. Also, regulatory obstacles may be increasing, making the ICO process more costly.

Pros and Cons of VC: VC funding is available for almost any economically viable project that exceeds a given value. More importantly, VC funding is more than just funding. Specialized VCs provide expertise and connections that are not available through the ICO channel. The long process of obtaining VC funding allows investors to perform due diligence, which would attract additional investors who use the reputation of the initial VC investors as a signal about the quality of the underlying investment.

While startups funded with ICOs may be under pressure to show results and profits rather quickly, VC investors are far more patient and hence enable developers to focus on the long-term strategic aspect of the project.

The primary shortcoming of VC is that less than 1% of startups are funded by VCs. VC funds make lumpy investments, and, therefore, cannot hold fully diversified portfolios of thousands or even hundreds of startups. As a result, VC funds have a very high threshold for return, leading them to reject many promising projects. Therefore, the time and energy spent on attracting VC investors are wasted in most cases.

ICO + VC Model: A new form of startup funding is emerging. For some projects, a combination of ICO and VC funding could represent the most promising way of raising the necessary funds, generating enthusiasm among potential customers, and using the expertise and the connections provided by VCs. VC funds are increasingly interested in participating in Pre-ICO transactions. This will allow them to purchase tokens at a discount and because of their reputation, their Pre-ICO participation will increase the potential demand for the eventual ICO. Further, a successful ICO is likely to lead to a more successful eventual IPO.

Further Readings

- https://hackernoon.com/ contains a wealth of practical information about blockchain, bitcoin and ICOs.
- http://www.ssrn.com/ contains a large number of academic papers on the same topics.
- The following sources are recommended:
    - "The Token Handbook," David Siegel, 2017, https://hackernoon.com/the-token-handbook-a80244a6aacb
    - "Some Simple Economics of Blockchain," C. Catalini et al., 2016, MIT Sloan Research Paper No. 5191-16. https://ssrn.com/abstract=2874598
    - "Blockchain-Based Token Sales, Initial Coin Offerings, and the Democratization of Public Capital Markets," J. Rohr and W. Aaron, 2017, Cardozo Legal Studies Research Paper No. 527. https://ssrn.com/abstract=3048104
    - "Initial Coin Offerings," P. Momtaz, 2018, https://ssrn.com/abstract=3166709
    - "Bitcoin and Cryptocurrency Technology," A. Narayanan et al., 2016, Princeton University Press.

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Metcalfe's Law as a Model for Bitcoin's Value

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Bitcoin[1] and network economics are areas which may be unfamiliar to many. To aid in understanding bitcoin as a network, we compare it to a now defunct Italian telephone token called the gettone, an ecosystem which married a telecommunications network with a currency.

Traditional currency models fail with bitcoin, but various mathematical laws which explain network connectivity offer compelling explanation of its value. Our purpose in conducting this research is to examine bitcoin's price as a function of the network effect. We use the word "currency" for convenience, without opining on the efficacy or suitability of bitcoin in that capacity. We stipulate that bitcoin is a fiduciary currency which has no intrinsic value by definition. Fiat currency is associated with governments, and so bitcoin does not strictly meet the definition of fiat currency.[2]

Metcalfe's law is relatively untested. Until recently, sufficient data has not existed to test network value models in general. However, it has recently been shown that Metcalfe's law is evident in the valuations of Facebook, Tencent, and internet usage in general. While Metcalfe's law is well known in the computer sciences, it is virtually unheard of in economics.

We believe we are the first to model bitcoin as a digital token currency network. Our goal is not to offer a comprehensive valuation model in the strictest sense. Rather, we demonstrate how Metcalfe value can be used to evaluate if bitcoin's price is behaving as model factors would predict. We conclude with the finding that Metcalfe's law helps explain bitcoin's price formation. An unexpected but welcome finding was corroboration that bitcoin's price was probably manipulated in 2013.

Bitcoin

Bitcoin was the first digital currency to solve two challenges associated with digital money—controlling its creation and avoiding its duplication—at once. Any currency which becomes successful is subject to the originator wanting to issue more of it. This inflationary effect reduces the currency's value. Bitcoin's production process (called "mining") limits the production of coins to 21 million over a period of approximately 150 years. Since the upper limit of bitcoins is fixed, over time bitcoins should become more valuable relative to other currencies as the supply of government-backed fiat currencies continue to increase. Its certain limited supply is a unique feature that stands in opposition to nearly every other traditional currency.

The actual number of bitcoins available will always be less than the maximum number created, because bitcoins can be "lost." Bitcoins must be stored on an electronic medium. Loss of that medium (or loss of one's own private key) removes those bitcoins from the marketplace, forever. Some Bitcoin wallets have only remnants of activity, called "bitcoin dust," that are too small to spend or exchange in practicality (for example, balances worth less than $1). Some wallets hold bitcoins which have never been spent or sent. Ratcliff [2014] identifies approximately 200,000 such "zombie" bitcoins in only four wallets. Ratcliff further estimates the number of bitcoins held in inactive addresses (defined as 18 months of inactivity) to be as much as 30% of all created bitcoins.

Over 75% of all bitcoins that will be created have been created. As of 2017, the rate of new bitcoin creation is approximately 60 per hour, creating near-perfect price inelasticity of supply.

Classical Currency Models and Bitcoin Price Models

There are two dominate schools of thought relating to the determination of the "equilibrium" value of a currency over the long term. The theory of purchasing power parity (PPP) states in its relative form that exchange rate movements reflect long-term difference between the respective inflation rates. The second explains the behavior of exchange rates by means of relevant economic variables. These two classical approaches are not likely to yield reasonable results for bitcoin.

By design, Bitcoin is intentionally disconnected from direct government oversight, fiscal policy, and monetary policy. Grinberg [2012] explains that because bitcoins earn no interest, its value is inoculated against country-specific differentials in purchasing power. Its decentralized nature is a characteristic envisioned by Hayek [1978] and favored by Mises [2014]. Kristoufek [2013] and Ciaian [2016] also concluded that macro-financial developments do not drive bitcoin price in the long run.

Brunner [1971] and Skaggs [1995] are part of a long list of researchers that cite Thorton's [1965] rationale for holding currency rather than spending it.[3]

There exists relatively little peer-reviewed, published research on bitcoin as compared to other assets. Van Wijk [2013] asserts bitcoin has value only in future exchange. Yermack [2013] and Begstara [2014] argue that bitcoin is not a currency at all, but simply a speculative investment.

Kristoufek [2013] also showed that not only are the search queries and prices connected, but there exists a pronounced asymmetry between the effect of an increased interest in the currency when price is above or below its trend value.

Garcia et. al. [2014] identified two positive feedback loops that lead to price bubbles in the absence of exogenous stimuli: one driven by word of mouth, and the other by new Bitcoin adopters. They also observe that spikes in information search precede drastic declines in price.

Kristoufek [2015] found that standard fundamental factors—usage in trade, money supply and price level—play a role in bitcoin price over the long term, and that bitcoin price is driven by investors' interest.

Hayes [2016] concluded that the total money supply, or ultimate number of units to ever be created is, not a driving factor in value creation. Rather it is the rate of unit creation that matters. Hayes' framework did not examine network effects in arriving at its conclusion, but rather computational power (indirectly difficulty), coins per minute, and which algorithm is used.

Ciaian et. al. [2016] found that that market forces and bitcoin attractiveness for investors and users have a significant impact on bitcoin price but with variation over time.

Price Manipulation in the Bitcoin Ecosystem

Gandal et. al. [2018] analyzed the impact of suspicious trading activity on the Mt. Gox bitcoin currency exchange between February and November 2013. They observed two distinct periods in which approximately 600,000 bitcoins valued at $188 million were acquired by agents who did not pay for the bitcoins. During the second period, the U. S. dollar-bitcoin exchange rate rose by an average of $20 at Mt. Gox bitcoin exchange on days when suspicious trades took place, compared to a slight decline on days without suspicious activity. The authors concluded that the suspicious trading activity caused the unprecedented spike in the U.S. dollar-bitcoin exchange rate in late 2013, when the rate jumped from around $150 to more than $1,000 in two months. Gandal's work is crucial because, if correct, it means that pricing during that period was not the result of normal market conditions.

Network Economics and Theoretical Framework

Network economics is an emerging field within the information society. Its premise is that products and services are created and value is added through networks operating on large or global scales. This is in sharp contrast to industrial-era economies, in which ownership of physical or intellectual property originated from a single enterprise.

In a New York Times article, Varian [2014] raises a fundamental question: why are the dollar bills in people's pockets worth anything? According to Varian, there are two possible explanations for this: (a) the dollar bills carry value because the government in power says so and (b) because people are willing to accept it as payment. He concludes that the value of a dollar comes not so much from government mandate as from network effects.

Italian Gettone Analogy

Bitcoin is best analyzed as a digital token. Some history regarding a popular Italian telephone token–the gettone–is necessary because Metcalfe's law, upon which our work is based, originated from a description of telephone networks.

The word gettone (pronounced "jet-TONE-ay", plural: gettoni) literally means "token." The first Italian telephone token was created in 1927. It was a little disc made of an alloy of copper, nickel and zinc, or bronze. Production stopped in 1983 when it was replaced with magnetic phone cards. It is estimated that 600 million such tokens were produced.

Gettoni were commonly used as and interchangeable with a 50 Lira coin until 1980, when its value (and the cost of a phone call) suddenly doubled to 100 Lira. The doubling occurred again in 1984, to 200 Lira, again a result of a price increase associated with pay-phone calls. It remained at that value until 2001, when the Euro was introduced and the gettone suddenly lost its money-like nature in the Italian economy.

The parallels between the gettone and bitcoin are many. Interestingly, during the periods in which the token's price was increasing or expected to increase, Italians hoarded gettoni. Gettoni were readily exchanged into Lira, but not other currencies. Both serve only limited roles as a literal form of currency, and as fiat money both are intrinsically worthless. It was not necessary to have a gettone to make a phone call; one could use a phone at the home or office to do that. Likewise, one is not required to use bitcoin to make purchases, but can choose to do so for convenience or other reasons. People carried both gettoni and Lira, in the same way people hold bitcoins and their currency of domicile. Like bitcoin, the cost to counterfeit a gettone, relative to its value as a medium of exchange, was so high it was ridiculous to even consider it. And, like bitcoin, a user could do one of three things: spend it, exchange it for government currency, or hold it.

The holders of gettoni and the payphones themselves are a network. The value of a gettone to someone in that network, when spending the coin, is one of convenience and the value of the information relayed over the network. If we assume a growing number of pay telephones and callers, and then apply the constraint of a fixed number of gettoni, we have mirrored the key elements of bitcoin's supply and demand characteristics.

Network Economics Explained

In the context of financial transactions, larger networks would seem to have more value than smaller networks. Suppose there is a network of four friends: John, George, Ringo, and Paul. John has tickets to a concert he believes is popular. He offers to sell the tickets for a large markup over face value to George, Ringo, and Paul. No one accepts his offer. What can John conclude about the asking price of the tickets? Perhaps none of his friends are free the night of the concert. Perhaps they don't like that type of music. Perhaps they don't like concerts.

John lists his tickets on a popular website where his offer is viewed by 40 would-be purchasers. Still, he receives no bids. Now John is more likely to conclude that his price is too high. The network has provided valuable information to John about his ask price. But everyone in the network receives valuable information: since all other participants see that the ask was not accepted, each participant receives 39 confirmations that his or her rejection of the ask price was justified. The important thing to note here is that all participants have gained value from the network, even though no transaction actually occurred.

Now suppose John is in the ticket sales business. He lists many thousands of tickets at various prices. Some ticket-price combinations attract a large number of bids, and some ticket-price combinations attract a small number of bids. Thus, transaction volume at a specific price level also provides valuable information, and this value accrues to all participants, whether they actually engage in a transaction or not.

Economides is prolific on the subject of network economics. Economides [1993] explains that we do not need to know the nature of the transactions to value a currency as a medium of exchange.[4] Appropriately, Economides [1995] uses a telephone network to explain value in a financial transaction network:

> *"[J]ust as in the telephone network, the addition of a new component (say a new offer to buy) affects positively the complementary components (the matching offers to sell). Further, the benefits of an additional offer to buy are not limited to the party (component) that directly matches this buy offer. In general, the addition of a new buy offer has beneficial effects (through price) for a wide subset of sell offers. Thus 'network externalities' in a financial central exchange network appear in a subset of traders 'on the other side' of the market."*

Lastly, a network's value cannot grow forever. Transaction volume and other factors such as transaction cost and decay of quality of information are captured in a coefficient Metcalfe calls "Affinity Value per User." While this topic is important, the complexities of these considerations require us to reserve a thorough analysis of Metcalfe's A value and diminishing marginal returns for another paper.

Overview of Network Models

We briefly review various network models, roughly in order of their introduction, and by proportionality factor (value relative to number of users).

Sarnoff (n). David Sarnoff of Radio Corporation of America is attributed with the statement that the value of a broadcast network is directly proportional to the number of viewers. Sarnoff felt value lay with its one-to-many broadcast application as opposed to peer-to-peer application.

Metcalfe (n^2). Metcalfe's law is based on the mathematical tautology describing connectivity among n users.[5] As more people join a network, they add to the value of the network nonlinearly; i.e., the value of the network is proportional to the square of the number of users. The underlying mathematics for Metcalfe's law is based on pair-wise connections (e.g., telephony). If there are 4 people with telephones in a network, there could be a total of 3 + 2 + 1 = 6 connections. This law, like most other laws, assumes equality among the members' network connections. The full math for Metcalfe's reasoning leads to the sum of all possible pairings between user, so the value of the network of size n is

$$\frac{n(n\text{-}1)}{2} \qquad (1)$$

Metcalfe himself applies a proportionality factor (A), which Metcalfe admits may decline over time. Metcalfe's law was originally designed to identify the breakeven n where total network costs ($c \times n$) are recouped. It is expressed more precisely as

$$c \times n = M = A \times \frac{n(n\text{-}1)}{2} \tag{2}$$

Reed (2^n). Reed's law is the assertion that the utility of large networks, particularly social networks, can scale exponentially with the size of the network. The reason for this is that the number of possible sub-groups of network participants is

$$2^n - n - 1 \tag{3}$$

This grows much more rapidly than either the number of users (n), or the number of possible pair connections (n^2).[6]

Odlyzko ($n \log n$). Briscoe et. al. [2006] believe that Metcalfe's and Reed's laws are too optimistic in their values. They argue, without mathematical proof, the growth rate of the network must decrease as subsequent members join because the most valuable links are likely to be formed first. This parallels the concept of "diminishing returns" central to neo-classical economics. Such diminishing incremental value was modelled

$$n \times 1\text{n}(n) \tag{4}$$

where future memberships have positive (but decreasing) growth in value. Metcalfe [2006] counters that the diminishing incremental value is already captured in his A coefficient.

A Model for Bitcoin: Metcalfe's Law

Bitcoin's price is best modeled as a network. Metcalfe's law, adjusted for the creation of new bitcoins over time, is best suited to this task. This approach provides insight into the long-term value of bitcoin, but it does not attempt to explain short term price movements, which we accept can be driven by a multitude of factors.

Critics of Bitcoin, knowing that supply is essentially fixed in the short term, generally point to changes in demand as responsible for all price changes. That may be true in the short term, but it is also an oversimplification. Demand-side approaches are often misspecified because they ignore the non-proportional value added through the addition of a new user.

Whereas most network laws are propositions, Metcalfe's law is a mathematical tautology. There are typically no "groups of groups" in a buy-sell financial transaction ecosystem as Reed [2001] suggests. Van Hove [2016b] argues Metcalfe's law is best suited to those cases where direct network effects dominate indirect network effects. Further, Metcalfe's law assumes homogeneity among connections. This assumption is met for Bitcoin, because each bitcoin user transacts only in bitcoin. Social networks, however, transact in a variety of media, the nature of which is heterogeneous, and the value of which is subjective.

Metcalfe [2013] successfully fitted his law to Facebook's annual revenues over the period 2004-2013 and concluded that "Facebook creates much more value than is captured and monetized by Facebook selling ads." Madureira et al. [2013] came up with an altogether different test of Metcalfe's law, as well as an alternative that they call Briscoe's law, but found Metcalfe's law superior. Van Hove [2016a] finds that Metcalfe's law outperforms competing network laws. Zhang et al. [2015] repeated Metcalfe's test in a more systematic way using data for both Facebook and (Chinese equivalent) Tencent and found that Metcalfe's law fits the better than competing laws.

Bitcoin Inflation

We are not interested in value per user (wallet), we want value per unit (bitcoin). The final step in our model development is to adjust for the creation of new bitcoins.[7] Over the subject period, the number of bitcoins more than doubled from 7.7 million to over 16 million (Exhibit 1).

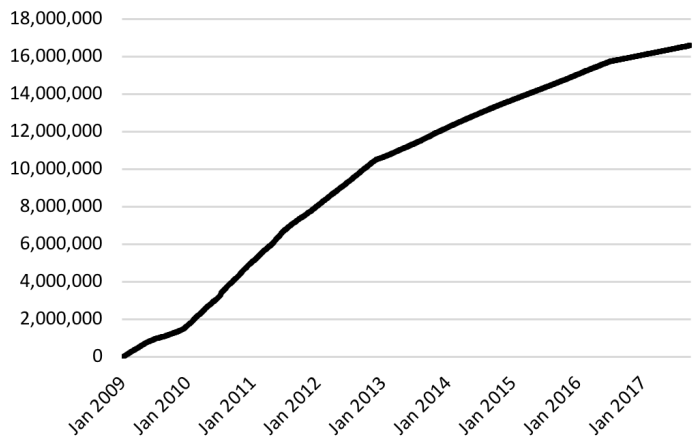

Exhibit 1: Total Number of Bitcoins Created

Bitcoin creation resembles a modest "S" curve which we model with a Gompertz function.[8] Islam et al. [2002] use a Gompertz sigmoid to model mobile phone uptake, where costs were initially high (so uptake was slow), followed by a period of rapid growth, followed by a slowing of uptake as saturation was reached. Caravelli et al. [2015] use a Gompertz model to explain participant impact in financial transaction activity.

Using the total number of bitcoins (B = 21,000,000) and number of bitcoins created (b), the Gompertz growth model is

$$b_t = b_{t\text{-}1} \times 1\text{n}\left(\frac{B}{b_{t\text{-}1}}\right) \tag{5}$$

Rearranging, we have

$$\frac{b}{b_{t\text{-}1}} = 1\text{n}\left(\frac{B}{b_{t\text{-}1}}\right) \equiv II \tag{6}$$

We use the Gompertz sigmoid as a decay factor, so that our final model becomes

$$V = A \times \left[\frac{n(n\text{-}1)}{2} \times \frac{1}{b_t}\right] \tag{7}$$

The constant of proportionality factor A must be expressed in terms of dollars per transaction (for our purposes), to capture the final unit of measurement V (which is in dollars). We assume A is constant, but it is likely not.[9] The b_t factor serves as compensation for this assumption.

Methodology and Data

The Bitcoin distributed ledger, implemented through blockchain, provides perhaps the most robust transaction dataset in history. Every transaction since Bitcoin's inception is recorded and publicly available in the blockchain. Distributed across a wide network with an inherent validation process, the blockchain is immutable, and therefore its integrity is exceptional.

The model requires only three datasets: wallets, number of bitcoins created, and bitcoin price. Wallets (Exhibit 2) and bitcoins are sourced from blockchain.info and extend back to 2011.[10] Bitcoin price is sourced from coindesk.com[11] and is a composite value from several active bitcoin exchanges. The U.S. dollar is the reference currency.

There are five ways to acquire bitcoins: mining, accepting them as payment, purchasing them in the open market, accepting them as a gift, or stealing them. In every case, one must first have a wallet. Definitionally, one cannot transact in bitcoin in any manner without a wallet, just as one cannot post a message to Facebook without a Facebook account. The creation of a new wallet is prima facie evidence that one intends to transact in bitcoin (or perhaps another cryptocurrency).

Bitcoin's genesis date of January 3, 2009 predates blockchain.info's inception, therefore we only have data on wallets from November 29, 2011, when two wallets were created (Exhibit 2).

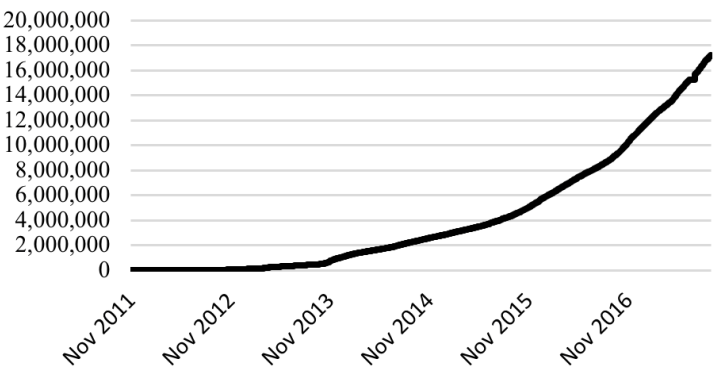

Exhibit 2: Number of Blockchain.info Wallets

There is a two-week period, from July 14, 2017 through August 1, 2017, where blockchain.info did not open (or did not record) new wallets. This period coincides with a software upgrade to the Bitcoin transaction processing protocol, known as "Segwit", where many were advised to not transact bitcoin or open new accounts.

The average daily growth rate for blockchain.info wallets since 2011 is 0.167%, or about 84% per year (Exhibit 3). On purely visual inspection, we can also see that this growth rate does not appear to be highly sensitive to exogenous factors such as google searches or other macroeconomic events. We believe that if exogenous events increased interest in bitcoin investing, as some suggest, we would see some sort of relationship with new wallet creation. Testing this hypothesis is beyond the scope of this paper, and so we leave it to others to investigate any such relationship.

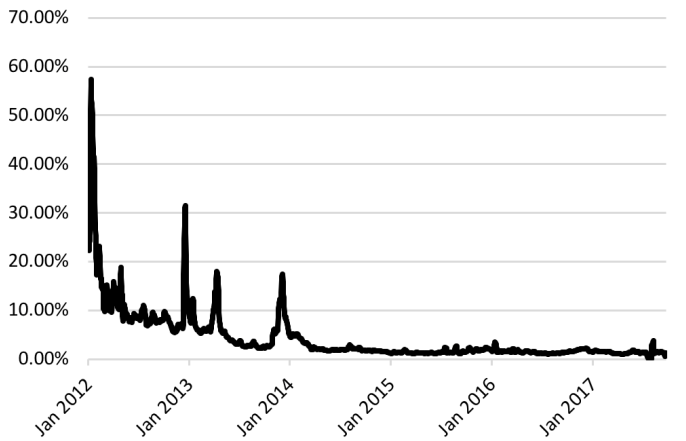

Exhibit 3: Weekly Growth in Wallets Since 2012

We selected data points at 61-day intervals, commencing with December 27, 2011 and ending December 31, 2017.

We transformed bitcoin price (Y) and Metcalfe value (X) to lognormal values. This transformation is necessary for several reasons.

First, the use of lognormal returns is common practice when dealing with currency returns. The choice of reference currency dictates the denominator of the rate-of-change calculation. Currency pairs trades are zero-sum results where one side's loss is equally offset by the other side's gain. The use of lognormal values ensures this condition is met by negating the effect of choice of reference currency on return.

Second, bitcoin is constantly traded, day and night, and knows no holidays, trading halts, or other stoppages. Lognormal values are best suited to capture what is literally the continuous function of bitcoin price formation.

Third, lognormal values will mitigate any heteroskedasticity associated with the regression.

We used a generalized difference equation to mitigate autocorrelation and fit Metcalfe's curve to the data. We adjusted for inflation resulting from bitcoin creation with a Gompertz function. Unfortunately, we cannot know cost per bitcoin (or user) or affinity precisely.[12] Instead, our regression model will serve to estimate A through the coefficient β_0.

$$1n(Y_t) - p1n(Y_{t-1}) = a_0(1-p) + \beta_0[1n(X_t) - p1n(X_{t-1})] + u_t \quad (8)$$

where

$$X_t = \frac{1n\,(M_t)}{b_t} \quad (9)$$

and Y_t is bitcoin's price, Mt is Metcalfe Value (Equation 2), b_t is from Equation 5. In our data set, $\rho \approx 0.81$

Results are shown in (Exhibit 4, next page).

Observation Date	(a) Bitcoin Closing Price (log)	(b) Number of Wallets	(c) Number of Bitcoins	(d) = b × (b -1) ÷2 Transaction Pairs (mil)	(e) = c × ln(21,000,000 ÷ c) Gompertz sigmoid	(f) = A × ln(d) ÷ e Metcalfe Value (log)
12/27/2011	1.40	369	7,971,100	0	7.76	1.36
2/26/2012	1.59	2,170	8,422,800	2	7.74	1.80
4/27/2012	1.63	5,566	8,873,500	15	7.68	2.05
6/27/2012	1.89	10,600	9,317,650	56	7.61	2.23
8/27/2012	2.39	19,855	9,798,100	197	7.51	2.42
10/27/2012	2.33	35,650	10,254,550	635	7.39	2.61
12/27/2012	2.60	73,919	10,597,225	2,732	7.29	2.83
4/30/2015	5.47	3,329,868	14,109,600	5,544,009	5.64	4.94
6/30/2015	5.57	3,666,010	14,326,975	6,719,813	5.51	5.09
8/30/2015	5.43	4,146,673	14,556,000	8,597,446	5.36	5.27
10/30/2015	5.79	4,677,539	14,777,750	10,939,683	5.22	5.46
12/30/2015	6.05	5,428,667	15,025,000	14,735,210	5.06	5.69
2/29/2016	6.08	6,227,655	15,260,900	19,391,840	4.90	5.93
4/30/2016	6.11	7,025,904	15,490,925	24,681,660	4.74	6.18
6/30/2016	6.51	7,794,814	15,714,300	30,379,559	4.58	6.44
8/30/2016	6.36	8,504,950	15,845,025	36,167,083	4.49	6.61
10/30/2016	6.55	9,494,407	15,956,400	45,071,877	4.41	6.78
12/30/2016	6.87	10,961,809	16,073,550	60,080,623	4.32	6.97
3/1/2017	7.11	12,331,325	16,189,988	76,030,782	4.23	7.17
5/1/2017	7.25	13,419,295	16,305,238	90,038,732	4.15	7.36
7/1/2017	7.81	14,968,009	16,419,900	112,020,639	4.06	7.56
8/31/2017	8.47	16,452,279	16,536,050	135,338,734	3.97	7.78
10/31/2017	8.76	18,174,840	16,656,963	165,162,395	3.88	8.01
12/31/2017	9.56	21,468,633	16,774,500	230,451,091	3.79	8.29

Exhibit 4

These results are plotted in Exhibit 5, and summary regression results are in Exhibits 6 and 7, next page.

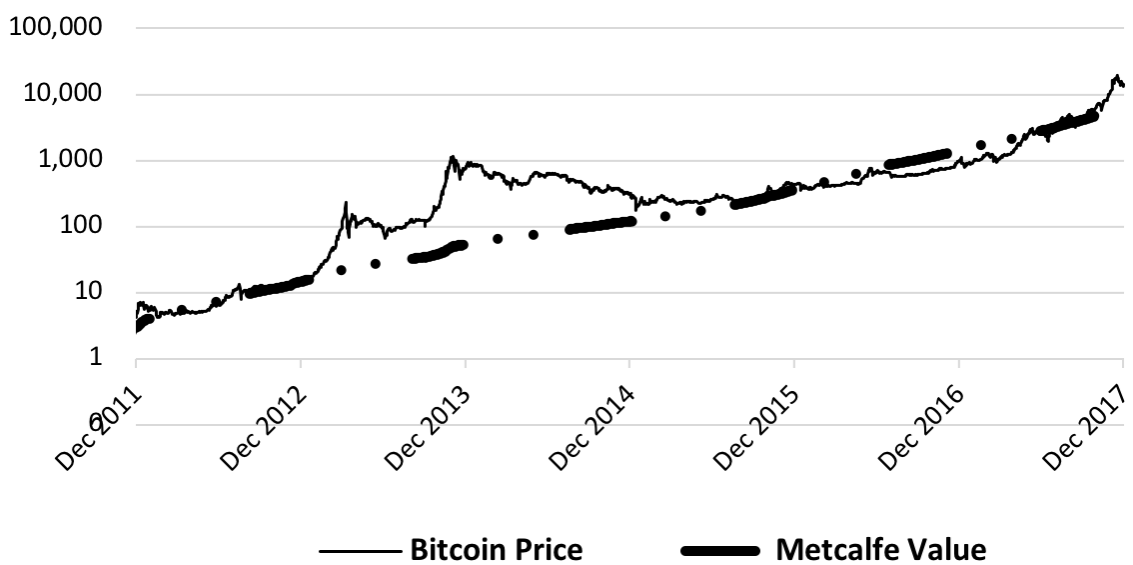

Exhibit 5

Multiple R	0.92
R Square	0.85
Adjusted R Square	0.84
Standard Error	0.22
Observations	23.00

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept (unadjusted)	(0.34)	0.15	(2.27)	0.03
LFD Metcalfe Value	1.31	0.12	10.90	0.00

Exhibit 6: Bitcoin Price as a Function of Metcalfe Value

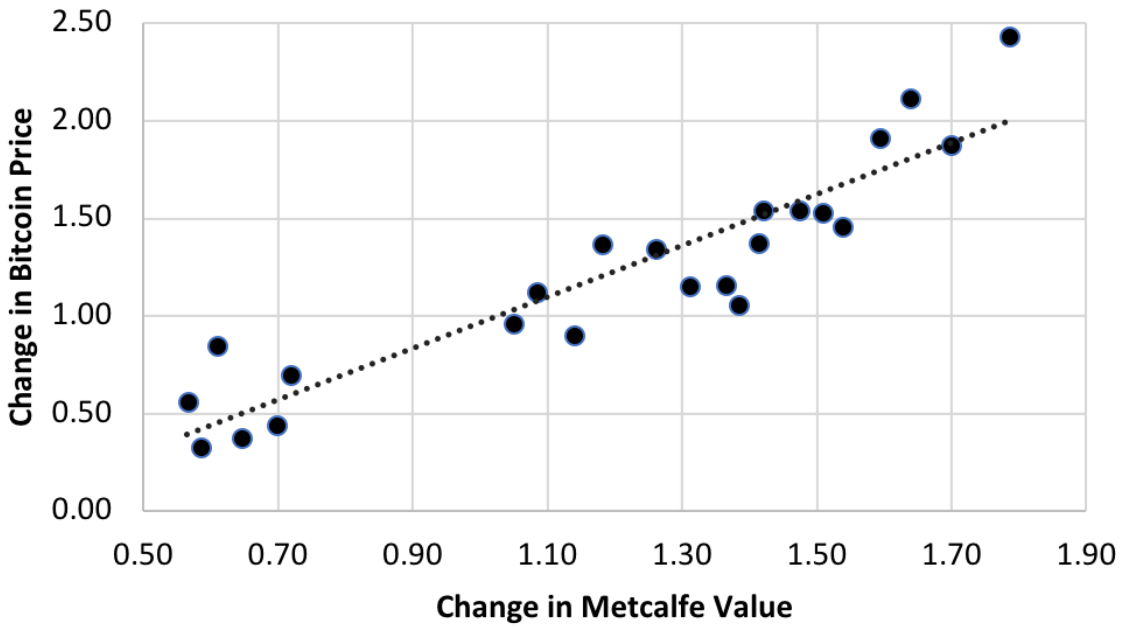

Exhibit 7: Change in Bitcoin Price vs. Change in Metcalfe Value

Discussion of Results

We modeled bitcoin's equilibrium value based solely on factors relating to supply (number of bitcoins) and demand (number of wallets). The resulting number of transactions, which is proportional to n^2, relate intuitively (per Economides) and mathematically (per Metcalfe) to price. We expect deviations to occur, but significant deviations should be subject to scrutiny. Exhibit 8 shows bitcoin's daily closing price as percentage above or below the value indicated by Metcalfe's law.

Gandal's [2018] compelling case of price manipulation presents us with a dilemma: do we exclude price history that is probably fundamentally flawed, or leave the entire price series intact? If we exclude the suspect periods, the fit will be a more conservative measure of value (because the intercept will be lower).[13] If we leave the suspect periods in, the fit will be a more conservative measure of any suspected price manipulation (because the intercept will be higher).

Metcalfe's value is a measurement of network capacity, literally the maximum number of paired connections that can be made. In that sense, it represents an upper limit of proportionality. If the price behavior in 2013 were the result of increased transaction activity (e.g. "irrational exuberance"), we should see transaction activity increase relative to Metcalfe's value. When we plot the ratio of daily transaction volume to Metcalfe value (Exhibit 9,next page), we do not observe an increase in transaction volume that would explain the dramatic increase in price in 2013. In fact, transaction activity as a percentage of network capacity declined over that time.

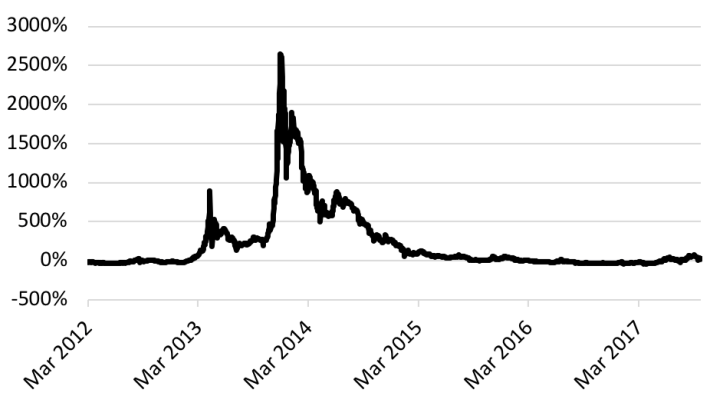

Exhibit 8: Price Deviation from Metcalfe Value

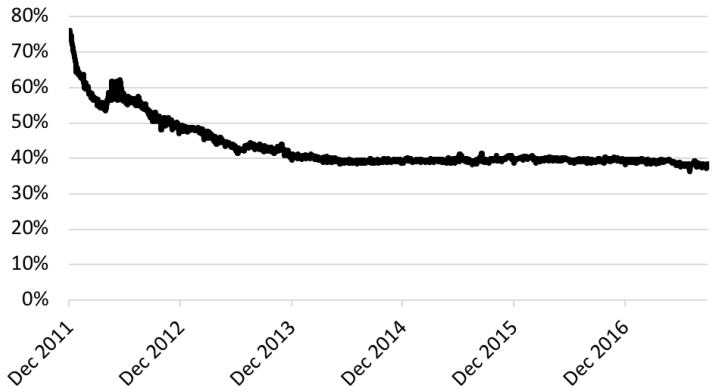

Exhibit 9: Transactions as a % of Network Capacity (log scale)

On the assumption that Metcalfe value is an indicator of price, we examined the distribution of daily deviations using a Wilcoxin Signed-Rank test. The calculated z-score was -3.34, which implies less than a 0.05% chance that the daily values were the result of expected variances.

Equation 5, taken in isolation, might be indicative of model misspecification. However, the Metcalfe model fits exceptionally well for all periods except 2013-2014. In light of Gandal's [2018] findings and our own results using Metcalfe's value, we believe the best explanation of the large variance in 2013-2014 is price manipulation. For that reason, we excluded data points 1Q2013 through 1Q2015 from our regression in Equation 8. While this treatment may undoubtedly rankle some, our defense is that we are attempting to provide evidence of a strong relationship between Metcalfe's law and bitcoin, and not necessarily define a value for bitcoin under all circumstances.

The following caveats must be noted. First, we cannot know for certain what–if anything– happened in 2013 and how it affected bitcoin's price. Second, the effects of "zombie bitcoins" on wallets is not considered in our model. If the ratio of "zombie bitcoins" to wallets is increasing, then we have overstated the effect of wallets on Metcalfe value, and Metcalfe value would be lower. Third, some wallets may have been opened which held other cryptocurrencies and no bitcoins, overstating n. Lastly, we cannot observe Metcalfe's network constant of proportionality A directly. Metcalfe himself said that A may increase with n over time, overwhelming n^2, and this would increase Metcalfe's value.

Conclusions

Our research offers two conclusions. First, bitcoin's price, in the medium- to long-term, appears to follow Metcalfe's law, with R^2 above 80% depending on periods used. We attribute the high degree of fit in both cases to the fact that a principle assumption of network laws–homogeneity of the transactions–is met. It helps that Bitcoin is perhaps the first widespread, transparent application of a network that is directly monetized with the inception of each wallet.

Also, we find evidence to support Gandal's [2018] hypothesis of market price manipulation in 2013. This was an unintended finding of our study. If Metcalfe's law helps explains bitcoin's price, then in layman's terms, the high price on November 29, 2013 would have been the result of "naturally occurring" variances only once in every 13,700 years. Consequently, we could also safely assume that prior studies of bitcoin's price formation that incorporated the 2013-2014 period are likely flawed, because prices during that period were not indicative of normal supply and demand under fair competition. We think there is a basis for further research into the application of Metcalfe's law to forensic detection of price manipulation for cryptocurrencies.

Metcalfe's law is largely unknown to economists, and cryptocurrency is new. Few can probably appreciate the effects of Metcalfe's law on a limited supply of a currency. It is a circumstance that has not developed until now, and it has done so in full view of a global public. Bitcoin's price provides a transparent look at Metcalfe's law at work.

Endnotes

1. Bitcoin is a global decentralized digital currency implemented in January 2009.The system is peer-to-peer, and transactions take place between users without an intermediary. The Bitcoin network consolidates transaction records into a block, timestamps them, and encrypts ("hashes") them into a continuing chain of hash-based proof-of-work. Additionally, a portion of the encrypted record is used to hash the next record, linking the records. This is called the blockchain. The blockchain is a public record, stored and globally distributed on (presently) over 9,000 computers. This distributed public record cannot be changed without re-doing the proof-of-work for the prior transaction, and recursively, all other transactions in the chain, as well as all copies of the blockchain in the globally distributed network. This protective mechanism, as well as blockchain hash itself, serves to practically eliminate counterfeiting a bitcoin or its associated transaction log. "Bitcoin" with a capital "B" refers to the network protocol while lowercase "bitcoin" refers to a unit of currency. Burniske et. al [2017] provide a well-rounded description of bitcoin and its uses; Hileman et al [2017] provide further insight into the cryptocurrency industry at large; and the original Nakamoto [2008] text serves as a good technical reference.

2. Keynes [1965]. "Fiat Money is Representative (or token) Money (i.e. something the intrinsic value of the material substance of which is divorced from its monetary face value)–now generally made of paper except in the case of small denominations–which is created and issued by the State, but is not convertible by law into anything other than itself, and has no fixed value in terms of an objective standard."

3. Thornton [1965] "(Money) presents to the holder no hope of future profit from the detention of it. Not only does it bear no interest, but it offers no substitute for interest; the quantity held by each person is only that which the amount of payments to be effected by it renders, in his opinion, necessary."

4. Economides [1996] "The act of exchanging goods or assets brings together a trader who is willing to sell with a trader who is willing to buy. The exchange brings together the two complementary goods, 'willingness to sell at price p' (the 'offer') and 'willingness to buy at price p' (the 'counteroffer') and creates a composite good, the 'exchange transaction.' The two original goods were complementary and each had no value without the other one. Clearly, the availability of the counteroffer is critical for the exchange to occur."

5. In the cryptocurrency lexicon, a *node* is a computer system that verifies and relays valid transactions to other nodes, propagates block solutions, and stores a copy of the Blockchain; nodes are operated by entities such as miners and certain users. Throughout this paper, we use the general term user to denote a point of connectivity in the network.

6. Reed [2001]."(E)ven Metcalfe's law understates the value created by a group-forming network (GFN) as it grows. Let's say you have a GFN with n members. If you add up all the potential two-person groups, three-person groups, and so on that those members could form, the number of possible groups equals 2^n. So the value of a GFN increases exponentially, in proportion to 2n. I call that Reed's Law. And its implications are profound."

7. Bitcoins are created each time a user discovers a new block. The rate of block creation is adjusted every 2016 blocks to aim for a constant two-week adjustment period (equivalent to six per hour.) The number of bitcoins generated per block is set to decrease geometrically, with a 50% reduction every 210,000 blocks, or approximately four years.

8. A Gompertz function is a sigmoid function used to model a time series, where growth is slowest at the start and end of a time period.

9. See Metcalfe [2006].

10. Per blockchain.info: "Blockchain is the world's leading software platform for digital assets. Offering the largest production blockchain platform in the world, we are using new technology to build a radically better financial system. Our software has powered over 100 million transactions and empowered users in 140 countries across the globe to transact quickly and without costly intermediaries. We also offer tools for developers and real-time transaction data for users to analyze the burgeoning digital economy."

11. Per coindesk.com: "CoinDesk is the leading digital media, events and information services company for the digital asset and blockchain technology community. Its mandate is to inform, educate and connect the global community as the authoritative daily news provider dedicated to chronicling the space."

12. Hayes [2016] provides a cost production model, based on the cost of electricity per kWh, the efficiency of mining as measured by watts per unit of mining effort, the market price of bitcoin, and the difficulty of mining. Except for the price of bitcoin, each of these factors would require an assumption on our part, one that we are reluctant to make for reasons of practicality, as well as the likely introduction of errors into our own model.

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Alpha and Performance Efficiency of Ivy League Endowments: Evidence from Dynamic Exposures

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Introduction

As of June 2017, the total AUM of university and college endowments was estimated in excess of $560 billion.[1] These funds are used to generate income in order to satisfy current and future operational expenses of their affiliated universities, with annual effective spending rates over 4 percent.[2] They have received much attention in the recent past for their superior investment returns compared to other institutional investors [Lerner, Schoar, and Wongsungwai, 2007]. With a combined $124 billion AUM[3], the Ivy League endowments[4] demand a lot of attention, given their impressive track record of mostly double-digit returns over the past two and half decades (Exhibits 1 and 2, next page), showing that the group has outperformed both historical payouts of 5 percent, even after an average inflation of 3 percent is added to those, and a 60-40 portfolio[5] by a wide margin.

Ivy League fund performance has been associated with their increasing allocations to private asset classes (real estate, private equity and hedge funds). These funds find it easier to invest in such assets, as they can afford managers and consultants with great expertise (Dimmock and Stephen 2012). Yale, in particular, held 69 percent of its assets in 2006 in real estate, private equity and hedge funds [Lerner et al. 2007]. As documented in the literature, such heavy weightings toward private or alternative asset classes largely explains why Ivy League endowments have enjoyed large positive returns in the past.

However, even the largest endowment funds were not immune to the recent financial crisis. The Ivy group experienced losses that exceeded 20 percent in 2009. Such losses have important policy implications because university endowments are typically forced to reduce payout rates during negative financial shocks [Brown et al. 2010]. Significant losses also put into question the endowment model as advocated by David Swensen, known as the 'Yale model'.[6]

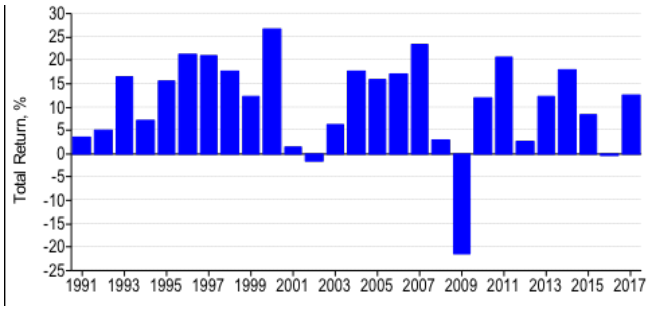


Exhibit 1: Annual Returns of Ivies Shown by Fiscal Year
Source: Nacubo
Note: The returns displayed for each year correspond to fiscal years that end June 30 as opposed to December31. This applies to all subsequent charts that display endowment returns

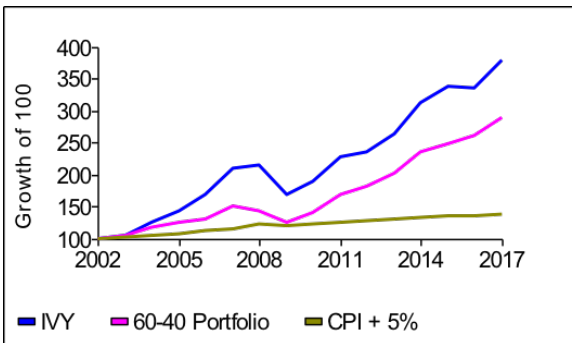


Exhibit 2: Cumulative Growth of Ivies vs. 60-40 Portfolio Shown by Fiscal Year
Source: Nacubo, Bloomberg

Motivation

The publicly available asset allocations that the funds disclose tend not to use traditional asset class breakdowns. They typically group investments by other attributes such as "Independent Return," "Real Assets" and "Absolute Return." This type of non-standardized disclosure makes endowment performance comparisons difficult. The fact that alternative investments occupy a large portion of Ivy League asset allocations further exacerbates this problem. In this paper we seek to shed light on the alpha-generating abilities of Ivy League endowments and the financial risks[7] they assume over time in order to evaluate their performance efficiency. The results will be derived at the individual endowment level and then aggregated bottom up in order to arrive at conclusions about Ivy League endowments as a group. We will also supply results based on the Ivy index for reference and particularly given that this index allows us to go back further in history.

Our analysis is based on investment returns experienced by the funds, which are reported on an annual basis. While these go back to 1988 across endowments, broken down by size of AUM and type of institution (public or private)[8], publicly available returns on individual Ivy League endowments are harder to obtain and typically only go back a few years. This data limitation makes returns-based analysis using traditional methods such as the one put forward by Sharpe (1992), very challenging.

To overcome this limitation, we perform style analysis based on market indices that correspond to allocations made by endowments (Private and Public Equity, Fixed Income,

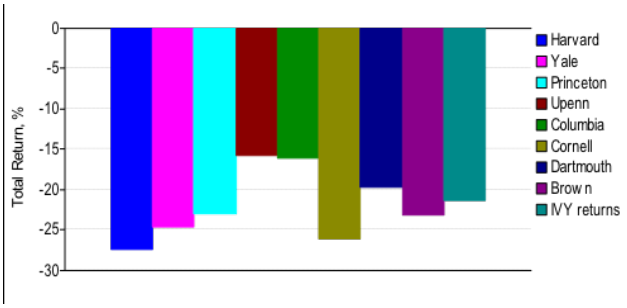


Exhibit 3: Performance of Ivies During Fiscal Year 2009
Source: Endowment Annual Reports

Commodities, Hedge funds). We used a Dynamic Style Analysis model (Markov et al., 2004) that enables the calculation of alpha and betas using small data sets. Our approach allows us to create a portfolio of indices that mimics the returns of the funds.

Even though the endowment funds provide only annual data, the factor-mimicking portfolio is available at a higher frequency[9] than annual. This provides us with sufficient observations to infer the aggregate risk of specific endowment funds.[10]

We present results on alpha related to manager selection and market timing, alpha against common public indices, risk and performance efficiency in terms of Sharpe ratio.

Existing work

Alpha

There have been many studies that analyze endowment returns. Lerner, Schoar and Wang (2008) find that endowments earn strong excess returns relative to S&P 500. Chen (2016) finds that larger endowments, proxied by Harvard, Yale and Princeton, earn returns that are 8 percent higher than the smallest endowments. This is partially due to their ability to absorb fixed costs associated with illiquid asset classes that have higher expected returns, and partially due to their informational advantage as they have more money to hire the best talent. Brown, Garlappi, and Tiu (2010) used reported asset allocation weights and benchmark returns and found that the average endowment earns a negligible alpha. In particular, timing and security selection explained 14.59 percent and 8.39 percent of the variation of each endowment's returns, whereas asset allocation explained 74.42 percent of it. Barber and Wang (2013) analyzed grouped endowment returns for the Ivy and top SAT schools by regressing their annual returns against common benchmarks. They found no evidence of manager selection, timing, and tactical asset allocation abilities.

Risk

There are not many studies that calculate the investment risks endowments take. Chen (2016) reports that larger endowments may have lower risk aversion and thus be willing to invest more of their wealth to riskier asset classes. Using reported allocations and using market indices as proxies, he calculates the risk each endowment takes. Although this approach doesn't account for the fact that the same asset class will have a different risk profile across endowments, it provides a good estimate of the risks endowments take in a boom period. The author finds that when

the market is in boom, the larger the endowment, the higher the return it achieves. This disappears or even reverses in high-risk regimes, indicating that larger endowments take on more risk and that may or may not result in higher returns, depending on the regime. It also becomes evident that larger endowments allocate more into riskier asset classes. In terms of Sharpe ratio, the larger endowments do not display any advantage over smaller ones and, in fact, in some cases they show a disadvantage.

Endowment data

Endowment returns are reported annually, usually during September, three months after the end of the fiscal year. Individual endowment return series were mainly collected from annual reports that endowments publish over the years on their own websites. For our analysis, these go back to 2003.[11]

Exposures

Analyzing endowment returns presents many challenges due to aggregate changes in allocations to major asset classes mentioned above. Such changes may be due to a different perception of expected returns to each asset class as well as changes in the risks that endowments are willing to take. If endowment funds face non-tradable risks for example, then they will choose portfolios that best hedge those risks. In other words, high standard deviation of non-financial income is associated with safer portfolios (Dimmock and Stephen, 2012). Credit constraints, amount of research taking place in the university and a large proportion of university revenues coming from endowments all result in safer portfolios. And while the need for regular cash flows to affiliated universities means that liquidity is a concern, universities with greater selectivity that can raise tuition at will or universities with a high ratio of donations to fund size do not face large liquidity constraints, allowing them to invest capital in illiquid private asset classes.

These considerations will result in time varying exposures against factor sets consisting of major asset classes such as the ones we use in this paper. This means that traditional methods of regression analysis such as the one put forward by Sharpe (1992) are not well suited given they assume constant exposures over the period analyzed. A way to get around this is to perform rolling regressions over shorter windows within the entire analysis period. Given the available returns are limited to only twelve annual observations, this is not a viable approach. To alleviate such concerns, we use a dynamic modeling technique called Dynamic Style Analysis (DSA) that is designed to work with scarce data and allows us to detect the dynamics of asset-based exposures (Markov et al., 2004).

The set of indices we used to explain the return series of each fund was formed based on common asset classes disclosed in endowments' annual reports. Any particular endowment portfolio may have (small) investments outside this set or may target different types of private investments than the ones corresponding to the indices chosen above. The indices we used, however, correspond to the largest percentage allocations reported by endowments and serve as a comprehensive set based on which risk and return can be evaluated. The fact that we are using the same set of indices across funds also enables us to have a common base for comparison.

For real estate we used the Cambridge Associates Real Estate index. This index represents an aggregate of individual commercial property returns based on properties owned by funds that institutional investors invest in, such as closed end funds, commingled funds and funds that are of sufficient size.[12] For hedge funds we used the Eurekahedge 50 index.[13] This index avoids the selection and instant history bias of the commonly used HFRI Fund Weighted Composite Index used in many studies, contains limited survivorship bias and is comprised of funds with top AUM. This makes it more applicable as a benchmark for hedge fund investments made by large institutional investors vs. an index that includes small funds. As a result, that index should represent more closely the institutional investor experience. For buyout and venture capital we used the corresponding indices from Cambridge Associates,[14] which are constructed based on the underlying cash flows and Net Asset Values provided by the general partners. Cambridge Associates obtains data from limited partners and general partners who have raised or are raising capital. Therefore, it may be biased toward well-performing funds, which may reduce the calculated fund alphas. However, given the large coverage of the database, this bias is likely to be low. Since we did not have many data points available for regression analysis, we used a portfolio with equal weights to the buyout and venture capital indices in our regressions. Given we didn't have access to a private natural resources index, we used a public commodity index as a proxy. For the rest of the public factors, we used indices that correspond to asset classes endowments invest in.

Public Equity	MSCI World
Real Estate	Cambridge Associates Real Estate
Private Equity	50% Cambridge Associates Private Equity + 50% Cambridge Associates Venture Capital
Commodities	Bloomberg Commodity
Bonds and Cash	Bloomberg Barclays U.S. Aggregate Bond Index
Hedge Funds	Eurekahedge 50

Exhibit 4: Index Proxies by Asset Class

We follow Sharpe's original approach by constraining the coefficients of the regression to be positive and add up to one. The budget constraint essentially assumes that there is no implied leverage in the aggregate holdings of the fund compared to the indices used to analyze its returns. In the case of endowment funds, we don't know whether the managers they invest in take on positions that are more levered than the indices being employed in the analysis. The allocation to each asset class may also be more concentrated than the indices we have used or the funds may invest in riskier stocks or bonds than what the indices hold. Alternatively, funds may invest in long/short equity strategies, which can have an aggregate market exposure close to zero.[15] Although in the aggregate level we do not expect our exposures to act as leveraged as a whole, the analysis will show factor exposures that may differ from actual holdings as some asset

classes may be more or less leveraged than others. The constraints we apply also have the effect of increasing stability and mitigate multicollinearity which is particularly useful in the presence of limited data.[16] We do not attempt to quantify any currency hedging that may take place against the equity or real estate portion of the portfolio, assuming that all foreign exposures are unhedged.

Model strength

Given the limited data availability, we use a powerful technique that avoids overfitting in order to calibrate the time varying properties of the model. This is based on MPI's proprietary cross validation statistic, called predicted R-squared.[17] Similar to R-squared, predicted R-squared is also used as an indicator of a model's explanatory power.

Endowment	R^2	Predicted R^2
Harvard	96.9	96.9
Yale	99.3	99.3
Princeton	99.4	99.4
Penn	97.7	97.7
Columbia	97.8	97.8
Cornell	98.0	98.0
Dartmouth	96.6	96.5
Brown	98.9	98.9

Exhibit 5: R-Squared

In our analysis, the predicted R-squared values are all high and above 96 percent, as shown in Exhibit 5, suggesting a high explanatory power.

Another indicator of a model's explanatory power is whether the fund and factor mimicking portfolio, including the alpha component, move together. In table A of the Appendix, we can see that each fund's cumulative growth is closely tracked.

The exposures estimated were also compared against the annual reports from the funds which show asset class breakdowns and were found to be very similar, providing further support to our results.

Exposure portfolios

Exhibit 6 shows the dynamic factor exposures obtained by our model,[18] and Exhibit 7 groups and displays the overall exposure to alternatives. What is immediately obvious is the large,[19] and for the most part increasing, exposure to alternatives across most endowments, driven mainly by increasing exposures to private equity.

Endowment performance

The performance of the Ivy League funds over the period analyzed has been rather impressive, with all of them beating the 60-40 portfolio. We hereby shed light on the ways these funds have been able to generate such returns.

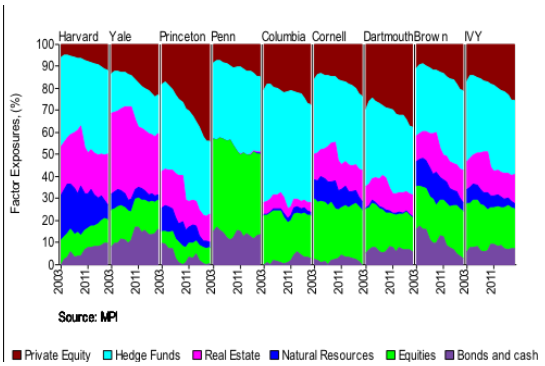


Exhibit 6: Factor Exposures of Ivies Shown by Fiscal Year
Source: MPI

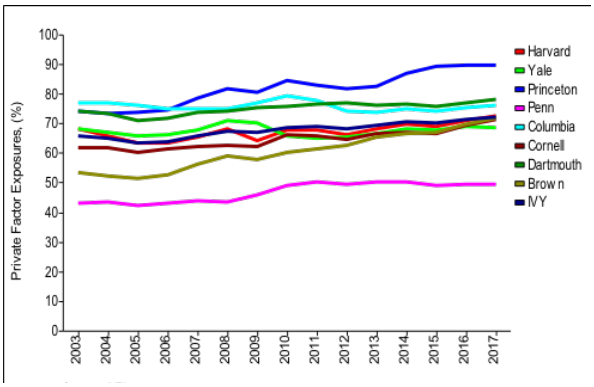


Exhibit 7: Exposures of Ivies to Private Investments Shown by Fiscal Year
Source: MPI

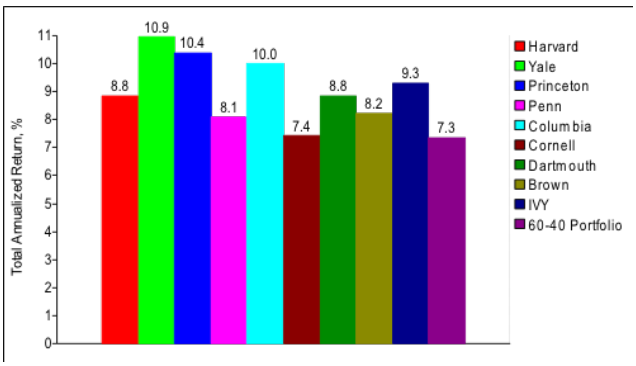


Exhibit 8: Total Annualized Return of Ivies and 60-40 Portfolio
Source: Nacubo

Timing

The first return component that we look at is called timing, and it is commonly used to measure the effectiveness of the portfolio's allocation decisions against a benchmark. In the absence of a well-defined benchmark[20] for the types of allocations the funds follow, we have used the average exposures of each mimicking portfolio over the analysis period as the benchmark. In order to calculate timing, we compared the returns of the mimicking portfolios against their average. This comparison provides us a measure of the return that was generated from shifts in asset class exposures over time. (Exhibit 9, next page) shows the annualized timing returns for the endowments. The timing returns are all small and negative, indicating that funds likely do not engage in market timing when measured on an annual basis and against the indices we use.[21]

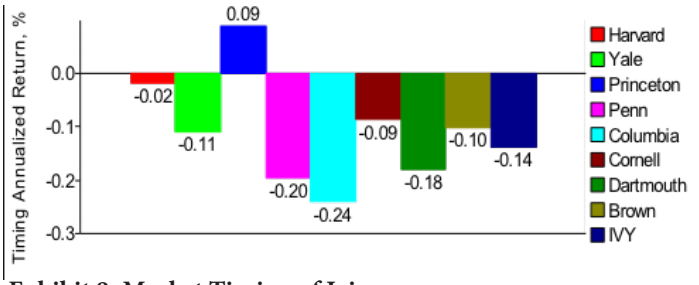


Exhibit 9: Market Timing of Ivies
Source: MPI

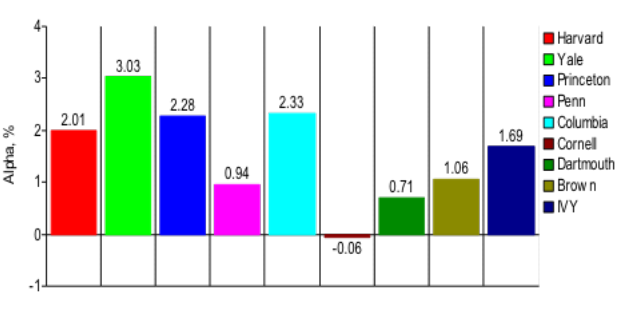


Exhibit 10: Private Alpha of Ivies
Source: MPI

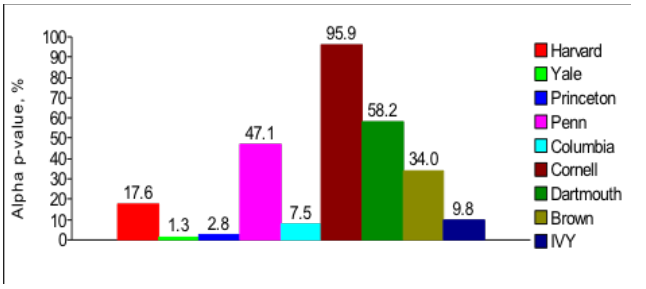


Exhibit 11: Private Alpha P-Values of Ivies
Source: MPI

Private alpha

We now turn to the question of whether endowment fund managers have superior alpha generation capabilities. This can arise from security selection, if the endowment manages their own investments, or selection generated by managers of the funds in which the endowment invests, in which case it speaks of the ability of the endowment team to select skilled managers.[22] For the rest of the document we will call this type of alpha private alpha.

In addition, returns arising from missing factors in the model could also impact private alpha. As Barber and Wang (2013) show in the case of regression with constant coefficients, any bias in the calculated alpha is given by the below relationship:

$$E(\alpha) = \beta_n \alpha_0$$

where α_0 is the alpha that the missing factor produces when regressed against the factors we used in the model and β_n is the beta of the fund to the missing factor when all other factors are included in the regression. A symptom of such a missing factor is low R^2. Given our set of indices spans the vast majority of asset classes that the Ivy League endowments invest in and that the R^2 of all regressions are high, it seems very unlikely that we have omitted a significant factor. Even if there is a missing factor, the beta against it should be small, resulting in a small alpha bias as the above equation.

While the aggregate index leads one to believe that Ivies do not generate superior returns, which is in agreement with the findings of Barber and Wang (2013), the results at the endowment level are mixed. Some endowments achieve private alphas above 2 percent, for the most part statistically reliable, while others do not.

Replication

To further evaluate the alpha-generating capabilities of the Ivy League funds, it would be of interest to find out if the factor-mimicking portfolios displayed in Exhibit 6 are able to generate similar returns out of sample.

Data

In order to have as much out-of-sample data as possible, the data we use for this exercise extends as far back as we can go depending on its fund's history, deviating from using a common and recent time period. This still leaves us with only a few data points to calculate out of sample statistics for some funds as shown in Exhibit 12. Given we do not have long history available for all funds, we also analyze the combined returns across all Ivy League funds as reported in Exhibit 1.

Endowment	History (number of years)	Out of sample (number of years)
Harvard	38	28
Yale	22	12
Princeton	18	8
Penn	32	22
Columbia	16	6
Cornell	18	8
Dartmouth	22	12
Brown	16	6
Ivy	28	18

Exhibit 12: Available History and Data Points for out-of-sample Estimations

Process

The replication takes place as follows. We use the first 10 years of an endowment's history to regress its returns against the public and private asset classes reported in Exhibit 4. Using the factor exposures obtained that correspond to the last year of the in-sample time period, we estimate the replicating portfolio returns over the next year by multiplying those exposures by the realized factor returns over the next year. We proceed repeating the same steps for each year going forward, each time using a 10-year rolling historical window for the estimation of the factor exposures.[23]

Exposures

Given the portfolios we are trying to replicate contain rather stable asset allocations, an indication that replication is reliable and avoids data overfitting is whether the exposures calculated at each time step are erratic or not. This has to be taken in context of the limited data we are working with, which will introduce sampling variability to a certain degree. Therefore, while we expect a rolling exposure calculation to produce more volatile exposures than a calculation that spans a longer time period, the change in exposures observed should not result in unreasonable turnover. We demonstrate what happens to the factor exposures of the replicating portfolio of the Ivy League index as an example. These are shown in Exhibit 13, which also shows for comparison the factor exposures of an in-sample analysis of the index over the entire period.[24] The exposures between the index and its replicating portfolio are similar to each other and consistent with the individual endowment exposures of Exhibit 6.

In Exhibit 14, we display the style dispersion for each endowment and replicating portfolio. For the most part, the style dispersion of the replicating portfolio is well controlled in relation to the in-sample dispersion.

Tracking

To first get a sense of whether endowments add value on top of their factor-mimicking portfolios, we examine how close each replicating portfolio tracks its corresponding endowment.

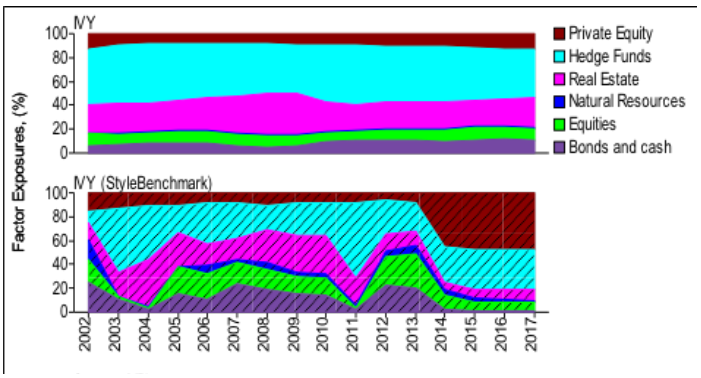


Exhibit 13: Factor Exposures of the IVY Index and its Replicating Portfolio (Style Benchmark) Shown by Fiscal Year
Source: MPI

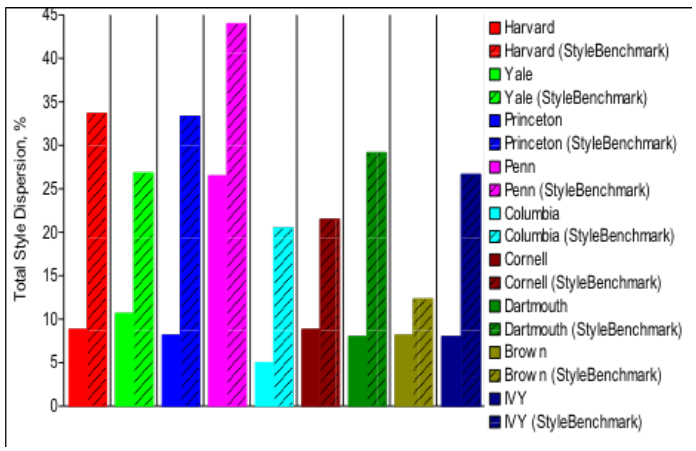


Exhibit 14: Style Dispersion of Ivies and their Replicating Portfolios.
Source: MPI

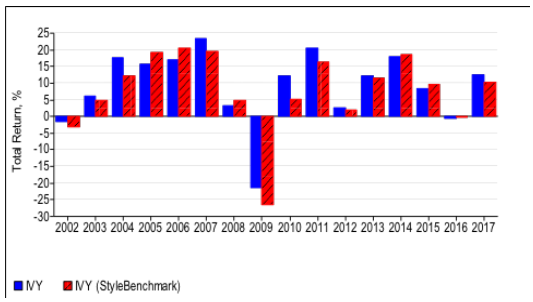


Exhibit 15: Yearly Returns of the Ivy League Index and its Replicating Portfolio Shown by Fiscal Year
Source: MPI

While a tight replication is not necessary, we should not observe deviations noticeably larger than the deviations of the in-sample factor-mimicking portfolios against their corresponding endowments.

Taking the Ivy League again as example, Exhibit 15 shows that the yearly returns between the index and its replicating portfolio are very close.

To quantify tracking across all endowments, in the next two charts we display statistics that summarize how well the endowment returns are being tracked. In Exhibit 16 we observe that the replicating portfolios achieve tracking errors that range between 1.9 percent and 4.8 percent. For the most part the results indicate close tracking, given the average standard deviation for the time period analyzed across all endowments is around 11 percent. With the exception of Cornell, the out of sample R^2 achieved across endowments in (Exhibit 17, next page) is at high to very high levels, in accordance to the R^2 values from Exhibit 5.

Excess return

The excess returns achieved by the funds are generally in line with their in-sample alphas from Exhibit 10. The excess return of Yale, the top performer, for example, against its replicating portfolio is 2.69 percent. By comparison, the average alpha reported in Exhibit 10 is 3.03 percent. Despite their recent 2017 under performance compared to the rest of Ivy endowments, Yale emerges on the top, followed by Harvard. The only endowments that break this rule are Columbia and Cornell, which show excess returns that flip sign in relation to the in-sample alphas. For both of these endowments, as per Exhibit 12, we had less than half the in-sample points available for excess return estimation though so the results are not directly comparable, rather they supplement each other.

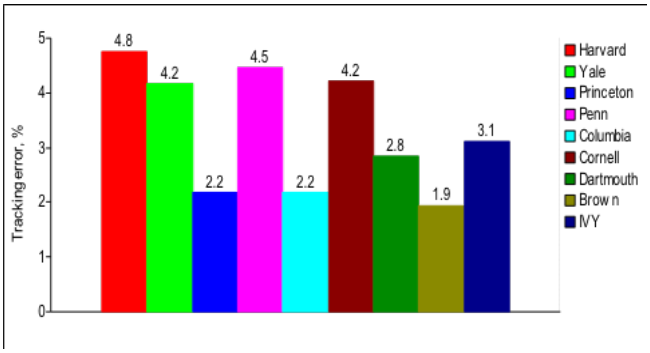


Exhibit 16: Tracking Error of Replicating Portfolios
Source: MPI

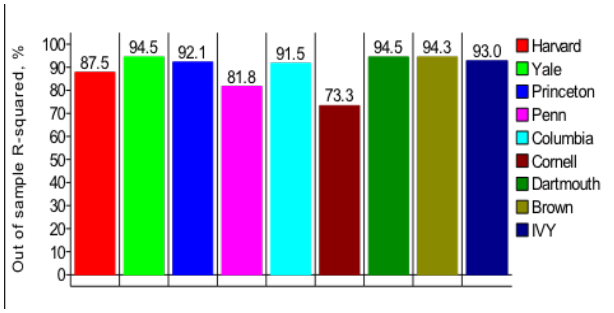


Exhibit 17: Out of Sample R^2 of Replicating Portfolios
Source: MPI

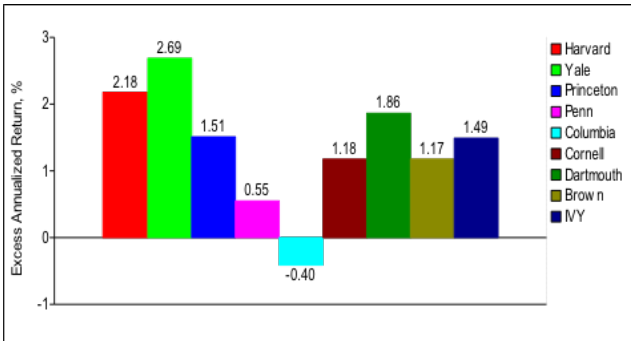


Exhibit 18: Excess Returns over Replicating Portfolios
Source: MPI

Unlike the in-sample results, in this case, none of the p-values of the excess returns are statistically significant. As shown in Appendix B, the excess returns are not just very volatile, but in many cases, they flip signs from one year to the next. This indicates that none of the Ivy League funds achieve reliably positive excess returns against the asset classes chosen.

Public alpha

Some of the asset classes endowments invest in, such as buyout, venture capital and hedge funds, have the potential of generating alpha against public indices, as shown in Exhibits 20 and 21 for buyout and venture capital. Although Exhibit 10 provides some clues of how true this is, for a more direct comparison against public indices, in particular, we omitted those from the analysis and reran the results. For the rest of the document we will refer to this alpha as public alpha.

The results were run with the same parameters as the original regression.[25] Previous studies (Woodward 2004) have found that the returns of private equity and real estate may depend on return lags that go beyond one year in the past. We attempted to include a one-year lag of each of the public indices, but this did not materially affect the results, therefore, the one-year lags were excluded.

Most funds now display large positive and significant public alphas. Interestingly, the rank of endowments in relation to their private alphas from Exhibit 10 is very close to the rank in relation to Exhibit 22. The public alphas of endowments have gone up about 2 percent in relation to the private alphas from Exhibit 10.

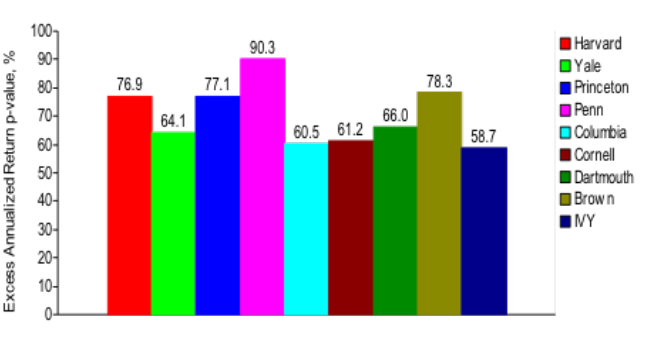


Exhibit 19: *p*-values of Excess Returns
Source: MPI
Note: The p-values have been produced using a two-tailed test

Beta	Annual alpha	Reference
2.2	1%	Buchner (2014)
2.2 – 2.4	8.3% - 8.6%	Axelson et al (2013)
1.39	-2%	Ang et al (2013)
1.4	0%	Franzoni et al (2012)
0.94	1.6%	Driessen et al (2008)
1	-3%	Phalippou et al (2009)
1	-0.1%	Jegadeesh et al (2009)

Exhibit 20: Alpha and Beta of Buyout

Beta	Annual alpha	Reference
2.6	3.5%	Buchner (2014)
2.57	-8.3%	Driessen et al (2008)

Exhibit 21: Alpha and Beta of Venture Capital

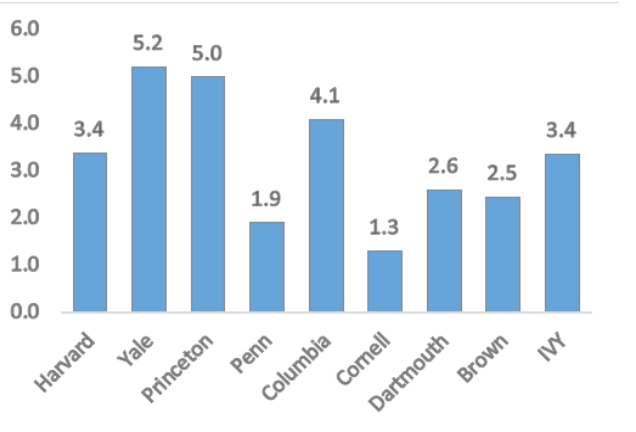


Exhibit 22: Public Alpha of Ivies
Source: MPI

Public alpha attribution

To understand which of the private assets mostly contributes towards the high public alphas observed in Exhibit 22, we perform alpha attribution. We first note that a fund's return may be decomposed as follows:

$$Y_{fund} = \alpha_0 + \Sigma b_{public} X_{public} + \Sigma b_{private} X_{private} \quad (1)$$

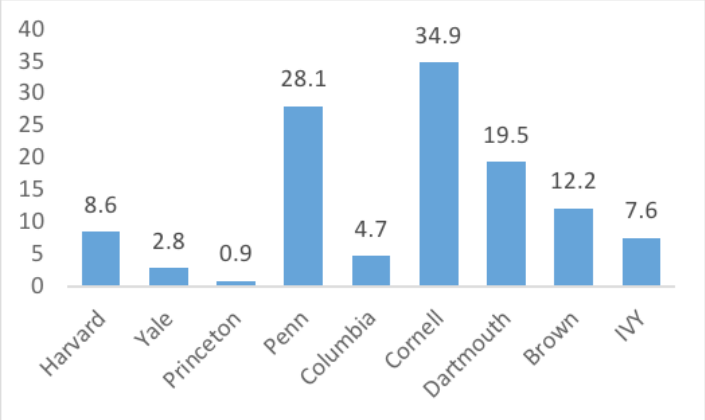


Exhibit 23: Public Alpha P-Value of Ivies
Source: MPI

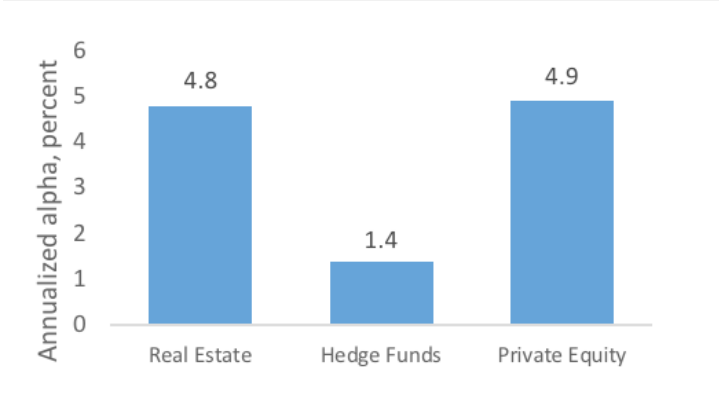


Exhibit 24: Public Alpha of Private Indices
Source: MPI

where Y and X denote return time series and α0 is the private alpha. We can also decompose each of the private series as follows:

$$X_{\text{private,i}} = \alpha_i + \Sigma b_{public} X_{public} \quad (2)$$

where αi is the public alpha of each private series. From (1) and (2), as an approximation, the public alpha of a fund will then be given by:

$$\text{Public alpha: } \alpha_0 + \Sigma b_{\text{private}} \alpha_i \quad (3)$$

This alpha has been calculated more accurately in Exhibit 22 based on the below regression:

$$Y_{\text{fund}} = \alpha_1 + \Sigma b_{\text{public}} X_{\text{public}} \quad (4)$$

We call the difference between the public alphas as calculated in (3) vs (4) as idiosyncratic alpha, α_u:

$$\alpha_u = \alpha_1 - \alpha_0 - \Sigma b_{\text{private}} \alpha_i \quad (5)$$

This term is still part of a fund's overall ability to deliver alpha against public indices but we do not know which of the private factors, if any, is responsible for this portion of the alpha. This term should generally be small. We can now attribute the public alpha calculated in (4) to its constituents:

$$\alpha_1 = \alpha_0 - \Sigma b_{\text{private}} \alpha_i + \alpha_u \quad (6)$$

We now proceed to regress each of the private indices against the set of public indices in order to obtain their public alphas, shown in Exhibit 24. The regression is performed using the same parameters as the regression in Exhibit 22 to ensure consistency.

The public alpha attribution results are displayed in Exhibits 25 and 26, omitting the idiosyncratic alpha for ease of comparison as that turned out to be quite small, compared to the public alpha.

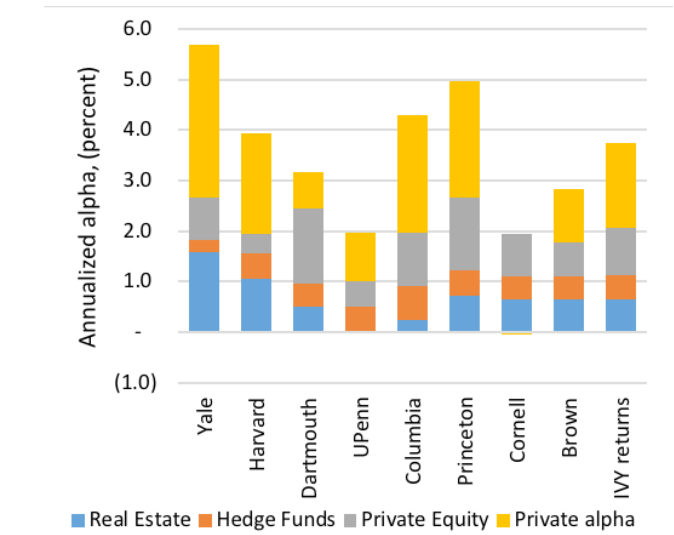


Exhibit 25: Public Alpha Attribution by Ivy
Source: MPI

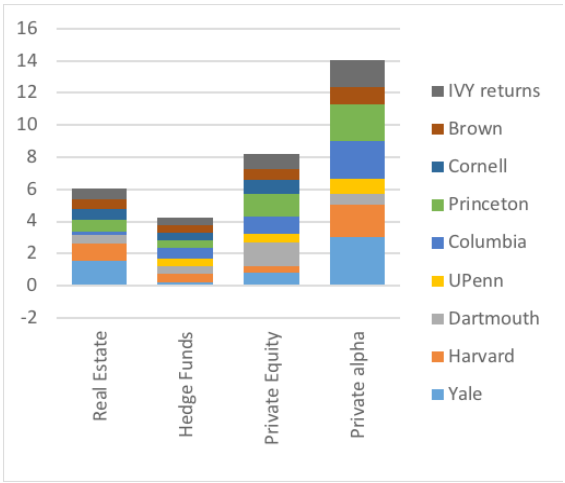


Exhibit 26: Public Alpha Attribution by Asset Class and Type of Alpha
Source: MPI

First, we observe that a good portion of endowment public alpha is due to their private alpha. This is particularly true for Yale, Harvard, Columbia and Princeton, in accordance with Exhibit 10. Cornell seems to be the only exception here with a negative private alpha, similar to a negative overall alpha from Exhibit 10. Second, we observe that, overall, it is private equity and real estate that contribute most to public alpha, with hedge funds having a smaller contribution. Finally, we observe that the public alpha contribution from hedge funds is consistent throughout all endowments, indicating no particular manager selection advantage among endowments. Private equity and real estate, on the other hand, show a less consistent view, with Yale and Harvard gaining a lot of alpha from real estate while the rest of endowments gained more from private equity.

Endowment risk

The question we are now trying to answer is how much risk funds take to achieve the high returns and alphas we saw in the previous section. To do this, we use the fund exposures and risk of the underlying factors over the period examined.

Once a factor-mimicking portfolio is constructed for each fund, the task of calculating the risk of that portfolio becomes essentially an exercise of calculating risk for each individual asset class within the factor-mimicking portfolio. While this is rather straight-forward for public asset classes, there are many challenges associated with this for real estate, private equity and venture capital.

Given there is no secondary market for the real estate properties held by real estate funds or private companies found inside private equity or venture capital funds, valuations (NAVs) for these entities are based on appraisals that are typically backward looking [Geltner, Jenkinson et al.]. This introduces smoothing in the time series of returns, which causes variance estimates to be biased toward zero. In commercial real estate, for example, there are infrequent purchases or sales of individual properties and valuations must be inferred based on recent sales of comparable properties, historical trends or current operating income (Geltner 1993). In venture capital, companies are valued every year or two when the time comes to negotiate new funding. Between such events, prices are typically carried forward or are a mix of recent and less recent company valuations. Buyouts are even more difficult to evaluate. There are few comparable transactions between when a company is bought and sold. So, just like in real estate, valuations are mainly based on appraisals, which may be quarterly or less frequent, and returns will certainly be backward looking and will avoid any transaction outliers. The lack of market-based valuations on a regular basis results in stated returns for these asset classes being artificially smooth.

One way to estimate the risk of these asset classes is to find out the factors they are exposed to along with the factor exposures. It would then be a matter of estimating risk for those factors as we describe further in the paper for the funds we analyze. A popular method that is followed by academics (Geltner 1992) and practitioners (Kinlaw et al. 2013), is to apply a de-smoothing algorithm that recovers the true volatility of the series. Since the approach based on factors leaves a large portion of the variance of each index unexplained,[26] we have chosen to apply the de-smoothing approach to the indexes in the factor-mimicking portfolio in order to estimate the risk of a specific fund.

As described in Geltner (2003), this method is based on an assumption that the effect of appraisal-based valuation is such that the observed, smoothed return of an aggregate private index is partially due to the true, de-smoothed and unobserved return of that index and partially due to past observed returns.[27]

$$r^*_t = w_0 r^D_t + \varphi_1 r^*_{t-1} + \varphi_2 r^*_{t-2} + \ldots$$

Where

r^*_t = the publicly reported index return for year t

r^D_t = the de-smoothed return

$$w_0 + \varphi_1 + \varphi_2 + \ldots = 1$$

In order to uncover the de-smoothed return to calculate its risk, we can regress the observed series against one or more of its lags.

$$r^*_t \sim \alpha + \varphi_1 r^*_{t-1} + \varphi_2 r^*_{t-2} + \ldots + u_t$$

The constant is there in order to fully separate the calculated betas from the idiosyncratic term, $w_0 r^U_t$. It contains uncaptured effects as well as any trend present in the residuals. We assume that any uncaptured effects are small, effectively making α part of the de-smoothed series: $w_0 r^U_t = \alpha + u_t$. Based on the coefficients we find, we can solve for the de-smoothed series:

$$r_t = [r^*_t - \varphi_1 r^*_{t-1} - \varphi_2 r^*_{t-2} - \ldots] / w_0$$

Where

$$w_0 = 1 - \varphi_1 - \varphi_2 - \ldots$$

De-smoothing takes place based on quarterly returns calculated over the time period June 2002 and June 2017, resulting in 60 quarterly data points.

Real estate

For the period examined, we used one index lag as it was enough to remove the serial correlation present in the original index.[28] The beta against the first lag was 0.68 with a highly significant p-value of 0.00000025. The de-smoothed index is plotted against the original index in (Exhibit 27, next page). We can see that they are both very close to each other, with the de-smoothed index having much higher risk with an annualized standard deviation of 25.27 percent compared to 11.05 percent of the original index. We also observe that the trough for the de-smoothed index took place in December 2008 as opposed to December 2009 for the original index.

Compared against the Case Shiller HPI index, which reached its lowest level in April 2009, it looks like the de-smoothed trough of the real estate index is a more realistic representation of what actually took place.

Exhibit 27: Original vs. De-smoothed Cambridge Associates Real Estate Index
Source: Cambridge Associate, MPI

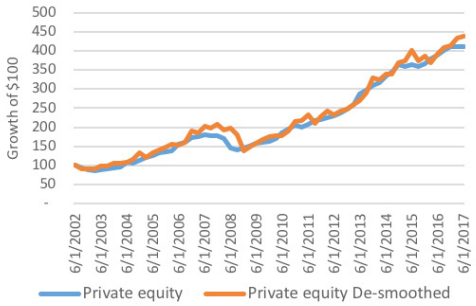


Exhibit 28: Original vs. De-smoothed Private Equity Portfolio
Source: Cambridge Associate, MPI

Private equity

For the private equity portfolio we have created, we also find one lag most suitable.[29] We obtain a beta coefficient 0.4712 with a highly significant p-value 0.0068 percent. The de-smoothed portfolio tracks the original very close but with a higher annualized standard deviation of 13.61 percent compared to 8.26 percent of the original portfolio.

Drawdown

Now that we have obtained the true series for each of the private indices, we can proceed with the risk estimation of the endowment funds. We start with the maximum drawdown, a commonly used statistic that measures the largest cumulative loss over a time period. It is often thought of as a tail-risk measure that offers insights into the magnitude of potential cumulative losses. Annual performance reporting tends to smooth out the performance pattern hiding the actual "investor pain" intra-year, something that quarterly factor-mimicking returns are now able to indicate. We follow the approach developed in Li et al. (2012), where reported monthly hedge fund returns were used to infer and project daily intra-month performance. In this case, we use the quarterly index returns to calculate intra-year performance. For real estate, buyout and venture capital, we used the de-smoothed indices since they more accurately represent the true drawdowns that these asset classes experienced.[30]

To make sure that we don't overestimate or underestimate the calculated drawdowns based on the factor-mimicking portfolios, we take an extra step to ensure that the total return from each factor-mimicking portfolio at each fiscal year equals the reported annual endowment return. To do this, we add a constant to each quarterly return of a factor-mimicking portfolio within a given fiscal year, such that the geometrically compounded factor-mimicking portfolio return equals the reported annual Ivy return. For the 15 fiscal years we examine, this means that we end up with 15 constant terms per each factor mimicking portfolio.

Exhibit 29 shows the maximum quarterly drawdowns of the endowments' factor portfolios compared to a 60-40 portfolio (orange bars). For comparison, we also supply the drawdowns based on annual returns (blue bars).

These drawdowns are significantly lower than if one were to calculate drawdowns based on the reported annual fund returns, highlighting the importance of our approach. They are also more severe than the 60-40 portfolio's drawdowns, indicating that endowments may take on considerably more tail risk.

Standard deviation

Exhibit 30 shows the annualized standard deviation of the various funds over the initial period. Having removed the bulk of serial correlation that the original indices displayed means that the factor-mimicking series are nearly i.i.d.

Similar to drawdowns, all endowments exhibit higher risk than the 60-40 portfolio, hinting that this may be the reason for the high returns.

Sharpe ratio

With better estimates of the endowments' risk using quarterly data and accounting for illiquid, appraisal-based investments, we are able to compare the endowments' risk-adjusted returns as

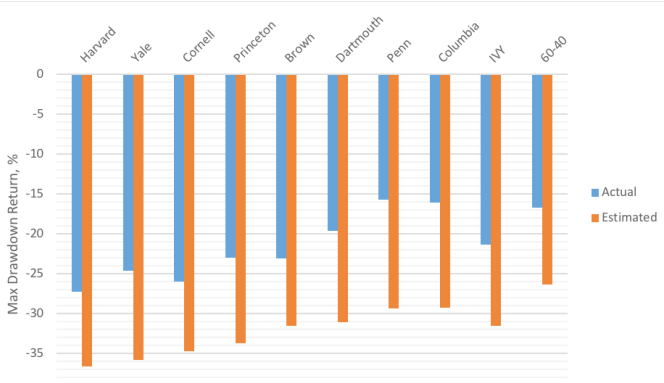


Exhibit 29: Actual and Estimated Max Drawdowns of Ivies
Source: MPI

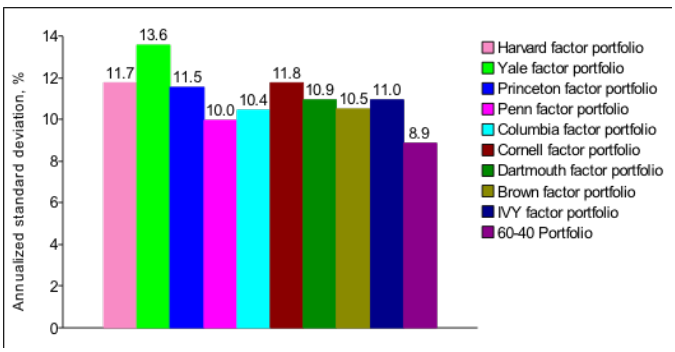


Exhibit 30: Estimated Annualized Standard Deviation of Ivies
Source: MPI

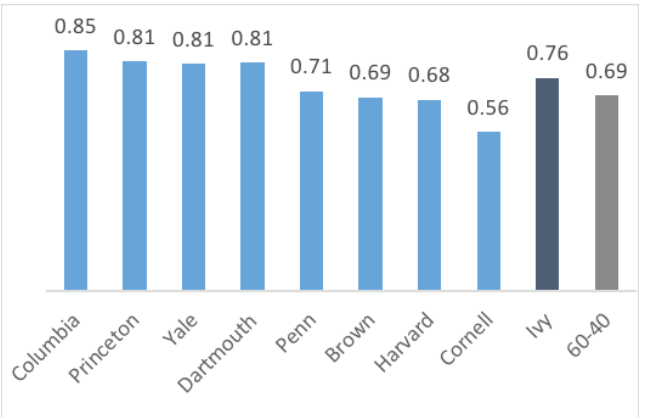


Exhibit 31: Sharpe Ratios of IVY Factor Portfolios
Source: MPI

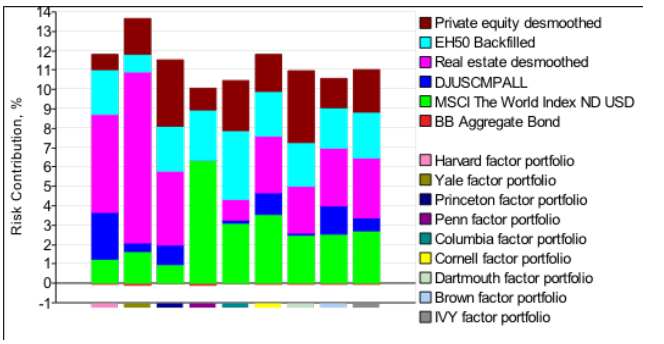


Exhibit 32: Estimated Systematic Risk Contribution of Ivies
Source: MPI

calculated using Sharpe ratio. The risk portion of the calculation is based on the risk of the factor-mimicking portfolios whereas the performance portion is based on the adjusted factor-mimicking portfolio returns as described in the Drawdown section. For the risk-free rate we used the three-month Treasury Bill Index. Our focus is on the ex-post Sharpe ratio measure over the period analyzed.[31]

The results are interesting. Despite the difference in total returns or alpha-generating capabilities, the dispersion in performance efficiency among the various funds is rather small. Moreover, the Sharpe ratios achieved by the Ivy endowments are all very close and span the 60-40 Sharpe ratio. From a performance efficiency standpoint and over the period examined, there doesn't seem to be any particular advantage in having endowments invest in private asset classes or in their manager selection ability.

The results are also somewhat different from the private alphas observed in Exhibit 10. For example, Yale is able to achieve a higher private alpha than Columbia, but Columbia has the higher Sharpe ratio. This may seem counter-intuitive at first. The explanation here is that, although Yale achieves higher alpha, that alpha is not high enough to achieve higher Sharpe ratio than Columbia.[32]

Indeed, from the risk contribution analysis in Exhibit 32 we observe that Yale's systematic risk is quite a bit larger than Columbia's, due to the increased real estate exposure. In the same sense, most endowments do not earn large enough alphas to be more efficient than a 60-40 portfolio which, although by construction achieves no alpha against public indices, exhibits much lower risk as per Exhibit 30.

Conclusion

This paper analyzed the historical performance of the Ivy League endowments over the fiscal period 2003–2017. We used a factor model that includes public and private benchmarks representing stocks, bonds, commodities, real estate, hedge funds and private equity. To take into account the distinct dynamics that each fund exhibits, we performed regressions using a proprietary Dynamic Style Analysis model. This dynamic model enables us to calculate market timing and more accurate alphas than if we were to assume constant exposures. We find that Ivy League endowments likely do not engage in market timing of significance or possess alpha-generating market timing abilities relative to the complete set of factors that explain the funds' performance. The in-sample private alphas seem to be noticeable and significant for some Ivies, indicating that some possess manager selection abilities. When tested out of sample, however, we found a similar magnitude in their excess returns over factor-mimicking portfolios, yet not significant, casting doubt on their alpha generation capabilities. When analyzed against public indices, we find that in-sample alphas go up by about 2 percent vs. when using all indices, indicating that the decision to invest in private asset classes does produce additional alpha. Alpha attribution analysis showed that public alpha is mainly due to private alpha. Public alpha contribution from asset classes came mainly from private equity and real estate as opposed to hedge funds.

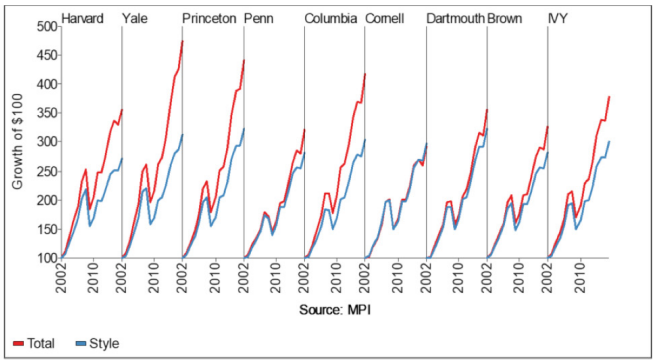
We find increasingly large exposures to private asset classes among most Ivy League funds, reaching as high as 90 percent. Although that helps them achieve high returns and alphas (against public indices), it doesn't come without risk. We used the factor-mimicking portfolios created by style analysis to calculate how much risk the funds take. For real estate and private equity, we applied a de-smoothing technique in order to overcome the staleness introduced by appraisal-based valuations and estimate the true risk of each index. Armed with proper exposures, frequent factor data and risk estimates, we then calculated drawdowns, standard deviations and Sharpe ratios. We find that all funds exhibited severe drawdowns during fiscal year 2009, and they all take on higher risk than the 60-40 portfolio.

Risk estimates have implications for Sharpe ratio where we find that the dispersion among endowment Sharpe ratios is small, spanning the Sharpe ratio of the 60-40 portfolio. The reason for this is that, although most endowments are able to achieve large alphas against public indices and overall high returns, the risk they may take is disproportionally higher than the alpha they may achieve in relation to the risk of the 60-40 portfolio.

Our findings highlight important aspects for other institutional investors who may be looking for guidance from these large endowments that have access to elite alternative and private market fund managers. On the one hand, the high exposure to private asset classes does help achieve high returns, as evident by the Ivy endowments' past performance. On the other hand, however, such large allocations to alternatives are not guaranteed to achieve much higher alphas than public indices, as one needs

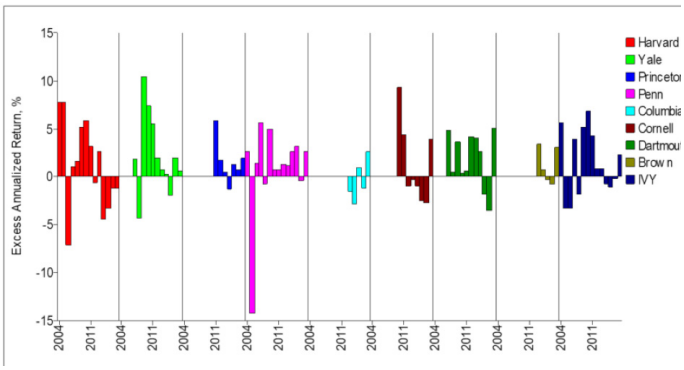
to know what private investment to allocate to as well as what managers to pick. Private equity has done much better than hedge funds during the same timeframe, for example, but within private equity there may be a large dispersion in terms of alpha against public indices. Our results are in accordance with Lerner et al. (2008), who raise caution with respect to large private allocations. Even if high alphas are achieved, the question then becomes whether they are high enough to result in high Sharpe ratios. Investors, particularly those with liability and liquidity constraints and shorter time horizons than large, well-funded endowments, need to pay attention to the true risk they take by investing in private asset classes as such allocations may easily erode any alpha or return gain and result in Sharpe ratios similar or inferior to a 60-40 portfolio.

Appendix



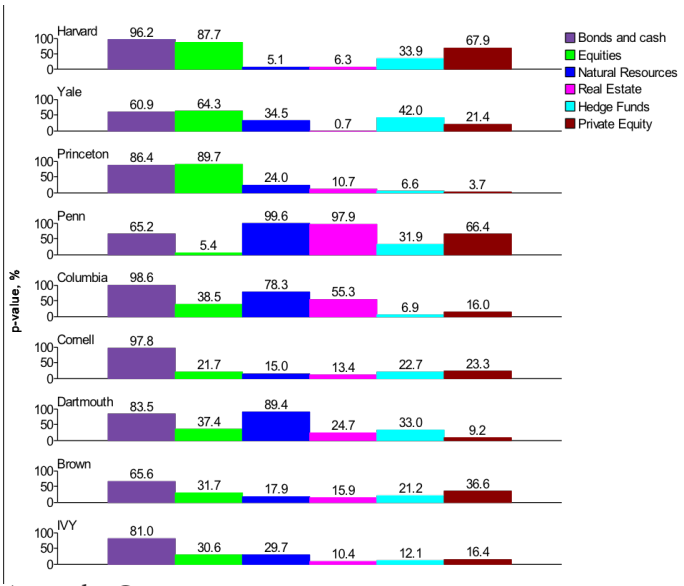
Appendix A

Factor mimicking portfolio tracking against endowment returns



Appendix B

Excess returns of factor mimicking portfolios



Appendix C

Figure C. Average p-values of the dynamic exposures shown in Exhibit 6

Endnotes

1. Based on the 2017 NACUBO study: https://www.nacubo.org/-/media/Nacubo/Documents/EndowmentFiles/2017-NCSE-Public-Tables--Number-of-NCSE-Participants--2.ashx?la=en&hash=936500535E61CA448ECD090E43B9E0733D9F4514

3. https://www.nacubo.org/-/media/Nacubo/Documents/EndowmentFiles/2017-NCSE-Public-Tables--Spending-Rates.ashx?la=en&hash=E1CE49F8E652B8C705F4414073B80E21DF1CFFEE

3https://www.nacubo.org/-/media/Nacubo/Documents/EndowmentFiles/2017-Endowment-Market-Values.ashx?la=en&hash=E71088CDC05C76FCA30072DA109F91BBC10B0290

4. https://en.wikipedia.org/wiki/Ivy_League

5.Consisted of 60% S&P 500 Index and 40% Bloomberg Barclays U.S. Aggregate Bond Index.

6. This refers to an asset allocation strategy that seeks to generate high returns by allocating to private equity and other alternative assets, having access to top performing managers and being broadly diversified.

7. By risk here we refer to the historical standard deviation that corresponds to each of the funds. This is purely an in-sample measure that treats the entire time series as identically independently distributed, ignoring volatility clustering or multiple regimes that may exist within the period examined. Had we had data of higher frequency it would have allowed for a more sophisticated risk analysis. Our measure however coincides with commonly used ways to evaluate risk for such funds, including variance for Sharpe ratio.

8. http://www.nacubo.org/Research/NACUBO-Commonfund_Study_of_Endowments/Public_NCSE_Tables/Total_Market_Value_of_Endowments.html

9. All indices have daily availability except indices used to factor mimic alternative asset classes, which are available monthly or quarterly.

10. We can still obtain standard deviations using annual data but this would result in estimates with very large variance (Kenney and Keeping, 1951) based on somewhat smooth return series.

11. Although there were many endowments that had returns prior to 2003, we constrained ourselves to using a common time period across all endowments in order to ensure a consistent comparison against their calculated alphas over the same time period.

12. Source: Cambridge Associates

13. The returns for this index prior to 2007 have been backfilled with the HFRI Fund Weighted Composite Index

14. We used preliminary data for the quarter ending on June 30, 2017, representing 61 percent of active funds updated compared to the prior quarter's NAV for US Buyout and 68 percent for US Venture Capital.

15. We acknowledge that long/short equity strategies or derivatives found in hedge funds may result in a negative market exposure. However, net exposure among long/short equity funds are typically positive, plus it is hard to think that endowment funds would take on negative overall market exposures.

16. Lobosco and DiBartolomeo (1997) find this to be the case on Sharpe regressions.

17. To calculate predicted R-squared, we re-estimate the model for a given fund while taking out one of the 15 annual return observations between 2003 and 2017 and then assessing the difference between the removed annual return observation and the estimated value for that observation made by the remaining observations. In this case, we re-estimate 15 different times taking out each observation in turn. We combine all 15 of the differences between estimated and actual returns to calculate the predicted R-squared.

18. In appendix C we display the p-values for each factor exposure

19. This is despite the fact that allocations to alternatives are generally reported to be less than the exposures we show here. The reason for this may have to do with the difference between exposures and allocations as explained further above. The lack of detailed data on the allocations that these funds follow makes it hard to reject or confirm the observed differences between exposures and allocations.

20. We could have used the 60-40 portfolio as a benchmark like we did in the introduction when we compared the Ivy League historical total returns. However, given the funds' exposures are very different from a 60-40 portfolio, we do not consider this portfolio to be appropriate for evaluation of the timing return component.

21. We can only evaluate timing on an annual basis. Although it is possible that funds may shift exposures more rapidly at a quarterly or higher frequency, this is unlikely given their size and policy.

22. Since the endowment fund returns we used are net of fees, to the extent that the funds invest in managers that trade public asset classes, given such asset classes in our regression use public indices where no fees are involved, high fees paid to those investment managers would have negative contribution to selection return.

23. Given the limited 10-year history of each window, we have dropped the alpha from the analysis so as to ensure we have as many degrees of freedom as possible.

24. We omit displaying the in-sample factor exposures for the first 10 years since we do not have available factor exposures during that period for the replicating portfolio. The in-sample style dispersion has been produced based on a regression that covers a time period that is 10 years longer than the replicating portfolio dispersion. Both dispersions are then calculated based on the weights of a common period that excludes the first 10 years.

25. This includes the same smoothness parameter found in the original regression. The reason for this is two-fold. On the one hand, we want to apply the same level of beta volatility among the two regressions to make them more comparable. We choose the original regression as the anchor on which we choose the optimal smoothness.

26. We followed the approach described in Woodward (2004) by regressing venture capital against six quarterly lags of Russell

2000 over the analysis period 2005-2016, using intercept and no constraints and got an R2 of 61.6 percent. Using the factor exposures from this approach to estimate risk would show much less of a variance than the index has. Doing the same for the private equity index resulted in a 68.7 percent R2 and a variance similar to the one obtained via the de-smoothing approach. Real estate does not have good enough market indices, that we are aware of, that explain most of its variance.

27. This is similar to equation (3) in Geltner (2003) but expanded to include more lags, as shown in equation (2) of Cho et al. (2001).

28. The Durbin-Watson statistic calculated against the residuals was found to be 2.36, indicating no statistical evidence of positive or negative serial correlation.

29. The Durbin-Watson statistic of the residuals based on 56 quarterly observations is 2.18 indicating no statistical evidence of positive or negative serial correlation.

30. Since the funds report returns in the same smoothed manner that the indices report, using the de-smoothed indices in the regression would have resulted in a mismatch. The only way to uncover the true drawdown is to use the original, smoothed, series in the regression and the de-smoothed series when calculating drawdowns.

31. The ex-ante Sharpe ratio requires expected values for the asset classes we looked at. Since this is very hard to obtain, we place our focus on the ex post measure.

32. Formally, assume a fund is given by: $y = \alpha + bx$. Assuming, for simplicity, that the risk-free rate has zero variance, the Sharpe ratio of this fund is given by: $SR = [a + b\text{mean}(x)] / b\sigma(x)$. If, among two funds, the systematic part increases in risk more than the alpha increase, then the Sharpe ratio will actually decrease.

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Author Bios

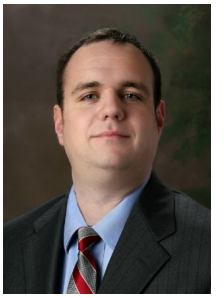
Apollon Fragkiskos

MPI

Apollon heads MPI's research team, where his mandate is to guide and advance research in key competitive areas of the firm, such as style analysis, hedge fund replication, fund selection and portfolio construction. His focus is to create cutting edge analytics based on machine learning and financial techniques and provide innovative solutions to fund buyers, fund sellers and asset allocators. He is also actively engaged in publications of blogs, white papers and research.

Prior to joining MPI, Apollon was the head of the Research team within the risk analytics group of State Street Global Exchange. In that role, Apollon created, researched and led the implementation of key product enhancements such as returns based style analysis, hedge fund replication and macro-economic stress testing. Prior to that, he spent several years as a senior financial engineer in charge of fixed-income and derivatives pricing models, which formed the backbone of State Street's market risk management system.

Apollon holds a BSc in Physics from the University of Athens and an MSc in Financial Engineering from the Michael Smurfit School of Business.



Sean Ryan

MPI

Sean Ryan is a senior research analyst at MPI. His specific focuses include mutual and hedge fund analysis, endowment research, quantitative fund surveillance and other research projects. He holds a B.S. in Finance and MBA from Indiana University of Pennsylvania.

Michael Markov

MPI

Michael Markov is co-founder and chairman of MPI. In 1992, recognizing the power that quantitative analysis delivers investors, he led the development of the industry's first returns-based style analysis application based on Bill Sharpe's groundbreaking methodology. Continuing this spirit of innovation, he co-authored Dynamic Style Analysis, a significant advancement to legacy returns-based modeling techniques for investors seeking the most precise analysis of managed investment products and portfolios.

Being an industry expert in quantitative analysis, Michael is a frequent speaker at investment management forums around the globe on fund performance attribution, due diligence and monitoring, investment risk management and hedge fund analysis. His thoughts and opinions are regularly sought by leading financial press.

Endgame

Michael Ning
PhaseCapital

Michael DePalma
PhaseCapital

Investors Should Be Concerned

Bull markets have come and gone. No market cycle has lasted forever and the current cycle is likely to be no different. The market turmoil experienced in early February may be a warning of what's to come. Although each market cycle peak and trough has come with its own unique set of circumstances and flashpoints, history suggests their attributes and trajectories follow similar patterns. Consequently, the investment implications at different points in market cycles have tended to follow similar patterns, and performance across and within asset classes is consistent within each phase of those cycles.

There are many ways to measure market cycles and at PhaseCapital we have our own, the Market Cycle Indicator (MCI) which we will detail in the next section of this paper. We believe our MCI provides insight into what the capital markets will be like over the foreseeable future. The MCI has been deteriorating throughout 2017 and 2018, and based on current readings, we think investors should be concerned (Exhibit1, next page).

Current U.S. economic data suggests a continued robust economy with increasing PMI, full employment and GDP that's modest by historical standards, but exceeding expectations. The MCI suggests otherwise (Exhibit 1). Despite the rosy economic backdrop, it signals that something more ominous lies ahead judging from its sharp deviation from PMI and other economic indicators. This divergence between MCI and PMI is similar to what we observed in 1999-2000 and 2005-2006 periods. History shows that economic cycles exhibit fairly consistent symptoms leading up to a recession, starting with a hot labor market, strong PMI and a monetary policy stance that progresses from loose to tight in response. During past cycles when the MCI and PMI (and other macroeconomic indicators) have converged, it has spelled trouble for financial markets.

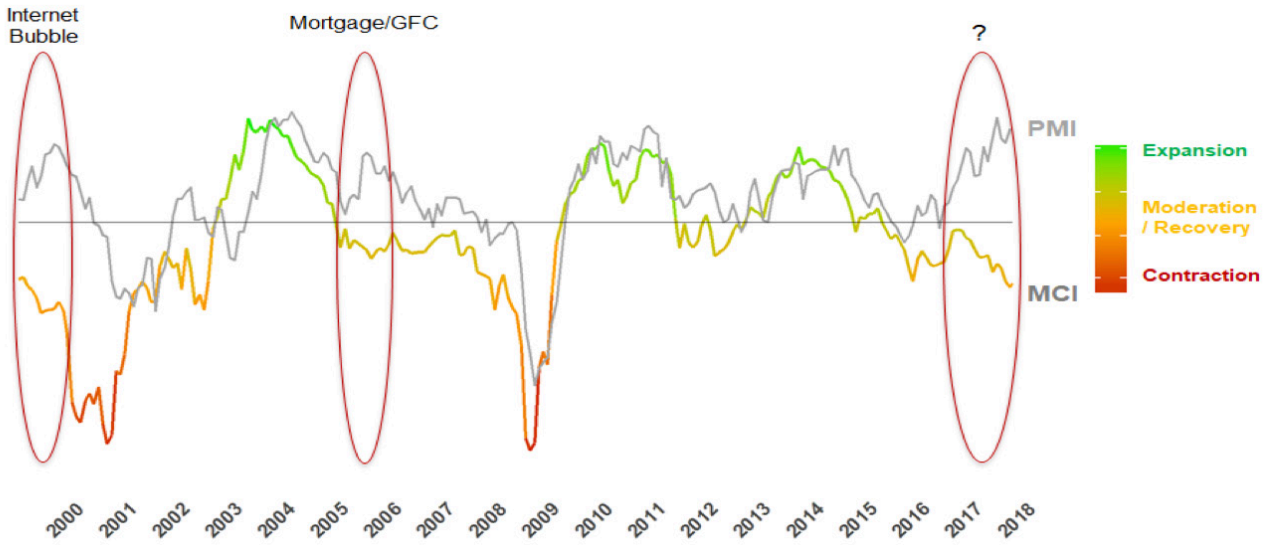


Exhibit 1: Phase Market Cycle Indicator (MCI) vs. ISM PMI
(Source: Bloomberg/PhaseCapital)

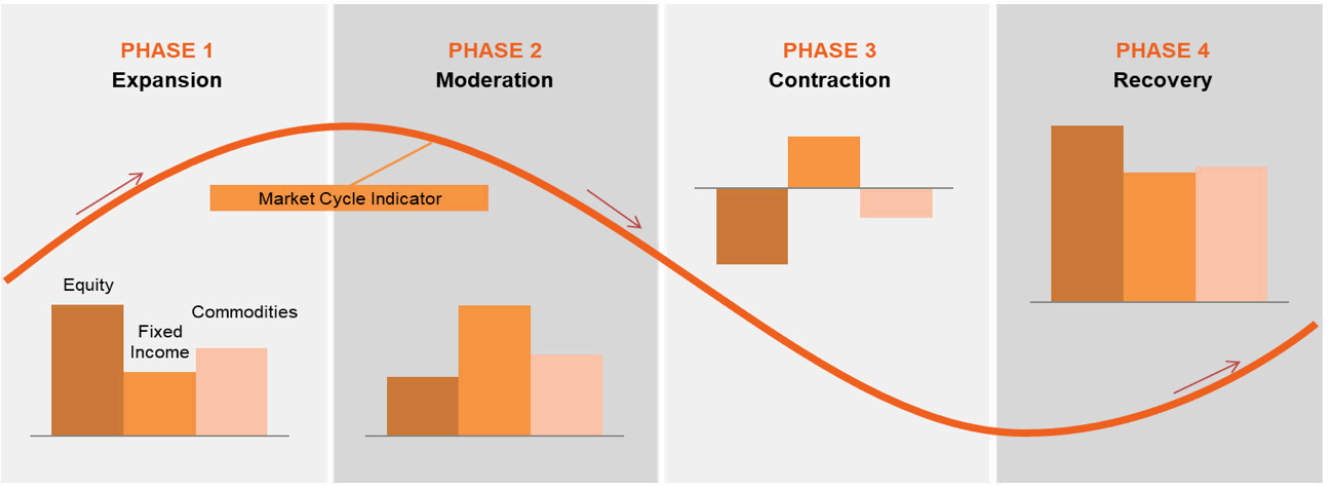


Exhibit 2: MCI – The Market Cycle Indicator
(Source: PhaseCapital)

It's easy to dismiss a single indicator in isolation. However, the MCI coupled with an array of other evidence suggests investors could face difficult markets in the near future. In the pages that follow, we will provide further insight into the MCI and present evidence which points to markets entering a late cycle phase. We believe investors should prepare for higher volatility, resetting risk premiums and the potential for significant drawdowns.

PhaseCapital's Market Cycle Indicator (MCI)

PhaseCapital employs a macro framework aimed at predicting turning points in the market cycle. Our objective is to determine which stage of the cycle we are in, and to predict the likelihood of transitioning to a new regime. We are long-term investors biased toward being long risk assets (equity and credit) over assets like government bonds, to earn economic growth risk premium. This framework is designed to be agnostic to short-term fluctuations in equity prices or credit spreads. Instead, we are interested in avoiding "the end of the market cycle", what we call the Contraction stage, a regime in which we believe equity/credit markets are likely to experience large and persistent drawdowns.

While the world is full of indicators to measure market cycles, our research finds that the slope of the yield curve and credit spreads are among the most reliable leading indicators to gauge credit conditions, liquidity and volatility. We have integrated these measures into our Market Cycle Indicator (Exhibit 2). The output of the MCI provides us with what we believe are clear signals of current financial conditions and a reasonable indication of what the capital markets will be like over the next 12-18 months.

Exhibit 2 displays the MCI through a full cycle along with an indication of the historical returns of equity, fixed income and commodities for the past 35 years in each of the phases. The level of the MCI recommends the risk profile we believe should be adopted in portfolios, while the direction of the MCI suggests the types of strategies we believe work best during transition.

The attributes of each phase are as follows:

Phase I (Expansion): Credit spreads are generally narrowing and volatility declining. Our view is that Phase I is a good environment to take risk, and riskier assets, such as equity and credit, generally outperform. We emphasize higher-beta industries, strategies and securities in this phase.

Phase II (Moderation): More modest environment for risk asset returns. With credit spreads reverting towards more normal levels and yield curves flattening, our portfolio strategies will tend to transition from exploiting equity growth and credit spread compression to exploiting "carry" during this phase. We think Phase II also lends itself to relative value strategies, long-short strategies with limited directional bias, as dispersion tends to increase during this phase.

Phase III (Contraction): Often marked by high volatility, credit spread widening, and negative excess returns for risk assets, with crises often occurring in this phase. A low level of overall portfolio risk and short positions are typically our approach in Phase III.

Phase IV (Recovery): The "recovery from crisis" phase. While volatility is often still relatively high, higher-beta assets and securities have typically outperformed during the Recovery phase. Increased portfolio risk budgets and barbelled strategies that capture a decrease in the dispersion in pricing of risky assets, are often effective.

The current bull market run is in its ninth year. The MCI has entered the Moderation phase. After a prolonged period of excesses, we are beginning to see many characteristics that have previously indicated a late-cycle market, where euphoric investor behavior coincides with peaking economic growth, tightening of monetary policy and a pickup in inflation. We believe the time is ideal for investors to consider the ***Endgame.*** In the context of the macro framework outlined above, the balance of this paper will touch on the specific late-cycle characteristics that the U.S. economy is exhibiting, build up a number of investment theses and discuss the management of macro risk exposures.

U.S Market Heading Towards Late-Cycle Phase

While U.S. economic growth is expected to remain solid for the foreseeable future, the bond market seems to believe the potential for increased growth is limited, and a growth decline is likely on the horizon as evidenced by the continued flattening of the U.S. yield curve. The slope of the yield curve offers a simple way to gauge market expectations for interest rates and, by extension, offers a way to gauge economic prospects. As shown in Exhibit 3, every recession in the past 60 years was preceded by an inverted yield curve.

On December 18, the spread between the 10-year Treasury yield and the 2-year Treasury yield fell to 51.4 basis points, the lowest since October 31, 2007. We checked all nine cycles of the past 60 years and examined the duration between the times the 2-year and 10-year yield spread fell through that level and the date when the yield curve slope flattened to zero:

Start	Flatten to Zero	Recession	#Months to Invert	#Months Invert to Recession
6/30/1955	4/30/1956	9/1/1957	10.0	16.0
8/31/1958	8/31/1959	5/1/1960	12.0	8.0
7/31/1963	12/31/1965	1/1/1970	29.0	48.0
12/31/1972	2/28/1973	12/1/1973	2.0	9.0
1/5/1978	8/17/1978	1/1/1980	7.5	16.7
8/18/1980	9/11/1980	7/1/1981	0.8	9.8
9/2/1988	12/14/1988	7/1/1990	3.4	18.8
2/6/1997	5/26/1998	3/1/2001	15.8	33.7
5/6/2005	12/27/2005	12/1/2007	7.8	23.5
		Median	7.8	16.7

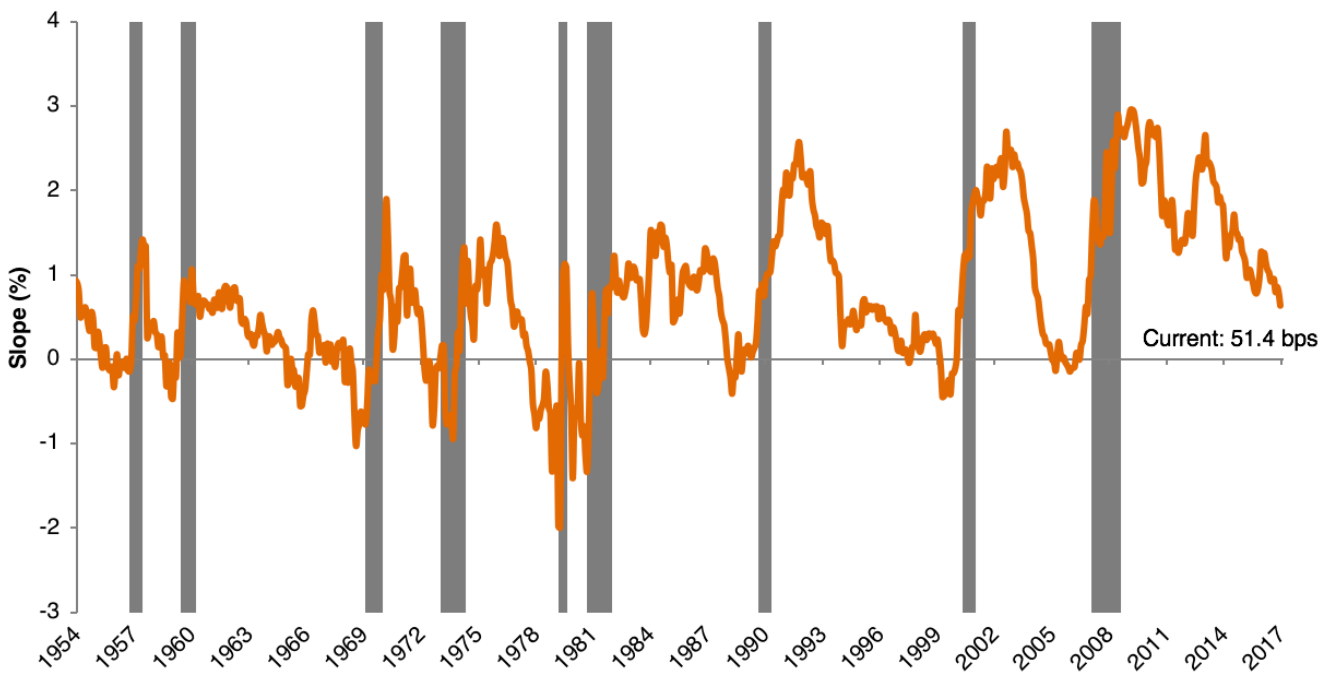


Exhibit 3: 2Yr – 10Yr Treasury Slope and U.S. Recessions
(Source: Bloomberg)

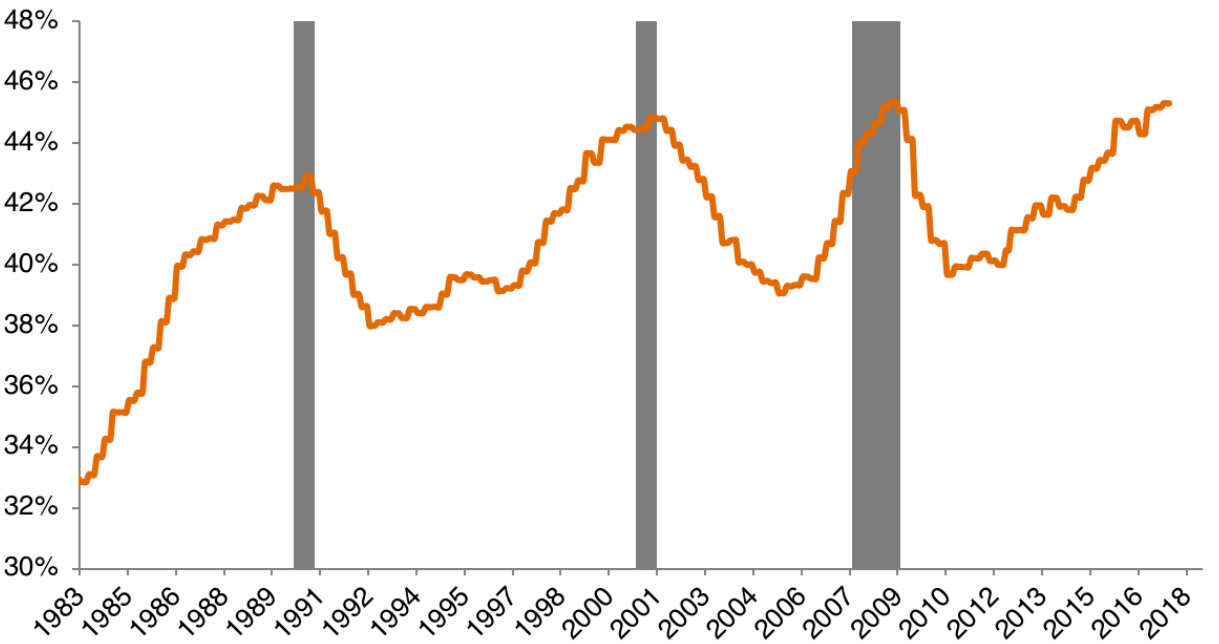


Exhibit 4: U.S. Nonfinancial Corporate Debt-to-GDP and U.S. Recessions
(Source: Bloomberg)

During 8 of the 9 cycles, the yield curve entered a "bear flattening" period from this point forward, where short-term interest rates are increasing at a faster rate than long-term interest rates, and the yield curve flattens as short-term and long-term rates converge. In most cases, the U.S. yield curve inverted within the next 12 months.

Expectations are beginning to build for the Fed to step up its pace of rate hikes as inflation shows signs of emerging and unemployment at the lowest rate in decades. The Fed has raised interest rates three times in 2017 and is set for at least three more hikes in 2018, leaving two-year notes at the highest yields since 2008. Meanwhile, demand from overseas investors, insurers and pension funds have kept 10-year yields near their March 2017 highs. Historically, the peak yield on the 10-year Treasury should roughly approximate the Fed's "terminal rate" - the final level where the funds rate settles. If history is any guide, we are likely to see the yield curve continue the current bear flattening trend, and perhaps even invert in 2018 if the Fed delivers the promised hikes. It's true that the Fed has been raising interest rates since 2015 and had engaged in tapering for two years before that. Yet these actions did little to tighten financial conditions, particularly when the ECB and BOJ continued to print money. Today, our view is that the bear flattening shows the Fed's tightening policy is effective and liquidity is being drained from credit and money markets.

On the credit side, U.S. corporate debt-to-GDP is near previous peaks (Exhibit 4). It appears, sooner or later, that the expansion of credit will come to an end. Credit is the life blood of the economy and credit expansion drives business cycles. During an expansion of credit, asset prices are bid up by those with access to leveraged capital. This asset price inflation can then cause a speculative price "bubble" to develop. The upswing in new money creation also increases the money supply for real goods and services, thereby stimulating economic activity and fostering growth in national income and employment. When buyers' funds are exhausted, asset price declines can occur in markets that benefited from the expansion of credit. The ripple effects are many, from insolvency, bankruptcy, and foreclosure all the way to threatening the profitability and solvency of the banking system itself in extreme cases. Ultimately, this results in a contraction of credit as lenders attempt to protect themselves from losses.

As the MCI, yield curve and credit markets indicate, the business cycle is maturing in the U.S. and these trends suggest recent tax reform is insufficient to prolong the business cycle. The real question is, are we at a turning point in the market cycle? We think the evidence suggests that we are at an inflection point, and in the following section, we will present evidence and offer suggestions on how investment portfolios might be repositioned as a result.

Common Late-Cycle Symptoms and Investment Opportunities

Market cycles vary in intensity and duration. However, the economic and financial conditions at different points in the cycle have historically remained remarkably consistent. The late cycle phase, what we call Moderation, is characterized by the deceleration of growth that precedes Contraction: inventories build, corporate profit margins fall and interest rates rise. Inflation will also increase due to tight labor markets and high capacity utilization. Equity valuations are typically expensive, leading to moderate returns and higher downside risks. The term "late-cycle strategies" has resurfaced in the financial press of late. The term refers to the types of investments that tend to outperform later in the business cycle. We discuss a few of these in the pages that follow.

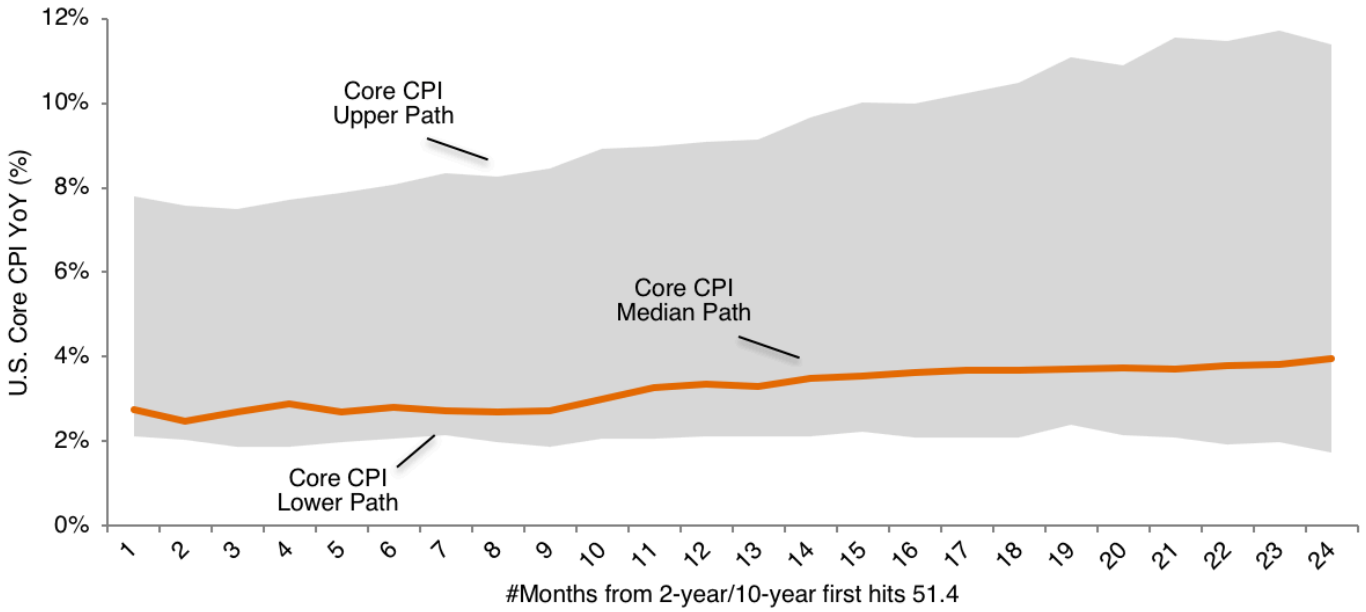


Exhibit 5: Inflation Path during Late Cycles
(Source: Bloomberg)

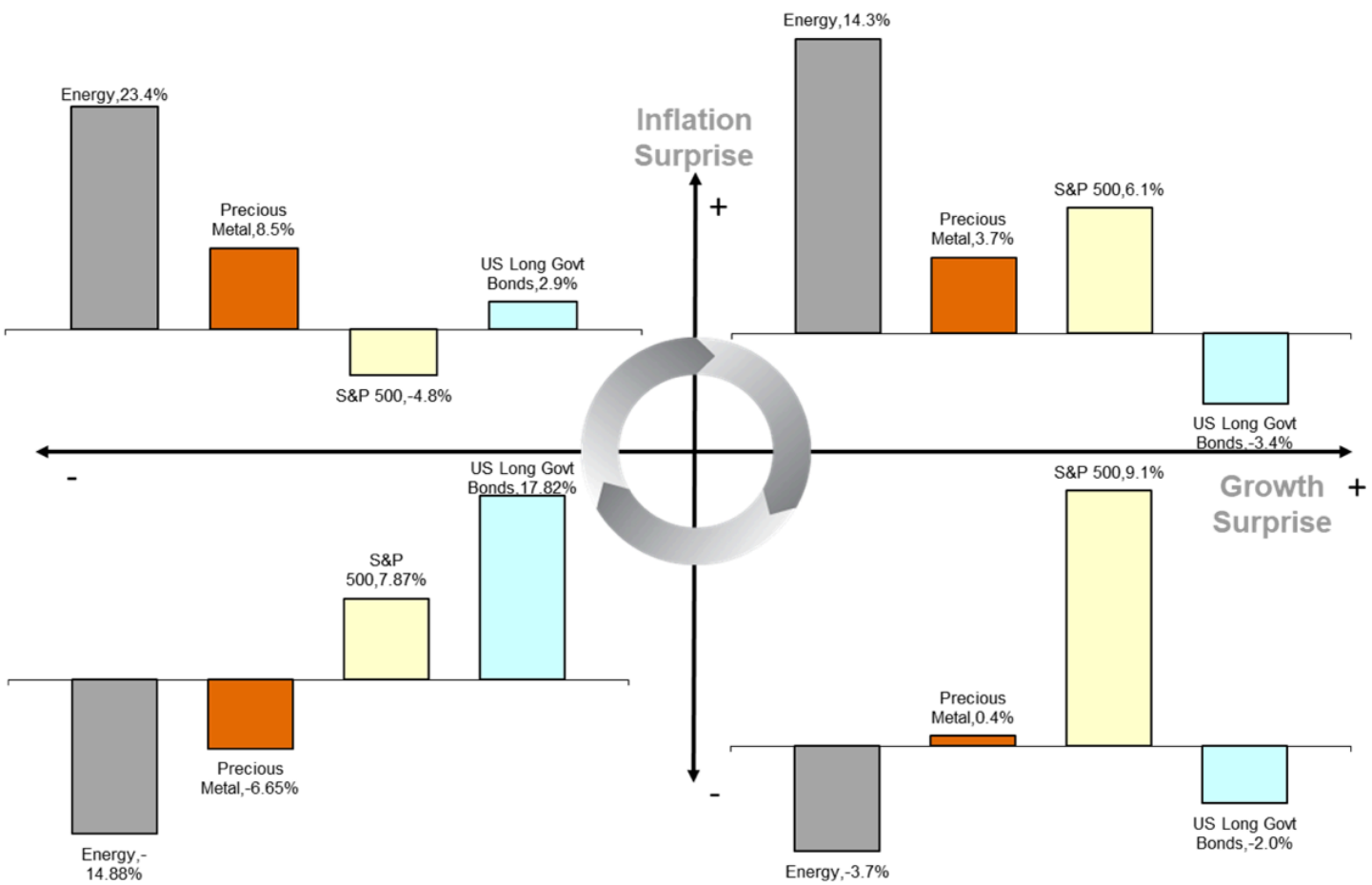


Exhibit 6: Asset Performance (Excess Return over 3month T-Bill) 1971-2017
(Source: Fed, Ibbotson, and Bloomberg)

Rising Inflation

As the business cycle matures, tight labor markets typically lead to demands for higher wages. In addition, resource utilization may approach full capacity and demand for materials such as copper, steel and energy tends to outpace supply. As a result, a common characteristic of late-stage business cycles is rising inflation. Over the past nine business cycles, when the slope of the yield curve fell through 51.4 bps, U.S. core inflation tended to increase steadily (Exhibit 5, previous page). Moreover, there has been a clear asymmetry to the path of realized core inflation over the nine cycles.

Other signs of rising prices emanate from the weakening dollar, which raises the cost of imports, and gains in key commodities, such as oil, are also regarded as potential threats. Inflation poses a threat to bond investors because it erodes the purchasing power of fixed coupon payments. Rising expectations for inflation have helped prompt selling in bonds in recent months. Inflation is a process that occurs when the purchasing value of cash declines. When inflation rises, it tends to drive up the price of oil, gold, silver, corn, soybeans, wheat and all other commodities.

As shown in (Exhibit 6, previous page) when U.S. quarterly inflation surprised to the upside (relative to Philadelphia Fed Survey of Professional Forecasters), energy and precious metal spot prices have performed well. We find a similar relationship between inflation surprise and other commodities. Interestingly, commodities have performed even better when U.S. quarterly GDP growth surprised to the downside. Although the inflation itself definitely has had a direct impact on the price of commodities, we believe other factors may also come into play. For example, inflation pressures may also prompt the Federal Reserve to raise interest rates if economic growth is robust. Higher interest rates tempers economic growth and limits the upside potential of commodity prices. Our view is that the best time for buying commodities is in the presence of both high inflation and an uncertain domestic economic outlook – typical of a late-cycle market.

We believe that the recovery in commodity prices that started in early 2016 and paused in 2017 is likely to continue in 2018. Underlying supply and demand imbalances are increasingly positive in key energy, metals and select agricultural markets. Importantly, the structural outlook for the dollar looks increasingly weak, while global inflation has likely bottomed.

Higher inflation can also help drive superior performance from energy and materials sectors, the profitability levels of which are dictated by commodity prices in the short term. Utilities, telecommunications and consumer staples stocks can gain the attention of forward-looking investors, who begin moving toward less cyclically sensitive sectors and strong dividends. Lean years require strong financial health, so interest rate coverage, debt-to-capital and the current ratio gain added importance. Dividend yield should also become more important as demand for growth stocks wanes.

Asynchronous Global Business Cycle

The past year was the first since 2010 where the performance of the global economy exceeded consensus expectations amid a pickup in manufacturing and trade, rising confidence, favorable global financial conditions, and stabilizing commodity prices (Exhibit 7). While growth remains weak in many countries, and inflation remains below target in most advanced economies, market participants are now expecting the global upswing in manufacturing activity to strengthen further, and the global economic expansion is projected to carry forward its current momentum into 2018. Broadly speaking, while it seems the U.S. has entered a more mature late stage of the business cycle, Eurozone economies seem to be mid-cycle, where business and consumer confidence, and access to credit have all continued to improve. China, Japan and many emerging countries seem to be in the early stages of improving business conditions, as global demand for goods has increased.

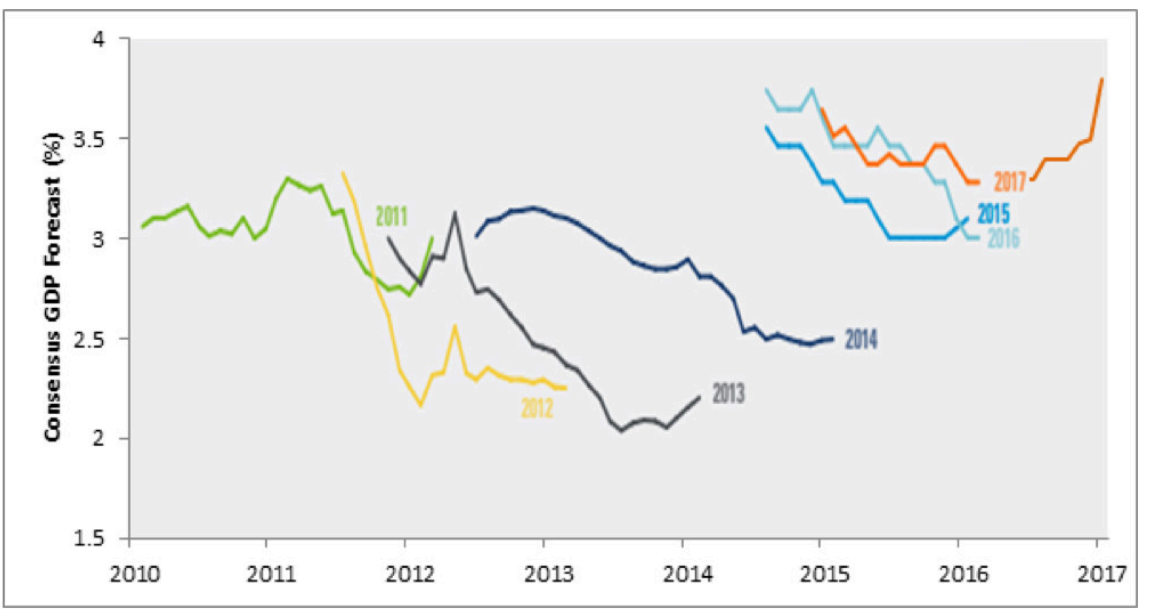


Exhibit 7: Global Growth Estimates Consistently Revised Lower Except 2017
(Source: LPL Research, Bloomberg)

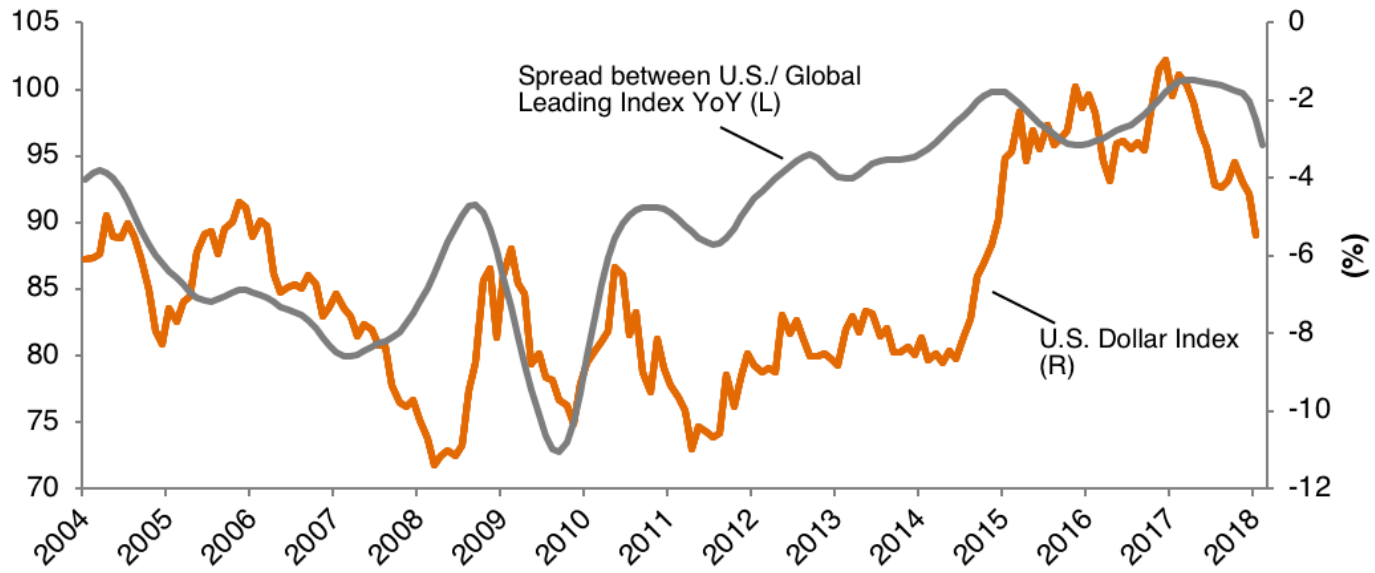


Exhibit 8: Spread between U.S./Global Leading Index YoY vs. US Dollar Index
(Source: OECD & Bloomberg)

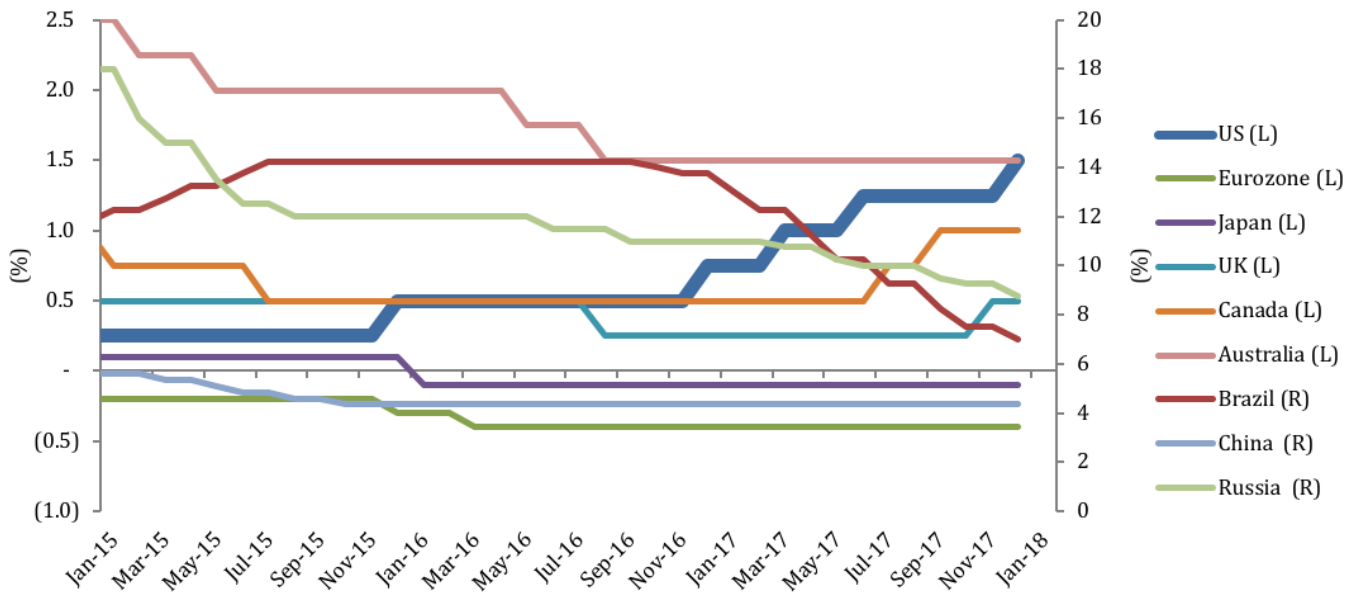


Exhibit 9: Diverging Central Bank Policy Rates
(Source: Bloomberg)

As shown in Exhibit 8, when global economic growth is expected to outperform the U.S., the U.S. dollar typically declines. One year since the inauguration of President Trump, the U.S. dollar has fallen sharply, by over 12%, against all major and emerging-market counterparts. Combined with recent evidence showing rising inflation and commodity prices, investors have reignited bets that the global reflation trade will take hold in 2018, dimming the greenback's appeal relative to currencies of faster-growing economies. There is probably more pain ahead for the dollar in 2018 as investors anticipate more capital flowing into other economies, despite the repatriation of overseas cash due to the recent tax reform.

We expect asynchronous business cycles to mean that countries will require different monetary policies. In contrast to the Fed's monetary policy tightening path, other major central banks have largely stayed on hold, and some have even embarked on further easing which has exacerbated monetary policy divergence (Exhibit 9).

In the first meeting of 2018, the Federal Reserve maintained its forecast for three hikes in 2018 with a notable upgrade to its economic outlook. Current economic conditions suggest that the number of hikes is more likely to increase then decrease. Consequently, investors will likely be discouraged from speculating on U.S. stock prices and set their sights on foreign markets where economic expansions are younger than in the U.S. and monetary policy more accommodative. Since the data series became available in 1969, the MSCI World Index has outperformed the S&P 500 in five of the six bear flattening periods.

Start	Flatten to Zero	S&P 500	MSCI World
12/31/1972	2/28/1973	-4.96%	0.92%
1/5/1978	8/17/1978	12.45%	17.45%
8/18/1980	9/11/1980	3.98%	4.98%
9/2/1988	12/14/1988	1.32%	10.31%
2/6/1997	5/26/1998	43.30%	30.57%
5/6/2005	12/27/2005	8.58%	11.98%

(Source: Bloomberg)

Since 2008, the U.S. market has outperformed international markets in both absolute and risk-adjusted terms by a large margin (Exhibit10).

Now, after underperforming the U.S. market for a decade, international stocks look more attractively priced on a variety of valuation measures. Coupled with superior growth prospects and stimulative monetary policy, an allocation to international stocks seems warranted.

Diverging Credit Markets

As the economic cycle advances, we will likely start to observe an increase in corporate leverage accompanied by rising corporate defaults, as well as declining recovery rates. We think this is especially true of the current growth cycle, which is one of the longest on record, having begun in March 2009. As we discussed earlier, after years of debt accumulation in the system, U.S. corporate leverage has exceeded the peak level of previous cycles. Moreover, our research suggests companies are finding it increasingly challenging to continue trimming costs or improve profit margins. Economic growth is perceived to be on track, business leaders' confidence is high, and the economy is showing all the signs of gaining momentum in the near term. Under these conditions, companies will likely start to favor external growth and engage in mergers and acquisitions, further expanding already stretched balance sheets.

High leverage increases the vulnerability of the corporate sector to external shocks, such as slowing economic growth or tighter lending standards. Those shocks can trigger a significant and persistent widening of credit spreads. When credit spreads widen, the prices of corporate bonds fall (assuming there is no change in Treasury yields) as investors price in greater risk by demanding a higher yield. These conditions can eventually result in rating downgrades, rising default rates and credit contraction.

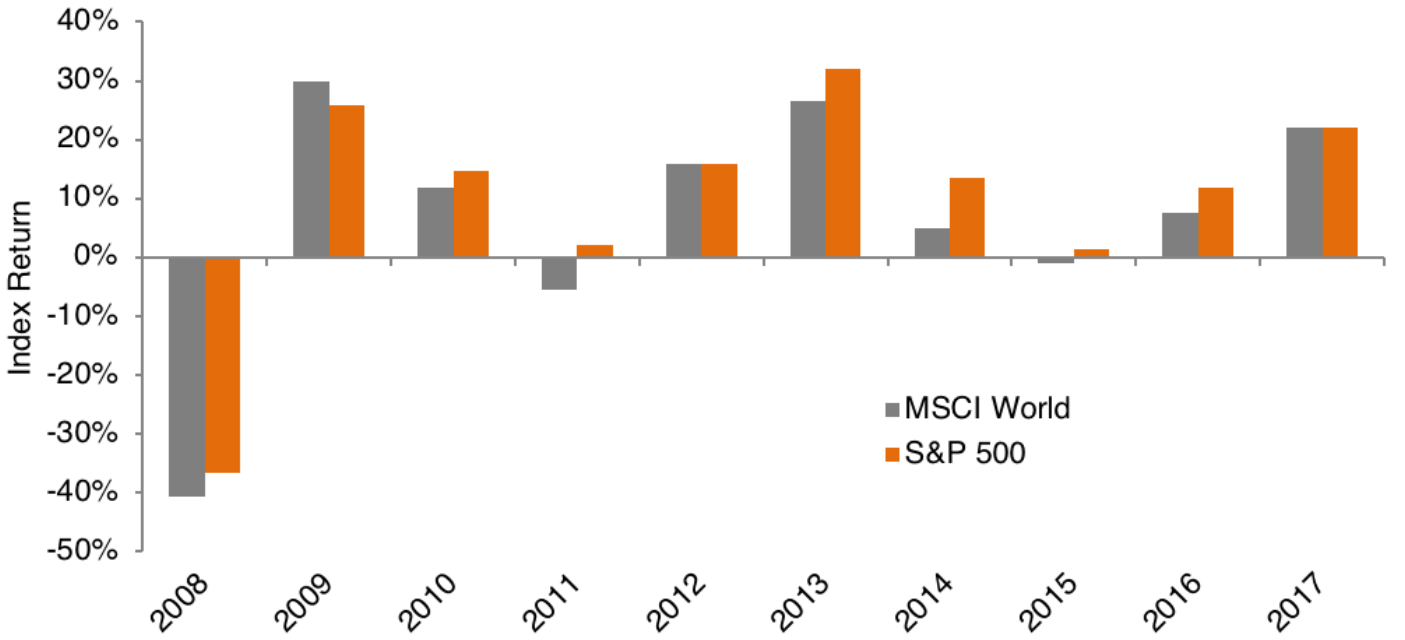


Exhibit 10: S&P 500 vs. MSCI World Historical Performance
(Source: Bloomberg)

As shown in (Exhibit11), credit spreads often begin to widen long before equities hit the peak of the cycle. The most glaring examples of this are between 1998 and 2002, and from mid-2007 through 2008, credit spreads widened sharply several quarters ahead of actual credit events. In this phase of the market cycle, high yield bonds often substantially underperform higher quality credit (Exhibit 12) and domestic credit markets usually underperform other asset classes, such as emerging market local-currency debt.

Accordingly, rotating from domestic high yield credit to emerging markets local debt seems a sensible idea in light of higher yields, superior economic and credit backdrop, and supportive currency dynamics in light of the falling U.S. dollar.

Increasing Downside Volatility and Tail Risks

On February 5, the CBOE Volatility Index posted its largest one day increase ever. For many investors, the rout in markets in early February 2018 may have come as a bit of a shock or at least a timely reminder that share prices can go down as well as up. We

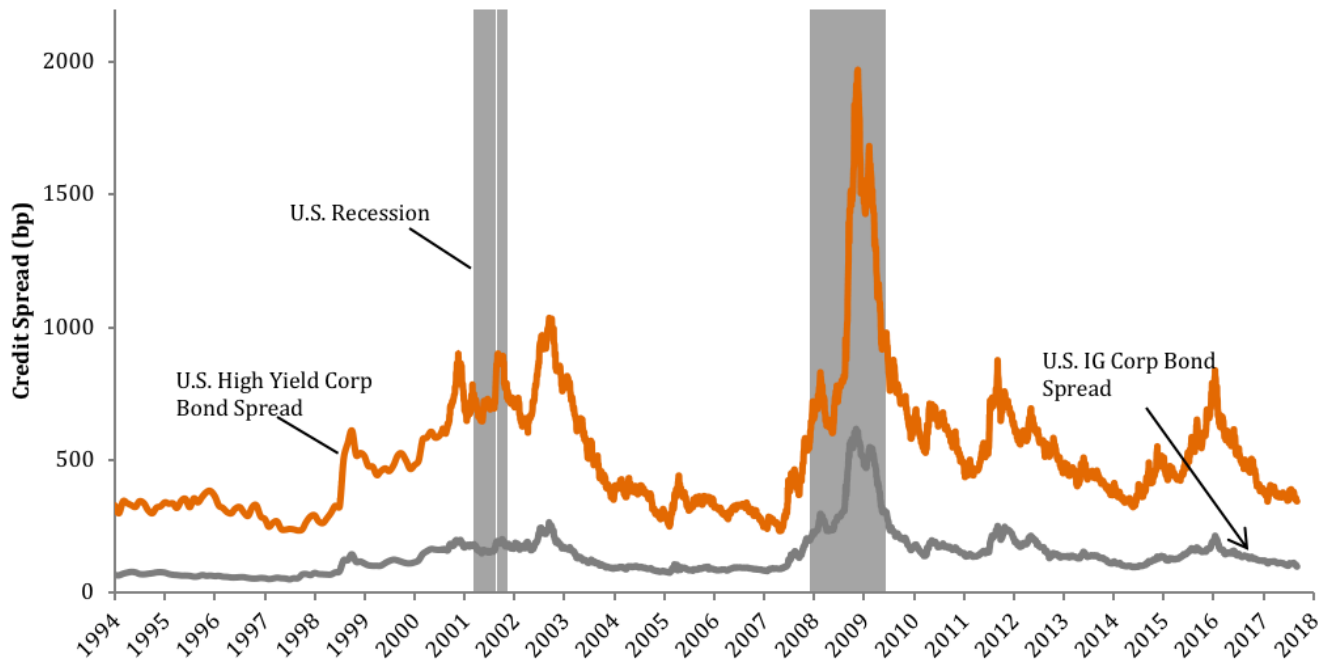


Exhibit 11: Credit Spreads Widen Ahead of Economic Downturns
(Source: Bloomberg)

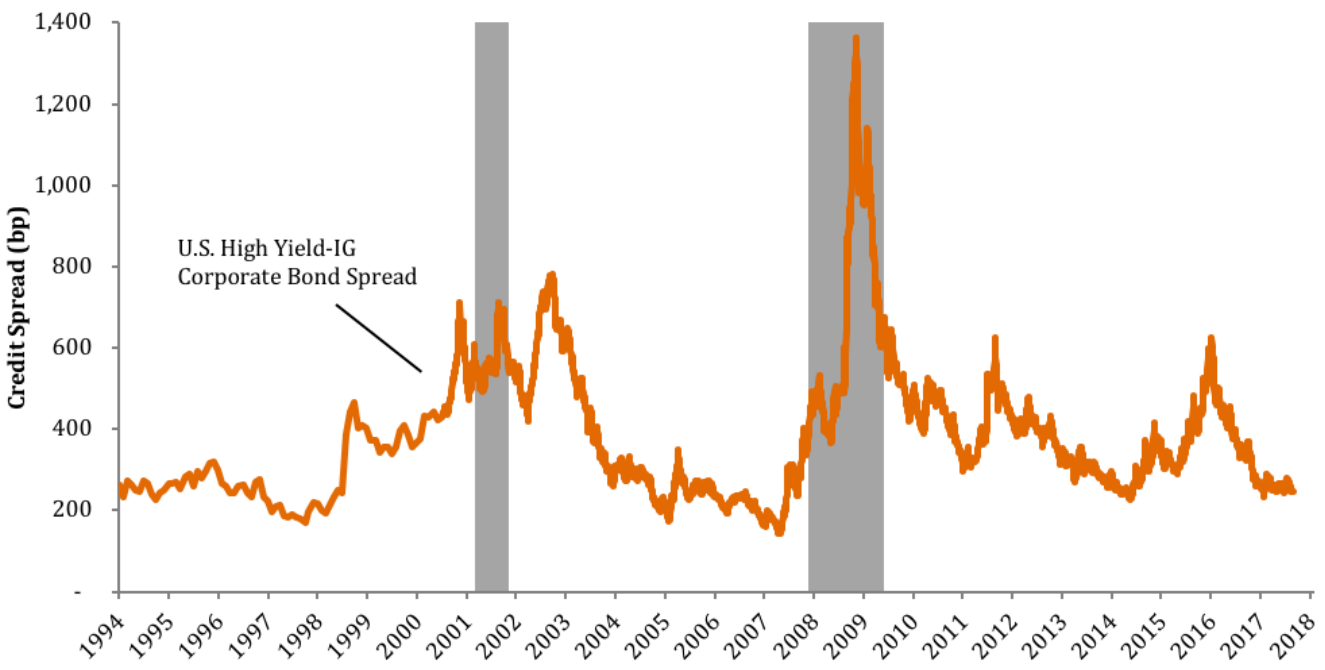


Exhibit 12: Credit Spreads Decompress Before and During Economic Downtur
(Source: Bloomberg)

believe today's late-cycle conditions place even greater importance on risk management.

At PhaseCapital, we don't equate risk as volatility. Volatility is the degree of variation of an asset's return from its mean return. We define risk as the likelihood of permanent loss of capital. It is normal and healthy for markets to experience corrections, whereby the S&P Index loses ~10% of its value or more. These corrections help to shake out some of the more speculative players and bring share prices back to their fundamental values.

At PhaseCapital, we strive to avoid large losses which interrupt compounding returns and can take many years to recover (Exhibit 13).

Recent data shows U.S. investors are overwhelmingly holding U.S. stocks at a time when they look expensive. The cyclically adjusted P/E (CAPE), a valuation measure created by economist Robert Shiller, now stands at 32.56, a level only exceeded during the 2000 tech bubble and higher than the 1929 mania (Exhibit 14).

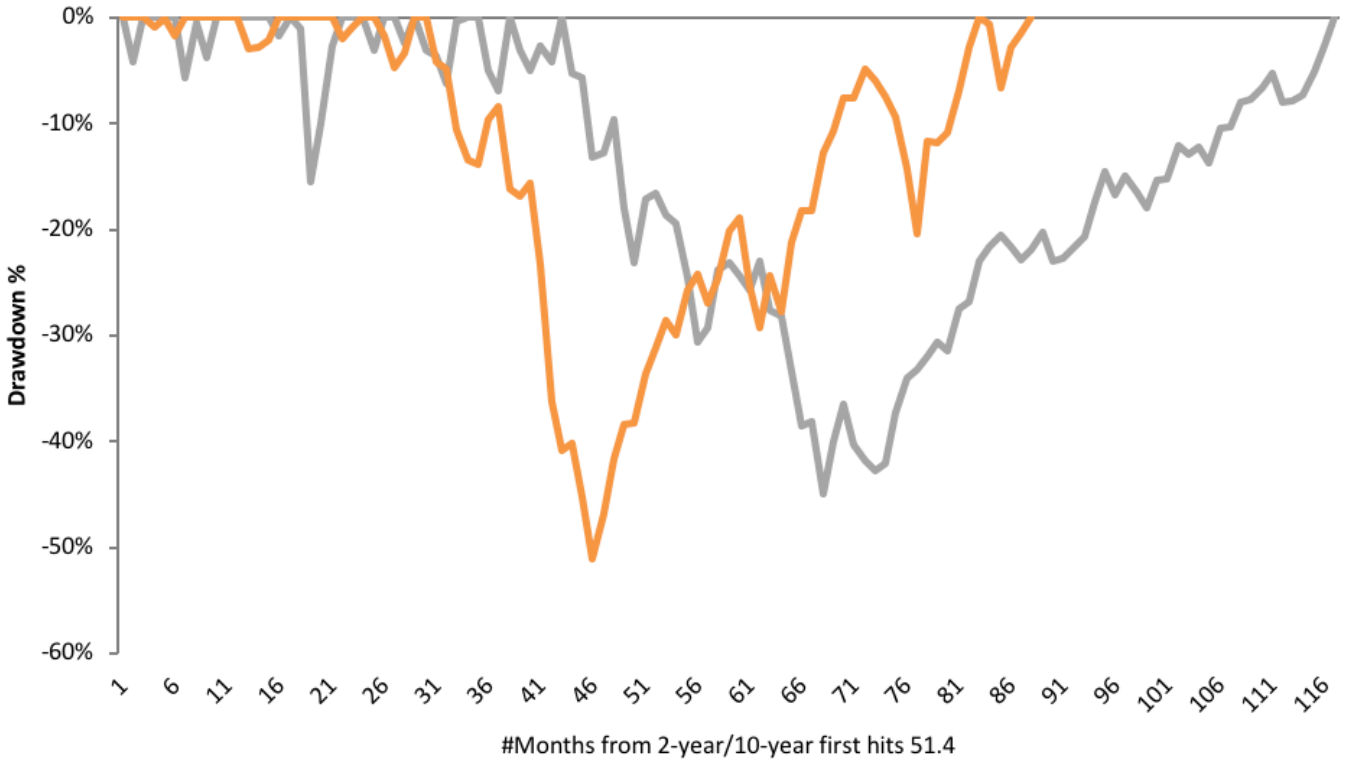


Exhibit 13: Peak-to-trough drawdowns of the past two downturns
(Source: Bloomberg)

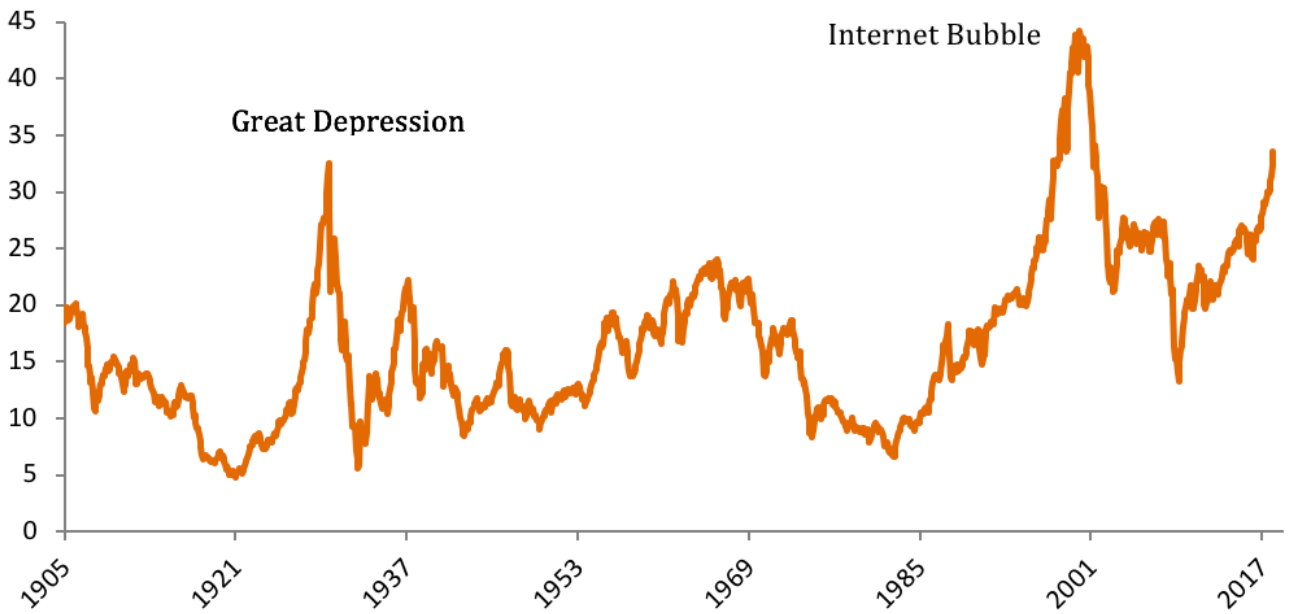


Exhibit 14: CAPE / Shiller PE
(Source: Robert Shiller, Yale University)

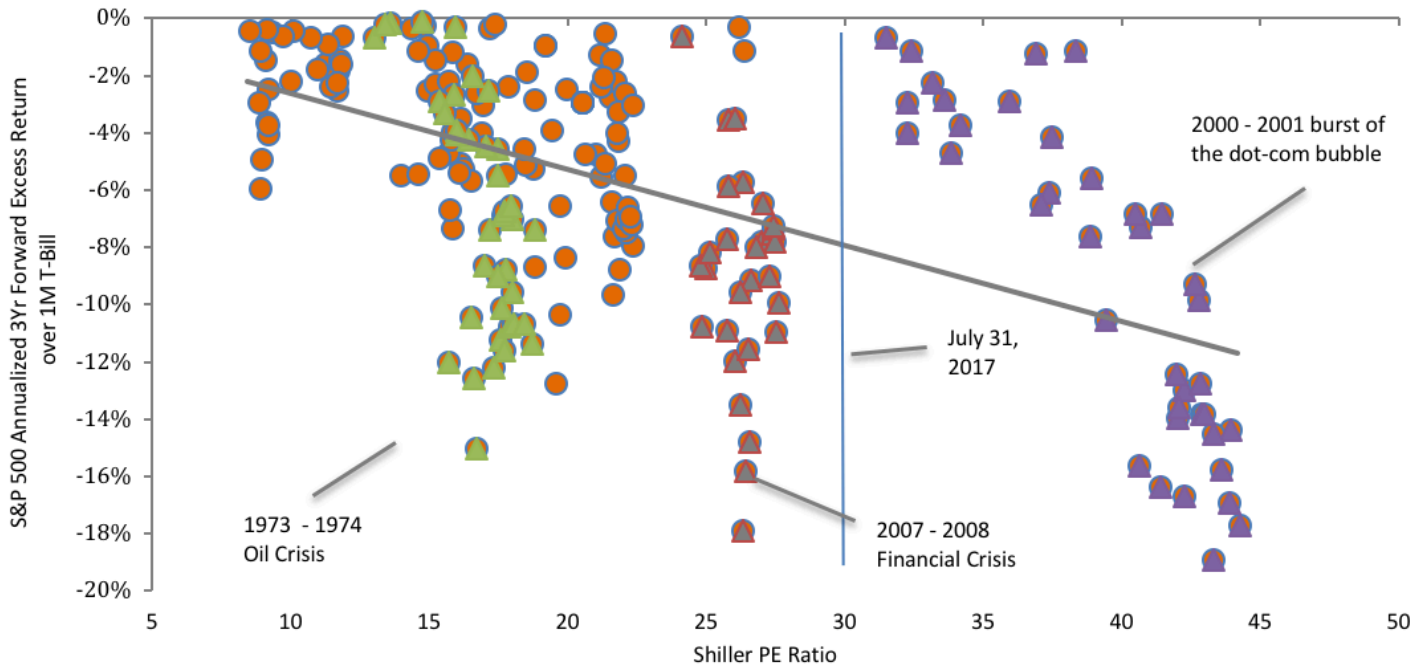


Exhibit 15: Shiller PE Ratio vs Historical 3Yr Drawdowns of S&P 500
(Source: Bloomberg)

Our research shows that high valuations have no predictive ability as to the timing of market drawdowns. However, it can indicate the severity of the potential loss if the market cycle turns. In Exhibit 15, we plot all the observations where the 3-year forward return on the S&P 500 is lower than the 1-month T-Bill since 1934 and the starting level of the Shiller PE ratio when the downturn begins.

Exhibit 15 indicates that the maximum peak-to-trough loss of each bear market cycle is closely related to the level of market valuation. Anecdotally, when valuation surpasses today's levels, the market has tended to experience large losses during the next downturn. We expect that high volatility in core financial assets will persist for the foreseeable future. As a result, we recommend investors seek low cost hedges in their portfolios to protect against large losses. Valuations may remain elevated for an extended period, but as we learned in February 2018, volatility could resurface and a significant correction could occur at any moment.

Conclusion

We expect the U.S. economy to continue to exhibit classic late cycle characteristics in 2018, with deteriorating liquidity, rising inflation and increasing dispersion in credit markets. Our models continue to implement the asset allocation adjustments recommended above, and we think all investors should consider similar changes in advance of the Endgame. Global markets will likely benefit more from the asynchronous global business cycle. Investors should consider rotating out of U.S. large cap into international equities; out of USD high yield bonds into EM local debt; selectively introduce commodities; and remain highly sensitive to bursting market bubbles and be dynamic in the face of them. Investors may also wish to selectively introduce low cost tail hedges into the portfolio.

General Disclaimers

Investments involve risk and include the potential for loss. Past results are not necessarily indicative of future results. Any indices referenced herein are generally not investable indices and are used for informational purposes only. References to indices herein are for informational and general comparative purposes only. There will be significant differences between such indices and the investment strategies discussed herein. For example, the investment strategies discussed herein do not contemplate investments in all (or any material portion) of the securities, industries or strategies represented by such indices. References to indices are not intended to suggest or otherwise imply that the investment strategies discussed herein will, or are likely to, achieve returns, volatility or other results similar to such indices. Indices do not reflect the result of management fees, performance-based allocations and other fees and expenses.

The content contained herein includes forward-looking statements, based on upon the current beliefs of PhaseCapital that are subject to risks and uncertainties. If underlying assumptions prove inaccurate or risks or other uncertainties materialize, actual results may differ materially from those set forth in the forward-looking statements.

Authors' Bios

Michael Ning, *Ph.D, CFA*
PhaseCapital

Michael Ning. Michael Ning joined PhaseCapital in November 2016 as the Chief Investment Officer. Previously, he was Senior Vice President and portfolio manager of First Eagle's Multi-Asset Absolute Return and Tail Hedge strategies. Prior to joining First Eagle in April 2013, Mr. Ning was Senior Vice President, Head of Credit Research, and portfolio manager for the Absolute Return Group at AllianceBernstein, managing70$bln Global Credit products, the Enhanced Alpha Global Macro Fund, Tail Hedge and Unconstrained Bond strategies. Before joining AllianceBernstein in 2004, Mr. Ning was a Senior Research Analyst at Citigroup. He has expertise in the research, development and management of trading strategies across global macro, equity, credit, rates and currencies. Mr. Ning received his PhD from Oxford University. He holds the Chartered Financial Analyst (CFA) designation.

Michael DePalma
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Michael DePalma joined PhaseCapital in June 2016 as Chief Executive Officer. He previously worked at AB (formerly AllianceBernstein) where most recently Mr. DePalma was Senior Vice President and Chief Investment Officer for Quantitative Investment Strategies, AB's systematic multi-asset and alternatives business, as well as Director of Fixed Income Absolute Return. Prior to that, Mr. DePalma was Director of Fixed Income and FX quantitative research globally and portfolio manager for AB's quant-driven multi-strategy hedge fund. Early in his career, Mr. DePalma was part of the team that developed AB's Capital Markets Engine and Wealth Forecasting System, the technology at the core of all the asset allocation services delivered to clients. Mr. DePalma graduated with a B.S. from Northeastern University and a M.S. from New York University's Courant Institute of Mathematical Sciences.

Managed Futures and the AC-DC Effect or Highway to Prosperity?

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Managed Futures – A True Alternative in Turbulent Markets

Recent developments have not only driven numerous financial markets to record highs, but also significantly increased correlations between various asset classes. Following one of the longest bull markets in history, current price levels and the co-movement behaviours of traditional asset classes suggest reduced expected returns and diversification benefits in future. The question, therefore, is whether investment strategies exist that still provide an attractive risk/return profile and consistent diversification benefits.

The hypothesis and aim of this paper is to demonstrate that the unambiguous answer is yes! The risk premia of - as well as correlations between - asset classes are time varying, and strategies that dynamically adjust to changing attractiveness and co-movements can harvest positive returns in various market environments. However, these strategies inherently need to be highly liquid in order to allow for dynamic exposure management. One type of alternative strategy that combines liquidity with adaptiveness is a managed futures strategy. Accordingly, this paper elaborates on the differences in the risk/return profiles of traditional balanced mandates and a long-only risk-balanced managed futures strategy. It shows that the latter is well suited to withstand adverse bond or equity market conditions. We call this the asset class diversification contribution (AC-DC) effect of long-only managed futures strategies. This relatively robust risk/return profile is mainly attributable to its broad and adaptively weighted investment universe, as well as a systematically managed total exposure.

Data and Methodology

Using a broad set of different asset classes and a long data history, we analyse the risk/return

profile of a long-only managed futures strategy alongside two classical, statically balanced portfolios. We simulate a long-only managed futures strategy (LOMF) that combines momentum and carry with a risk budgeting engine. The idea is that various asset classes provide long-only, yet time-varying risk premia. The strategy measures the current attractiveness of these risk premia based on momentum and carry. The more attractive an asset class, the bigger the position in the portfolio. In order to spread market risk evenly, a risk budgeting engine adjusts the positions by examining both the volatility of and co-movements between the individual assets. The more risk a specific asset exhibits, the smaller its position in the final allocation. To dynamically adapt the exposure to a specific target risk, leveraged positions are allowed. Rebalancing is daily, factoring in transaction costs.

The benchmark consists of a classical capital-weighted portfolio that is always fully invested 60% in bonds and 40% in equities. We hereinafter call this portfolio the traditional benchmark (TB). While it still represents the point of reference for many institutional investors, its focus on only two asset classes foregoes significant diversification benefits. Therefore, we additionally simulate a portfolio invested 50% in bonds, 40% in equities and 10% in commodities and call it the diversified benchmark (DB).

Both benchmarks are rebalanced on a monthly basis.
To factor in various scenarios, we first compare the change in yield level with the average return delivered by the different strategies over a fixed 12 month time window. In order to attain stably underpinned scenarios in the analysis, we divide the evolution of yield into quintiles. The same concept is then applied to changes in equity markets.

Interest Rate Scenarios vs. Empirical Risk/Return Characteristics

What basic findings does this empirical analysis bring to light? Let us first focus on the interest rate scenarios. The top section of (Exhibit 2, next page) compares the interest rate change over 12 months with the average return from the individual asset classes under different yield scenarios. The returns from bonds are significantly inversely correlated with changes in interest rates. Equities benefit from falling yields but, on average, maintain gains even during periods of strong interest rate increases. We attribute this to the fact that interest rates are usually positively correlated with the business cycle and, therefore, corporate profitability. Commodities and gold live up to their reputations as inflation hedges, if one takes interest rate levels as a proxy for inflationary pressures. They gain the most during periods of rising yields and associated inflation.
How well did the various asset allocation strategies exploit the diverse characteristics of the different asset classes to generate a stable performance? To glean an answer, the middle section of Exhibit 2 and Exhibit 1 show the average 12 month returns of the strategies. All three strategies obviously prefer falling over rising interest rates. For that matter, the traditional benchmark correlates most negatively with interest rates due to its significant bond exposure. The diversified benchmark tempers that dependency somewhat, benefitting during times of rising yields from gains by commodities. What's striking is that the long-only managed futures program outperforms both benchmark strategies under almost all scenarios and especially in the cases of the strongest yield increase and yield decrease.

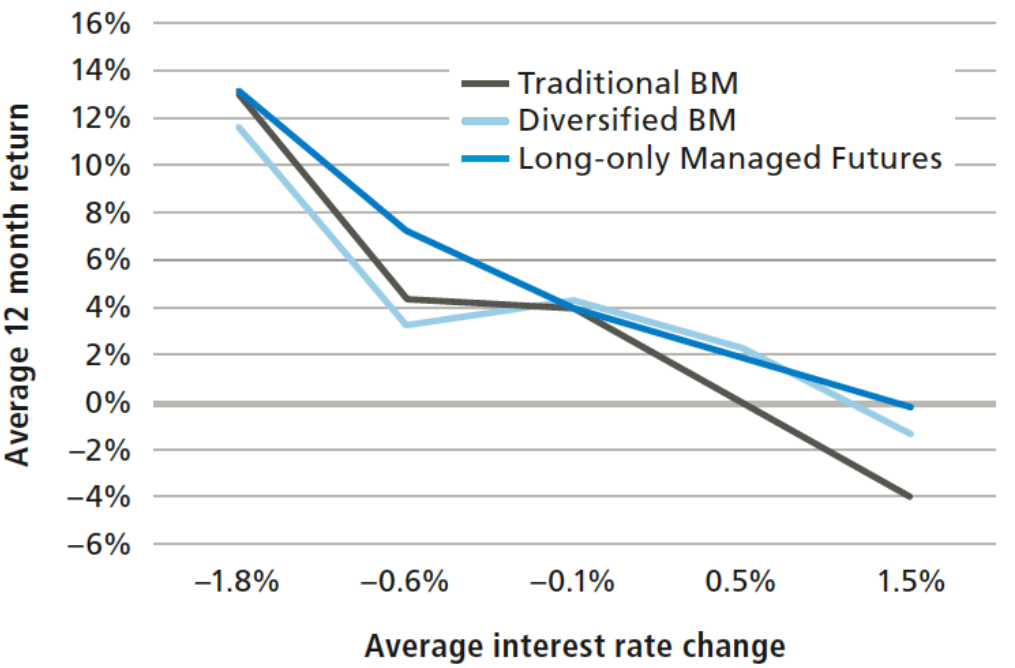

Exhibit 1: Yield Scenario vs. Return Behavior
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

	Falling interest rates			Rising interest rates	
	1st Qntl	2nd Qntl	3rd Qntl	4th Qntl	5th Qntl
Market environment and asset prices					
Change in interest rates	–1.8%	–0.6%	–0.1%	0.5%	1.5%
Return on bonds	14.3%	5.0%	0.7%	–3.7%	–10.8%
Return on equities	10.9%	3.3%	9.1%	5.9%	6.9%
Return on commodities	1.7%	–6.0%	2.8%	18.7%	18.0%
Return on gold	4.5%	2.3%	3.9%	3.7%	11.0%
Total return and return attribution					
Traditional benchmark (TB)	12.9%	4.4%	4.0%	0.1%	–4.1%
Diversified benchmark (DB)	11.6%	3.2%	4.2%	2.2%	–1.4%
Long-only managed futures (LOMF)[2]	13.1%	7.2%	3.9%	1.7%	–0.4%
TB bonds	8.3%	3.0%	0.4%	–2.2%	–6.6%
DB bonds	6.9%	2.5%	0.4%	–1.8%	–5.6%
LOMF bonds	8.1%	4.7%	0.7%	–3.5%	–6.4%
TB equities	0.4%	0.2%	0.3%	0.2%	0.0%
DB equities	0.4%	0.2%	0.3%	0.2%	0.0%
LOMF equities	3.5%	1.4%	1.7%	0.8%	1.7%
TD commodities	0.0%	0.0%	0.0%	0.0%	0.0%
DB commodities	0.0%	0.0%	0.0%	0.1%	0.2%
LOMF commodities	0.6%	0.7%	1.1%	4.1%	3.2%
LOMF gold	0.5%	0.3%	0.5%	0.7%	1.5%
Net exposure data					
Total exposure	2.37	2.67	3.51	3.23	1.99
Bond exposure	1.06	1.35	1.61	1.45	0.66
Equities exposure	0.28	0.25	0.37	0.36	0.38
Commodities exposure	0.14	0.12	0.13	0.16	0.18
Gold exposure	0.12	0.12	0.12	0.14	0.11

Exhibit 2: Interest Rate Scenarios
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

What lies behind these different risk/return characteristics? The middle section of Exhibit 2 and Exhibit 3 provide initial answers; for each strategy they compare the returns of the individual asset classes under different interest rate scenarios. Regarding the return attribution for bonds, the findings indicate that the traditional benchmark exhibits the highest interest rate sensitivity in the extreme scenarios of the strongest 20% yield movements both to the up- and down-side. In between, it is the long-only managed futures program that profits the most in an environment of falling interest rates but, at the same time, it suffers the most in a climate of rising yields. The diversified benchmark on the other hand demonstrates the lowest co-movement with bond prices because of its smallest average exposure to bonds. It is worth pointing out the diversification benefits of combining asset classes that the different strategies can exploit when interest rates increase. Concerning the return attribution for equities, it is remarkable that the long-only managed futures program substantially gains from equities when yields jump, while the two benchmarks only benefit negligibly from equities in times of interest rate stress. The same holds true with respect to the commodity return attribution. The long-only managed futures strategy is the one that profits the most from commodities markets, which are a hedge against inflation and yield shocks. Further to that, the dynamically adjusted gold exposure additionally stabilises the long-only managed futures strategy when interest rates jump. It therefore provides a much stronger diversification by exploiting the inverse correlation between bonds and equities or commodities than the two benchmarks.

To confirm this supposition, the bottom section of Exhibit 2 and (Exhibit 4, next page) show the average exposure of the long-only managed futures strategy under different interest rate scenarios. The overall exposure is the highest when interest rates do not change. It decreases both when yields rise and when they fall. The former effect is mainly driven by a significant decrease in bond exposure; the latter by a reduced investment in all asset classes. While the inverse relationship between bond exposure and interest rate level as well as the positive correlation between commodity exposure and yields intuitively make sense, the exposure pattern of equities is more interesting. Even though equities perform best in the negative interest rate change quintiles, their exposure decreases in these scenarios. This is partly due to the elevated market volatility that often accompanies significantly falling yields during a flight to less-risky asset classes. Another explanation is the negative correlation between bonds and equities, and its impact on the risk contribution to total portfolio volatility. When yields fall, both bonds and equities perform on average positively, resulting in a positive co-movement. Accordingly, the risk contribution of both asset classes increases

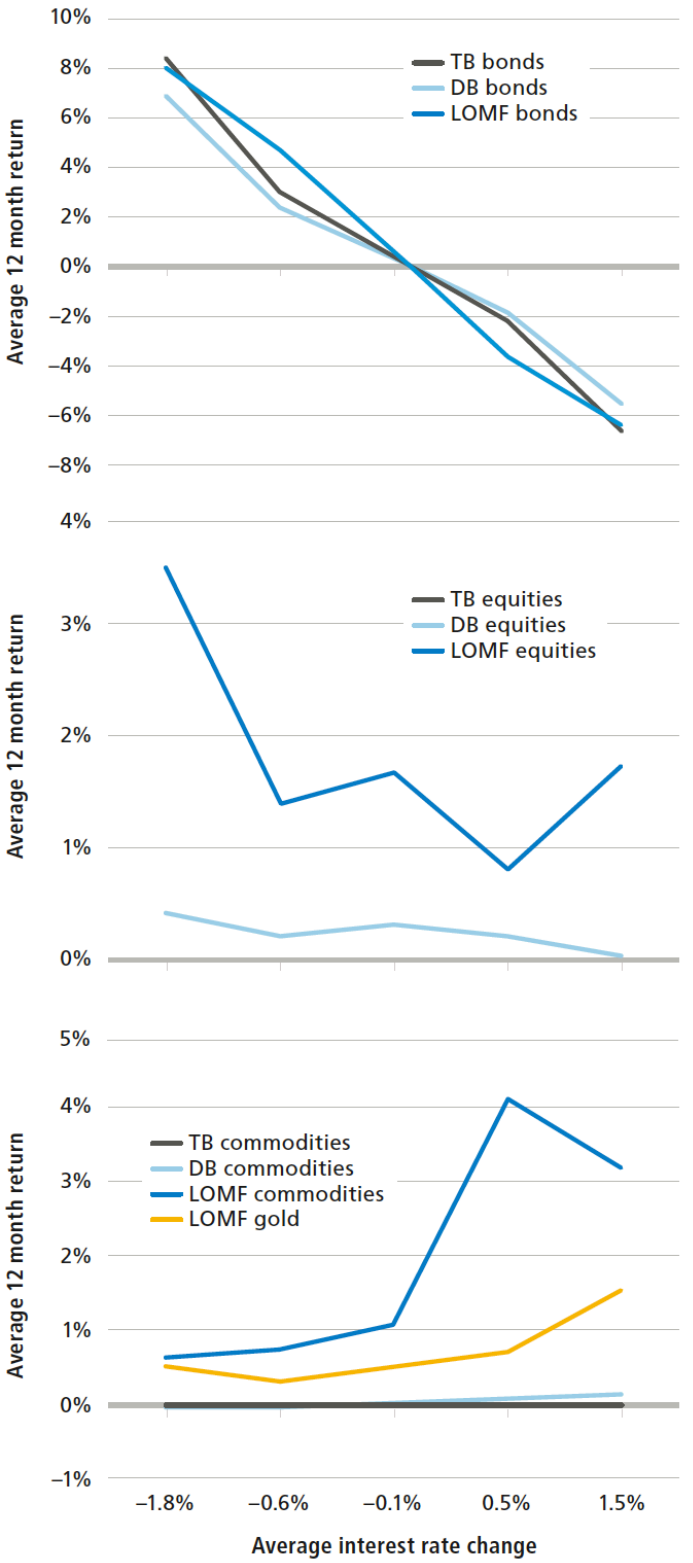

Exhibit 3: Interest Rate Scenarios vs. Return Attribution
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

on a ceteris paribus basis. On the other hand, bonds experience losses on average when yields jump, while equities uphold their on-average positive return contribution. Accordingly, the co-movement between these two asset classes becomes negative in higher interest rate change quintiles, reducing their risk contribution to total portfolio volatility – ceteris paribus.

Thus, empirical evidence confirms a negative correlation between the change in the overall interest rate level and returns from the different asset allocation strategies. From a relative perspective, it is the long-only managed futures strategy that copes best with both falling and rising interest rates by dynamically and adequately adjusting its exposure to changing market conditions. The traditional benchmark exhibits the highest interest rate sensitivity, due to its significant bond exposure and lack of diversification into other asset classes. Therefore, its returns almost match the gains of the long-only managed futures strategy when yields plummet, but it suffers the most when they increase. Finally, the diversified benchmark exploits diversification effects from its commodities exposure when interest rates advance and performs comparably to the long-only managed futures strategy in an environment of rising yields. However, unlike the latter, it only partially benefits from its bond exposure when yields decrease, thereby losing relative return in comparison to the long-only managed futures strategy.

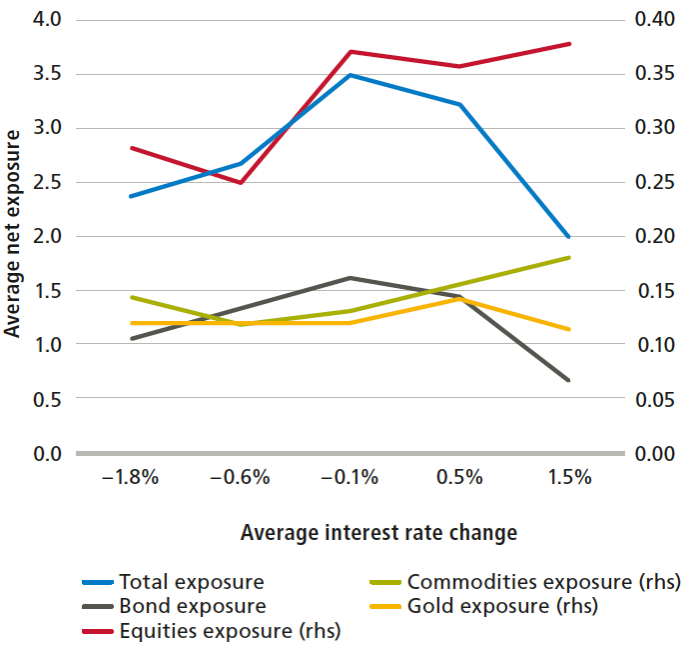

Exhibit 4: Interest Rate Scenarios vs. Exposure
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

Equity Scenarios vs. Empirical Risk/Return Characteristics

The question of how each asset allocation strategy has historically performed under different yield scenarios is only one side of the coin. Against the backdrop of record high equity valuations, a similarly pressing question relates to how the strategies have performed in explicit relation to the equity environment.

The top section of Exhibit 6 compares changes in equity markets over 12 months with the average returns from the individual asset classes under different equity scenarios. Interest rates and, consequently, the return from bonds are, on average, inversely correlated with equity markets. The strong performance of bonds in the scenario of the strongest 20% of equity markets is attributable to the 1980s, when both bonds and equities rose. Commodities are not strongly linked to the development of stocks, but tend to perform better when equities rise. Gold on the other hand proves a hedging characteristic by performing better when equity markets are weaker.

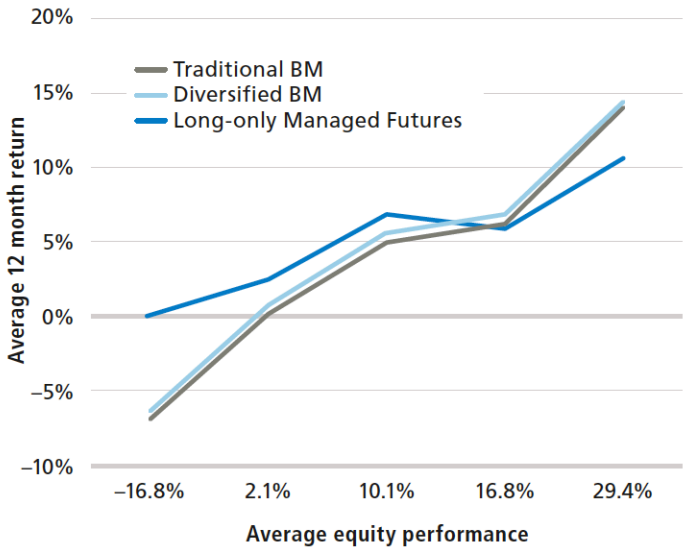

Exhibit 5: Equity Scenarios vs. Return Behavior
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

	Falling equity markets			Rising equity markets	
	1st Qntl	2nd Qntl	3rd Qntl	4th Qntl	5th Qntl
Market environment and asset prices					
Change in interest rates	0.0%	0.2%	–0.2%	0.1%	–0.6%
Return on bonds	0.0%	–1.6%	1.2%	–0.5%	4.7%
Return on equities	–16.8%	2.1%	10.1%	16.8%	29.4%
Return on commodities	5.7%	5.3%	8.2%	5.9%	8.1%
Return on gold	4.2%	10.0%	9.5%	1.7%	0.8%
Total return and return attribution					
Traditional benchmark (BM)	–7.1%	–0.1%	4.7%	6.1%	13.9%
Diversified benchmark (DB)	–6.6%	0.6%	5.4%	6.8%	14.3%
Long-only managed futures[2]	0.1%	2.3%	6.6%	5.8%	10.5%
TD bonds	0.0%	–0.9%	0.7%	–0.3%	2.8%
DB bonds	0.0%	–0.8%	0.6%	–0.2%	2.3%
LOMF bonds	0.3%	–0.5%	0.9%	0.2%	1.9%
TD equities	–7.1%	0.8%	3.9%	6.4%	10.9%
DB equities	–7.1%	0.8%	3.9%	6.4%	10.9%
LOMF equities	–3.6%	–0.4%	2.3%	4.0%	7.0%
TD commodities	0.0%	0.0%	0.0%	0.0%	0.0%
DB commodities	0.6%	0.5%	0.8%	0.6%	0.8%
LOMF commodities	2.9%	2.0%	2.2%	1.3%	1.4%
LOMF gold	0.7%	1.3%	1.2%	0.3%	0.0%
Net exposure data					
Total exposure	1.98	2.81	3.32	3.10	25.0
Bond exposure	1.07	1.25	1.43	1.27	10.1
Equities exposure	0.15	0.34	0.40	0.41	0.36
Commodities exposure	0.14	0.13	0.16	0.15	0.14
Gold exposure	0.12	0.13	0.11	0.12	0.12

Exhibit 6: Equity Scenarios
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

How does this translate into the risk/return profile of the different strategies? The middle section of Exhibit 6 and Exhibit 5 show that all three strategies significantly benefit from rising equity markets. The capital allocated benchmarks perform best in the two strongest equity market scenarios. However, they fall short of the long-only managed futures strategy elsewhere. Underperformance increases the worse equity markets perform. Only the managed futures strategy is, on average, able to avoid losses when equity markets plunge.

What lies behind these different risk/return characteristics? The middle section of Exhibit 6 and Exhibit 7, next page show that, irrespective of the scenario, the balanced portfolios consistently allocate more capital to equities than the risk-balanced managed futures strategy. Consequently, they benefit more when equity markets rise, but suffer much more significantly when equities fall. Interesting to see is the bond contribution, which looks very similar in the various scenarios for all strategies. Where then does the diversification, that allows the long-only managed futures strategy to compensate for the losses from equities in different equity market conditions, come from? The bottom chart of Exhibit 7 indicates that both commodities in general and gold in particular provide considerable diversification benefits when equity markets are falling. So similar to the interest rate scenarios, it is the long-only managed futures strategy that profits the most from using commodities markets as a hedge.

The bottom section of Exhibit 6 and Exhibit 8, next page show the average exposure of the long-only managed futures strategy under different equity scenarios. Similar to the interest rate scenarios, the total exposure is the highest in relatively smooth markets. It decreases both when equities rise and when they fall disproportionally. The former effect is mainly driven by a significant decrease in bond exposure; the latter, to a certain degree, by a reduced investment in bonds, but mainly by a lower equity exposure. Striking to see is the strong correlation between the performance of equities and the allocation to them. However, the exposure to equities during the strongest bull markets is slightly decreased. Unlike what one would expect at first sight, it is not the bond component that gains the most in attractiveness when equities fall, but rather commodities and gold. This is due to the fact we have already highlighted, that bonds do not show a consistently negative correlation to the different equity scenarios. Accordingly, they can't provide a systematic hedge against equity bear markets.

To recapitulate, empirical evidence highlights that equity performance considerably impacts the different asset allocation strategies. However, in a similar vein to the interest rate analysis, it is the longonly managed futures program that, due to its adaptive nature, copes best with turbulent equity market conditions, while not falling behind unduly when equities rally. The two capital-weighted benchmarks exhibit a very strong sensitivity to equity markets, caused by their significant equity exposures and lack of diversification into other asset classes. Even though the diversified benchmark benefits in all scenarios from its commodities exposure, it is not able to fully exploit the diversification benefits, given that it holds its asset allocation steady across all scenarios.

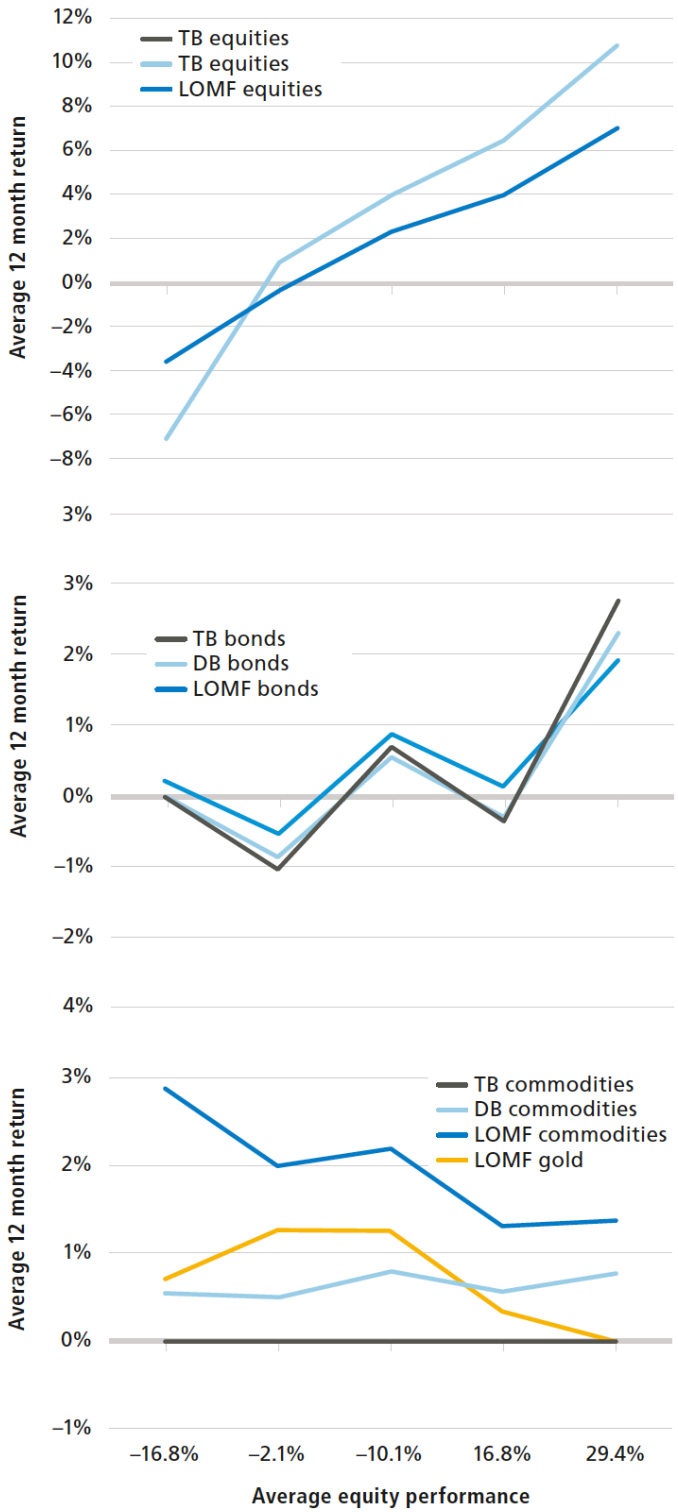

Exhibit 7: Equity Scenarios vs. Return Attribution
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

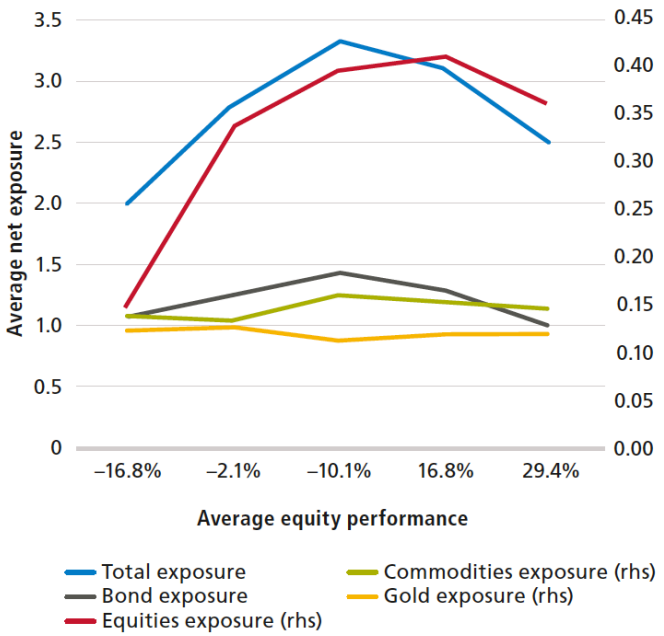

Exhibit 8: Equity Scenarios vs. Exposure
Calculations: Aquila Capital Concepts GmbH, Data base / source: Bloomberg

Conclusion

By means of an empirical analysis that takes the US as a point of reference, we have demonstrated that a long-only managed futures strategy that focuses on balancing the risk contributions within a portfolio and accounts for both momentum and carry effects, is well suited to withstand adverse market conditions, whether these conditions are experienced by bonds or equities. It not only stands up well from an absolute perspective, but also against traditional capital-weighted portfolios over a period that dates back as far as the 1970s. This added value in the risk/return profile is attributable to three main factors:

- The long-only managed futures strategy invests in the broadest investment universe
- The high dynamism of the strategy better exploits the diversified characteristics of the different asset classes
- The definition and targeting of a specific volatility level ensures that the strategy continually adapts its total exposure to the current risk climate by pro-cyclically reacting to opportunities

Despite these favourable findings, it should be noted that, although the long-only managed futures strategy is the one that is the least sensitive to rising interest rates and plummeting equity markets, it still suffers from holding asset classes when they perform negatively. Its attractive risk/return profile is primarily attributable to the fact that other asset classes have been able to offset bond or equity loss phases. This can become problematic particularly in the event of market shocks like the ones in 1994 or 2013, when the correlations between individual asset classes suddenly spiked and thus curtailed the diversification potential within the portfolio. To adequately mitigate the impact of such events, it appears advisable to additionally allow for short positions. We are leaving this point open to be addressed in a future research note.

Authors' Bios

Urs Schubiger,
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Urs Schubiger has comprehensive experience in the research, development and implementation of quantitative investment strategies as well as leading business development initiatives. Prior to founding pprime Capital and being a partner of Achievement AM's Swiss subsidiary, he held senior positions at leading companies including Vescore Ltd, 1741 Asset Management Ltd, Wegelin & Co. Private Bankers and UBS O'Connor. Mr Schubiger holds master's degrees in Mathematics from the ETH in Zurich and in Law from the University of Basel.

Egon Ruetsche, *PhD,*
Aquila Capital

Egon Ruetsche has in-depth experience in the development and modeling of quantitative investment strategies. He was a partner of the Swiss subsidiary of Achievement AM LLC before joining AQ Investment AG. Prior to that, Ruetsche was a senior quantitative researcher and portfolio manager at Man AHL where he developed momentum and carry models and shared responsibility for managing volatility strategies. Ruetsche holds a master's degree in Mathematics and a PhD in Arithmetic Geometry from the ETH in Zurich.

Fabian Dori, *CRM, CFA*
Aquila Captial

Fabian Dori has more than 10 years' experience in fund management and was previously Chief Investment Officer and member of the Management Board of La Roche Private Bank. Prior to this, he was Head of Portfolio Management and a member of the Management Board at 1741 Asset Management, as well as a portfolio manager at Wegelin & Co. Private Bankers. Dori holds a Master's degree in Quantitative Economics and Finance from the University of St. Gallen and is Certified Risk Manager and Chartered Financial Analyst.

Special Purpose Acquisition Company IPO as an Alternative Tool of Financing to Traditional IPO: Case Studies from an Emerging Market

Hon-Wei Leow
University of Malaya

Wee-Yeap Lau
University of Malaya

Introduction

The introduction of the reverse merger of a company known as Special Purpose Acquisition Company (SPAC) to Malaysian financial market as a means of accumulating funds from investors can be considered as a new trend in the emerging Asia. Some investors would contend this as a form of a non-traditional Initial Public Offerings (IPOs). According to Jenkinson and Sousa (2011), SPAC is established with the intention of asset acquisition, merger, and other business combination. It provides greater liquidity for the flow of fund and trading volume through the stock market, and this financing tool enhances the market efficiency.

As shown in (Exhibit1, next page), new SPACs have been established since 2011, and over the years, this idea has slowly gained popularity. Albeit a small growth from 2011 to 2016, to-date, five SPCAs are listed on the Malaysian stock exchange. The first four SPACs are oil and gas companies while the recent SPAC is in the food and beverage industry.

The first SPAC listed on the Bursa Malaysia is Hibiscus Petroleum Berhad. It was listed on the Main Market on 25th July 2011. The main business activity of Hibiscus Petroleum Berhad is the exploration and production of oil and gas. In 2012, Hibiscus Petroleum had made acquisition of business and asset that would pave the way for the company to become an independent oil and gas exploration and production player in future. It has no income or operation from the business prior to the initial public offering (IPO), and the exposure of risks is higher for underpricing compared to the traditional IPO.

According to the Malaysian Stock Exchange (also known as Bursa Malaysia), SPAC is defined as a company which has no income or operation from business prior to the initial

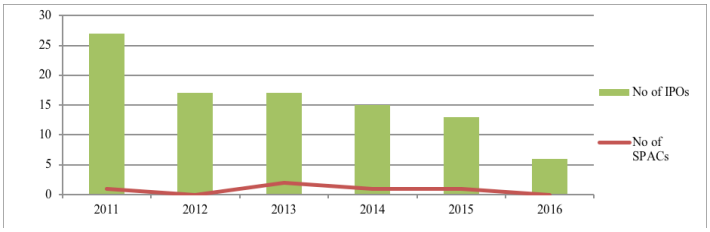

Exhibit 1: Number of Malaysian IPOs Compared to SPAC IPOs
Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

public offering (IPO). Under the present guideline, a SPAC must make its initial acquisition (also known "qualifying acquisition") within 36 months from its initiation or IPO, else the SPAC must be liquidated and the proceeds held in a trust account, and be distributed back to the shareholders on a pro-rata basis. It is clearly stated that at least 90 percent of the gross proceeds from a SPAC's IPO must be deposited in a trust account. The listing requitements are stated in Exhibit 2.

It is no doubt that SPAC is a new breakthrough as it provides another alternative tool to raise fund and caters for another segment of investors which have higher risk appetite as compared to traditional IPOs. SPAC attracts the flow of investors' monies into the market and hence increases the market liquidity. However, there has not been any documented study done on SPAC in Malaysia despite its existence since 2011. Hence, this study intends to bridge the gap between the research in this area.

Malaysian SPAC IPO has evolved as an interesting subject to study the financing issue from the perspective of financial management. Firstly, according to Bloomberg, Malaysian stock market has raised a total capital of USD 7.56 billion in 2012 and has grown to be the world's fourth largest market for IPOs.

Secondly, Malaysian SPAC IPO is the pioneer in the Southeast Asia region. It has also recorded some successful transaction for companies such as Hibiscus Petroleum and EcoWorld International. For the former, after the completion of the acquisition of a 35% stake in Lime Petroleum Plc (Norway) in April 2012, Hibiscus Petroleum has become a full-fledged oil and gas exploration and production company.

In addition, Hibiscus Petroleum Berhad is the first company which has been discharged from the SPAC and re-listed to the Industrial Products under the Main Market. For the latter, the first SPAC property proposed by EcoWorld International has also ceased to be SPAC because the company is able to meet the new listing requirement.

The paper aims to account for the recent development of SPACs in Malaysia with respect to the companies listed and their key indicators. In addition, the paper intends to evaluate the usefulness of SPAC as an alternative financing vehicle in an emerging market like Malaysia. The remainder of the paper is organized as follows. Section two reviews the past literature followed by the methodology on how SPAC is listed in stock exchange. Section four discusses a number of SPACs in Malaysia. The last section concludes the study.

Literature Review

SPACs as public listed companies

The past studies on SPAC are sparse; however, it is a successful alternative financing in the recent financial innovation. It becomes one of the important sectors for U.S. IPO market since 2003. In 2008, SPACs achieved one-third of the U.S. IPO market in terms of a number of offerings and fund raised. The fund raised from SPACs is sold through IPO which consists of common stock and a free detachable warrant. As usual, warrants can be traded immediately on the first trading day. The fund raised from IPO is used for business combination.

The main assets for SPAC are the fund raised, experience and skill of the management team. The primary objective of SPAC is to seek for a business combination. With regard to this, the underwriter has obtained financial interest to purchase additional units at a premium to the offer price in SPAC; therefore they assist in advising a business combination.

Aspect	Main Market
Listing Board	SPAC is allowed on Main Market only
Place of Incorporation	Must be incorporated in Malaysia under the Companies Act, 1965 The Securities Commission Malaysia may allow SPAC incorporated in a jurisdiction outside Malaysia the requirements set out under Additional Criteria for Primary Listing of Foreign Companies are complied with
Minimum Fund Raised	RM150 million
Management Team Credibility	Members of its management team have the experience, qualification and competence to:- ↘ Achieve the SPAC's business strategy; and ↘ Perform their individual roles, including understanding of the nature of their obligations and those of the SPAC
Management Team Ownership	Must in aggregate own at least 10% in the SPAC on the date of its listing
Moratorium on Securities	Management team's entire interest from date of listing until completion of the qualifying acquisition Upon completion of the qualifying acquisition, sell down is allowed on a staggered basis over a period of two years
Management of Proceeds	Must place at least 90% of the gross proceeds raised in a trust account and may only be released by the custodian upon termination of the trust account At least 80% of the amount in trust account to be used for qualifying acquisition
Qualifying Acquisition	Must complete qualifying acquisition within 36 months from the listing date

Exhibit 2 Key Listing Requirement of SPAC
Source: Bursa Malaysia (http://www.bursamalaysia.com/market/listed-companies/listing-on-bursa-malaysia/listing-criteria/, accessed 1 June 2016)

SPAC Features

The activity of business combination requires huge capital, SPACs serve as an alternative financial tool for IPO fundraising. It is essential to provide management team a different way to acquire target company, access to potential investors, provide more choices for investor and capitalize on their expertise (Hale, 2007).

Davidoff (2008) describes the distinctive characteristics of SPACs and Sjostrom (2008) studies the legal features of the SPACs. In this regard, Securities Commission of Malaysia is the first to implement a dedicated soft law to SPACs through Bursa Malaysia in 2011. The soft law ensures greater transparency to SPACs' investors in terms of the implementation process, its duration, capital structure and moratorium periods (D'Alvia, 2014). Therefore, it is suggested that the soft law approach is the best guidelines to control economic issues such as to protect the investor from moral hazard and asymmetric information.

The other focal point is, the SPAC's future demand and the prospect can be influenced by asymmetric information such as management skills and staff knowledge. It is essential for SPAC as the business nature is very much relying on the investment and acquisition of assets. According to Jog and Sun (2007), SPAC insiders and public investors without sufficient information about firm's prospects such as management skills and staff knowledge cause the low initial return to investors. On the other hand, Jenkinson and Sousa (2011) mention risk-free investment is defined as the funds allocated to the trust account and SPACs are the combination of risk-free investment with a potential future acquisition.

According to Schultz (1993), Chemmanur and Fulghieri (1997), Garner and Marshal (2005) focus on other aspects such as stakeholders' incentives, institutional structure, SPAC performance, SPAC success factors. Schultz (1993) finds SPAC commits to issue additional stocks during the exercise of the warrant in future. It is because the size of SPAC is relatively small, low earnings, a low value of assets and agency cost problem between managers and stakeholders. Chemmanur and Fulghieri (1997) also agree with Schultz (1993) that SPAC IPOs solve information asymmetry problems in terms of the fair price of SPAC and inherent risks. Garner and Marshal (2005) agree to Chemmanur and Fulghieri (1997), Schultz (1993) results, they find the first-day performance is higher because of SPAC firms allocate the bigger proportion of firm value to its warrants during IPO.

SPACs Performance

The first-day performance is important for the issuers, underwriters, stakeholders, and investors. Most of the studies focus on the issue of IPO pricing. The issue of pricing causes the under-pricing or over-pricing on the first day of trading. Therefore, SPAC is getting substantial attention from investors due to the different listing requirement as compared to traditional IPO. Jog and Sun (2007), Boyer and Baigent (2008), Rodrigues and Stegemoller (2012) show SPACs have a low initial return. They conclude that the poor performance can cause higher uncertainties about SPAC firm's future demand and prospect.

In addition, according to Jog and Sun (2007), they find a lower IPO underpricing with negative post-SPAC IPO return and positive returns for SPAC management. More studies from Jog and Sun (2007) and Boyer and Baigent (2008) find SPAC issue provides a very low average initial return as compared to other traditional IPOs (Ritter and Welch, 2002; Loughran and Ritter, 2004; Gao, Ritter, and Zhu, 2011). This is a norm as the SPACs without stable business income and sophisticated operation prior to the listing; subsequently, it accelerates the uncertainty about the future demand and prospects of the ability to generate profit.

An early study from Rock (1986) shows the information asymmetry of traditional IPO performance that insiders have extraordinary information compared to public investors. However, Jog and Sun (2007) found neither investor has insider information about the SPAC's prospects. They found this is consistent with the little information. First, SPACs performance is slightly underpriced on average; Second, there is a lack of mispricing where the underwriter helps in matching the supply and demand of IPO under the over allotment option.

Boyer and Baigent (2008), and Jog and Sun (2007) report the size of SPACs IPOs is relatively small with average less than $100 million. Moreover, they also report a low asset value and low earning because SPACs are required to acquire new business to grow stronger. Therefore, they conclude SPACs are not experiencing any underpricing on the first day of trading (Chakraborty et al., 2011). This finding is consistent with Lewellen (2009), Thompson (2010), Lakicevic and Vulanovic (2011), and Ignatyeva, et al. (2012) with a substantial sample of SPACs from US and European markets, the results show SPACs do not experience any underpricing. According to Lewellen (2009) reports a month return of negative 2% and Jog and Sun (2007) report an approximately overall performance of negative 22% to those investors who hold common stock of SPACs.

Similar to the performance of post-merger announcement, Tran (2012) reports a low monthly return of 1.7% and Lakicevic and Vulanovic (2011) also report a negative return after the post announcement to common stockholders. It can be explained in the study of Datar et al. (2012), they report that the performance of SPACs is inferior as compared to IPO firms. They explain that SPAC acquires companies which are highly leveraged, smaller in size, lower investment and growth opportunities as compared to IPO firms.

SPACs Volumes

The study of IPO volume is interesting as it reflects the investors' sentiment and behavior of the share movement. Ibbotson and Jaffe (1975) and Ritter (1984) find the traditional IPO volumes is substantial during "hot issue". However, the studies on SPACs volumes still needs more attention.

SPACs Risk

SPAC structure reflects its risky investments, especially dealing with the confiscation of shareholders' fund. However, SPACs are able to mitigate these risks and incorporate some protection for shareholders such as holding funds in trust, a limited time frame for assets acquisition, allowing conversion and shareholders are given voting right on the business acquisition (Securities Act Rule 419).

In relating to the IPO performance, Berger (2008) finds bigger market capitalization of SPACs is harder to identify a larger target for acquisition as it may cause shareholders estimate the firm value inaccurately before the target is announced. Therefore, size, time or conversion limits are the determinants for evaluating a firm's future combination for shareholders.

SPACs' Acquisition

According to Malmendier et al. (2012), the potential of SPAC future acquisition reflects the value added and as well as for both target and bidder firms, it is subsequently brought to the synergies creation. Therefore, the IPO of SPAC is a value creation tool as the business scale can be expanded to the distinct level through international acquisition. Some further studies by Netter et al. (2011), Faccio et al. (2006), and Officer et al. (2009) reported acquisition completion by SPAC is about 63.50 percent as compared to Jacobsen (2014) which reported 92 percent from the acquisition of public and private targets. Malmendier et al. (2012) and Officer (2003) reported as an acquisition of public targets are about 88.7 per cent and 78 per cent.

According to Ljungqvist (2007), the IPO study on SPAC issue attracts less attention as compared to traditional IPOs, especially after the European Debt Crisis in 2011. However, many variables such as IPO demand, IPO type, asymmetric information, board of listed companies have been used to explain the performance of traditional IPO (Yong and Isa, 2003; How et al., 2007; Chang et al., 2011) in various dimensions such as offer-to-close, offer-to-open, offer between the advertising period to closing date and offer between the announcement date to closing date (Ritter, 1991; Ibbotson et al., 1994; Ritter and Welch, 2002; Lowry et al., 2010; Chahine and Saade, 2011). Therefore, the study on IPO SPAC in Malaysia is a new idea that provides a huge opportunity to be added to the extant literature.

Background and Framework of SPACs

Recent development of Malaysian SPACs

SPAC as an alternative means to IPO has attracted investors' attention from leading financial institutions and established sovereign wealth funds, especially in the aftermath of plummeting oil prices. A lot of oil and gas companies which involved in exploration and production are divesting their non-core assets. This new listing framework of Bursa Malaysia has enabled new companies which do not have a track record to be given opportunities to raise fund and subsequently make a qualified acquisition.

With the five SPACs listed in Bursa Malaysia, four are under oil and gas industry and one from food and beverage industry. The former are Hibiscus Petroleum Berhad, CLIQ Energy Berhad, Sona Petroleum Berhad and Reach Energy Berhad while the latter is Red Sena Berhad. There are also some potential SPACs which have been rejected by Bursa Malaysia in the recent times.

From Exhibit 3, the total gross proceeds raised is RM2,299 million with the average deal size of RM1842 million. Among these SPACs IPO, the highest gross proceeds raised is RM914 million in 2013, followed by RM750 million in 2014, RM400 million in 2015, and RM235 million in 2011. Surprisingly, there is no SPACs IPO in the year 2012 as the debt crisis in Europe has affected the

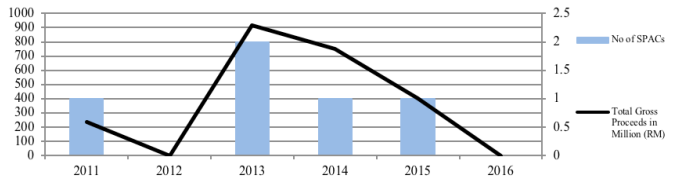

Exhibit 3 Malaysian SPACs: Funds Raised by Period 2011- 2016
Source: Bursa Malaysia, Securities Commission and Yahoo Finance (as at March 31, 2016)

IPO market.

In addition, the proceeds from IPO which are intended for assets acquisition or business opportunity must comply with the new listing requirement strictly regulated by Security Commission Malaysia. Exhibit 4 shows two SPACs are seeking for a new acquisition, two SPACs have announced an acquisition target, and one SPAC has completed the acquisition.

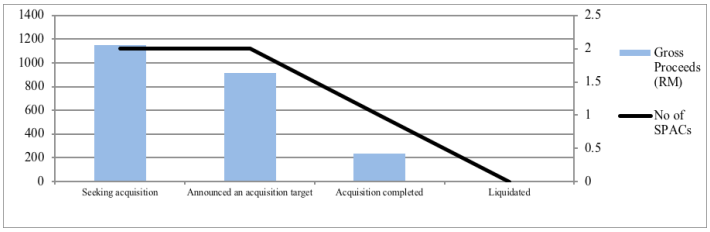

Exhibit 4 Malaysian SPACs Status
Source: Bursa Malaysia, Securities Commission and yahoo finance (as at March 31, 2016)

In the wake of the failure of SPACs to acquire new assets within three years as stated in the statutory requirement, there is liquidation for SPACs. Liquidation is a process to refund the capital to the shareholders. The total guaranteed capital is at least 90 percent of the total proceeds from IPO of which is retained under the IPO trust. The purpose is to reduce the risk exposure to the shareholders as the SPACs companies without financial track record prior to the acquisition.

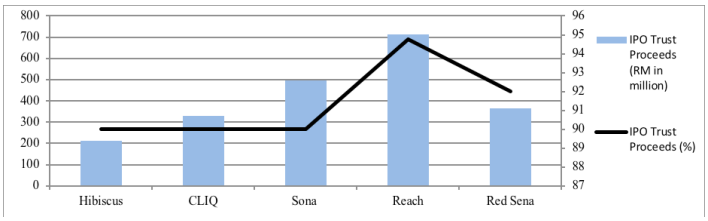

Exhibit 5 Malaysian SPACs with IPO Trust Proceed
Source: Bursa Malaysia, Securities Commission and Yahoo Finance (as at March 31, 2016)

As shown in Exhibit 5, among the SPACs, Reach Energy contributed approximately of 94.75 per cent (equivalent to RM712 million) out of the total proceeds raised from the IPO to the IPO trust. The contribution of IPO trust is the highest amount as compared to Red Sena IPO trust of 92 percent (equivalent to RM364 million), followed by Hibiscus Petroleum Berhad, CLIQ Energy and Sona Petroleum of a total of 90 percent to the IPO trust.

The life cycle of Malaysian SPAC

Exhibit 6 shows the formation and processes of a SPAC. As shown in the exhibit, SPAC must seek the approval from the shareholders to acquire the qualifying asset or else it will face the fate of being liquidated. This could be a form to protect the interest of shareholders but at the same time, this condition restricts the management team's decision to exercise their wisdom. This could also hinder the CEO to exercise his stewardship in implementing the strategy for the survival of the companies.

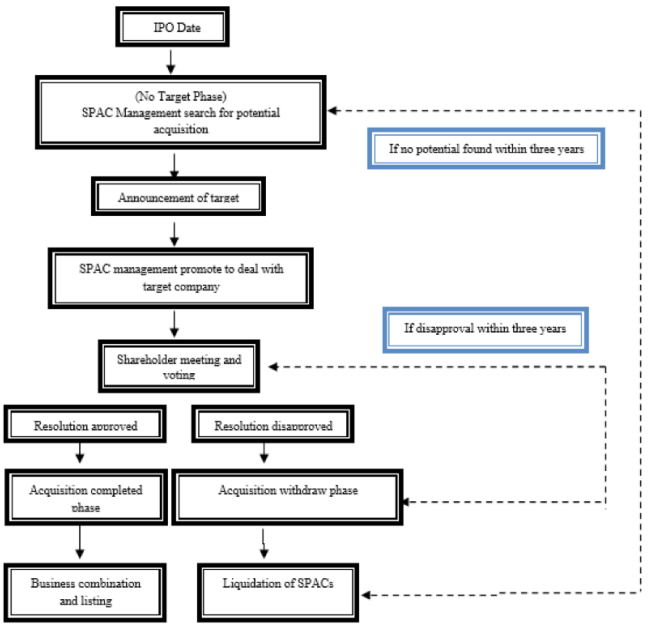

Exhibit 6 The Flowchart on the Formation and Liquidation of SPAC

Source: Authors' own sketch based on information from Bursa Malaysia and Securities Commission

Time frame for the SPAC IPO

Exhibit 7 indicates the timeframe for the IPO of a Malaysian SPAC called Reach Energy Berhad. According to Securities Commission, SPAC is given a maximum time frame of three years to acquire new qualifying asset after IPO. The company was listed on 15 August 2014. The SPAC offer price was RM0.75 with a free detachable warrant, warrant strike price was RM0.75. The total proceeds with more than 90% are capital guaranteed and to be returned shareholder in the event of liquidation.

Case Studies

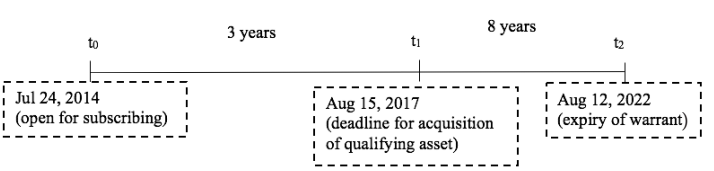

Exhibit 7 A Complete Time Frame for the IPO of a Malaysian SPAC

Source: Authors' own sketch based on information from Bursa Malaysia and Securities Commission

This paper utilizes case study approach in view of the small number of SPACs. Public information, as well as annual reports, are used to analyze the performance of the respective SPACs.

Hibiscus Petroleum Berhad

Hibiscus Petroleum Berhad is the pioneer SPAC in Southeast Asia and listed on Bursa Malaysia under Main Market on 25 July 2011. The IPO of Hibiscus consists of 418 million ordinary shares at the debut price of RM0.75 per share at RM0.01 par value. Successful subscribers obtain one free detachable warrant for each ordinary share subscribed. The total capital raised from the IPO is RM235 million and approximately of the 90% of the capital raised is retained in the IPO trust. The primary aim of Hibiscus is to achieve assets or business acquisition.

The Exhibits on the next page indicate share price performance, the initial return of IPO for the first day of trading is 6 percent; in other words, the closing price on the first day of trading is higher than its debut price. The total IPO trading is near to 26 million volume which is equivalent to about 24.88 percent from the total market trading volume.

Moreover, Hibiscus Petroleum is the first successful SPAC to meet the new listing requirement after the completion of the acquisition of a 35% stake in Lime Petroleum Plc in April 2012. The proposal of acquisition is approved by the Securities Commission and shareholders. Therefore, the company becomes a full-fledged oil and gas exploration and production company.

With the success story of Hibiscus Petroleum, the IPO of SPAC gains higher confidence level from foreign and local investors.

CLIQ Energy Berhad

The second SPAC, CLIQ Energy Berhad was listed on the Main Market on April 10, 2013. The IPO of CLIQ consists of 200 to 667 million ordinary shares at the debut price of RM0.75 per share with the par value of RM0.01. Similar to Hibiscus shareholders, successful subscribers obtain one free detachable warrant for each ordinary share subscribed. The total capital raised from the IPO is RM364 million and approximately 90 percent of the capital raised is retained in the IPO trust. The purpose of CLIQ Energy is to achieve assets or business acquisition within three years set by the Securities Commission.

(Exhibit 10, next page) shows the performance of the share price, the initial return of IPO for the first day of trading is14 percent; in other words, the closing price on the first day of trading is higher than its debut price. As compared to Hibiscus Petroleum, CLIQ Energy provides greater returns on the first-day trading. The total IPO trading is near to 46 million volume which is equivalent to about 33.28 percent of the total market trading volume.

According to Focus Malaysia dated March 11, 2016, CLIQ Energy is unlikely to meet its deadline to secure a qualifying asset before April 9, 2016. However, Securities Commission has refused to extend the time frame for CLIQ Energy to acquire a qualifying asset. There are stringent measures to protect the shareholders. Prior to the failure of acquisition, CLIQ Energy has submitted the potential target to the Securities Commission, eventually failing to get approval for the purchase of energy assets in Kazakhstan due to incomplete information. CLIQ Energy will eventually be liquidated and proceeds will be refunded to shareholders.

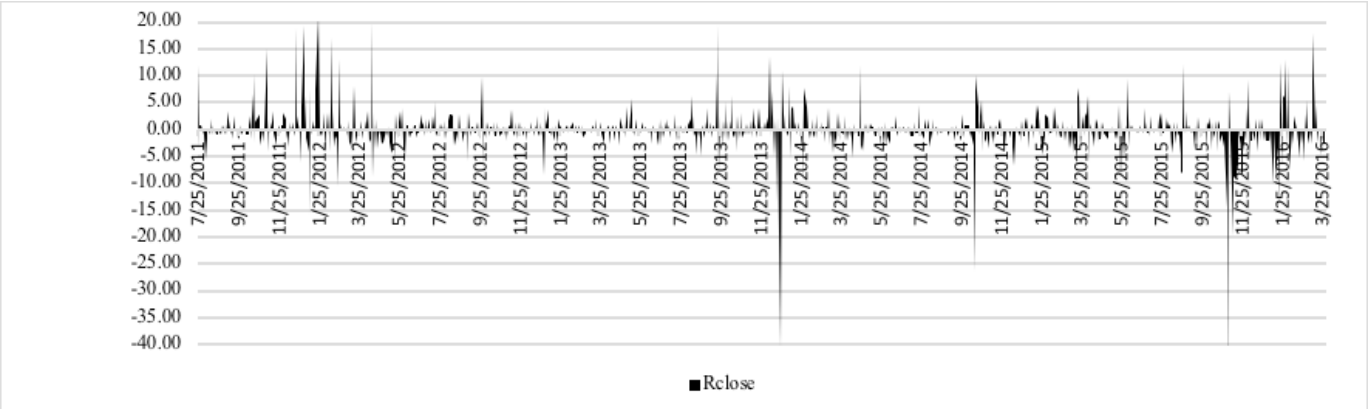

Exhibit 8 Daily Return of Hibiscus SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

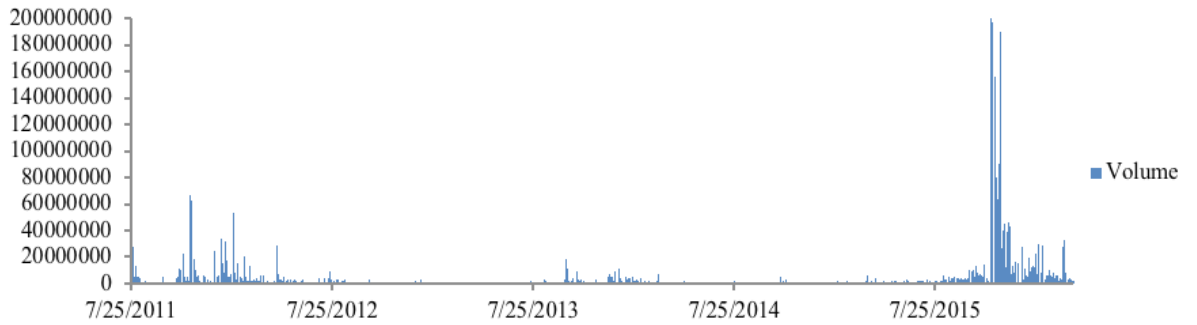

Exhibit 9 Daily Closing Price and Volume of Hibiscus SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

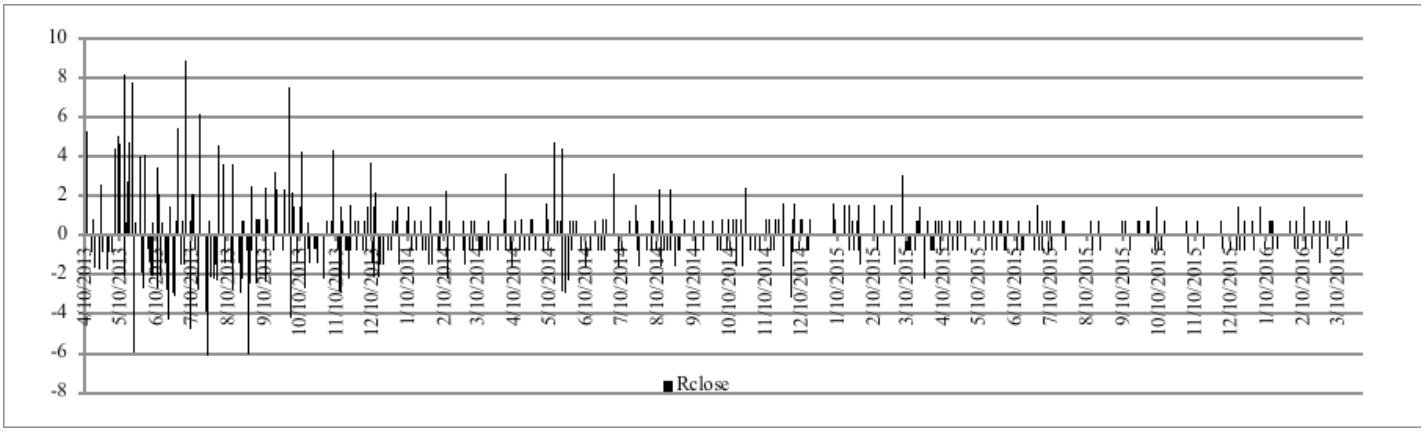

Exhibit 10 Daily Return of CLIQ Energy SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

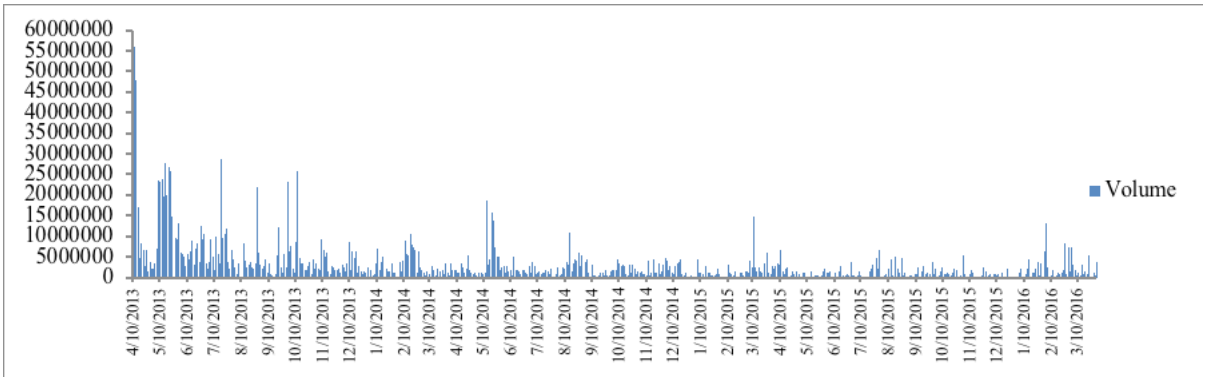

Exhibit 11 Daily Closing Price and Volume of CLIQ Energy SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

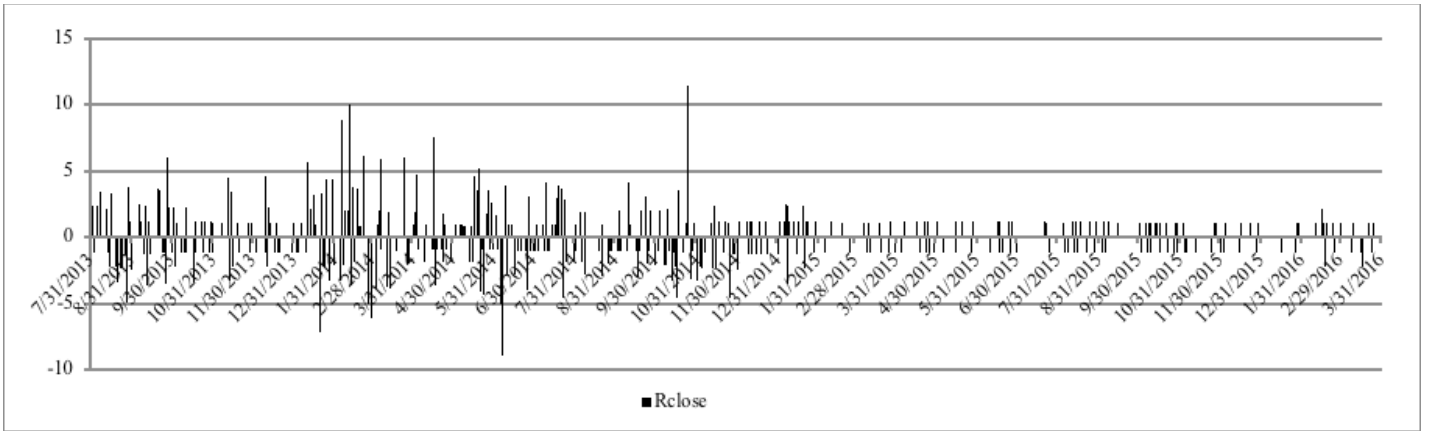

Exhibit 12 Daily Return of Sona Petroleum SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

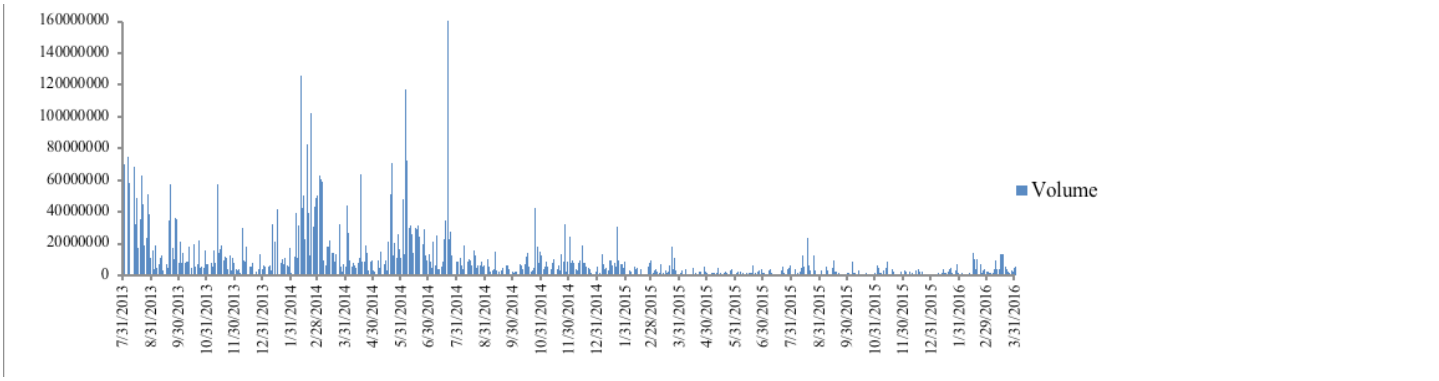

Exhibit 13 Daily Closing Price and Volume of Sona Petroleum SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

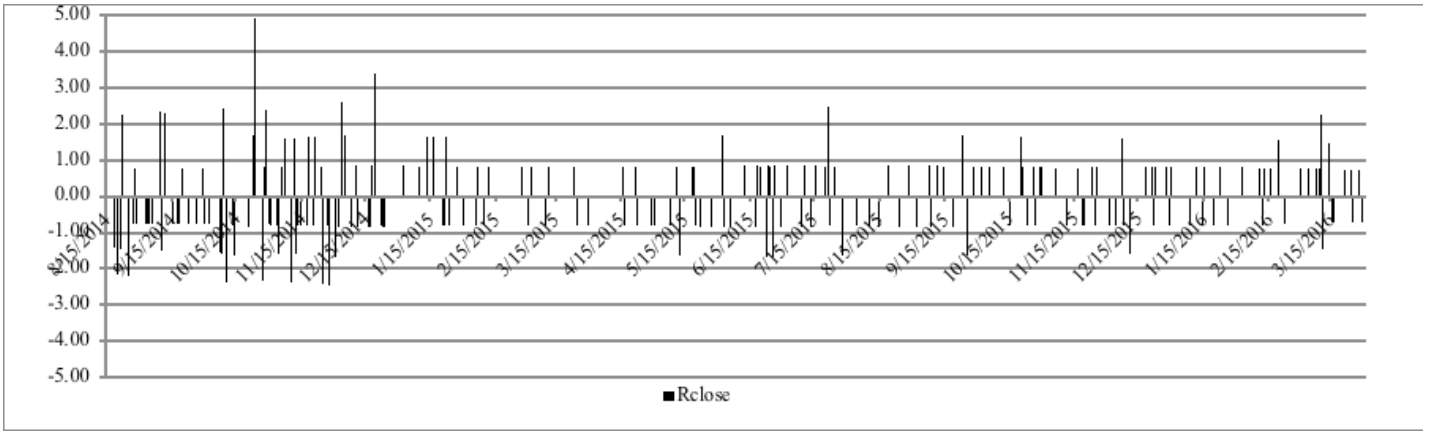

Exhibit 14 Daily Return of Reach Energy SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

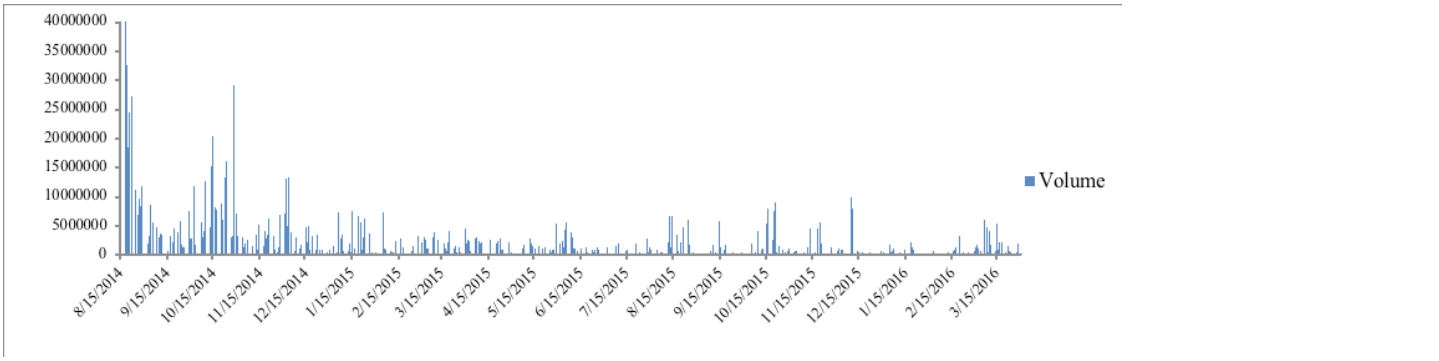

Exhibit 15 Daily Closing Price and Volume of Reach Energy SPAC

Source: Bursa Malaysia, Securities Commission and Bloomberg (as at March 31, 2016)

Sona Petroleum Berhad

The third SPAC named Sona Petroleum Berhad was listed on Bursa Malaysia in Main Market on July 30, 2013. The IPO of Sona consists of 1.1 billion ordinary shares at the debut price of RM0.50 per share with the par value of RM0.01. Interestingly, Sona is the first SPAC to be allowed to issue a huge number of shares. Similar to Hibiscus and CLIQ, successful subscribers get one free detachable warrant for each ordinary share subscribed.The IPO has raised RM550 million funds and 90 percent of the capital raised is retained under the IPO trust.

Exhibit 12 shows the share price performance, the initial return of IPO for the first day of trading -6.67 per cent which is the closing price on the first day of trading is lower than its debut price. As compared to Hibiscus Petroleum, CLIQ Energy provides lesser returns in the first-day trading. The total IPO trading is near to 78 million volume which is equivalent to about 28.20 percent of the total market trading volume.

According to Focus Malaysia dated March 18, 2016, Sona Petroleum Berhad has announced a proposed acquisition of Stag Oilfield at a cost of $25 million. The acquisition of Stag Oilfield is the company second attempt to secure qualifying assets. In 2015, it terminated a deal to buy a stake in two oil and gas blocks in the Gulf of Thailand from London-listed Salamander Energy for US$280 million.

Reach Energy Berhad

On August 15, 2014, Reach Energy Berhad with 1.0 billion ordinary shares at the debut price of RM0.75 per share with par value of RM0.01 was listed on the Main Market of Bursa Malaysia. Reach is the largest SPAC listed in Bursa Malaysia to date and also the second SPAC to allow issue a huge number of shares. Similar to others, successful subscribers get one free detachable warrant for each ordinary share subscribed.

The IPO raised RM750 million and 94 percent of the capital raised is retained under the IPO trust. Prior to its IPO, the business has no financial track record from its business operations but the management team has about 30 years of experience in the oil & gas sector worldwide. Similarly, the objective of Reach Energy is to achieve assets or business acquisition within three years.

	Hibiscus Petroleum	CLIQ Energy	Sona Petroleum	Reach Energy
IPO Proceeds	RM235 million	RM364 million	RM550 million	RM750 million
Issue Price	75 sen	75 sen	50 sen	75 sen
Market Cap	RM913.70	RM397.50	RM740.60	RM958.37
Management's subscription price per share	1 sen	2 sen	3 sen	7.5 sen
Management investment pre-IPO	RM1.05 million	RM1.72 million	RM2.82 million	RM19.17 million
Target of QA	Exploration, development, and production	Development and production	Exploration, development, and production	Development and production
Regions of interest	Asia and Oceania	South Asia, Middle East, East Asia and Oceania	Southeast Asia, Middle East, and Africa	Asia-Pacific
Moratorium on Securities				
Management team (shares and warrants)	Up to completion of QA	Up to completion of QA	Up to one full year of audited revenue	Up to one full year of audited operating revenue
Initial investor shares	Up to completion of QA	Up to completion of QA	Up to completion of QA	Up to completion of QA
Initial investor warrants	-	-	-	Up to completion of QA

Exhibit 16 A Comparison Between Listed SPACs
Source: The Edge Malaysia, May 16, 2014

Exhibit 14 shows the share price performance, the initial return of IPO for the first day of trading -6.00 per cent i.e. its closing price on the first day of trading is lower than its debut price. The total IPO trading is nearly 29 million in volume and about 370% compared to market volume.

According to the press released by Reach Energy on March 2016, Reach management has announced a tripartite conditional agreement with Palaeontol Cooperative U.A. and MIE Holding Corporation for a proposed acquisition of oil and gas producing fields. In addition, MIE Holding Corporation is a corporation listed on the Main Board of the Hong Kong Stock Exchange. The proposal of the acquisition consists of 60% equity interest in Palaeontol B.V for a total acquisition price of USD154.9 million. Palaeontol B.V is a wholly-owned subsidiary of Palaeontol Cooperative U.A.

Conclusion

Weaknesses of SPAC

Exhibit 16 provides the comparison among the current SPACs in Malaysia. Due to the current listing requirement as discussed in section 4, it is evidently clear that there are a few issues which are perceived to be negative factors by investors. Among the issues are:

Firstly, investors should be aware that SPAC is akin to participating in venture equity where unlike traditional IPOs, SPAC IPOs may promise a higher return to investors. However, like other venture capital, the eventual success of IPO listing is not certain.

Secondly, unlike traditional IPOs, SPACs are companies without an adequate financial track record for investors to make a decision. Henceforth, investors rely on the reputation of the management because it serves as a fundamental reference for investors to make a decision.

Thirdly, the recent drop in WTI crude oil price in the World Market from USD100 to USD 30 per barrel poses a great challenge to Oil and Gas companies. Since most of the SPACs are from Oil and Gas industry, it is a question whether they would like to proceed to the stage of making a qualified acquisition. Due to the uncertain macroeconomic environment, there is a higher possibility for companies to meet with financial difficulty.

Fourthly, the time frame of three years set by the Malaysian Securities Commission for the SPAC to make qualified acquisition seems to be too restrictive. There is a greater tendency for the company being forced to purchase new assets at an inflated price due to the time limit. Therefore, the quality of the acquired asset is in a doubt and this increases the risk to the business.

Finally, when a SPAC makes a public announcement that it fails to make the acquisition, its share price will fluctuate. The volatility of share price allows the investors who intend to take advantage of the arbitrage play of the poor performance.

Subsequently, if SPAC fails to acquire new assets, investors will get the refund back from SPAC liquidation. The above problems cause SPAC IPOs to be less attractive to investors. Hence, some measures must be changed to increase the market confidence.

Strength of SPACs

On the other hand, there are built-in mechanisms which can be considered as the advantages of SPACs. Among them are:

Firstly, SPAC provides better investors protection as compared to venture capital as the listing requirement states that a total of at least 90 percent of the capital raised from IPO is retained under an IPO trust. In the event of SPAC liquidation, there is a capital guaranteed fund ready for the shareholders.

Secondly, if subscribers of SPAC successfully obtain the new IPO, investors are rewarded a free detachable warrant for each of the ordinary share subscribed. The purpose of providing a free warrant is to compensate the risk of investing in the SPAC and attract more investors to subscribe IPOs.

Thirdly, SPAC is given a timeframe of three years to acquire new assets which are sufficient for the business. Before the deadline, SPAC has the opportunity to explore different new qualifying asset.

Policy Implications

Unlike Malaysian market, SPAC is more popular in the U.S. as an alternative tool to some of the investors to shift their monies from the hedge fund to SPACs' market where it is originated. As a relative safer product in a low-interest rate environment, US SPAC provides the avenue as an alternative tool to some of the investors to shift their monies from the hedge fund to SPACs.

In the context of Malaysian market, it is pertinent for investors to understand the product as it is different from traditional IPOs. Following the failure of CLIQ Energy and Sona Petroleum, policy makers should review of the term and condition s for the SPACs. If SPACs is liquidated properly, it shows that the SPAC is a workable model for a new listing framework. Shareholders will get back their money and future investors feel comfortable with the fact that the system works.

On the contrary, if policy maker allows an extension for those SPACs which fail to acquire new qualifying assets, it would destroy the market confidence. It is more viable to liquidate if the SPACs are unable to get the deal on time to protect shareholders and not put them at risk by entering into the last minute transaction.

In conclusion, industry players reckon that SPACs still have a bright future through its controlled experiment, stringent measurement and effective built-in mechanism with numerous safeguards to the processes of SPAC IPOs.

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A Primer for Today's Secondary Private Equity Market

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The Evolution of the Secondary Market

Like any market, the secondary private equity market connects buyers and sellers, allowing the former to access private equity limited partnership positions beyond the initial investment period, and the latter to access liquidity along an earlier timeframe. As today's investors navigate a richly valued, low yield environment against a backdrop of global macro uncertainty, and as the role of the secondary market becomes increasingly accepted within the alternative assets universe, secondary investing is being considered in new ways – not only as a source of liquidity for distressed investors, but as a differentiated investment strategy and as a regular portfolio management tool to rebalance fund exposures and lock in realized gains.

The secondary market began to emerge as early as the 1980s. Activity remained muted until the mid-2000s, when a confluence of factors began to drive increasing volume. Since then, secondary private equity has matured from a derivative asset class largely driven by distress and short term market volatility, to a broader, institutionalized market where seller and buyer types now include every investor category. Today, more secondary funds are in market and more capital is being sought than at any point in recent history.[1]

Secondary market activity is influenced by public market dynamics, corresponding investor sentiment and the availability of primary private equity interests to market. Primary private equity fundraising tends to increase with strengthening public market conditions (Exhibit 1, next page). With each inflection point in financial markets over the past decade, the secondary market has also experienced increased activity as investors

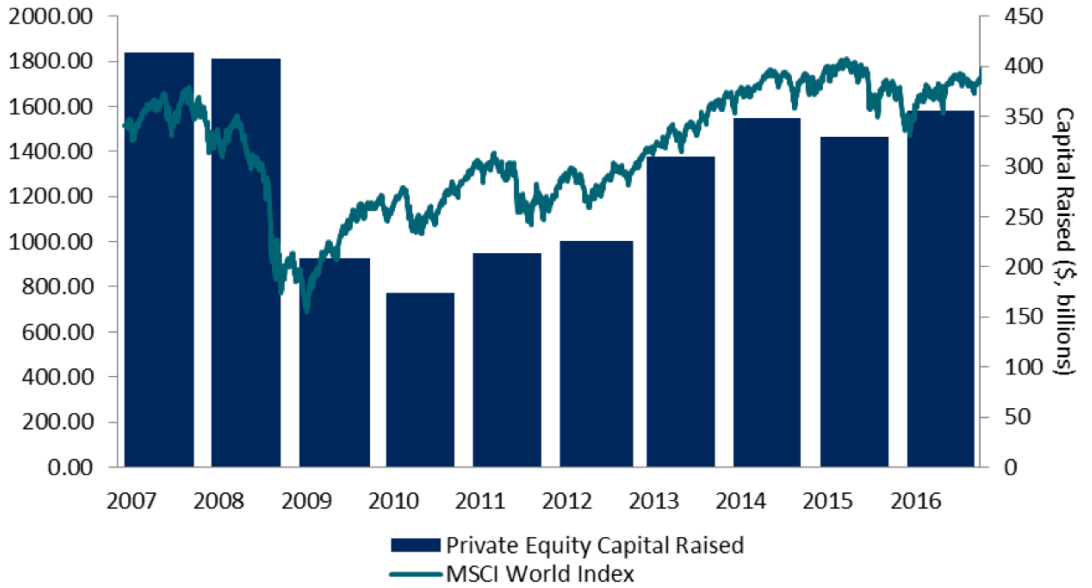

Exhibit 1: Primary Commitments and Market Performance (US$ in billions) *

attempt to unload distressed stakes or to take advantage of market gains. (Increased activity does not always lead to completed deal volume, as will be discussed below.) The secondary market has experienced marked secular growth over this period as well, as buyers and sellers become increasingly sophisticated and as the volume and availability of primary private equity product has expanded over time (Exhibit 2, next page).

A Brief History

Pre-2000

Following regulatory changes in the late 1970s that permitted pension funds to invest in private equity, assets under management in the organized private equity market increased dramatically, from under $5 billion to over $175 billion between 1980 and 1995.[2] By the 1990s, private equity had become a core holding for most institutional investors, with average portfolio allocations ranging from 5% for public pension plans to nearly 15% for endowments and foundations.[3] Secondary activity had existed from the early days, largely as one-off transactions. However, as the primary market matured through the 1990s, secondary activity began to grow meaningfully. The first globally focused secondary private equity fund was launched in 1998.

2000-2003

In the 1990s, regulators changed the capital requirements for commercial banks and insurance companies, forcing these institutions to set aside more capital in order to support their alternative asset investments.[4] In 2000, Chase Capital Partners sold a $500+ million portfolio of private equity fund interests to two secondary players, marking the beginning of larger scale portfolio transactions in the secondary marketplace as well as the beginning of buyer mosaics. In 2003, UBS sold a portfolio of more than fifty LBO and venture capital fund interests, estimated to be valued around $750 million. That same year, Deutsche Bank also completed a fund portfolio sale. Following the global technology losses of 2000, sellers turned to the secondary market out of distress as well. The market was marked by large discounts at this time, though the pricing gap between buyers and sellers began to narrow over the coming years as the exit climate for primary private equity assets improved, and as sellers had time to absorb several quarters of gradual balance sheet write-downs.

2004-2008

The secondary market landscape began to change in the mid-2000s as public pension plans began to sell assets from their private equity portfolios. In 2004, the State of Connecticut Retirement Plans and Trust Funds became one of the first pension funds to sell in the secondary marketplace. Secondary market deal volume was roughly $8.4 billion for the year.[5] Over the next two years, secondary fundraising surged, with Coller Capital raising a $4.5 billion fund in 2007. In 2005, California Public Employee's Retirement System (CalPERS) decided to restructure its Alternative Investment Management program, creating a 'legacy portfolio' of non-core assets and manager relationships. In 2007, CalPERS sold this legacy portfolio to a buyer syndicate for $1.5 billion, the largest secondary transaction to date. By 2008, secondary deal volume had almost doubled from 2004 levels, to $16.4 billion.[6]

2009-2013

Following the global financial crisis, widespread market dislocations had a dramatic impact on the pricing of secondary private equity transactions, resulting in wide bid / ask spreads and muted volume. An expected surge in deal flow following the economic downturn failed to materialize, as investors resisted selling in late 2008 to early 2009 to avoid significant losses. However, through 2009 and 2010, the bid / ask spread narrowed and completed transaction volume increased significantly, as investors wanted to rebalance investment allocations and to reduce unfunded private equity exposure. In 2010, Bank of America sold a $1.9 billion portfolio to AXA Private Equity, marking the beginning of truly large portfolio transactions. In 2011 and 2012, financial institutions again became increasingly

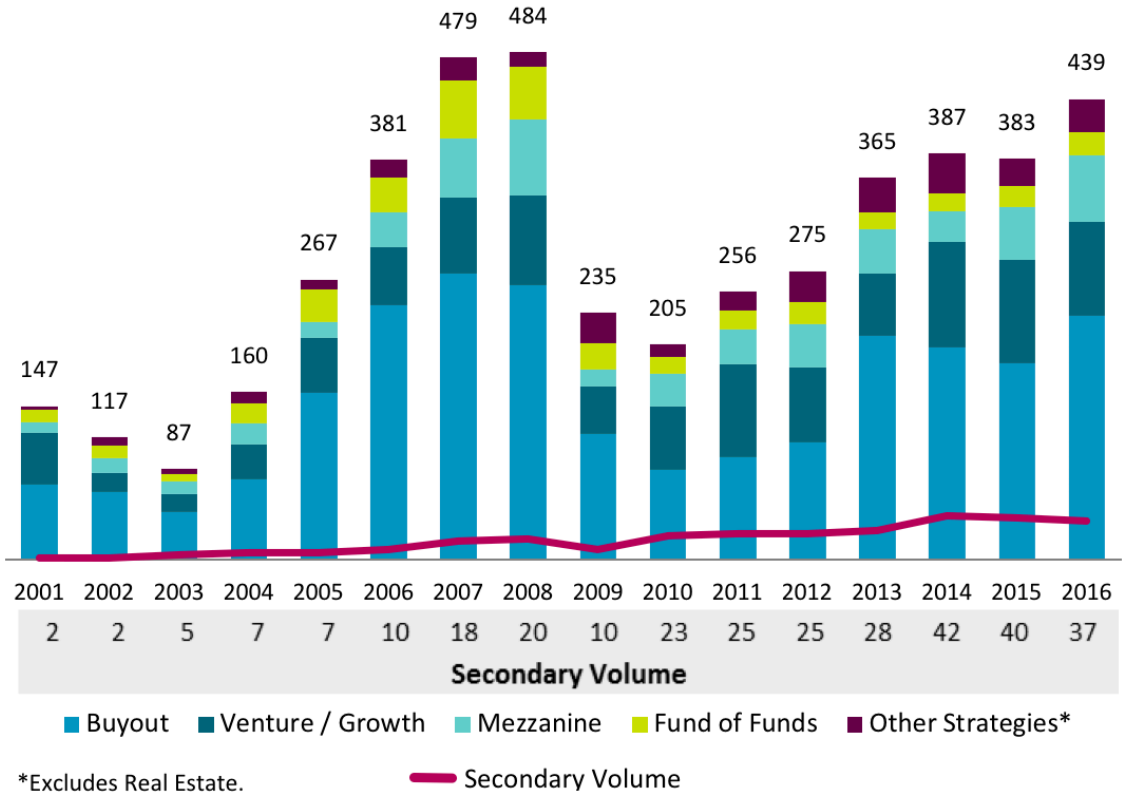

Exhibit 2: Primary Commitments and Secondary Volume (US$ in billions)*

active sellers, driven by regulatory reform following the crisis, capped off by the release of the final draft of the Volcker Rule in 2013.

2014-Today

2014 and 2015 saw a meaningful jump in global secondary transaction volume, as public equity gains and strong realization activity through 2012 to 2014 flowed through to the secondary market. Exits from buyouts exceeded $450 billion in 2014, surpassing the 2007 all-time high of $354 billion.[7] Continued strong secondary fundraising increased the amount of dry powder available, and new secondary market entrants emerged, including non-traditional buyers. Competition for high quality asset portfolios intensified and secondary market pricing grew robust, to a post-crisis high of 93% of Net Asset Value ("NAV").[8] More multi-strategy portfolios came to market, often including real estate and infrastructure / energy fund stakes. Deal volume hit record levels in 2014, driven partly by a dozen billion-dollar-plus transactions, including portfolios from GE Capital, Mizuho Financial and J.P. Morgan Chase, in addition to several large US public pension plans. Deals became increasingly structured, with buyers using deferred payment structures and third-party leverage to boost returns.

2016 posed yet another inflection point. In the first half of 2016, macro volatility driven by a drop in crude prices in January, worries over a China slowdown and Brexit slowed market volume. Although a large number and variety of potential sellers entered the secondary private equity marketplace seeking liquidity, many early 2016 deals were not completed as buyers and sellers had differing expectations, leading to yet another pricing gap. Pricing for buyout fund stakes fell – the first half-yearly drop since 2013.[9] Meanwhile, dry powder increased to a record $65 billion, the joint result of slower capital deployment in the first half of the year due to market uncertainty and the successful completion of several large secondary fundraises over the year.[10] As 2016 progressed, valuations in underlying portfolios began to stabilize and consequently, secondary buyers became increasingly willing to transact. As a result, the second half of 2016 saw a spike in completed transactions. 2016 secondary completed deal volume reached $37 billion, slightly down from prior year volume of $40 billion.[11]

Where is the Market Going?

We believe the near term will be marked by continued volatility, driven by political uncertainty and a challenging market environment. In December 2016, the Federal Reserve extended the deadline for banks to qualify for the Volcker Rule extension, up to an additional five years beyond July 21, 2017 to divest legacy "illiquid fund" investments. Financial institutions, historically motivated by regulatory reasons to pare down their private equity asset portfolios, are now taking a "wait and see" attitude, especially in light of indications from the current U.S. presidential administration that further changes may be made to Dodd-Frank legislation.

While this will certainly impact the secondary market in the shorter term, we believe secondary activity will nevertheless continue to expand in size and scope over the longer term, both in the number of transactions and in total dollars transacted. While 2016 completed deal volume decreased almost 10% from

the prior year, this was largely driven by a decrease in average deal size (which fell from over $200 million in 2015 to under $180 million in 2016). Not only were more total transactions completed by number, but the average number of funds per transaction increased over 30% from 13 in 2015 to 18 in 2016.[12] As increasingly diverse portfolios are brought to market, and as more buyer and seller types recognize the secondary market as a viable portfolio solution, we believe secondary private equity will be poised for continued growth.

Going forward, we can identify several meaningful growth trends, including:

- A growing universe of players

  - Sellers driven by changing needs, macro forces and normalizing attitudes

  - Buyers driven by the search for yield and ample dry powder

- A broadening of assets available for sale

  - Widening spectrum in terms of quality, asset class and maturity

  - Growing asset backlog in the primary PE market

- The expanding role of fund of funds managers and general partners

A Growing Universe of Players

Between January 2015 and today, over $70 billion of dedicated secondary capital was raised, an influx of dry powder waiting to be deployed in the next two to four years.[13] As more capital enters the secondary market, news headlines increasingly reflect investor concerns over intensifying competition, "full" pricing and a supply / demand imbalance in the secondary market. A growing universe of players can mean more competition as traditional secondary players and institutional investors alike focus their attention on the same portfolios, often with larger-than-ever pools of capital. However, digging a little deeper, more market participation can also mean greater specialization and sophistication.

Over the past five years, the secondary private equity market has expanded meaningfully, from $25 billion (2011) to $37 billion (2016) in annual transactions.[14] In the first half of 2016, pension funds became the most active sellers of stakes on the secondary market, overtaking financial institutions.[15] Sophisticated institutional investors including pension plans and sovereign wealth funds are increasingly turning to the secondary market as a regular portfolio rebalancing tool. These same investors are also treating secondary private equity as an alternative investment strategy, committing to secondary managers in their investment allocations and even building dedicated, in-house secondary investing platforms. These platforms often have global reach and robust teams, reflecting a growing shift away from traditionally passive investing to more active market participation.

Approximately half of active buyers in the secondary market today are also sellers, and over half of all secondary buyers have the ability to purchase interests across multiple private equity strategies, suggesting that while competition in the secondary market is certainly growing, participant sophistication is growing as well.[16]

A closer look at pricing levels in 2015 and 2016 reveals that par and premium prices were paid mostly on large-cap US and European funds, with well-diversified underlying investments and regular distribution streams.[17,18] While "full" pricing is grabbing investor attention, these headline prices do not reflect the bifurcation of the market as buyers concentrate on assets perceived as higher quality. This pricing disparity becomes evident as one examines the average price paid for venture capital assets, with less predictable cash flow streams and less perceived upside potential, which was 78% of NAV, compared to buyout pricing, which averaged 95% of NAV in the same year.[19]

Buyers have also focused on broader subsets and large portfolios, where bidding was more aggressive, rather than niche subsets (where fewer buyers have prior knowledge, or access to information) or smaller portfolios (where fewer buyers are incentivized to transact, given the pressure to keep pace with capital deployment, and where opportunities may be off-market and more relationship-based). We believe this dispersion allows those buyers with more transaction experience or greater specialization to continue to find value in the secondary market. As a final point, secondary sale processes are generally based off a historical reference date, and underlying portfolio valuation changes over time can often be reflected in pricing, especially if buyers have access to subsequent quarters of information. Over periods of strong public market activity or meaningful private valuation uplifts, par or premium pricing for reference date NAV from three or six months prior may actually equate to a discount to latest market value.

The current secondary penetration rate (defined as the percentage of total NAV across all private equity strategies that trades in the secondary market) is still less than 2%.[20] Primary private equity makes up a growing proportion of investor portfolios, and investor demand continues to support robust primary private equity fundraising, driven by historically strong cash distributions over the past six years.[21] As the primary market continues to expand, we believe the secondary market will follow suit (Exhibit 3, next page).

A Broadening of Assets Available for Sale

The expansion of the secondary private equity market has led to a broadening of assets available for sale. Sellers are increasingly coming to market with multi-asset portfolios, which reflect the realities of alternatives investing. Real estate, natural resources and infrastructure funds, asset classes which were not institutionalized until the mid-2000s, are being offered for sale both due to their maturation over time, and in response to growing investor appetite for asset diversification. The flight to quality discussed above has fuelled another growth trend in the secondary market, as opportunistic sellers are incentivized to "sweeten the pot" by blending in younger assets with greater perceived upside potential into portfolios available for sale.

Although down in 2016, active fund of funds portfolio management drove two-thirds of 2015 volume compared to just under half in 2014, a trend that will likely continue as transacting in the secondary market becomes increasingly normalized.[22] Fund of funds managers are not only paring down mature

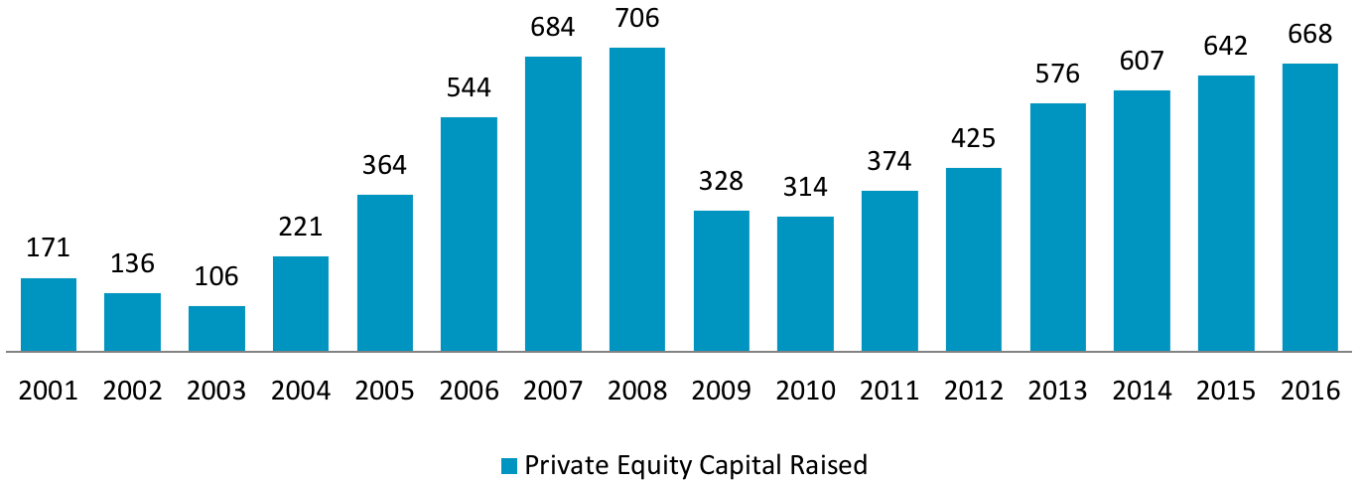

Exhibit 3: Historical Private Equity Fundraising (US$ in billions)*

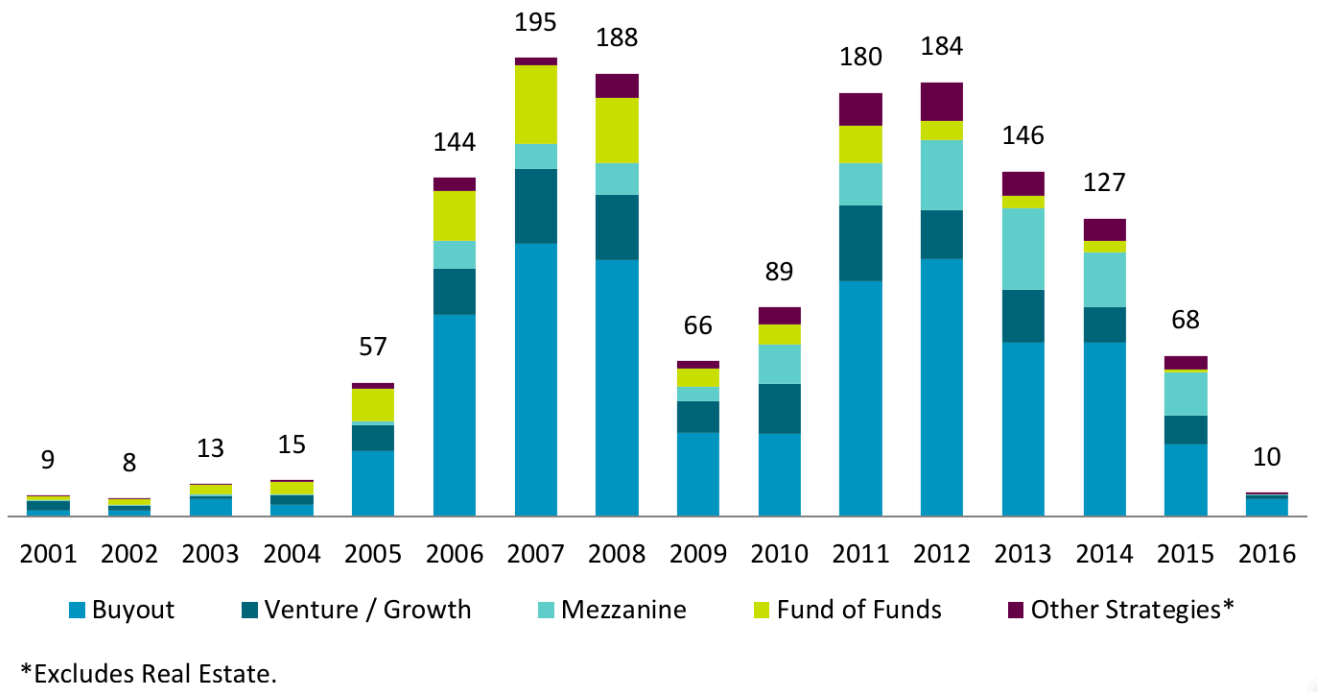

Exhibit 4: Remaining Value in Private Equity Funds by Vintage (US$ in billions)*

assets in vehicle wind-downs, but also strategically selling younger assets. Fund managers may choose to sell down partial commitments, tailoring their exposure to certain private equity sponsors or investment strategies, but maintaining a foot in the door to capitalize on future upside, or to maintain the sponsor relationship.

As funds raised prior to the 2008 financial crisis hit the ten-year mark (the traditional "end of fund" life) and funds raised following the crisis gradually reach maturity, the maturity spectrum of the secondary market is not only expanding but also shifting generally. There is $649 billion of remaining value in 2005-2009 vintages, which comprises the new "tail-end" opportunity set to enter the market over the next three to five years (Exhibit 4).[23]

Younger, post-crisis funds will begin to shape the profile of secondary market supply. Primary private equity funds raised between 2009 and 2012 entered a depressed market, with three year rolling IRR horizons of 0.3% across all strategies.[24] With fewer opportunities to deploy capital early in their investment periods, these funds are not only younger, with more blind pool risk, but also distinguished by comparably longer active fund lives.

As PE funds raised over the past decade harvest the unrealized value in their portfolios, the average holding period has lengthened—and will continue to stretch because holdings acquired during the boom years have yet to be fully exited. Many pre-crisis investments were often acquired at high purchase multiples, and need more time in order to yield acceptable

returns. Likewise, holdings acquired following the crisis need more time for their investment theses to be proven out. For buyouts exited in 2014, the median holding period had grown to 5.7 years, up from just 3.4 in 2008. 60% of assets sold in 2014 had been in PE portfolios for more than five years; in comparison, only 11% had been held less than three years.[25]

The Expanding Role of General Partners

Although the secondary private equity market emerged as a solution designed for limited partners seeking liquidity, general partners are becoming increasingly active participants. By virtue of the transaction between an existing limited partner and an aspiring buyer, the general partner ("GP") is party to the exchange, though traditionally in a more passive role. However, GPs are initiating transactions directly on the secondary market, both independently, and on behalf of their limited partners. Greenhill Cogent estimates that GP-led transactions were 18% of 2016 total deal count, and just under 25% of the total secondary market, topping $9 billion.[26]

In recent years, we have seen GPs proactively offering investors liquidity options, as well as adopting new fund-level equity and debt structures to manage capital needs. GPs are also introducing greater complexity to the secondary market through restructuring / recapitalization processes, team spin-outs and secondary direct investments. These solutions are poised for additional growth, especially with the growing specialization of the market, as a broadening of asset classes introduces varying risk-return profiles, differing fund structures (closed-end, open-end, etc.) and investment time frames. In real estate, for example, select sponsors are shifting away from traditional closed-end fund vehicles towards deal by deal transactions and co-investments, as investor appetite is growing for smaller club deals.

General partners and fund of fund managers are running secondary processes often with an eye towards the primary capabilities of interested buyers, as a secondary transaction could present the opportunity for managers to enhance and structure their limited partner base. The secondary market becomes not only a tool for managers to "clean up" older, legacy investments, but provides access to a different, often new capital pool. Staple transactions, in which managers will allow prospective buyers access to existing funds only with commitments to new funds, allow fund of funds managers to balance limited partner commitments across vintages (allowing a limited partner to be released from an older vintage for the guarantee that the substituting party will commit to the latest fund raised, often at a pre-determined ratio of NAV).

Conclusion

As the secondary private equity market has evolved, the participant universe, asset spectrum and amount of available dry powder have all expanded meaningfully. We predict that the market will continue to grow more complex, mirroring developments in the primary private equity market, which can be traced along a similar trajectory from its early history to today. Just as private equity expanded across strategies (venture capital, real estate, infrastructure, etc.) and spread across the capital structure (mezzanine debt, distressed for control, rescue financing, etc.), we believe the secondary market will expand similarly.

Forward projections of traditional asset class performance remain underwhelming, and investors of all types are increasingly seeking out creative approaches to deploying capital and generating solid risk-adjusted returns in a challenging market environment. As investors turn to the secondary market as both buyers and sellers, increasingly broad asset portfolios will be brought to market, and increasingly complex solutions will emerge. For investors, it is important to keep sight of fundamentals in the face of increasing complexity. We believe intrinsic analysis of underlying assets can determine the "right price" for any portfolio, within any structure. With thoughtful portfolio construction, we believe the secondary market offers diversified exposure to the primary private equity market, indexed across vintage years, geographies, asset classes and strategies.

Though impacted by macro-economic trends and public equity volatility in broadly the same way as other alternative assets, secondary private equity is a derivative of the broader alternative assets universe, with a time lag and performance curve following that of the primary market. By removing some of the start-up risks facing private equity funds, secondary private equity investing may ultimately provide more efficient exposure to the alternative assets market, offering accelerated returns with lower volatility, lower loss rates and greater downside protection, regardless of the current market cycle.

** Source for all Exhibits: Preqin.*

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Verdun S. Perry is a Senior Managing Director and Co-Head of Strategic Partners, Blackstone's secondary fund of funds business, which it acquired from Credit Suisse in August 2013. Mr. Perry joined Credit Suisse in November 2000 when it acquired Donaldson, Lufkin & Jenrette ("DLJ"), where he was an Associate in the Investment Banking Division before joining Strategic Partners the year it was founded. Mr. Perry sits on Strategic Partners' Investment Committees and his current responsibilities include fundraising, deal-sourcing, negotiating and executing secondary transactions and co-investments, as well as various post-purchase fund monitoring activities. Previously, Mr. Perry worked in the strategic investments group at Bozell, Jacobs, Kenyon and Eckhardt, Inc. and in the Investment Banking Division at Morgan Stanley & Co. Mr. Perry received a B.A. from Morehouse College, where he graduated magna cum laude and was elected Phi Beta Kappa, as well as an M.B.A. from Harvard Business School, where he was a Robert Toigo Foundation Fellow. Mr. Perry serves on the boards of The Blackstone Charitable Foundation and Sponsors for Educational Opportunity (SEO).

Julie Chang
Strategic Partners

Julie Chang is an Associate, having joined Strategic Partners in 2013. In 2016, Ms. Chang relocated to Strategic Partners' London office to complete a two year rotation. Prior to joining Strategic Partners, Ms. Chang worked for the American Chamber of Commerce in Almaty, Kazakhstan. Ms. Chang attended Princeton University where she was elected to Phi Beta Kappa and earned a B.A. summa cum laude in Classics, with certificates in European Cultural Studies, Medieval Studies and Russian and Eurasian Studies.

Private Equity Laid Bare: An Interview with Ludovic Phalippou

Barbara J. Mack
Pingry Hill Enterprises, Inc.

Introduction

As interest in the field of private equity has grown, so too have publications about the industry, from textbooks that outline the principles of financial accounting and term sheets to case studies, war stories, and blow by blow descriptions of deals from heaven or, more dramatically deals from hell. After surveying the existing literature and having taught private equity courses at Oxford for over 15 years, Ludovic Phalippou felt there was a gap in knowledge and room for improvement in how the basics of PE were taught to students and represented to the outside world. He has recently published a book that addresses some of the shortcomings and provides an intriguing and creative addition to the private equity industry. We spoke with Ludovic recently to learn more about *Private Equity Laid Bare*.

The Bare Bones

The book is an outgrowth of the course that Ludovic has developed at Oxford over the past fifteen years. The course itself takes a comprehensive approach to what is essentially a hands-on subject and includes contributions from an array of industry practitioners who are involved as guest lecturers and tutors throughout the semester. *Private Equity Laid Bare* captures the sense of engagement and practice, combining concise descriptions, dialogues, and short pithy case studies to illustrate key points. "I came to private equity by luck," says Ludovic, "and my research received a lot of attention. People had hardly ever seen such data and analysis. Clearly there was a headwind when it came to really understanding the essence of private equity and what makes deals tick. Ever since then I have gathered data, worked closely with practitioners, and followed the latest developments, which all create a better base for teaching students and executives about the industry."

As heavy as the subject of finance can be, Ludovic kept the writing style accessible and fun; he made use of the tale Alice in Wonderland to explain the nature of the deal, from points of failure to highlights of success. Staying current with themes that are running though the industry these days, he addresses the topic of fees and expenses through a vibrant dialogue between Alice (a GP) and the Hatter (an LP), which conveys the various tensions in a humorous way.

Readers will come away with a strong sense of what is at stake in every deal and fund, and four key points deserve particular attention.

Four Key Points

Leverage – In Ludovic's words, "The amount of debt in an LBO will only affect the value-added positively if the target was purchased below its competitive value." This means that when asset prices are at all-time highs, as they have been, firms should use less leverage in LBOs, not more. Viewed at a deeper level, he notes, "The usual decomposition of value-added into leverage, multiple arbitrage, and earnings growth does not make sense conceptually and the practical implementation, through a so-called 'value bridge,' only exaggerates the contribution of earnings growth." Financial engineers take note!

Financial Bankruptcy – Looking out over the history of private equity deals, Ludovic observes that most of the controversies around LBOs arise when companies end up financially bankrupt. "A financial bankruptcy is one that would not have happened without the extra debt that has been added due to the LBO," he says, "and indeed, most bankruptcies in private equity are in this category." As an interesting counterpoint he adds, "Actually these bankruptcies should not be that controversial, since a purely financial bankruptcy should not, in principle, disrupt the underlying business. Naturally there should be a change of ownership to some of the debt claimants, and if there is actually a disruption of the business, then people should turn to bankruptcy laws, rather than focusing on the private equity side of the situation."

Fees – In an era where the high fees of many

forms of alternative investment have come under fire, private equity is no exception. Ludovic takes a strong stance on this issue and offers some concrete advice. "When we hear of fees of 2 and 20, it may seem high, but it is also misleading," he says. "The headline fees are only remotely related to the fee bill because the actual fees will depend on minute details in the term of the contract, a document that is notoriously difficult to read and understand." One of the critical elements of the ultimate fee structure lies in portfolio company fees and expenses; until recently, this topic was not out in the open and had the potential to create substantial conflicts of interest for GPs.

Education – Following from the discussion of leverage, bankruptcy and fees, one might be discouraged from considering investment in private equity at all. However, the picture is not as bleak as it may seem. The role of private investment in firms is a critical feature of a healthy financial landscape and education, not avoidance, is the key to unlocking its potential.

Advice for CAIA Members

For those who are interested in breaking into private equity, Ludovic offers the following advice: "Many people, early in their careers, start off thinking that they want to work for a big GP – a KKR or a Blackstone, but it is helpful to consider what opportunities exist with smaller funds as well. There are funds that focus on emerging markets and niche funds where the ability to have an impact and develop a very strong area of expertise will come quickly. You may be able to execute deals faster, develop an excellent Rolodex, and do a lot of exciting things in a smaller firm." In addition, he recommends that potential candidates consider roles at pension funds, sovereign wealth funds, and endowments. These institutions may be involved as LPs and some do deals themselves. "By working on the LP side of the industry, you can develop insights and connections that will carry across if you eventually want to make the move to a GP," Ludovic notes. Legal and accounting jobs also provide opportunities to learn deal mechanics and comprise valuable skill sets on both sides of the industry. And finally, consulting can be an avenue into this intriguing area of finance. "Whatever you do," says Ludovic, "you need to read, question, and don't trust anyone; the sharpest business minds are drawn to fields like private equity and it is one of the most challenging and exciting areas in the financial world."

One excellent way to start will be to read *Private Equity Laid Bare* this year.

On Amazon: https://www.amazon.com/Private-Equity-Laid-Ludovic-Phalippou/dp/1973918927

You can also follow the book on Twitter: @PELaidbare and on Facebook at PE Laid Bare https://www.facebook.com/PElaidbare/

If you are interested in further details, feel free to contact Ludovic at ludovic.phalippou@sbs.ox.ac.uk.

Bios

Barbara J. Mack
Pingry Hill Enterprises, Inc.

Barbara J. Mack is founder and president of the consulting firm Pingry Hill Enterprises, Inc. For over fifteen years, she has worked as a consultant, editor, writer, and researcher on projects involving alternative investments, international economics, and technological innovation. Her previous work experience includes appointments as a case writer at Harvard Business School and a research affiliate at the Computer Science and Artificial Intelligence Lab (CSAIL) at MIT.

Barbara has a Masters degree from Harvard University's Kennedy School of Government, with a focus on law and policy in the European Union. She also has a Bachelor of Arts from Tufts University, where she focused on English Literature, Anthropology, and Fine Art.

Ludovic Phalippou, PhD
Said Business School, University of Oxford

Author of the best-seller *Private Equity Laid Bare,* Ludovic is a tenured faculty member of the Said Business School at the University of Oxford. He specializes in the areas of private equity that are of interest to investors in that asset class, such as fee tracking, interest alignment, and return benchmarking. Named as one of "The 40 Most Outstanding Business School Professors Under 40 In The World" in 2014, and as one of the 20 most influential individuals in private equity in Europe in 2016, Ludovic has strong links with senior practitioners in the industry, routinely speaks at practitioner conferences, and appears in the media internationally.

Ludovic's research papers have been widely cited in academia, in the press, and in regulatory circles. He worked with a number of large institutional investors on their private equity investment decisions and benchmarking systems.

At Oxford, Ludovic teaches 'Asset Management' and 'Private Equity'. He achieved a degree in Economics from Toulouse School of Economics; a Master in Economics and a Master in Mathematical Finance both from the University of Southern California; and a PhD in Finance from INSEAD. Ludovic has two main hobbies: tasting great wines and racing road bikes.

The CAIA Endowment Investable Index

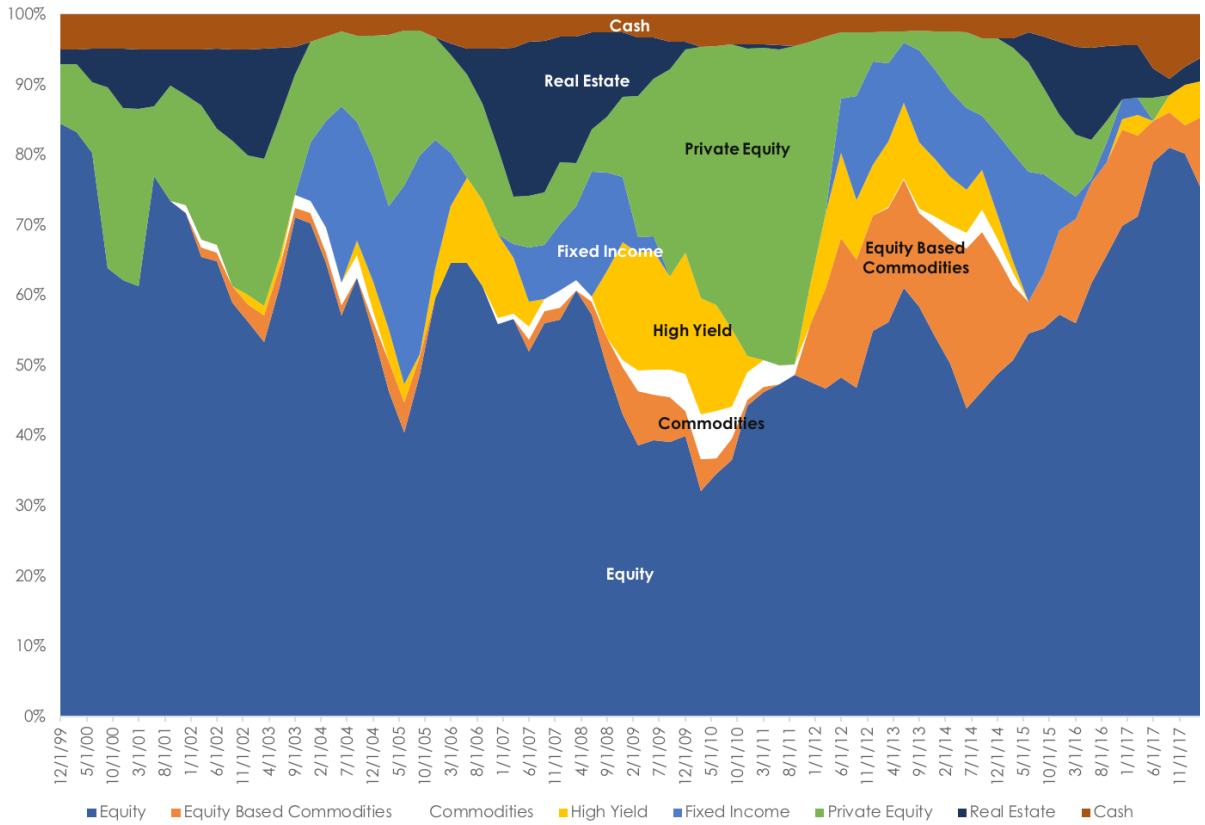
Hossein Kazemi

Kathryn Wilkens, *CAIA*
Pearl Quest

We present the historical weights, allocation as of month-end March 2018, and historical performance to the replication portfolio that was introduced in our AIAR publication Volume 6 Issue 1.

The below graph shows the exposures of the Multi-Asset ETF portfolio through time. It is important to note that the volatility displayed by these exposures does not imply that endowments alter their asset allocations as frequently as the Multi-Asset ETF portfolio. While an endowment may hold a fixed allocation to various asset classes, the underlying assets/manager may display time-varying exposures to different sources of risk. For instance, a hedge fund manager may decide to increase her fund's exposure to energy stocks while reducing the fund's exposure to healthcare stocks. Though the endowment's allocation to that manager has remained unchanged, its exposures to energy and healthcare sectors have changed. Also, if returns on two asset classes are highly correlated, then the algorithm will pick the one that is less volatile. For instance, if returns on venture capital and small cap stocks are highly correlated, then the program will pick the small cap index if it turns out to be less volatile.

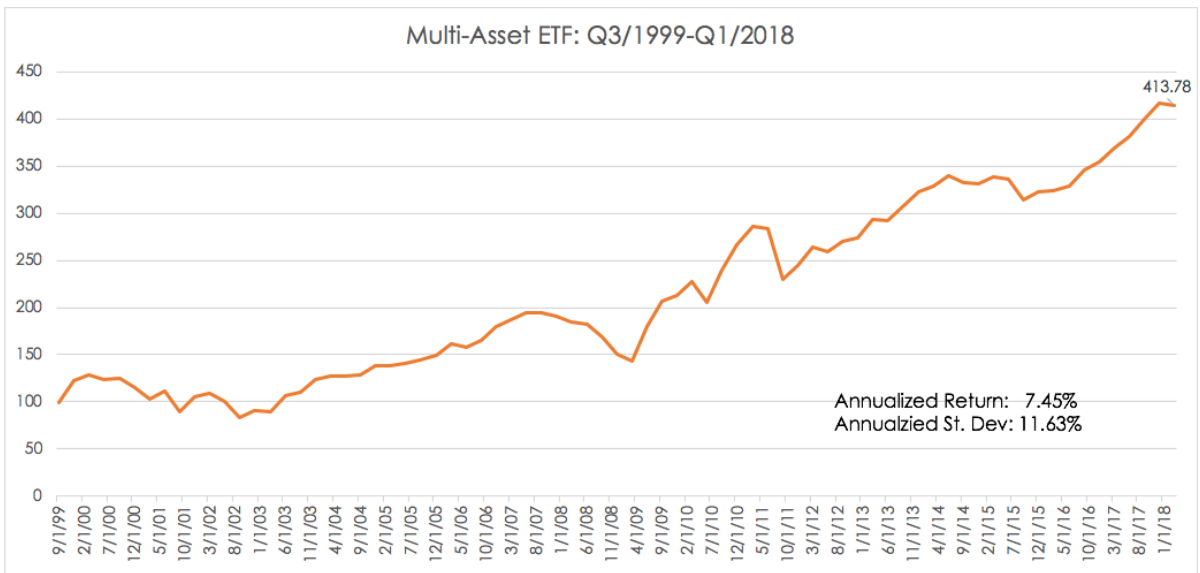
Endowment Index Weights



Allocation Suggested by Algorithm

Russell 2000 ETF	Power Shares QQQ ETF	MSCI World Free ETF	Vanguard FTSE Emerging Markets ETF	Materials Select Sector SPDR® ETF	Technology Select Sector SPDR® ETF	Consumer Staples Select Sector SPDR® ETF	Health Care Select Sector SPDR® ETF	BBgBarc US Corporate High Yield TR USD	SPDR® Dow Jones Global Real Estate ETF	Cash & Short-Term Treasuries
19.72%	8.41%	26.14%	4.79%	9.89%	5.76%	4.02%	6.61%	5.10%	3.35%	6.22%

Historical Performance



Authors' Bios

Hossein Kazemi, *Ph.D., CFA*
CAIA Association
Isenberg School of Managment,
University of Massachusetts Amherst

Dr. Hossein Kazemi is the Senior Advisor to the CAIA Association's Program. Dr. Kazemi has been involved with the CAIA Association since its inception as a senior advisor and a managing director. In his current role, he helps with the development of the CAIA program's curriculum and directs the CAIA Association's academic partnership program. In addition, he serves as the editor of *Alternative Investment Analyst Review*, which is published by the Association. He has worked with universities and industry organizations to introduce them to the CAIA program. Dr. Kazemi is Michael and Cheryl Philipp Distinguished Professor of Finance at the Isenberg School of Management, the University of Massachusetts - Amherst. He is the Director of the Center for International Securities & Derivatives Markets, a nonprofit organization devoted to research in the area of alternative investments, a co-founder of the CAIA Association, and home to CISDM Hedge Fund/CTA Database and the *Journal of Alternative Investments*, the official research publication of the CAIA Association. He has over 25 years of experience in the financial industry and has served as consultant to major financial institutions. His research has been in the areas of valuations of equity and fixed income securities, asset allocation for traditional and alternative asset classes, and evaluation and replication of active management investment products. He has a Ph.D. in finance from the University of Michigan.

Kathryn Wilkens, *Ph.D., CAIA*
Pearl Quest LLC

Kathryn Wilkens is the president and founder of Pearl Quest LLC, a consulting company currently focused on tracking and replication products, and educational services in the alternative investments space. She is also an RIA with S Capital Wealth Advisors and assistant editor for the *Journal of Alternative Investments*.

About CAIA

Founded in 2002, the CAIA Association is the world leader and authority in alternative investment education. The CAIA Association is best known for the CAIA Charter (www.caia.org), an internationally-recognized credential granted upon successful completion of a rigorous two-level exam series, combined with relevant work experience. Earning the CAIA Charter is the gateway to becoming a Member of the CAIA Association, a global network of more than 9,000 alternative investment leaders located in 90+ countries who have demonstrated a deep and thorough understanding of alternative investing. The CAIA Association now supports 30 vibrant chapters located in financial centers around the world and sponsors more than 150 educational and networking events each year.

The List:
Alternative Indices

The performance table below is a collection of both traditional and alternative indices for the 1, 5, and 10-year period annualized through March 2018. Both the annualized volatility and draw-down figures are calculated using a 10 year quarterly return series.

Alternative investments have been growing markedly over the past few years, creating a multitude of opportunities for owners and allocators alike. As the number and type of alternative asset classes continue to proliferate, we believe they are playing a more unique role in assisting investors achieve their desired investment outcomes. As we expect this trend to continue, we found it necessary to structure a pure alternative assets portfolio to have visibility in this exciting marketplace.

We set out to strike a balance between available assets in proportion to their market value, and to reflect the average "alternative investor". We defined the investment opportunity to simply be the following three assets classes: Real Asset, Private Equity/Venture Capital, and Hedge Funds. Real assets are comprised of real estate, commodities, timberland, farmland, infrastructure, bank loans, and cat bonds; within real asset the weights were structured to reflect the market portfolio[1] within that universe. To arrive at our weight's, we researched various endowments and foundations, as well as surveys conducted by Willis Towers Watson and Russell Investments. Based on our research, alternative historical allocations have not had material deviation and therefore we decided to implement a market weight of 1/3 across each of those asset classes. A few of the constituents are not investable, and some may be reported gross or net of fee.

	Ending March 2018				
	1 Yr	5 Yr	10 Yr	Ann. Vol	Draw-down
MSCI World Free	14.20%	10.32%	6.51%	17.40%	-42.19%
Barclays Global Agg	8.14%	1.20%	2.03%	7.30%	-10.20%
MSCI Emerging Markets	25.37%	5.37%	3.36%	23.56%	-47.44%
Barclays Global High Yield	6.65%	5.31%	8.27%	12.93%	-26.20%
HFRI Fund Weighted Composite	5.87%	4.18%	3.58%	7.39%	-17.91%
CISDM EW Hedge Fund	6.34%	5.18%	4.69%	7.99%	-17.95%
CISDM CTA EW	2.71%	4.07%	4.16%	7.07%	-7.93%
CISDM Distressed Securities	3.45%	4.39%	5.37%	7.54%	-17.97%
CISDM Equity Long/Short	6.16%	5.98%	5.22%	7.04%	-11.90%
CA US Private Equity	16.51%	13.23%	10.37%	8.58%	-24.12%
CA US Venture Capital	12.00%	14.88%	9.49%	8.16%	-17.07%
LPX Mezzanine Listed Private Eqty	-17.59%	3.61%	1.52%	33.27%	-74.41%
FTSE NAREIT All Equity REITs	-1.09%	6.66%	6.88%	24.90%	-58.31%
NCREIF Property	7.13%	10.00%	4.72%	5.75%	-23.88%
S&P Global Property	8.05%	5.42%	6.09%	22.42%	-55.70%
S&P Global Infrastructure	5.15%	6.88%	3.74%	17.28%	-44.03%
Bloomberg Commodities	3.71%	-8.32%	-7.71%	20.10%	-65.91%
NCREIF Timberland	3.79%	6.09%	4.06%	3.60%	-5.69%
NCREIF Farmland	7.07%	10.43%	12.10%	4.82%	0.00%
Alternative Assets Portfolio	**8.09%**	**8.91%**	**6.71%**	**6.89%**	**-21.34%**
Global 60/40	**11.80%**	**6.73%**	**5.13%**	**11.15%**	**-28.10%**
60% Portfolio/40% Global 60/40	**10.31%**	**7.62%**	**5.81%**	**9.08%**	**-25.14%**

Source: CAIA, CISDM, HFRI, Cambridge Associates and Bloomberg.

1. Global Invested Capital Market by Hewitt EnnisKnupp, an Aon Company

Submission Guidelines

Article Submission: To submit your article for consideration to be published, please send the file to AIAR@caia.org.

File Format: Word Documents are preferred, with any images embedded as objects into the document prior to submission.

Abstract: On the page following the title page, please provide a brief summary or abstract of the article.

Exhibits: Please put tables and graphs on separate individual pages at the end of the paper. Do not integrate them with the text; do not call them Table 1 and Figure 1. Please refer to any tabular or graphical materials as Exhibits, and number them using Arabic numerals, consecutively in order of appearance in the text. We reserve the right to return to an author for reformatting any paper accepted for publication that does not conform to this style.

Exhibit Presentation: Please organize and present tables consistently throughout a paper, because we will print them the way they are presented to us. Exhibits may be created in color or black and white. Please make sure that all categories in an exhibit can be distinguished from each other. Align numbers correctly by decimal points; use the same number of decimal points for the same sorts of numbers; center headings, columns, and numbers correctly; use the exact same language in successive appearances; identify any bold-faced or italicized entries in exhibits; and provide any source notes necessary. Please be consistent with fonts, capitalization, and abbreviations in graphs throughout the paper, and label all axes and lines in graphs clearly and consistently. Please supply Excel files for all of the exhibits.

Equations: Please display equations on separate lines. They should be aligned with the paragraph indents, but not followed by any punctuation. Number equations consecutively throughout the paper, using Arabic numerals at the right-hand margin. Clarify, in handwriting, any operation signs or Greek letters, or any notation that may be unclear. Leave space around operation signs like plus and minus everywhere. We reserve the right to return for resubmitting any accepted article that prepares equations in any other way. Please provide mathematical equations in an editable format (e.g., Microsoft Word, using either Equation Editor or MathType).

Reference Citations: In the text, please refer to authors and works as: Smith (2000). Use parenthesis for the year, not brackets. The same is true for references within parentheses, such as: (see also Smith, 2000).

Endnotes: Please use endnotes, rather than footnotes. Endnotes should only contain material that is not essential to the understanding of an article. If it is essential, it belongs in the text. Bylines will be derived from biographical information, which must be indicated in a separate section; they will not appear as footnotes. Authors' bio information appearing in the article will be limited to titles, current affiliations, and locations. Do not include full reference details in endnotes; these belong in a separate references list; see next page. We will delete non-essential endnotes in the interest of minimizing distraction and enhancing clarity. We also reserve the right to return to an author any article accepted for publication that includes endnotes with embedded reference detail and no separate references list in exchange for preparation of a paper with the appropriate endnotes and a separate references list.

Submission Guidelines

References List: Please list only those articles cited, using a separate alphabetical references list at the end of the paper. We reserve the right to return any accepted article for preparation of a references list according to this style.

Copyright Agreement: CAIA Association's copyright agreement form giving us non-exclusive rights to publish the material in all media must be signed prior to publication. Only one author's signature is necessary.

Author Guidelines: The CAIA Association places strong emphasis on the literary quality of our article selections.

Please follow our guidelines in the interests of acceptability and uniformity, and to accelerate both the review and editorial process for publication. The review process normally takes 8-12 weeks. We will return to the author for revision any article, including an accepted article, that deviates in large part from these style instructions. Meanwhile, the editors reserve the right to make further changes for clarity and consistency.

All submitted manuscripts must be original work that has not been submitted for inclusion in another form such as a journal, magazine, website, or book chapter. Authors are restricted from submitting their manuscripts elsewhere until an editorial decision on their work has been made by the CAIA Association's AIAR Editors.

Copyright: At least one author of each article must sign the CAIA Association's copyright agreement form—giving us non-exclusive rights to publish the material in all media—prior to publication.

Upon acceptance of the article, no further changes are allowed, except with the permission of the editor. If the article has already been accepted by our production department, you must wait until you receive the formatted article PDF, at which time you can communicate via e-mail with marked changes.

About the CAIA Association

Founded in 2002, the Chartered Alternative Investment Analyst (CAIA) Association® is the international leader in alternative investment education and provider of the CAIA designation, the alternative industry benchmark. The Association grants the CAIA charter to industry practitioners upon the successful completion of a rigorous two-level qualifying exam. Additionally, it furthers the Association's educational mandate through the dissemination of research, webinars, and videos. CAIA supports three publications for members: AllAboutAlpha.com, The Journal of Alternative Investments, and the Alternative Investment Analyst Review. CAIA members connect globally via networking and educational events, as well as social media.

CAIA.org   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