Alternative Investment Analyst Review

Call for Articles

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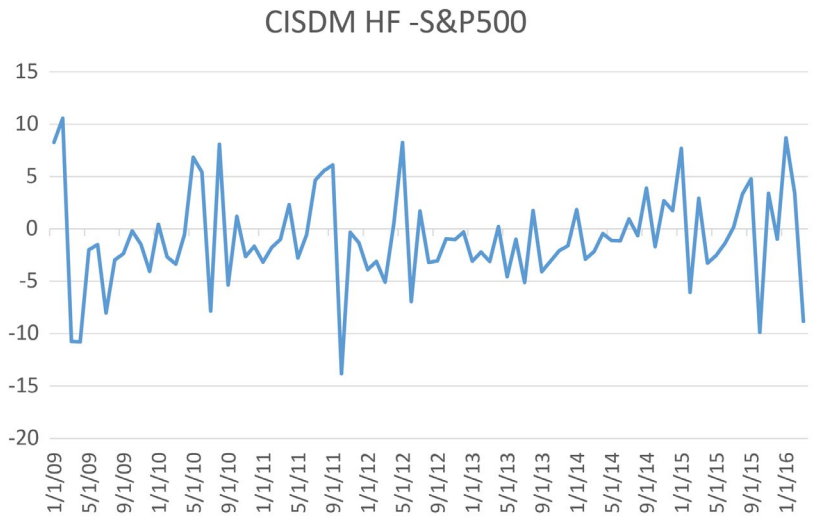
Editor's Letter

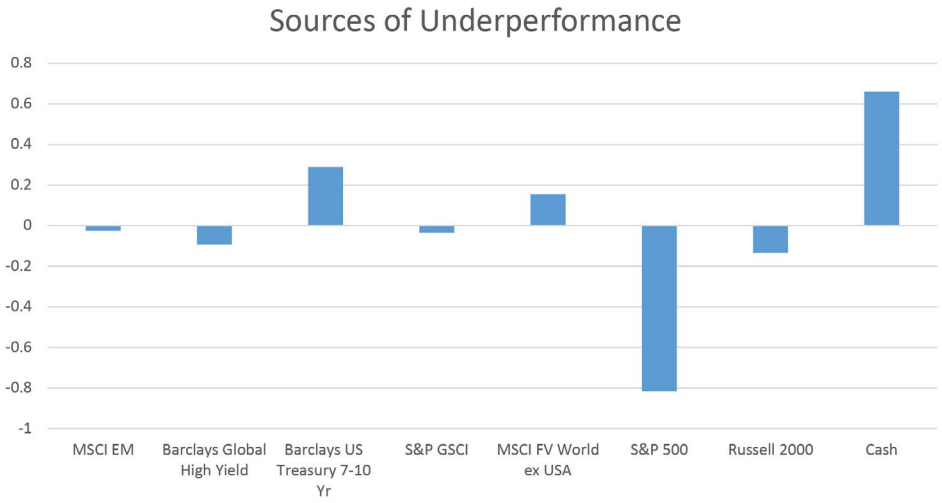
Why Have Hedge Funds Underperformed?

It is widely reported that hedge funds have performed poorly in recent months. The typical report focuses on broad indices of hedge funds such as CISDM or HFR hedge fund indices and uses the S&P 500 index as the benchmark. The following exhibit displays the performance of the CISDM Equally Weighted Index of all hedge funds that report to the CISDM/Morningstar database relative to that of S&P500 index.



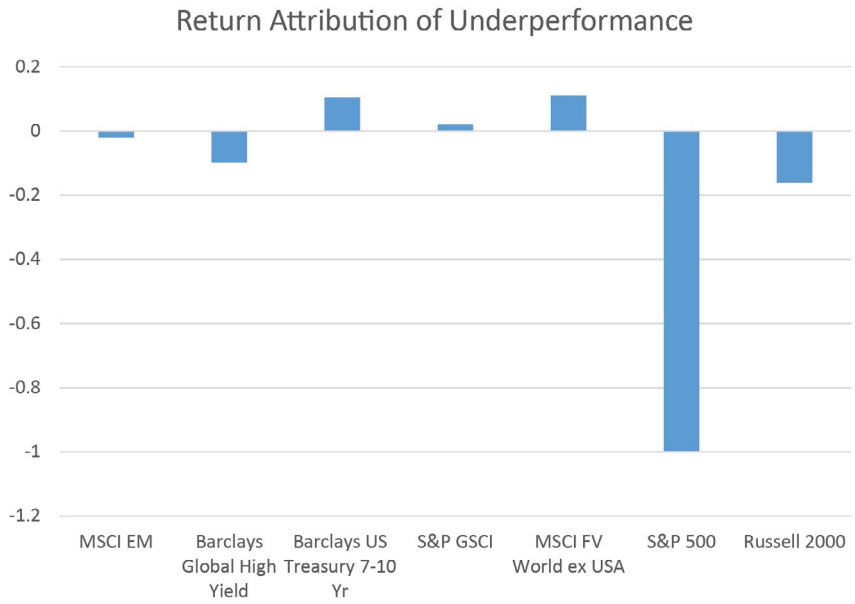
The CISDM index has underperformed the S&P500 index by an average amount of 0.87% per month since January 2009, the end of the financial crisis. During the same period, the monthly standard deviation of the CISDM Index return is about 53% of the monthly standard deviation of S&P500 Index's return. It is reassuring that the underperformance of hedge funds has come with lower risk. However, the degree of underperformance has been too much for some investors, as some institutional investors have recently announced that they are reducing their allocations to hedge funds. The question is why have hedge funds underperformed so badly since 2009?

First, we need to question whether the S&P500 is the correct benchmark for hedge funds. If the universe of assets that hedge funds invest in is different from the S&P 500 index, then it should not be surprising that hedge funds have performed differently than the S&P 500 index. Further, ignoring the fees, it follows that hedge funds have underperformed the S&P500 index because those parts of the investment universe not covered by the index have underperformed. Second, we need to find out about the degree to which hedge funds are invested outside the S&P 500 universe and the implications of these investments for their underperformance. To answer these questions, we use a 7-factor model. I regressed the underperformance against these seven factors to learn about the potential sources of underperformance. The following exhibit displays the result.



The R-squared of the regression is 78%, indicating that the above factors can explain 78% of the total variation in the underperformance of hedge funds. We can see that the most important contributing factor is that fact that hedge funds had low exposure to S&P 500 index, where hedge funds were 80% under-invested. Noting that the CISDM index covers most hedge fund strategies, with many of them operating in fixed income, real assets and currency markets, it is not surprising the CISDM index was not fully invested in S&P500 index. With hindsight, not being fully invested from January 2009 through March 2016 was a bad idea. On the other hand, being exposed to US Treasuries during this period was a good idea as they performed well (up 0.36% per month). However, next to under exposure to the S&P 500 index, the most important contributing factor to underperformance was the large cash positions held by hedge funds. Clearly, hedge funds remained cautious after the financial crisis.

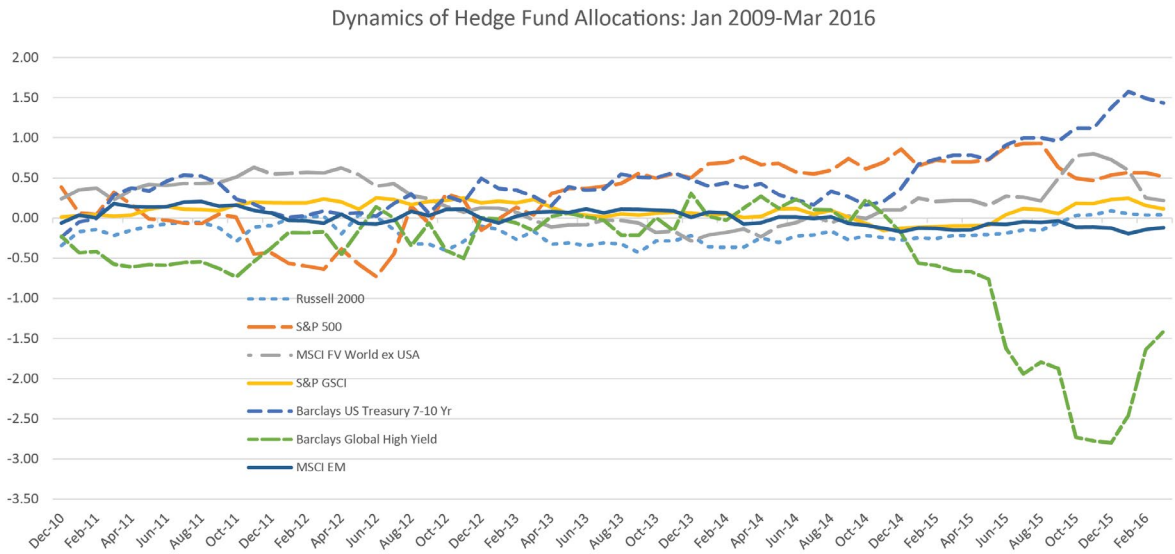
The following exhibit displays the costs and benefits of the long/short positions that are displayed in the above chart.



For example, the under exposure to S&P 500 index cost almost 1% per month in performance. The short position in commodities (S&P GSCI) contributed modestly to the performance (0.2% per month) as commodities declined during this period.

Since the R-squared of the above regression is not 100%, it means there are other sources of returns not captured by the regression. These sources made a positive contribution of 0.17% per month. If we assume that our seven factors cover all sources of systematic risks in the economy, then we may call the 0.17% monthly return alpha.

Next, it is useful to see whether hedge funds changed their asset allocations through the period considered in this note. The following chart displays the dynamics of hedge fund allocations:



We can see that right after the financial crisis and until mid-2012, hedge funds had zero to negative exposures to S&P 500 index. Then, from 2012 until recently, hedge funds increased their exposures to S&P 500 index. For instance, they were fully invested by August 2015. Further, since then hedge funds have substantially reduced their exposures to equities and high yield bonds while increasing their exposures to Treasuries. In other words, hedge funds were too slow to react to the bull market that started in 2009 and have been cautious since August 2015.

Do these results show that investors are correct in reducing their hedge fund allocations? The answer is, it depends. First, the S&P 500 is the wrong benchmark for hedge funds, even for equity-oriented strategies. Therefore, if an investor is determined to use the S&P500 index as a benchmark, it should have little or no allocation to hedge funds and only to equity-oriented hedge fund strategies. Second, the results reported above are for an index of hedge funds. Results not reported here is that the top quartile of hedge funds outperformed the S&P 500 index during this period. Therefore, if an investor has access to managers with a strong track record and the skills to select top quartile managers going forward, then it will be wise to allocate to hedge funds. Of course, this may mean that very large allocations to hedge funds will lead to diminishing returns since in some strategies the top quartile consists of a small group of managers.

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Editor

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An Introduction to Green Bonds

Impact Investing Committee
NEPC

Introduction

The nascent market for green bonds saw a growth spurt in 2014 with issuance tripling from a year earlier, surpassing $38 billion.[1] The growth in green bonds comes amid greater awareness of climate change and expanding investor appetite for environmentally-aware investment products. The prevalence of these securities is likely to rise as they allow issuers and investors alike to demonstrate their commitment to environmentally focused initiatives.

Bonds labeled 'green' signify that proceeds raised from the issuance will be tagged for projects intended to benefit the environment—for instance, the funds could be used for renewable energy or energy-efficient endeavors—with the issuer agreeing to report on the use of proceeds. This is the main factor distinguishing green bonds from the rest of the fixed-income market; they are otherwise identical to their non-green brethren. To be sure, it is important to note that green bonds only developed in the last decade and occupy a tiny sliver—less than 1%—of the global fixed-income market. Additionally, the process for labelling a bond as green is largely unregulated. Issuers have full discretion to self-label and there is no process for formal approval or standardized reporting. That said, the surge in issuance in 2014 and increased investor appetite point to continued growth in this segment.

> Green bonds possess a label signifying that proceeds raised by the bond issue will be ear-marked or ring-fenced to fund projects intended to benefit the environment with issuers agreeing to report on the use of proceeds. These terms are noted within the bond's issuing documents. This is the key factor differentiating green bonds from the rest of the fixed-income market; they are otherwise identically structured to their non-green counterparts.

In line with NEPC's commitment to keep abreast of developments and trends in the investment landscape and educate investors, this paper provides an overview of green bonds and details important considerations for investors. We believe this area of the market, like any other, should be analyzed on its merit. To this end, NEPC's dedicated Impact Investing Committee, comprising a cross-discipline team of members from research and consulting, will continue to monitor the market and vet investment opportunities for clients as they arise.

The Evolution of Green Bonds

In many ways a green bond is no different than the standard debt issued by a corporation, government or supranational entity – it is a coupon-paying instrument bearing a promise by the issuer to repay interest and principal at maturity. The key difference is that the proceeds of a green bond are intended to fund initiatives that benefit the environment. The first green bond was issued by the European Investment Bank (EIB) in 2007, followed in 2008 by the World Bank. The goal of these pioneering banks was to create a high-quality fixed-income security to finance projects aimed at mitigating climate change. The end product was a standard bond with a simple label alerting investors to the 'green' nature of the security.

After the bond offerings' initial success, the EIB and the World Bank continued to mobilize this source of funding and have issued several additional green bonds. Other entities followed suit and the green bond universe gradually grew. The first six years drew only a few billion dollars of new issuance per annum, but in 2013 the market reached a tipping point. Since then, there has been an exponential increase in supply (Exhibit 1).

The growing universe of green bonds has also allowed for differentiation among issues (Exhibit 2). For example, although corporate green bonds only entered the market at the end of 2013, these bonds comprised about a third of total issuance of green bonds in 2014. Green-labeled asset-backed securities and US municipal debt also saw an uptick last year. While the majority of issues are still denominated in US dollars and euros, issuers from a number of other countries, including China and India, have begun to enter the market. As such, better diversification across geography and currency is expected. Projections for 2015 issuance vary widely, ranging from $30 billion to $100 billion, but actual issuance has been slow so far this year. Approximately $30 billion in new green bonds have been introduced to the market in 2015 through September, according to Bloomberg. Yet, if pacing follows current trends, we should see an uptick in issuance as the year progresses.

Borrower Incentives

Given the similarity in structure and terms of green and non-green bonds, investors often wonder what the incentives are for issuers to self-label their debt offerings as green. For some issuers, raising funds through a green bond offering presents an opportunity to attract new investors, as these securities may be especially appealing to investors focused on environmental, social and governance (ESG) factors. Likewise, issuing a green bond presents a powerful marketing opportunity to demonstrate an organization's commitment to sustainability. Tax incentives and subsidies may also be available for state and local government issuers within the United States through federal programs, such as those granting Qualified Energy Conservation Bond (QECB)[2] and Clean Renewable Energy Bond (CREB)[3] status. Corporations may also be eligible for federal tax credits and other incentives by taking steps to make their business operations more energy efficient — projects that may be funded by issuing green bonds. Additional incentives may be available based on programs offered in the country of origin.

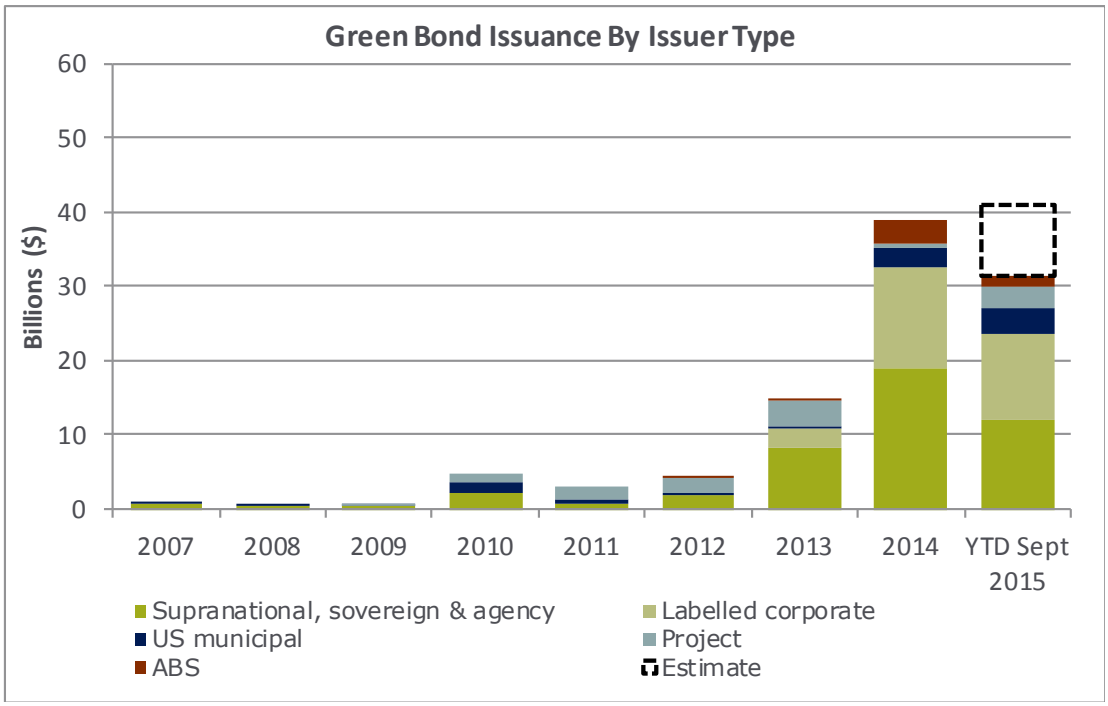

Exhibit 1: Issuance of Green Bonds from 2007-2015
Source: Bloomberg New Energy Finance (2015).

Corporate: Issued by corporations; repayments are from general corporate funds. Have the same credit rating as other bonds of similar composition from the same issuer. Bank of America became the first corporate issuer in 2013; other issuers include Iberdrola, TD, Unilever and Rikshem.
Green ABS: Asset-backed securities with cash flows supplied by a portfolio of underlying receivables (loans, leases and Power Purchase Agreements (PPA) that are associated with green projects). Issuers include Toyota, SolarCity and Fannie Mae.
Government: Issued by national, regional or local governments/ municipalities to finance green projects. Have the same rating as other debt issued by the entity. Green municipal bonds may have tax advantages for investors. Issuers include the State of Massachusetts and the County of Stockholm.
Project Bonds: Backed by the cash flows of an underlying renewable energy project or portfolio of projects. A remote account—separate from the issuer's general funds—is created such that the project's credit rating is distinct from that of the issuing entity. Repayment is based on cash generated by the venture; these bonds are implicitly more risky as repayment hinges on the success of the project. Issuers include Berkshire Hathaway Energy (Topaz) and Continental Wind.
Supranational/International: Bonds issued by supranational or international organizations, including multilateral banks, development banks and export credit agencies. This is the most common type of green bond and typically has high credit ratings. Issuers include the World Bank and the African Development Bank.

Exhibit 2: Issuance of Green Bonds from 2007-2015
Source: Bloomberg

Labelling, Regulation and Transparency

Currently, the process of labelling a bond as green is largely unregulated. Issuers have the discretion to self-label and there is no formal approval or vetting process. Issuers claiming green bond status must include a brief declaration statement within their offering documents indicating that the proceeds raised will be allocated to green projects. There is an expectation that issuers will also provide reports in the future, detailing the actual use of proceeds. However, there is no requirement to provide standardized reporting, so actual reporting may vary greatly from issuer to issuer. While green bonds are subject to the same oversight from the Securities and Exchange Commission (SEC) and the Financial Industry Regulatory Authority (FINRA) as their non-green counterparts, there is no regulatory body ensuring that the funds raised through the issuance of green bonds are actually benefiting green initiatives.

Regulations prohibiting companies with otherwise poor environmental practices from issuing green bonds are also non-existent. For these reasons, greenwashing—a term used to describe the act of a bond issuer self-labelling an issue as green for marketing purposes without having a true commitment to the environment or intention to use the proceeds as indicated—is a buzzword among investors in the space. To be sure, this is a potential problem since there are no official requirements for green labelling. That said, reputational risk may be enough to prevent pervasive greenwashing.

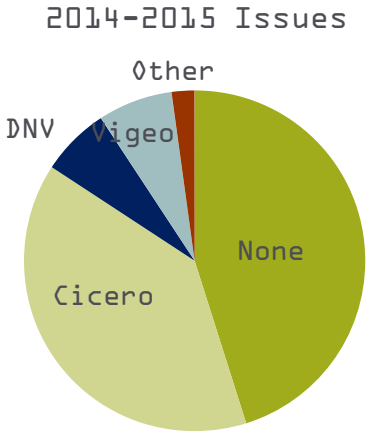

Exhibit 3: Issuance of Green Bonds from 2007-2015
Source: Bloomberg

This lack of regulation has led to the development of a handful of organizations providing independent opinions on green-labelled issues. These reviews are funded by the issuer and are not yet required. The reviews are typically based on an evaluation of the projects to be financed by a specific green bond; they also may incorporate a review of the governance, transparency and other practices of the issuer. A summary of the findings is typically included in the offering documents for investor reference. The Center for International Climate and Environmental Research – Oslo (CICERO), Vigeo Rating and DNV GL are the main firms offering these services. While not required, there is a preference among investors for issuers to seek a second opinion prior to marketing new green issues. However, some issuers opt against hiring an independent reviewer because second opinions are costly and the supply of green bonds is still limited. In fact, only about half of the green bonds issued in 2014 and in the first six months of 2015 touted this additional verification; however, many offerings still have been oversubscribed (Exhibit 3). Pressure from investors is likely necessary for an independent appraisal to become standard practice.

In an attempt to foster further transparency within the green bond market, the International Capital Markets Association (ICMA) collaborated with a group of investors, issuers and underwriters to form an Executive Committee, which serves as an unofficial governing body in the space. The group developed and published the Green Bond Principles ("Principles") in 2014, a document providing voluntary process guidelines for green bond issuers. It includes sections addressing the proper use of bond proceeds, project evaluation and selection, management of proceeds, and reporting. While still in its infancy, investors are beginning to expect issuers adhere to the Principles. In 2015, a second group of investors, led by Ceres's Investor Network

Commonwealth of Massachusetts Series E 2014 General Obligations Green Bonds

Issue Date: 9/24/2014

Issue Amount: $350 million

Coupon: Varies (2.0-5.0)

Credit Quality: Aa1/AA+

Maturity Date: Varies (last bond matures on 9/1/2031

Second-Party Opinion: No

Use of Proceeds: Will benefit a number of projects, including:

- Improving drinking water quality
- Energy efficiency and conservation in state buildings
- Land acquisition, open space protection and environmental remediation
- River revilization, preservation and habitat restoration
- Marine commerce terminal to support offshore wind projects

Exhibit 4: Example of a Green Bond
Source: The Commonwealth of Massachusetts Investor Program

on Climate Risk (INCR), released A Statement of Investor Expectations for the Green Bond Market. (Ceres is a non-profit organization advocating for sustainability leadership.) This document supports the Principles but provides additional structure around key elements, including project eligibility, issuer disclosures, reporting and independent assurance. INCR urges issuers to observe the Principles and the Statement of Investor Expectations to facilitate standardization and credibility within the market.

Investing in Green Bonds

Since green bonds and standard debt issues are nearly identical in structure, investors should still conduct a fundamental analysis of the issuer and relative value analysis to evaluate these securities; investors may also perform further ESG analysis. Green bonds structured as general obligations will tend to trade at similar levels and with comparable liquidity to non-green bonds, all else equal. Typical buyers of green bonds tend to be buy-and-hold investors due, in part, to the limited availability of these securities. This investor attribute is attractive to issuers, giving them an additional incentive to issue green bonds. On an issue-by-issue basis there is anecdotal evidence of a "green premium" priced into some green bonds. However, since the investor base is still dwarfed by those not specifically targeting these bond types, there is little proof of this premium embedded in the overall market for green bonds.

Investors interested in green bonds can purchase securities directly or achieve exposure through a handful of investment funds dedicated to green bonds. That said, potential investors should be aware of certain factors when evaluating these strategies, for instance, the emergence of green bonds is a relatively recent occurrence. Therefore, dedicated strategies tend to have short track records and limited assets. Also, the universe of green bonds is still limited in scope. In addition, less than 50% of issues are denominated in US dollars, further reducing the opportunity set for many strategies. Some funds navigate this issue by utilizing broader mandates such as investing in US Treasuries or by investing in bonds that are not officially labelled green but benefit green initiatives. For example, many municipal bonds may qualify as green bonds based on their intended use of proceeds, for instance, those supporting access to public transportation or water conservation, but are not labeled as such. While common among municipals, this is true across the spectrum of fixed-income securities. In fact, the Climate Bond Initiative's 2015 Bond and Climate Change report estimated the value of the outstanding total climate bond universe at nearly $600 billion, of which labelled green bonds comprised only about 11%. Exhibit 4 outlines an example of a green bond from Massachusetts.

Some larger, more mainstream investment managers may also hold green bonds in their portfolios. However, many of these managers are not investing in green issues because of their environmental bent. Rather, such investors tend to lump green bonds with other non-green options and analyze them based on their assessment of value. Since green bonds represent less than 1% of the total fixed-income market, it is unlikely that a non-green focused strategy would hold a sizeable allocation to green bonds.

The recent surge in issuance and increased investor appetite has led to the launch of several green bond indices, for instance, Solactive, S&P Dow Jones, Bank of America Merrill Lynch and Barclays (in partnership with MSCI) released new green bond indices in 2014. The indices vary in composition and may capture different segments of the market. It should be noted that while the indices are meant to provide a snapshot of the green bond space, some smaller issues may be excluded as they do not meet the inclusion criteria (minimum issue size for major index inclusion is typically $250 million). Despite the emergence of these new indices, few corresponding index funds have been launched.[4]

Alternatives to Labelled Green Bonds

While labelled green bonds expressly support projects that benefit the environment, climate-conscious investors should be aware that these instruments are only one of many available options. In fact, a number of strategies invest assets based on environmental, social and governance (ESG) considerations. Such managers invest in equity and debt of companies or other entities highly rated for their ESG practices. In addition to factors affecting climate change, these managers may include other criteria, for instance, an issuer's hiring practices, working conditions and board membership. This process may also be helpful in screening out 'greenwashed' investments. Many investors find this approach attractive as it incorporates a broader subset of issues into the investable universe.

Looking Forward

The growth in green bonds comes amid greater awareness of climate change and expanding investor appetite for environmentally-aware investment products. The prevalence of these securities is likely to rise as they allow issuers and investors alike to demonstrate their commitment to environmentally responsible initiatives. The growing need for energy efficient and clean technologies globally, especially in emerging market countries, also may help drive issuance going forward. These securities, which form a subset of the fixed-income market, present issuers with the opportunity to widen their investor base as they also appeal to ESG investors. As green bonds become more diversified across credit quality, geography and instrument type, they will likely integrate more readily with mainstream investment products.

However, as this segment grows—it currently makes up less than 1% of the global fixed-income market—widespread acceptance of the Principles and the Statement of Investor Expectations will be essential to facilitate standardization and credibility within the market in the absence of an official regulatory body and/ or independent scrutiny from third-party organizations. We will continue to monitor this growing market and vet investment opportunities for clients as they arise. Please contact NEPC if you have any questions or want to know more about impact investing.

Endnotes

1. Issuance estimates may vary by source. For the purposes of this paper, data published by Bloomberg New Energy Finance was utilized.
2. QCEBs are taxable bonds that allow qualified state, tribal and local government issuers to borrow at lower rates to fund energy conservation projects. The issuer's borrowing costs are subsidized by the US Department of the Treasury.
3. CREBs may be issued by qualifying entities to finance renewable energy projects. Investors possessing CREBs receive federal tax credits in lieu of a portion of the traditional bond interest, lowering the effective interest rate for the borrower.
4. The first green bond index fund was launched in 2015 by SSgA.

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- All Investments carry some level of risk. Diversification and other asset allocation techniques do not ensure profit or protect against losses.
- The opinions presented herein represent the good faith views of NEPC as of the date of this report and are subject to change at any time.
- All investment programs have unique characteristics and each investor should consider their own situation to determine if the strategies discussed in this paper are suitable.
- This report contains summary information regarding the investment management approaches described herein but is not a complete description of the investment objectives, portfolio management and research that supports these approaches.

Author's Bio

NEPC's Impact Investing Committee

NEPC's Impact Investing Committee provides strategic oversight and thought leadership of the firm's Impact Investing efforts. The Committee includes a cross section of both research and consulting professionals which works together to help shape policy, produce ongoing research reports, educate clients and propose impact oriented solutions for clients.

NEPC has been analyzing impact investing strategies for over 25 years, recognizing its strategic importance to institutional investors. Today, the firm has over 50 clients pursuing various impact investing strategies across the entire institutional spectrum. In addition to authoring numerous white papers, hosting industry events and speaking at conferences across the country, NEPC has also partnered with The White House on their Clean Energy Initiative, joined the United Nations Principles for Responsible Investment (PRI) and Mission Investors Exchange, and partnered with MSCI to create customized ESG reporting. Learn more about NEPC's impact investing insight and resources at www.nepc.com.

Inflation Hedging Abilities of Indirect Real Estate Investments in Switzerland

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Introduction

Real Estate investments have been discussed for a long time in both academic literature and practice. Intuitively, many people assume that real estate returns may have a high correlation with inflation (Fama and Schwert, 1977: 4; Anson, 2009: 78). They therefore expect real estate investments to provide inflation hedging abilities (Wohlwend and Goller, 2011; Marti, Meier, and Davidson, 2014: 12). Accordingly, most of the past research on real estate has focused on the diversification effects of real estate in portfolios of stocks and bonds and on the inflation hedging abilities of real estate.

There are different ways to invest in real estate (Garay and Ter Horst, 2009: 90): (1) Equity: One can invest in the equity part of real estate by buying real estate mutual funds, like US-American Real Estate Investment Trusts (REITs)[1], or by acquiring real estate physically. The first is considered as an indirect, public, securitized, or financial investment. The latter is said to be a direct, physical, or private investment. (2) Debt: It is also possible to invest in the debt part of real estate. This is normally done in a securitized form, for example, with mortgage-backed securities (MBS). This paper, however, only considers indirect investments in the equity part of real estate.[2]

There are only a limited number of publications considering the situation in Switzerland and this research, which considers Switzerland particularly, is often not very recent. This is problematic because inflation hedging abilities could change over time as it was shown by the study of Moigne and Viveiros (2008: 282). In addition, investigations have often focused on institutional rather than individual investors, thereby analyzing effects of direct real estate, which is often not suitable as an investment for a private person.

This paper examines inflation hedging abilities of Swiss indirect real estate investments. It only considers indirect investment solutions[3] that are

realizable for an individual investor and therefore offers important insights on how real estate protects private investors against inflation. As a proxy for indirect investment solutions, we use the indices of real estate mutual funds.

In this paper, we provide a new evaluation of the research question for Switzerland. As shown in the study of Moigne and Viveiros (2008: 282), the relationship between real estate returns and inflation can change over time. Their paper shows that in Canada, this change was due to the decrease in interest rates. In Switzerland, there was a structural interruption in the real estate market in the early 1990's, when a real estate bubble burst (Alvarez, 2013: 6). Therefore, it makes sense to conduct new research on the situation in Switzerland using more recent financial market data.

The paper is organized as follows: After the introduction we present the previous research on this topic. Afterwards follows a discussion of the applied research methodology and the data used. In the subsequent part, the results of the paper are presented. This is followed by a discussion of the findings and a conclusion.

Literature Review and Previous Research

This section summarizes the results of previous research regarding the inflation hedging abilities of real estate.

The inflation hedging abilities of real estate have interested researchers and practitioners since the 1970s. Although a strong relationship between inflation and real estate returns may sound intuitive to some people (Fama and Schwert, 1977: 4), there are some valid reasons to question this relationship. For instance, if a building were leased at a fixed rent, which does not adjust to inflation, the value of this building would decline if inflation increases (Goetzmann and Valaitis, 2006: 2). The two main reasons for an inflation hedge are that rental and lease payments are adjusted regularly to inflation and the capital shift from stock and bonds in times of inflation into real estate, which leads to price appreciations (Anson, 2009: 79). Graff and Cashden (1990) have therefore postulated a decomposition of real estate returns into income returns and capital appreciation returns. The basic idea is that capital appreciation returns provide a good inflation hedge, as opposed to income returns, where this hedge is questionable.

International Evidence

Two of the first researchers who examined the inflation hedging abilities of real estate were Fama and Schwert (1977). They found evidence that real estate provides a hedge against unexpected inflation. However, the coefficient for unexpected inflation was significantly lower than one, thus rejecting the hypothesis of a complete hedge against unexpected inflation (Fama and Schwert, 1977: 130). The estimate for expected inflation was not significantly different from one, which does not reject the proposition that all assets should be a hedge against expected inflation (Fama and Schwert, 1977: 127). The study was conducted using data ranging from 1953 to 1971. The results changed only slightly if the researchers used quarterly or semiannual instead of monthly data.

Miles and Mahoney (1997) used the Fama and Schwert framework in their research for the United States. They concluded that direct real estate is a complete hedge against expected inflation, but that it is only an incomplete hedge against unexpected inflation when using quarterly data. This study thus confirms the results of the research conducted by Fama and Schwert (1977).

Hartzell, Hekman, and Miles (1987: 626) also used the Fama and Schwert approach and found that direct real estate provides a hedge against expected inflation. However, they also found that direct real estate is a complete hedge against unexpected inflation. This result is therefore contradictory to the result of the Fama and Schwert study. That of Hartzell et al. (1987: 618) used quarterly holding period returns from over 300 properties.

Moigne and Viveiros (2008: 275) researched Canadian direct real estate investments and found that real estate acts as a complete hedge against expected inflation and even "overhedge" unexpected inflation ($\gamma = 2.04$). This is a huge discrepancy to the results for the US, where real estate seems to provide only an incomplete hedge against unexpected inflation. However, Moigne and Viveiros (2008: 282) found that the inflation hedging ability has disappeared since the mid-1980s when the Canadian inflation rate decreased significantly.

Research for Singapore has found no significant inflation hedge for indirect real estate investments but has found an inflation hedging ability for shop and industrial property (Sing and Low, 2000: 380).

All of the above-mentioned studies applied the approach developed by Fama and Schwert (1977). However, it should be noted that there is also some criticism to this approach. Hence, other authors have used different techniques to research the topic.

Chaudhry, Myer, and Webb (1999) used co-integration techniques for data of the United States. They concluded that, "… there is an underlying factor that links the financial-asset [sic] and real-assets markets, at least in the long run. When CPI is included in the three systems, the number of common factors increases to two, implying that inflation does play an important role in creating a linkage between these time series." (Chaudhry et al., 1999: 347). Furthermore, they found that all of the tested financial and real estate returns are non-stationary. Therefore, they argue that conventional statistical methods like the Fama and Schwert framework should not be applied (Chaudhry et al., 1999: 342).

In Hong Kong, evidence in favor of the inflation hedge was found with the method of Fama and Schwert, but not with a co-integration method (Ganesan and Chiang, 1998: 65). This indicates that there might be a short run relationship between inflation and real estate returns, but it also indicates that this relationship may not be stable in the long run. Therefore, the regression of the Fama and Schwert framework could be spurious (Ganesan and Chiang, 1998: 65).

Hardin, Jiang and Wu (2010) analyzed the development of equity REITs dividend yield relative to the expected inflation. Hardin et al. (2010) came to the conclusion that a certain inflation protection exists but is undermined due to the inflation illusion perceived by investors. The results additionally provide an alternative explanation as to why the yields on REITs often negatively correlated with expected inflation.

The study of Demary and Voigtlander (2009) focuses on the inflation protection of direct and indirect real estate investments.

REITs cannot protect investors from general inflation. As well as other stocks, they offer no effective protection from inflation, and analysis of yields and inflation rates show negative correlations. A rising price level thus adversely affects the actual returns on this investment. According to Demary and Voigtlander (2009), this is explained by the fact that investors adjust their expectations due to inflation and the resulting possible deterioration of the macroeconomic environment.

Demary and Voigtlander (2009) and Giljohann-Farkas and Pfleiderer (2008) found that for direct real estate investments a positive correlation between consumer price index and real estate index confirms better inflation protection.

The analysis of Simpson, Ramchander and Webb (2007) arrived at similar conclusions for REITs as inflation protection as did Demary and Voigtlander (2009). Simpson et al. (2007) concluded that there is an asymmetric development of yields from REITs and the inflation rate, while not explicitly postulating a negative correlation.

The studies of Adrangi, Chatrath and Raffiee (2004), Glascock, Lu and So (2002), Stevenson (2001) and Chan, Hendershott and Sanders (1990) conclude from the analyses of the yields of REITs that no effective protection against inflation can be explained. The investigation of an unexpected inflation component suggests, however, that a link between monetary policy and real estate prices does exist.

From this perspective Hoesli, Lizieri and MacGregor (2008) also consider the inflation protection properties of direct and indirect real estate investments, but they cannot explain a causal link between the development of the inflation rate and yields on REITs.

Maurer and Sebastian (2002), on the other hand, state that indirect real estate investments do provide inflation protection due to the excess returns, whereas the studies of both Maurer and Sebastian (2002) and Lu and So (2001) come to the result that the analysis of the development of yields on REITs and other underlying macroeconomic factors such as monetary developments are more revealing. Lu and So (2001) concluded further that the future of inflation could derive from the yields on REITs. This would confirm the delay effect, where the inflation expectation in the market prices of REITs is anticipated, and therefore, if investors are correct, inflation only occurs after a certain delay.

Although Chatrath and Liang (1998) determined no connection between REITs yields and inflation in the short term, however, a certain link could be detected in the long term.

Generally, real estate has its own risk and return profile. Nevertheless, the public stock and bond markets influence the performance of the real estate market (Anson, 2012: 59), especially indirect real estate investments (Garay and Stevenson, 2009: 242; Wohlwend and Goller, 2011; Marti, Meier, and Davidson, 2014: 17).

In summary, previous results cannot confirm a direct causal relationship between the inflation rate and the yield of indirect real estate investments. The studies of Hoesli et al. (1997) and Hamelink, Hoesli und MacGregor (1997) also join this core conclusion. In the long term, the total return (price change and distribution) of indirect real estate can compensate for a loss of purchasing power, but in the short term no hedge against inflation exists.

Evidence for Switzerland

There are only few papers that analyze the situation in Switzerland. Most of the research for Switzerland was conducted in the 1990s. One of the first papers was written by Anderson and Hoesli (1991), who found that Swiss stocks, bonds and real estate mutual funds protected investors from inflation in Switzerland in the period between 1978 and 1989. The research of Hamelink and Hoesli (1996: 47) for Switzerland was conducted with direct and indirect real estate investments using the Fama and Schwert approach. However, they did not find any inflation hedging abilities - neither for direct real estate investments nor for indirect investments.

Hoesli (1994) focused on real estate mutual funds in Switzerland. The paper analyzes the inflation hedging ability using monthly, quarterly, annual and five-year data. For all time intervals no significant inflation hedging ability was found. However, the β coefficient, in this study being the coefficient for total inflation, is 0.463 for five-year data and the t-statistic is 1.557. This indicates that real estate funds may provide an inflation hedge in the long run (Hoesli, 1994: 56).[4] All coefficients for expected and unexpected inflation are as well not significantly different from zero (Hoesli, 1994: 57).

Liu, Hartzell, and Hoesli (1997) conducted international research on real estate mutual funds. Although it is known that US Real Estate Mutual Funds (REITs) do not provide inflation hedging ability and indeed behave more like stocks than like real estate, Mengden and Hartzell (1986 in: Liu et al., 1997) argue that this might not be true for other countries. For example, Swiss real estate mutual funds are different from US-REITs in that the Swiss units can be redeemed at the intrinsic value (Hoesli, 1994: 52), whereas US-REITs have a closed form structure (Liu et al., 1997: 196). One would therefore expect Swiss real estate mutual funds to behave differently than US-REITs. However, the study does not find any inflation hedging ability in Switzerland (Liu et al., 1997: 208).

Wohlwend and Goller (2011) conducted a comprehensive study on the inflation hedging abilities of different asset classes. They found that, with a high probability, there is no relationship between real estate and inflation in Switzerland. None of the studied asset classes offer complete inflation protection in the long run (Wohlwend and Goller, 2013: 21).

To sum up, it can be stated that direct real estate was found to provide inflation hedging abilities in most countries around the world but not in Switzerland. Internationally, direct real estate seems to provide a good hedge against expected inflation and at least a partial hedge against unexpected inflation. This is not the case for Switzerland where real estate does not seem to provide any hedge against inflation. Indirect real estate investments seem not to provide protection against inflation, no matter whether the real estate funds have a closed form or an open form structure. Exhibit 1 pictures the stylized results of previous research on the inflation hedging abilities of real estate (see also Anson, 2009: 102).

	Direct investments	Indirect investments
International	Yes	No
Switzerland	No	Probably not (focus of the paper)

Exhibit 1: Inflation Hedging Abilities According to Previous Research
Source: Authors' Calculations

Research Methodology

In this section we discuss the Fama and Schwert approach to determine the inflation hedging abilities of real estate investments. Previous studies show that this approach has been frequently used by numerous other authors (e.g. Hamelink and Hoesli, 1996; Miles and Mahoney, 1997) and is still a widely accepted approach.[5]

The Fama and Schwert Approach

Fama and Schwert (1977) developed a common approach to determine inflation hedging abilities. In accordance with Fisher (1930) they argued that the expected nominal return of an asset is the sum of the expected real return of the asset and the expected inflation rate (see also Wohlwend and Goller, 2011). Therefore, expected inflation is priced in for all assets and a complete hedge against expected inflation should be provided. Hence, it is necessary to make a distinction between unexpected and expected inflation. Fama and Schwert (1977) therefore analyzed the inflation hedging abilities with a two-factor model. The asset return is the dependent variable and the expected and unexpected inflation are the independent variables.

$$R_{it} = \alpha_i + \beta_i(E(\pi_t)) + \gamma_i(\pi_t - E(\pi_t)) + \varepsilon_{it} \qquad (E1)$$

Where:
R_{it} is the return of asset i in period t
$E(\pi_t)$ is the expected inflation for period t
$\pi_t - E(\pi_t)$ is the unexpected inflation for period t
ε_{it} is an error term, residual effects that are not explained by the data

If $\beta = 1$, an asset is said to be a complete hedge against expected inflation. An asset is called a complete hedge against unexpected inflation if $\gamma = 1$. If $\beta = \gamma = 1$, then an asset is said to provide a complete hedge against inflation (Fama and Schwert, 1977: 117). One would expect all assets to be a complete hedge against expected inflation ($\beta = 1$) but only some assets to provide a complete, if any, hedge against unexpected inflation ($\gamma = 1$) (Fama and Schwert, 1977: 117).

Further Development of the Fama and Schwert Approach

However, the approach introduced by Fama and Schwert can also be criticized. The main difficulty of this approach is to distinguish between expected and unexpected inflation. Fama and Schwert solved this problem by using treasury bills as a proxy for expected inflation. The expected inflation equals the T-bill yield minus the real return (i.e. the real interest rate; Miles and Mahoney, 1997: 32). This made it necessary to assume constant real interest rates, because one can otherwise not assume that a change in the T-bill yield was due to a change in inflation expectations (see also Wohlwend and Goller, 2011). This assumption was true for the period that Fama and Schwert analyzed, but the assumption may not hold nowadays (Ganesan and Chiang, 1998: 58). In later papers, other methodologies have therefore been developed to find another measure for expected inflation.

For instance, Fama and Gibbons (1982) and Hartzell, Hekman, and Miles (1987) apply moving-average processes to estimate expected inflation. Hamelink and Hoesli (1996) researched the topic for Switzerland. They also used the model of Fama and Schwert, but they estimated expected inflation using four different ways.

1. First, they follow Gültekin (1983) by assuming that expectations are perfect. Hence, expected inflation equals the actual inflation and there is no unexpected inflation. This reduces the model of Fama and Schwert to a simple one-factor model in which actual inflation is the only independent variable (Hamelink and Hoesli, 1996: 36):

$$R_{it} = \alpha_i + \beta_i(\pi_t) + \varepsilon_{it} \qquad (E2)$$

Where:
R_{it} is the return of asset i in period t
π_t is the actual inflation for period t
ε_{it} is an error term, residual effects that are not explained by the data

2. The second approach used to proxy expected inflation by Hamelink and Hoesli (1996: 36) is a linear regression model, which specifies the expected inflation rate at time t as a linear function of the inflation rate at time t-1. This model is:

$$\pi_t = \alpha + \beta(\pi_{t-1}) + \varepsilon_t \qquad (E3)$$

Where:
π_t is the expected inflation for period t
π_{t-1} is the actual inflation for period t-1
ε_t is an error term, residual effects that are not explained by the data

3. The third method is a qualitative threshold autoregressive conditional heteroscedasticity (QTARCH) model, introduced by Gouriéroux and Monfort (1992). This model leads to a conditional mean and a conditional variance, which are endogenous stepwise functions (Hamelink and Hoesli, 1996: 36).

4. The fourth approach is based on an ARCH in mean (ARCH-M) model. In this model, developed by Engle, Lilien and Robins (1987), conditional expected inflation is a function of the conditional variance of the period before. This method is therefore different from the second and the third methods because the expected inflation is derived from the variance of the period before, and not the inflation rate of the period before (Hamelink and Hoesli, 1996: 37).

Methodology of the Current Paper

To keep it simple, for our analysis of the inflation hedging abilities of real estate we have also applied the approach proposed by Fama and Schwert (1977). We decomposed the actual inflation in an expected and an unexpected part with two different methods. (1) We assume for the decomposition that expectations are perfect, just as Gültekin (1983) did. This reduces the model of Fama and Schwert to the equation E2, which was presented above. (2) Furthermore, we apply in this paper the second method proposed by Hamelink and Hoesli (1996: 36). The decomposition is conducted by inferring the expected inflation at time t from the actual inflation at time t-1. This paper uses the formula that was presented above in equation E3.

Data

Biases in Real Estate Performance Data

Real estate is often considered as an illiquid asset class (Anson, 2012: 45; Marti, Meier, and Davidson, 2014: 12): On the one hand, the transaction size is high, but on the other hand, real estate objects are not publicly traded and trading is infrequent. The "semi strong" notion of market efficiency (all public information is included in the price) does not exist, because transactions are regularly private. Without public price information available, other assessment methods are necessary.

But appraisal based valuation methods tend to lead to an underestimation ("smoothing") of the volatility of real estate investments (Anson, 2009: 84; Marti, Meier, and Davidson, 2014: 12). This could also be a problem not only for the measurement of the inflation hedge ability, but in the level of index construction too where different biases can occur (Garay and Stevenson, 2009: 229). We often see a difference between the net asset value of the mutual fund and its stock market price for indirect real estate investments products (Garay and Stevenson, 2009: 237).[6]

Past financial market data are existent as time series and tend to affect current data. Hence, autocorrelation is a frequent problem in real estate time series. Autocorrelation leads to problems in the statistical analysis of the data. As a result, or to counter this, correction procedures need to be applied (Marti, Meier, and Davidson, 2014: 16).

We are aware of the difficulties of the performance measurement for real estate investments. Consequently, we assume for this study (1) that the investor can realize the performance of the investment fund and neglect any valuation issues within the fund (realistic). (2) Further, we assume no transaction costs for the investor (unrealistic). (3) In addition, we assume that the indices of the empirical analysis are investable for private investors (not always true).

Data sources and description

The research was conducted with quarterly data using the inflation rates and real estate fund returns during a 20-year time span from 1995q1 (SWIIT, RUEDIF) and 1997q1 (WUPIXF) until 2015q2.

The study uses log-changes in the consumer price index (CPI) of Switzerland as a proxy for inflation (data source: Swiss Federal Statistical Office). The CPI represents the price of a typical basket of goods consumed by a private person. Since the study focuses on individual investors, the CPI is a better proxy for inflation than, for example, the GDP-deflator (see also Wohlwend and Goller, 2011).

During the whole time period of the research interest rates and inflation rates in Switzerland were extremely low and fluctuated around zero. Switzerland and the Swiss Franc have acted as safe havens in recent years, especially since the start of the crisis in 2007. Therefore, the real estate markets have faced price appreciations due to huge capital inflows and the "search for yield".

In Switzerland, we can distinguish between four groups of real estate indices (Marti, Meier, and Davidson, 2014: 12): (1) stock market based real estate indices[7], (2) indices by independent real estate specialists, (3) real estate indices based on selling offers, and (4) indices based on transaction data. Indices of Group 1 are suitable for our purposes. These are constructed from the pricing of real estate stock corporations and real estate mutual funds.

As a proxy for the indirect real estate returns we used three stock market based real estate indices (group (1), see above): SWIIT: SXI Real Estate Funds Index, RUEDIF: DB RUEDBLASS IF Index, and WUPIXF: Wüest & Partner AG Index für Immobilienfonds (data source: SIX Group, Rüd Blass, Wüest & Partner).

As an example, the SXI Real Estate index (an umbrella structure) contains real estate funds and real estate companies; the SXI Real Estate Funds index (a sub structure) contains only real estate funds (Meier, 2011: 8). It can be assumed that real estate stocks behave more like stocks than like real estate due to their closed form structure. Hence, this study uses real estate fund indexes to track indirect real estate performance.

As performance data, we applied quarterly log-changes of total return (price changes and distributions) index values.

Results

In this section we discuss the findings of our research regarding the inflation hedging abilities.

The inflation hedging abilities of Swiss real estate mutual funds were tested using the approach of Fama and Schwert (1977). The decomposition of actual inflation in an expected and an unexpected part was done using two different methods. (1) Firstly, by assuming that expectations are perfect. (2) Secondly, by inferring the expected inflation at period t from the actual inflation at period t-1.

(1) Assumption that expectations are perfect

First, the calculation was carried out under the assumption that expectations are perfect using equation E2:

$$R_{it} = \alpha_i + \beta_i(\pi_t) + \varepsilon_{it} \qquad (E2)$$

This leads to the results on Exhibit 3.

The negative sign of the beta coefficient of all index returns for actual inflation would actually suggest that Swiss indirect real estate acts as a "reverse" hedge against inflation. However, the standard error of the regression is high in order to state that with certainty. All coefficients are not significant at standard levels. The values for R-squared are extremely low. This is an indicator of poor fit of our model.

Variable	Obs	Mean	Std. Dev.	Min	Max
CPI	83	94.81807	4.195792	86.7	100.7
SWIIT_ret	82	0.0146025	0.03309	-0.0783483	0.094881
RUEDIF_ret	82	0.0152531	0.0346421	-0.0846643	0.1014157
WUPIXF_ret	74	0.0139985	0.0323943	-0.0673932	0.0791508

SWIIT: SXI Real Estate Funds Index
universe: all at the SIX Swiss Exchange listed real estate funds, which invest ¾ of the real estate values in the Switzerland, currently 26 positions

RUEDIF: DB RUEDBLASS IF Index
universe: maximum 10 Swiss real estate funds

WUPIXF: Wüest & Partner AG Index für Immobilienfonds
universe: in Switzerland listed real estate funds, currently 24 positions

Exhibit 2: Summary Statistics Consumer Price index and Real Estate Indices
Source: Authors' Calculations

Variables E2	SWIIT_ret	RUEDIF_ret	WUPIXF_ret
INF	-0.806 (0.643)	-1.001 (0.670)	-0.929 (0.658)
Constant	0.0158*** (0.00377)	0.0168*** (0.00394)	0.0152*** (0.00384)
Observations	82	82	74
JB chi2 JB Prob > chi2	0.1791 0.9143	0.7923 0. 6729	1.289 0.5248
BP chi2 BP Prob > chi2	0.02 0.8904	0.23 0.6345	0.37 0.5415
R-squared	0.019	0.027	0.027

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
JB: Jarque-Bera test for normality (H0: normality). We cannot reject the hypothesis that our returns are normally distributed.
BP: Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (H0: constant variance). We cannot reject the hypothesis that our returns have a constant variance.

Exhibit 3: Regression Results E2
Source: Authors' Calculations

Variables E3	INF
INF_L1	-0.315*** (0.102)
Constant	0.00185*** (0.000602)
Observations	81
R-squared	0.108

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Exhibit 4: Regression Results E3
Source: Authors' Calculations

(2) Inferring expected inflation from past actual inflation rates

As a second approach, the expected inflation at time t is inferred from the actual inflation at time t-1. This is done by a regression analysis as presented in equation E3 following Hamelink and Hoesli (1996: 36).

$$\pi_t = \alpha + \beta(\pi_{t-1}) + \varepsilon_t \qquad (E3)$$

The regression leads to the outcome illustrated in Exhibit 4.

The lagged inflation INF_L1 and the constant are both highly significant and the R-squared of the regression is 0.108. The negativity of the beta coefficient for INF_L1 is somewhat surprising. This indicates that a higher inflation rate in the quarter t-1 is likely to lead to a lower inflation rate in quarter t. Hamelink and Hoesli (1996: 40) found a highly significant positive beta, but for yearly data. In addition, bimonthly data for the US seems to indicate that inflation normally has a positive autocorrelation (Bils, Klenow, and Malin, 2012: 2806). The negative coefficient found in our study may be due to the extraordinary economic environment after the financial crisis or due to seasonal effects.

In particular, the monetary policy of the Swiss national bank was very unusual as the national bank pegged the value of the Swiss franc at the Euro (from September 2011 to January 2015). It is also imaginable that autocorrelation of inflation behaves differently for yearly or bimonthly than for quarterly data.

Using the estimates for π_t from the above regression as expected inflation, it is now possible to compute the values for unexpected inflation (actual inflation minus expected inflation). After the values for expected and unexpected inflation were obtained, the regression as presented in equation E1 was conducted.

$$R_{it} = \alpha_i + \beta_i(E(\pi_t)) + \gamma_i(\pi_t - E(\pi_t)) + \varepsilon_{it} \qquad (E1)$$

This regression leads to the following results on Exhibit 5.

According to the theory of Fisher (1930) presented earlier in this paper, the beta coefficient for expected inflation should be one for all assets. The present results cannot reject this. In addition, the results of previous studies, that Swiss indirect real estate is not a hedge against expected inflation cannot be rejected. However, the sign is always positive, but the standard error of the coefficient is very large, which makes it hard to infer anything from the beta coefficient. We see no significant values as normal levels.

The gamma coefficient for unexpected inflation is always negative (a "reverse" hedge), but only significant at the $p < 0.1$ level for WUPIXF_ret. The hypothesis that Swiss real estate mutual funds are a hedge against unexpected inflation can be rejected. Most likely, Swiss indirect real estate does not provide a hedge against unexpected inflation as suggested by previous studies.

In conclusion, it can be stated that Swiss real estate mutual funds are not a hedge against inflation. It seems also to be very reasonable to state that they do not provide any inflation hedge at all.

Conclusion

Previous research suggested that no inflation hedging ability of indirect real estate exists in Switzerland. This suggestion could not be rejected by the research of the current paper, as all coefficients were not significantly different from zero. The relatively small sample size caused large standard errors of the regression. The current research could reject the hypotheses that Swiss indirect real estate is a complete hedge against total inflation and / or a complete hedge against unexpected inflation. Those results are also in line with the results of previous research conducted for Switzerland.

Several interesting questions in this research field remain still unanswered. Although it is now a widely accepted fact that Swiss real estate does, in contrast to foreign real estate, not provide inflation hedging abilities, nobody has yet been able to establish a theory why this is the case. A possible reason is the rigid tenancy law for private residential purposes in Switzerland, which leads to relatively fixed rents. In our study, we analyzed the hedging ability with quarterly data. We found in the literature some evidence for inflation hedging in the long run, which could be an indication for longer lag structures in the data. And finally, the special situation of Switzerland as a safe haven for investors in turbulent markets has led in the last few years to extremely low interest and inflation rates. And the "search for yield" has boosted the real estate prices in recent years. This could have affected our results.

Endnotes

1. Indirect real estate investments are structured as mutual funds in Switzerland. There's no special legal structure like American REITs.
2. Direct real estate is heterogeneous, indivisible, and illiquid (Garay and Stevenson 2009: 219). Indirect real estate investments are suitable and appropriate for individual investors due to asset diversification, divisibility, liquidity, and professional management of the investment product.
3. An advantage of indirect real estate investments (REITs, mutual funds) is the access to illiquid and indivisible assets for small investors. A disadvantage is the listing on a stock exchange (or an other public market). Real estate prices pick up some systematic risk of that market. It is a less pure play in real estate (Anson, 2009: 69).
4. Therefore, some studies deal with time-lag structures of the return and inflation data.

Variables E1	SWIIT_ret	RUEDIF_ret	WUPIXF_ret
EX_INF	0.617	0.189	1.687
	(2.061)	(2.152)	(2.081)
UNEX_INF	-0.973	-1.136	-1.238*
	(0.716)	(0.747)	(0.695)
Constant	0.0139***	0.0152***	0.0115**
	(0.00465)	(0.00485)	(0.00477)
Observations	81	81	74
JB chi2	0. 3261	0.9916	2.462
JB Prob > chi2	0. 8495	0.6091	0.2919
BP chi2	0.24	0. 31	0.22
BP Prob > chi2	0. 6259	0.5798	0.6389
R-squared	0.024	0.029	0.050

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

JB: Jarque-Bera test for normality (H0: normality). We cannot reject the hypothesis that our returns are normally distributed.
BP: Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (H0: constant variance). We cannot reject the hypothesis that our returns have a constant variance.

Exhibit 5: Regression Results E1
Source: Authors' Calculations

5. There are other methodologies to test the relationship between real estate returns and inflation. (1) Ganesan and Chiang (1998: 56) discuss a simple comparison between these two variables. However, such approaches are generally considered as oversimplified. (2) Furthermore, the model of Fama and Schwert is criticized because it does not reflect possible non-stationarity in the variables (Goetzmann and Valaitis, 2006: 3). Therefore, researcher might reject the tested hypotheses too often. To solve these problems cointegration techniques have been developed. The logic behind these approaches is that even if the real estate returns and inflation rates themselves are non-stationary the linear combination of both might be (Goetzmann and Valaitis, 2006: 3). If this is true the two variables are cointegrated. The regression of those two variables would therefore be meaningful (Ganesan and Chiang, 1998: 63). (3) Wohlwend and Goller (2011) apply a short-term and a long-term sensitivity measurement.
6. In Switzerland, the exchange price is often above the net asset value. A positive agio are common for real estate mutual funds.
7. Examples are: Deutsche Bank Rüd Blass Immobilienfonds Indizes (DBCHREE, DBCHREF); SXI Real Estate Indizes (REAL, REALX, SWIIT, SWIIP, SREAL, SREALX); Wüest & Partner Indizes (WUPIX-A, WUPIX-F).

Acknowledgments

We would like to thank the editor of the AIAR and two anonymous referees for valuable comments and suggestions. It significantly improved the quality of this article. We are indebted to Larissa Marti, Thomas Ankenbrand and John Davidson for helpful and constructive comments. We thank Avni Asani and Mathieu Chaignat for providing us with literature.

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Studying Financial Disruption: Bubbles and Crashes - An Interview with Didier Sornette

Barbara J. Mack
CAIA Association

Overview

The history of the financial markets is punctuated with extreme events, from the Dutch Tulip Bubble of the 17th century to the Global Financial Crisis of 2007-2009. Didier Sornette, Professor and Chair of Entrepreneurial Risks at ETH Zurich (the Swiss Federal Institute of Technology) has devoted over two decades to studying bubbles and crashes, producing a book, Why Stock Markets Crash: Critical Events in Complex Financial Systems (Princeton University Press, 2003), and numerous papers and articles. This short interview covers some of the main themes of his empirical research, the launch of the Financial Crisis Observatory (FCO) at ETH Zurich, and the development of the FCO Cockpit, a project that analyzes a vast array of asset classes, searching for evidence of bubbles or crashes in early stages of their formation.

Interview

BJM: Your research on bubbles and crashes dates back to the mid-1990s; what drew you to these topics and what are your main observations on such phenomena?

DS: The fundamental background is my philosophy that in order to learn about a system it is good to look at it out of equilibrium, particularly when it is in an extreme state of disequilibrium. Many of the systems that we observe seem to be in balance most of the time, but underneath their structures are tremendous conflicting forces that essentially cancel each other out. At the beginning of my scientific life, it was just a conjecture that extreme events could provide a fantastic opportunity to decipher the hidden forces that are combatting and counterbalancing each other and therefore hiding the true nature of the system from the investigator.

The work on financial bubbles and crashes also emerged from an analogy comparing the rupture of the financial system and a rupture of a material engineering structure. At the starting point of our research, we saw similar tell signs involving a progressive maturation towards instability that could be modeled similarly in both contexts. Specifically, we found that the mathematical language we developed for predicting the failure of key engineering structures like the Ariane space rocket turned out to be very flexible and convenient to apply to financial markets, and to bubbles in particular. Since that initial observation, the systems for analysis have become more complicated, because when you dive into the specifics of the financial markets, you must go beyond relatively superficial analogies. However, combined with the scientific and social significance of these phenomena, this was also part of our motivation and approach.

BJM: There have been numerous dramatic events around the world over the past few decades, including the Crash of '87, the dot-com bubble, and regional crises of various types, so how has studying these events guided the work up to the most recent crisis?

DS: One of our group's most important conceptual breakthroughs has been to understand how the global financial crisis in 2007-2008 occurred and examine the way in which it is tied to the evolution of the previous decades. The financial markets and national economies are continuously punctuated by phases of overheating. Some might call it over-enthusiasm, but actually it is healthy enthusiasm, because this is the kernel of innovation: taking risks and deploying capital to develop new ideas. This leads to phases of engineering and advancement, but often the system overreaches and then there is a correction. The typical view on these dynamics is based, in part, on a misconception about economics.

The GDP of the US, for example, is said to have grown at a remarkably constant average of 2% per year from 1790 until now. This is incredible, when you think about the vast technological advances, shifting demographics, and major wars that have taken place during this period. Nevertheless, there is an impression of steady, consistent growth in spite of these dramatic changes in the environment. However, when we look more closely at the figures, we find that GDP growth of 2% per year is never happening. Instead, we see a broad bimodal distribution with growth ranging between 0-1% (with tails of negative spells associated with recessions) on one hand, corresponding to an underperforming economy or recession, and growth of 3, 4, or 5%, on the other hand, which marks a boom period, hence the long-term average of 2%, but that itself is not the norm.

In order to understand 2007-2008, we can look back as far as the post war period; at the end of the Second World War, the level of technical advancement due to the war effort, largely in the US, but also in Germany and elsewhere, had spillovers with extraordinarily good consequences in terms of productivity growth for the next 30 years, in a period known as "Les Trentes Glorieuses." Then a significant change took place and after three decades of real growth, in capacity and output, the economy shifted to another regime, starting around 1980, which can be described as the "Illusion of the Perpetual Money Machine." Since that time, two-thirds of the US "productivity" was based in finance and entailed the rapid growth of credit, debt, and financialization. Early on, this new paradigm was interrupted by the global crash of '87. There was another break in 1991-2 and a larger disruption with the dot-com crash, in 2000-2001. Finally we have the most recent bubble that formed in response to the Fed's interest rate policy and derivatives markets expansion leading to the crisis of 2007-2008, and we have seen a number of commodity bubbles as well.

During much of this period before the crisis of 2007-2008, GDP appeared to be predictable and we generally saw mild volatility, decreasing unemployment, and low inflation. However, while people were toasting the "Great Moderation," they were forgetting to look at other signatures, i.e. the bubbles acting as the canary in the financial coal mine, which were telling us that this growth was not obtained from real productivity growth and would not be sustainable. So in spite of beliefs to the contrary, the events of 2007-2008 are not a surprise – in fact, the crisis can be seen as the culmination of 30 years of relying on indebtedness, credit creation, and financialization – not real value and productivity gains.

BJM: When you mention the waves of creation and destruction – Schumpeter came to mind and this type of cycle seems more natural than the idea of an endless period of uninterrupted growth.

DS: Yes, exactly, the point is that during the 25-year story – the belief was that we could have strong growth and no volatility. This is a complete misconception. And yet in spite of the crashes, some bubbles are very beneficial in the longer term. The dot-com bubble produced a lot of hype and investors lost a great deal of money, but it also produced a massive amount of human capital, well educated and experienced young people who were relatively cheap to employ and ready to develop the next boom that we see in Google, Facebook, Amazon, and many others. Such social or tech bubbles create opportunities because they result in creation of excess capacity, in fiber optics and bandwidth, for example; once it is installed it will certainly be reused and enables the next wave of creation. The history of railroads in the UK and the US in the mid to late 1800s is a similar situation. It is an extreme version of Schumpeter – bubbles and crashes can have benefits, but it may take several decades to obtain the return on the investment, not a few years, which is so often the expectation.

BJM: What is happening with the Financial Crisis Observatory and the FCO Cockpit reports?

DS: We are interested in developing experiments in finance just as we are able to do in scientific labs, so we came up with a methodology for the work of the FCO, started in 2009, which has integrity and security built in to the observation and reporting processes. We were watching for the most evident bubbles, documenting the cases, putting the written work aside for six months, sealed and encrypted, and publishing the public key immediately, so that six months later, everyone would be able to check that the document was legitimate and see how accurate it was. We used the best encryption technology of the time and this went very well.

We ran the analytical experiment for two years and then moved on to actual trading through an Interactive Broker account with about $100,000 CHF, so now we were testing it in real time and introducing the operational aspects: risks, transaction costs,

slippage – all of the practical details. We ran the investment experiment for one year, (still as an academic project)–and we did very well. This confirmed to us that there is predictability in the markets and it is possible to create diagnostics that watch for turning points successfully. In order to make this feasible for active investment, it takes a substantial amount of work; our best performance occurred when we had two dedicated senior researchers working full time – like real traders. Even so, this demonstrated that there is something to our analysis in real life.

Since then we have been publishing the FCO cockpit, which is improving over time.

We have a quadrant to classify the universe of assets in a positive bubble-negative bubble, high valuation-low valuation framework and we are running a portfolio on paper to assess the value of this scheme with back tests. In the future, we will publish it as an index for investors.

On a daily basis for the public, we offer fresh bubble indictors for the major markets - indices, commodities, bonds, and so forth, but right now we are only showing 40-50 assets that people can watch and experiment on. In our own research, we are watching 25,000 assets every day, so there is much more in the works for the future.

BJM: Turning to ICBI, you will be speaking about the FCO there in your talk, "Diagnostic Forecasting of Future Bubbles, Crashes, and Crises."

DS: Yes, a part of it will be a diagnostic of the present time, so we will run the cockpit and present a state of the world – where are the bubbles and the opportunities. My first paper on bubbles was published in 1996, so we are celebrating the 20th anniversary and all that we have developed in my group over the past 20 years. Bubbles and crashes are extremely interesting and complex phenomena and are deeply connected with policy, regulation, politics, beliefs, and culture – so they have many facets and we have developed a number of exciting models that offer new ways of understanding them – with recent improvements towards more mathematical rigor and generality while keeping a fundamental anchor in finance.

Thinking specifically about the Global Derivatives conference in May, this field is dominated by financial mathematics and engineering and yet we do not have many relevant models for bubbles and crashes. There is enormous work to be done and I am happy to offer an approach to the challenge in a solid axiomatic way, rooted in extensive empirical works.

Links

Why Stock Markets Crash: Critical Events in Complex Financial Systems, by Didier Sornette (Princeton University Press, 2003) http://press.princeton.edu/titles/7341.html

Didier Sornette TED Talk: https://www.youtube.com/watch?v=C_eFjLZqXt8

ETH Zurich Chair of Entrepreneurial Risks – Financial Crisis Observatory

http://www.er.ethz.ch/financial-crisis-observatory.html

Bio

Didier Sornette
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Didier Sornette is professor of Entrepreneurial Risks in the department of Management, Technology, and Economics at the Swiss Federal Institute of Technology (ETH Zurich), a professor of finance at the Swiss Finance Institute, and an associate member of the department of Physics and the department of Earth Sciences at ETH Zurich.

He uses rigorous data-driven mathematical statistical analysis combined with nonlinear multi-variable dynamical models, including positive and negative feedbacks to study the predictability and control of crises and extreme events in complex systems. This methodology has applications to financial bubbles and crashes, earthquake physics and geophysics, the dynamics of success on social networks, and the complex system approach to medicine (immune systems, and epilepsy, for example) all leading towards the diagnostics of systemic instabilities.

Didier has authored numerous papers and articles on the topics of bubbles, crashes, financial markets, and analytical methodologies. In 2003, he published Why Stock Markets Crash: Critical Events in Complex Financial Systems (Princeton University Press: NJ).

In 2008, he launched the Financial Crisis Observatory at ETH Zurich to test the hypothesis that financial bubbles can be diagnosed in real-time and their termination can be predicted probabilistically.

The Ins and Outs of Investing in Illiquid Assets

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Introduction

The commonly held view is that investors should be able to harvest a liquidity premium from illiquid investments. We look into the fundamentals on which this view is based.

Investments in illiquid asset classes have become more common in recent decades. According to Ang (2014) the share of illiquid asset classes held by pension funds has risen from 5% in 1995 to 20% in 2011. There are a number of reasons for this increasing popularity including the perception that (expected) returns are higher as well as that they offer greater diversification potential. It is however not always clear what the required extra return or diversification benefits for the illiquidity should be. Additionally there are numerous reasons for illiquidity each with their own challenges.

The most widely known illiquid investments are probably hedge funds, real estate, private equity and infrastructure. However, examples can also be found in more liquid markets. For instance, on-the-run (newly issued) bonds are found to be more liquid than off-the-run (older) bonds with similar characteristics and the same remaining maturity. When a certain asset is illiquid it is usually more difficult to find counterparties to trade with at a reasonable price. Therefore, the costs associated with transactions in illiquid assets can become large. For some assets, legal impediments make it sometimes impossible to trade in a timely manner at all.

Investing in illiquid assets introduces additional risks. Probably the best known example of a situation where large positions in illiquid assets caused significant problems is the Harvard University endowment case (see Ang 2014). After a prolonged period of good performance, during the turmoil in 2008 the endowment's illiquid asset investments suffered heavy losses. The liquid part of the portfolio had become too small to meet the running expenses. In need of cash, the Harvard endowment tried to sell some private equity investments. Although

this was possible they faced having to sell at 50% discounts in the secondary market.[1] All in all, the Harvard case showed the world the dark side of having a large part of a portfolio invested in very illiquid assets.

In this note we will discuss theoretical and empirical findings on investing in illiquid assets. We look at why investors in illiquid assets should be compensated with higher returns (liquidity premium) than those on comparable liquid assets and whether this is actually the case. Moreover, we comment on the possible diversification benefits of investing in illiquid assets and address some of the associated problems and risks. Do the pros of investing in illiquid assets outweigh the cons?[2]

Sources of Illiquidity

Different assets have different liquidity characteristics. There are many explanations why some assets are more illiquid than others.

There are many effects that determine an asset's liquidity. Some assets like public equity can be traded within seconds, while municipal bonds may trade as little as twice a year and the average holding period for institutional real estate is a decade. The academic literature on liquidity related topics is extensive. Amihud, Mendelson and Pedersen (2005), Khandani and Lo (2011) and Vayanos and Wang (2012), among others, summarize and describe various sources of illiquidity.

Liquidity can be defined as the ease of trading a security. The liquidity of certain assets will be impacted by different factors (see e.g. Amihud et al. 2005) such as:

i. Exogenous transaction costs

ii. Demand pressure and inventory risk

iii. Private information

iv. Search frictions

Exogenous transaction costs are the most straightforward source and characteristic of illiquidity. These are the fixed costs that need to be made to process the trade. For institutional investors trading in public large cap equities these costs will be small, as all transactions are processed electronically in a highly regulated central market. However, for investments in certain alternative asset classes these costs can become substantial, as sometimes lawyers and solicitors need to be involved in the process. Higher costs make trading more expensive and thus the ease of trading is thereby reduced. In equilibrium, more liquid assets (i.e. assets with lower transaction costs) are held by investors who trade more frequently, while those assets that are more expensive to trade are held by investors with low trading frequency (see e.g. De Jong and Driessen 2013) .

Demand pressure and inventory risk are another source of illiquidity. When an investor wants to sell an amount of stock, there may not necessarily be any buyers. In many markets, a market maker will then buy the asset from the investor, but will also require compensation for the risks that he faces due to warehousing the stock.

Private information is also a potential cause of illiquidity (see for instance Vayanos and Wang, 2012). If some traders have different information to others, one party may enter a bad deal. This was first described by Akerlof (1970) as the market for lemons.[3] A buyer faces the risk that the seller has private information that the stock is expected to perform badly in the future. To compensate for the possibility of entering into a bad deal with an informed seller he therefore gives a bid price that is below the asset's fair value. A seller who might be dealing with an informed buyer on the other hand will quote a higher ask price. In regulated markets this leads to the well-known bid ask spreads. This phenomenon makes investors more hesitant to trade, leading to illiquidity.

Search friction is yet another source of illiquidity, as the lack of a centralized market may result in long waiting times before a counterparty can be found. In addition to the waiting period, the transaction price needs to be negotiated and the bid-ask spread may be very wide if there is little competition in these markets. This type of transaction may also be hampered by costs such as due-diligence and lawyer fees etc.

The sources of illiquidity outlined above have some overlap and might reinforce each other. The inventory risk for instance might have a larger impact if informed traders are involved. In markets where search frictions play an important role transaction costs are usually also higher. In addition, the above sources of illiquidity often also have a larger impact when the traded volume increases. While some assets can easily be traded in small quantities, it might be difficult or impossible to trade them in larger quantities due for instance to the price impact this will have.

Brunnermeier and Pederson (2009) and Driessen (2014) identify two types of liquidity: funding and market liquidity. They relate funding liquidity to the costs of generating cash, for example, to fulfil the demand for cash flows that can originate from currency or interest rate hedging positions for institutional investors. Market liquidity is related to the costs relating to transactions in both liquid and illiquid assets. The two types of illiquidity are positively related. In this study we will mainly focus on market liquidity, and refer readers interested in more information to the two articles cited above.

In this chapter we have shown that there are different effects at play that could result in one asset being more illiquid than another. We have elaborated on four main potential sources of illiquidity found in the academic literature (see for instance Amihud et al. 2005). The next chapter explains why investing in an illiquid asset theoretically should be rewarded

How is Illiquidity Reflected in (Expected) Returns

Investors should demand an extra reward for holding illiquid assets. This reward should at least compensate for the extra costs that the investor incurs.

This section uses two examples to look at a possible explanation of why illiquidity should result in an extra reward. All else being equal, it would be fair to assume that an investor would always prefer a liquid investment to an illiquid one. So why do some institutional investors make investments, sometimes in large volumes, in illiquid assets? The answer to this question is related to the fact that they might receive a reward for holding these less liquid investments. This reward is usually called the "liquidity premium" and its existence has been a lively subject of debate between practitioners and academics. Possible diversification benefits are also an argument for investing in illiquid assets.

However, this chapter focusses on reward in terms of expected return. In the next section we will discuss several components of the liquidity premium as we analyze the division between liquidity level and liquidity risk. Diversification benefits will be examined in a later chapter. Next we discuss two studies which explain why a liquidity premium could emerge.

Study 1: De Jong and Driessen (2013)

First we analyze a theory on why illiquidity could result in a liquidity premium. When investors expected trading horizons differ, for instance short horizon investors versus long horizon investors, the market is what is known as 'segmented'. The theory predicts that this segmentation gives rise to a liquidity premium over and above the expected transaction costs. It predicts that the required liquidity premium increases with the expected holding period.[4] We use a simplified numerical example from De Jong and Driessen (2013) to illustrate this theory. The model consists of the following settings and assumptions:

- short term investors with a 1 year investment horizon
- long term investors with a 10 year investment horizon
- liquid asset with normal transaction costs equal to 1%
- illiquid asset with high transaction costs equal to 5%
- both assets are risk-free
- the risk-free rate is set equal to 2%

The short horizon investors have no interest in the illiquid asset, as its transaction costs are too high, so they all hold the liquid asset. As the assets are risk-free, the gross return should be the risk-free rate plus a compensation for the trading costs. This equals 2% (risk-free) + 1% (trading cost) = 3%, which is summarized in column 2 of Exhibit 1.

If the long horizon investors decide to hold the liquid asset for 10 years they would also earn the gross return of 3%. However, the yearly trading cost is now 0.1% instead of 1%, as the long horizon investors only trade once every ten years. Therefore, they earn a yearly net return of 2.9% (=3% gross return – 0.1% transaction costs).

The illiquid asset needs to generate at least the same net return of 2.9% if long term investors are going to be encouraged to invest. The annualized transaction costs for the illiquid asset are equal to 0.5% (=1/10 * 5%). Thus, the gross return on the illiquid asset should be at least 3.4% to obtain the aforementioned net return of 2.9%.[5] Even in a stylized model like this we observe that illiquid investments must offer long term investors a liquidity premium (in the gross return) in order to remain on par with liquid investments.

Study 2: Ang, Papanikolaou and Westerfield (2014)

Another example of why a liquidity premium can exist is found in Ang, Papanikolaou and Westerfield (2014)[6]. They consider using a highly stylized model with an investor who consumes a certain amount of wealth and invests the rest in liquid and illiquid

	Short Term	Long term	
	Liquid	Liquid	Illiquid
Transaction Costs	1%	0.1%	0.5%
Gross Return	3%	3%	3.4%
Net Return	2%	2.9%	2.9%

Exhibit 1: Example of the Liquidity Premium Derived from Segmentation Theory
Source: Authors' Calculations

Expected period over which the asset cannot be traded	Required liquidity premium (Yearly)
10 years	6.0%
5 years	4.3%
2 years	2.0%
1 year	0.9%
1/2 year	0.7%
Always tradeable	0.0%

Exhibit 2: Required Annual Liquidity Premium for Various Horizons
Source: Ang (2014)

assets. The illiquid asset can only be traded (converted into liquid wealth) at random times. The more wealth that is invested in the illiquid asset the greater the probability that at a certain time the investor will not have enough liquid wealth to consume ("probability of having nothing to eat"). Therefore, the investor requires compensation for holding the illiquid asset.

Exhibit 2 shows this compensation derived under the specific model assumptions, which is denoted as the required liquidity premium. This is the premium the investor requires as compensation for not being able to trade for an expected period of time. The table clearly shows that investors require large premiums for holding an illiquid asset instead of a liquid asset. For holding periods of around 5 years, which is also the average holding period for private equity investments[7], the net required compensation is already over 4%.

It is important to note that these numbers result from specific model assumptions. The example above should only be viewed as an illustration as to why a liquidity premium should exist. More refined estimates of liquidity premiums could be quite different depending on the investment fund in question. This model for instance assumes that an investor has no intermediate income. For a very grey pension fund, which receives almost no contributions, the required premiums could be of the same order of magnitude as in Exhibit 2. However, for a younger pension fund with regular contributions the required premiums will be lower than the ones reported in this example.[8]

Final Remarks on How Investors are Rewarded for Bearing Illiquidity

Brunnermeier and Pederson (2009), who distinguish between market and funding liquidity, observe that there is no guarantee that there will be a substantial liquidity premium. It will depend on a number of factors including the level of illiquidity, the type of investor (e.g. long-term vs short-term investors) as well as time. In times of crisis, for example, both liquidity premiums will be higher.

Longstaff (2014) analyses the valuation of thinly-traded assets such as private equity and commercial real estate using an American option approach. He finds that the value of immediacy (i.e. the ability to sell immediately) is much higher than that of future liquidity; the value of the first day of illiquidity is much higher than that of the second day. Liquidity today is more valuable than liquidity tomorrow or next week. He confirms the findings of other studies that the value of illiquid assets can be heavily discounted in the market; the discount can be as high as 30% for an illiquidity period of 5 years. Finally he finds that the effects of illiquidity on asset prices are smaller for assets that pay higher dividends.

Vayanos and Wang (2012) analyze how asymmetric information and imperfect competition[9] can affect liquidity and expected returns. They show that expected returns are higher when information is not spread evenly between all market participants compared to those situations where information is widely known or when the private information is not observed. They identify two partly overlapping measures of illiquidity. The first one is related to transaction volume and is based on the idea that trades in illiquid markets usually have a large price impact. This measure can be seen as the more permanent component of the price effect. The other measure is related to the transitory component which is driven by the fact that trades in illiquid markets can result in large temporary deviations between the asset's price and its fundamental value. Moreover, they show that the relationship between liquidity or lack of it and expected returns is not always positive. It depends on several factors including the source of the illiquidity (asymmetric information or imperfect competition) and the measure of illiquidity. If the illiquidity is driven by imperfect competition the relationship can become negative.

In general the liquidity premium is a compensation for not being able to trade at a fair price at any given time. It is the interplay between many variables that determine the exact ex-ante reward required for bearing illiquidity risk. Although it is hard to derive the exact size of a liquidity premium the academic literature seems to agree that a liquidity premium should theoretically exist.

Liquidity Level and Liquidity Risk Premium

There are actually two types of liquidity premiums. First, a compensation for average illiquidity itself and second a compensation for the risk of illiquidity.

This split is for instance found in Khandani and Lo (2011), who divide the literature on the impact of liquidity on asset prices into two groups. The first group (liquidity level) focuses on liquidity as a deterministic characteristic of securities in the same way that transaction costs are. As investors prefer liquid assets to illiquid ones, all other things being equal, they will want to be compensated for holding an asset with low liquidity. Moreover, higher costs translate into higher gross expected returns for those assets. This premium should at least be sufficient compensation for the illiquid asset's transaction costs, but may extend beyond that, as seen in the previous section. The premium resulting from the liquidity level of an asset is called the liquidity level premium.

Secondly, the liquidity risk premium is a compensation for holding assets that perform poorly when there is a systematic liquidity shock.[10] This premium should be regarded as a systematic factor premium. Economic theory predicts that assets that have their lowest returns when the global financial markets encounter bad times should offer some compensation with respect to other assets.[11] Times of scarce liquidity can also fairly be categorized as bad times (see e.g. Brunnermeier and Pedersen 2009). Assets that perform badly during these periods should offer a liquidity premium, otherwise investors have no incentive to hold them. In this case liquidity is regarded as a risk factor.

Acharya and Pedersen (2005) show that in most cases there will be a positive relation between both premiums, which makes it difficult to attribute the premium to either the liquidity level or the liquidity risk effect. As Lou and Sadka (2011) observe, the liquidity level can be considered as the mean effect, whereas the liquidity risk is related to the volatility effect. In addition, Khandani and Lo (2011) state that even though the two approaches have an overlap, their effects on empirical analyses can be quite different. They state that this could explain why there is little consensus on how to measure liquidity risk.

Particularly for these reasons we will look mostly at the total liquidity premium, although we believe that the distinction outlined above is important for understanding why liquidity premiums exist. However, depending on specific investor

preferences, there may be more focus on one of the individual premiums rather than on the total liquidity premium.

Time Variation in Illiquidity and the Liquidity Risk Premium

The previous paragraph explained that the exposure to aggregate liquidity is regarded as a specific risk for which a premium is demanded: the liquidity risk premium. This premium is thus closely related to the time variation in illiquidity. Therefore, it is also important to understand how liquidity varies over time.

In tranquil times liquidity might be abundant, while in times of crisis it is often very scarce.[12] For instance, during the credit crisis even the usually very liquid money markets became illiquid (see e.g. Hanson, Scharfstein and Sunderam 2014). In the same period the liquidity of corporate bonds decreased dramatically which resulted in much higher transaction costs. Exhibit 3 shows the Barclays liquidity cost score[13], which shows how expensive it was to trade US high yield bonds and credits during the crisis.

Assets that have a strong liquidity risk exposure will be vulnerable to systematic shocks in aggregate liquidity (see Exhibit 4). A systematic liquidity shock here refers to the situation where the liquidity in global asset markets suddenly dries up. Thus, when a systematic liquidity shock happens, prices of these assets will plunge. Expected returns on these assets should therefore be higher. Exhibit 4 shows the monthly liquidity factor from Sadka (2014). He analyses whether the liquidity risk, defined as the exposure to the shocks in the liquidity factor shown in Exhibit 4, is a priced factor premium. He shows that even within the universe of liquid indices a higher exposure to the liquidity risk factor resulted in a higher (although not statistically significant) return over the period 1994-2010. Jensen and Moorman (2010) find that aggregate liquidity improves during expansive periods in monetary policy and deteriorates during restrictive periods. The prices of illiquid stocks increase relative to those of the more liquid stocks during periods of monetary expansion.

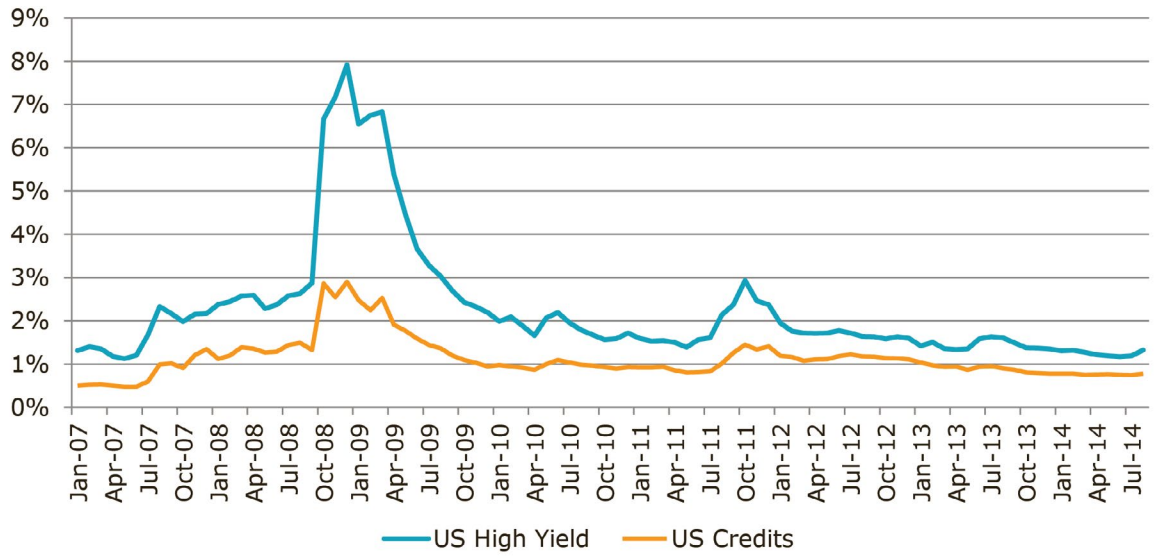

Exhibit 3: Barclays Liquidity Cost Score (LCS)
Source: Barclays POINT

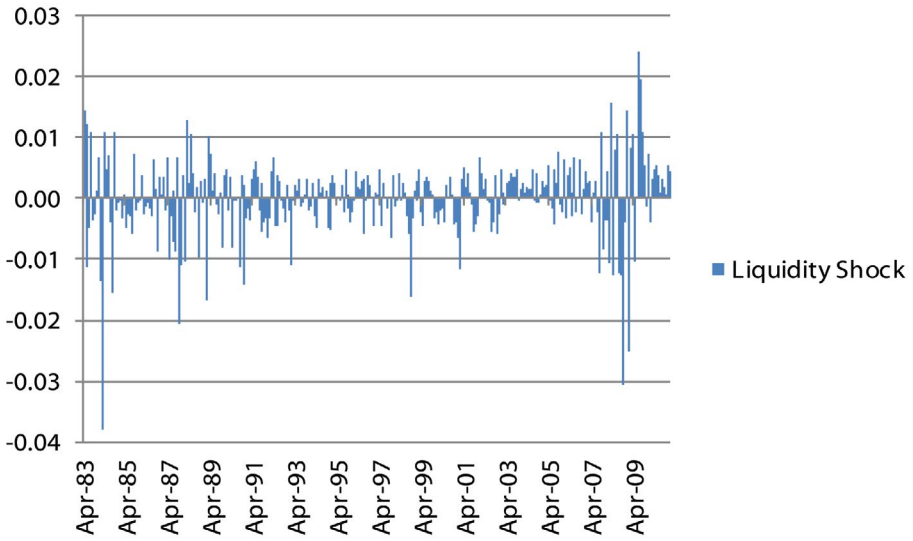

Exhibit 4: Changes in the Monthly Liquidity Factor
Source: https://www2.bc.edu/~sadka/

The time variation in liquidity suggests that long horizon investors might pick up liquidity premiums when these are at their highest (i.e. after systematic decreases in liquidity). De Jong and Driessen (2013) review the literature on dynamic trading strategies based on liquidity. They find that the exact timing of these liquidity events is difficult to predict and it is therefore hard to reap liquidity premiums using dynamic strategies. Ang (2014) states that rebalancing is the easiest way to earn liquidity premiums as this can be interpreted as providing liquidity to the markets. Rebalancing supplies liquidity because it is a countercyclical strategy. More specifically, the investor is actually selling assets when others want to buy at high prices and buying when prices are low and others want to sell, which generates liquidity. He states that an investor is thus rewarded for behaving in a contrarian way and providing this liquidity. It is important to also rebalance the illiquid assets when possible. It should be noted that these strict rebalancing rules are part of the strategic asset allocation decision.

Asset Allocation

Although it might be possible to earn liquidity premiums, one should also take into account the risk characteristics of the investments involved. Investing in illiquid assets can be risky as illiquidity is usually most prevalent when liquidity is most needed.

Investors can opt to allocate to illiquid assets for various reasons. In addition to the liquidity premium, investments in illiquid assets can also be selected because of the possible diversification opportunities. In the previous sections we have discussed the theoretical existence of liquidity premiums. In this section we will discuss some other important elements that need to be taken into account when investing in illiquid assets. These relate to the diversification opportunities and the consequences of not being able to adjust holdings in illiquid assets at times when rebalancing is required.

Diversification

Another reason for investing in illiquid rather than liquid assets, apart from the higher return expectations, could be the diversification offered through exposure to specific underlying return factors which are yet not available in liquid markets (infrastructure projects which invest in e.g. inflation generating projects).

A large part of these diversification opportunities are a direct result of appraisal based valuations. Exhibit 5 shows the cumulative returns for listed as well as non-listed real estate. Although the underlying assets are in theory comparable, the return patterns differ substantially. Investing in non-listed real estate would have had a less negative impact on a portfolio's performance in 2008-2009 than an investment in listed real estate. This is because the shocks in non-listed real estate are included in the prices with a delay. From our point of view this diversification is therefore mainly artificial, as it can largely be explained as a consequence of accounting practices. This results in apparently lower volatilities. In practice it is not possible to trade on the appraisal based valuation as the Harvard University's endowment case has shown. When comparing public listed stocks to private equity for instance we also expect to see a comparable lag in returns caused by appraisal based valuation.

Asset Allocation Models

Ang et al. (2014) develop an asset allocation model which takes illiquidity into account. Their main results are based on a scenario where an investor consumes a certain amount of their wealth in each period. The universe consists of three assets: a risk-free bond, a liquid and an illiquid risky asset. They analyze how much should be invested in the illiquid risky asset according to the different levels of illiquidity of this asset. The remaining, liquid wealth is allocated to the risk-free bond and the liquid risky asset. The investor consumes out of this liquid wealth. The analysis is performed for an investor with average risk aversion.

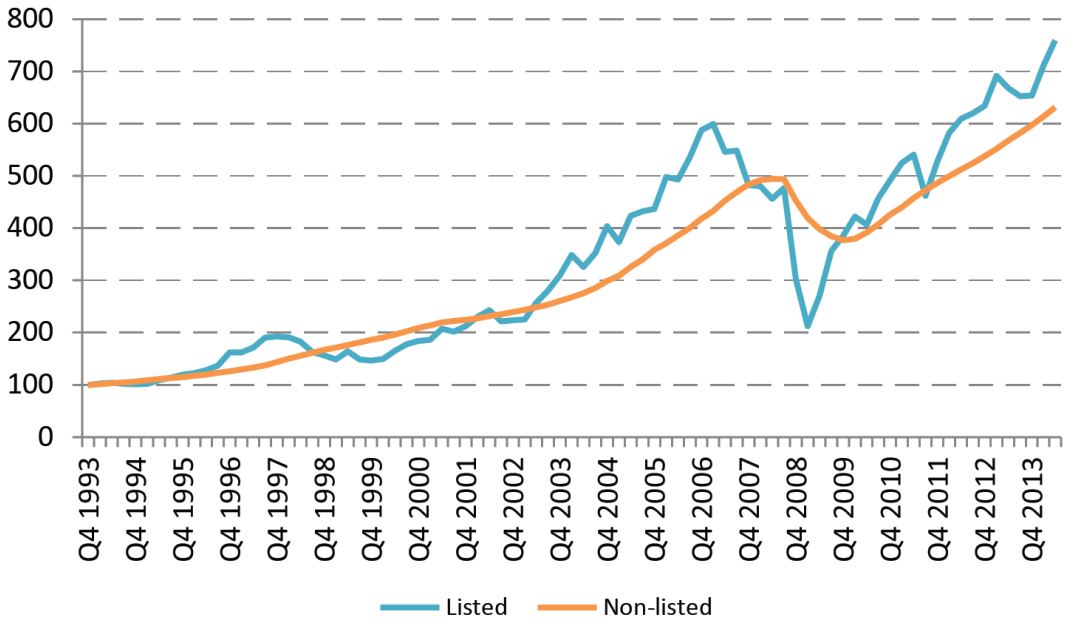

Exhibit 5: Cumulative Returns for US listed (NAREIT) and Non-listed (NCREIF) Real Estate
Source: NCREIF, DataStream

Expected period over which the asset cannot be traded	Optimal allocation with consumption	Optimal allocation without consumption
10 years	4.8%	51.8%
4 years	13.2%	52.0%
2 years	25.1%	52.3%
1 year	37.3%	52.7%
1/2 year	44.2%	53.5%
Always tradeable	59.3%	59.3%

Exhibit 6: Optimal Holdings of Illiquid Assets
Source: Ang et al. (2014)

Exhibit 6 reports the optimal holding of illiquid assets in their model for different expected periods during which the asset cannot be traded. Optimal holdings in the illiquid asset are shown in column 2. The optimal holding in the illiquid risky asset in case of intermediate consumption sharply decreases as its illiquidity rises. For instance, the investor's holding in the risky asset would decrease from 59% in case of full liquidity to 37% if the risky asset can only be traded once a year on average. If the risky asset can only be traded once every four years, which is close to the average effective duration of private equity and direct real estate investments, for example, they find an allocation of 13% to be optimal. Column 3 shows that the results depend largely on whether or not intermediate consumption is taken into account. If this is not the case the effect of illiquidity is much smaller. This is because if there is no need for immediate liquidity in intermediate periods, there is less risk attached to not being able to access the funds. The results in Exhibit 6 without intermediate consumption (i.e. column 3) are in line with the results of Driessen (2014). His study looks at terminal wealth after 10 years and does not take into account the intermediate pension payments that need to be made. In addition, he also assumes that illiquid assets cannot be traded during the period under consideration.

The results in Exhibit 6 without intermediate consumption and the findings of Driessen (2014) might underestimate the true impact of illiquidity as many funds do need immediate liquidity. On the other hand, the results in Exhibit 6 with consumption might overestimate the effect of illiquidity because funds in general receive regular inflows. Therefore, the optimal holdings in illiquid assets will depend on the balance between inflows and outflows and will probably somewhere between column 2 and 3 of Exhibit 6.

Considerations for Allocation to Illiquid Assets

The above implies the importance of the specific setting in which the effect of illiquidity is analyzed. Therefore, it is important to know the liquidity risks the investors face. Pension funds, for instance, might have an additional source of liquidity risk when they hedge their interest rate or currency risk mostly using derivatives. If interest rates will start to rise sharply from the current low levels, losses on the swap positions might have to be financed if there are not sufficient assets to serve as collateral. In this case, liquid assets are needed. As illiquid assets cannot be rebalanced during a given time period, the position in the illiquid asset may deviate from the strategic portfolio (see e.g. Driessen 2014). Siegel (2008) shows that in certain economic scenarios, the share of illiquid assets in the portfolios of institutional investors can become undesirably high. An institutional investor with large positions in direct real estate, hedge funds, infrastructure and private equity could then end up with a very unbalanced portfolio. In the worst case scenario the fund might not even have enough liquid assets to be able to pay out their obligations (e.g. pensions). This is exactly what happened in the Harvard endowment case we described in the introduction.[14] Moreover, the deviation from the strategic portfolio can be costly as the new portfolio might have sub-optimal risk-return characteristics. To compensate for this sub-optimal profile an investor should demand a liquidity premium. Note that the risks also depend on the demography of the fund: a young fund with large contributions could take on more liquidity risk than an old fund with mostly retirees.

Empirical Evidence

The existence and size of liquidity premiums is difficult to determine due to the subjectivity of illiquidity definitions and data issues.

Although theory predicts an ex-ante liquidity premium, in this section we look at whether this is also the case in practice. There is extensive academic literature that empirically investigates the existence of liquidity premiums and there seems to be some empirical evidence that such premiums exist (see Amihud et al., 2005, Ang 2014 and De Jong and Driessen 2013, for a summary of the literature). This evidence is however mixed in the sense that it is only found in certain markets and it depends on the liquidity measure used. In order to keep this report short, we are not going to discuss every liquidity premium found, but rather show some examples of these premiums to clarify the findings of both studies.

Government Bonds

Within fixed income, the yield on government guaranteed agency bonds can be substantially higher than the yield on otherwise comparable government bonds, while the (default) risk is the same because the agency bond is backed by the same government. As the default risk is the same, the yield difference should be a result of differences in liquidity only. Government bonds are generally regarded as more liquid as they are more widely traded, serve as eligible collateral for many derivative transactions and offer relatively easy access to cash via the repo market. According to Longstaff (2004) and Schwarz (2010) yield differences between

these agency bonds and government bonds are usually around 20 to 30 bp. Ejsing, Grothe and Grothe (2012) find that during crisis periods the agency-treasury bond spreads could widen to 80 bp. Another liquidity premium in this market is found between on-the-run (newly issued) and off-the-run (older) bonds with the same remaining maturity and similar characteristics. The newly issued bonds are usually more liquid and carry a lower yield. The yield difference is however small and short selling the on-the-run bonds and buying the off-the-run bonds is not a profitable arbitrage strategy due to the shorting costs (see Amihud et al. 2005, and, Krishnamurty, 2002). Finally there is an indication of a liquidity premium for inflation linked bonds (TIPS) too, although the premium seems too high to be solely due to liquidity effects (see e.g. Fleckenstein, Longstaff and Lustig 2014).

Corporate bonds

Within the corporate bond world there is evidence to suggest that bonds that are less liquid often have a higher return. Dick-Nielsen, Feldhutter and Lando (2012) show that the liquidity level premium before the financial crisis was 4 bp for investment grade and 58 bp for high yield. After the crisis these premiums were found to be 40 to 90 bp for investment grade and 200 basis points for high yield. Bongaerts, De Jong, and Driessen (2011) take into account both liquidity level and liquidity risk and find that substantial liquidity premiums were already present before the crisis. They report premiums up to 100 bp for investment grade bonds and up to 200 bp for high yield bonds. The largest part of total liquidity premium in this market, comes from the liquidity level premium rather than the liquidity risk premium. This liquidity premium in corporate bond markets varies considerably over time, and there may be significant differences in bull and bear markets. In general it is however not easy to distinguish between the different premiums (for default and liquidity risks, for example).

Public Equity

In equity markets, stocks with low liquidity levels appear to earn higher returns than liquid stocks. It is noteworthy that this group of more illiquid stocks also comprises microcap stocks. For instance, Brennan and Subrahmanyam (1996) find that low liquidity stocks outperform high liquidity stocks by 6.6% per year. In a more recent study, Acharya and Pedersen (2005) find this premium in equities to be 3.5%. These premiums are observed over a longer time span, but have diminished in the recent past according to Ben-Rephael, Kadan and Wohl (2015). Lou and Sadka (2011) show that liquidity risk rather than liquidity level can help explain the cross section of equity returns during the crisis in 2008; some liquid stocks had larger drawdowns during this period than the more illiquid stocks with lower exposure to liquidity risks. Acharya and Pedersen (2005) find the liquidity risk premium to be 1.1%. This total liquidity premium on equities according to Acharya and Pedersen (2005) is thus 4.6% (3.5% level +1.1% risk).

Premiums Within Illiquid Asset Classes

There also seems to be some evidence that illiquidity (for instance longer lock-up periods) results in higher returns for private equity (Franzoni, Nowak and Phalippou 2012), hedge funds (Khandani and Lo 2011) and real estate (Liu and Qian 2012). With respect to hedge funds, Khandani and Lo (2011) show that the risk adjusted liquidity premiums for illiquid categories such as convertible arbitrage were sometimes as high as 10% per year in the period 1986-2006.[15] Even more liquid strategies such as managed futures have premiums of 5%. It is however somewhat puzzling that the risk adjusted liquidity premium for global macro funds is almost -6% (although the premium is not statistically significant). There is not much evidence for a liquidity premium for equity market neutral funds. Over the period 2002-2006 the premiums have declined significantly for a number of reasons including lower volatility for the major asset classes and greater demand for hedge funds.

Premiums Across Illiquid Asset Classes

It is however much harder to find conclusive research evidence for the existence of liquidity premiums particularly across alternative asset classes. This might sound surprising as they are 'known' for their high returns. Ilmanen (2011) for instance relates the average returns of a set of both liquid and illiquid asset classes to a (subjective) illiquidity measure. As can be seen in Exhibit 7 there seems to be a relation between the average return and the illiquidity measure. Ilmanen (2011) notes however that the return differences can also be due to exposures to risk factors which are not related to liquidity. Also the various biases in the databases of especially illiquid assets can explain part of the return differences.

Research on returns of illiquid asset classes is hampered by lack of good quality data. Ang (2014) gives a clear description of these data issues. This largely explains why it is so difficult to find conclusive evidence on whether liquidity premiums exist or not (see also De Jong and Driessen 2013) in these asset classes. For instance, there is a large ongoing debate on whether private equity outperforms risk-adjusted public equity or not (see Driessen et al. 2012).

Ang (2014) gives two possible explanations why liquidity premiums are found within asset classes but not between them. The first reason could be limited integration of asset classes where investors tend to look at asset classes individually rather than together as one group. This might result in imperfections for the market as a whole, which could lead to mispricing from the perspective of a completely integrated market. It is difficult to distinguish between price differences based on illiquidity and price differences caused by mispricing due to institutional constraints or slow-moving capital.

Secondly, Ang (2014) poses that investors may simply pay too much for illiquid assets in their desire to achieve higher returns. Prices are then bid up high enough to substantially reduce the liquidity premium that should theoretically exist.

Manager Selection

Finally an important element of investing in illiquid assets is the manager selection. Exhibit 8 shows that the dispersion between managers is much higher for investments in hedge funds than for investments in listed equities (see also e.g. Malkiel and Saha 2005). Due to the high dispersion and the lack of 'objective' high quality benchmarks within illiquid asset classes it is hard to draw a clear conclusions regarding the existence and level of liquidity premiums within those asset classes.

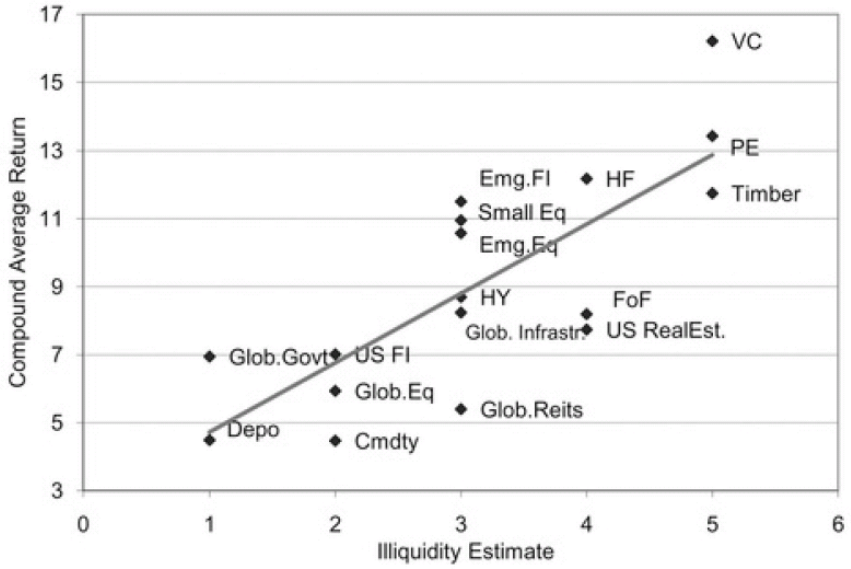

Exhibit 7: Average Return (1990-2009) vs. Illiquidity Measure.
Source: Ilmanen (2011)

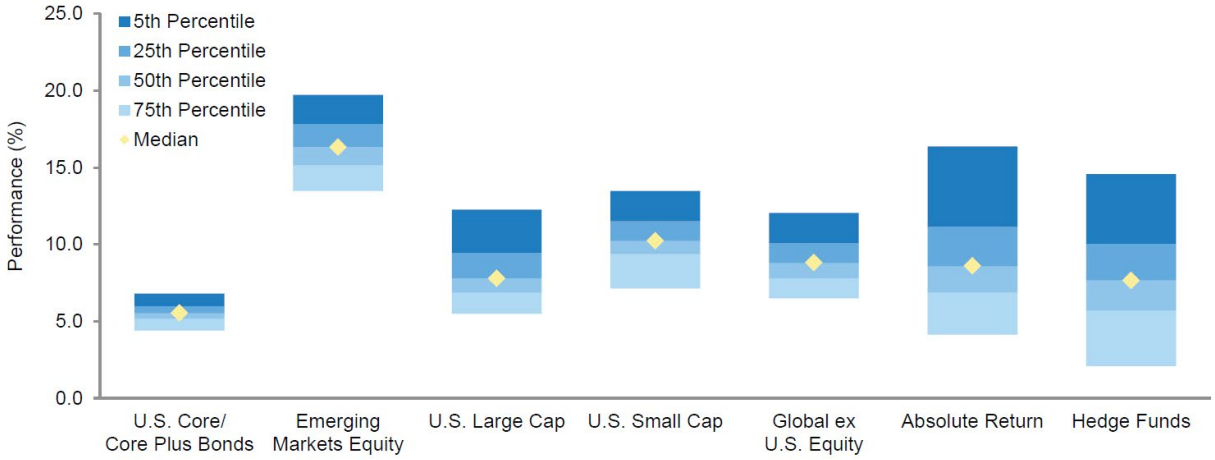

Exhibit 8: Dispersion Between Managers for Various Asset Classes
Source: Cambridge Associates

As there is no clear consensus on the existence of a liquidity premium, the decision to invest in an illiquid asset to capture this premium is mainly supported by investment beliefs. Firstly the belief, supported by theory, that the premium is out there and more importantly the belief that the investor is capable of capturing this premium. In our view, the decision to invest in illiquid asset classes and how successful this is depends mainly on the ability to select top-performing managers. This is in line with Swensen (2009)[16], who argues that the reason for investing in illiquid asset classes should not be higher risk-adjusted returns. He suggests that alpha opportunities are greater in illiquid markets than in liquid ones, as information in illiquid markets is much more difficult to gather and analyze. Skilled investors in these illiquid markets are able to use this information to distinguish between good and bad investments.

Conclusion

We have evaluated the common view that investors should be able to harvest a liquidity premium from illiquid investments. Unfortunately it is hard to find evidence of such a premium, which makes the decision to invest in illiquid assets one of the tougher challenges for investors.

We have looked at several aspects of investing in illiquid assets. On theoretical grounds we would expect a liquidity premium to exist. However, the historical evidence for this is mixed. Within some asset classes more illiquid assets appear to deliver higher returns than liquid alternatives. In contrast, academics struggle to find evidence on liquidity premiums between asset classes. For example, it is hard to find evidence of such premiums for direct real estate versus listed real estate or private equity versus listed equity.

Even if liquidity premiums exist, it is questionable whether these premiums can be exploited in practice and whether they are large enough to compensate for the extra risks involved. These risks include the risk of deviating too much from the optimal strategic portfolio as a result of the inability to rebalance and the probability of not being able to cover running expenses caused by too great an allocation to less liquid assets.

Allocation to certain illiquid asset classes however may have a significant effect on a portfolio's return as it is a top-down allocation decision. Research on the existence of a liquidity premium in illiquid asset classes is hampered by the lack of good quality data. In practice there are many examples of both good and bad results of investing in illiquid assets. The difference in performance in these markets depends for a large part on the managers that are selected. Therefore, in our view investing in illiquid asset classes could form part of a portfolio strategy, if it is combined with the capability of selecting top-performing managers.

If a fund decides to invest in illiquid assets we recommend that it set a maximum allocation to illiquid assets based on a stress test. In the worst case scenario there should still be enough liquid assets to meet obligations. We emphasize that investing in illiquid assets is a decision that has long-term consequences. The strategy will need support not just today but also in the future.

Endnotes

1. Harvard endowment finally solved their liquidity problems by borrowing.
2. We abstract from more detailed analyses of the various illiquid assets. For these, we refer the reader to specific Robeco white papers on:
   - Real estate (Onroerend goed in portefeuillecontext, 2012)
   - Private equity (De rol van Private Equity in een beleggingsportefeuille, 2013)
   - Hedge funds (De toegevoegde waarde van hedgefondsen in een pensioenportefeuille ,2014)
3. A bad quality second hand car in the US is called a lemon. If the car that is being sold is of bad quality, the seller is probably aware of it, while the buyer is not able to determine the quality of the car. This information asymmetry leads to the probability of "buying a lemon".
4. If there is no heterogeneity in the expected trading frequency, investors in illiquid assets will be only compensated for the expected trading cost according to this theory.
5. In the example the net returns on the liquid and illiquid asset are equal. In practice however the turnover in the liquid asset might be higher than once every ten years (i.e. long term investors need to rebalance their portfolios etc.). In this case the net return of the illiquid asset will exceed that of the liquid asset.
6. Ang (2014) describes the model and the results from Ang et al. (2014) in simpler language. Ang defines the illiquidity premium as the certainty equivalent.
7. Private equity contracts usually span a 10-year period. The effective average holding period is shorter, because dividends and capital are returned to the investor before the end date of the investment (see for instance Driessen, Lin, and Phalippou, 2012).
8. Ang et al. (2014) also consider a case without consumption. In this case they find that the required liquidity premiums are much lower, as there is no intermediate risk of not being able to consume.
9. This source of illiquidity is an additional source to the main ones described in the previous section and in Amihud et al. (2005).
10. We define a systematic liquidity shock as an event during which liquidity suddenly dries up. Investors and other liquidity suppliers such as banks are then reluctant to trade. Liquidity shocks can lead to price volatility, which can increase expectations of future volatility. This will lead to higher margin requirements as was the case for S&P 500 futures during the liquidity crises of 1987, 1990, 1998 and 2007 (see e.g. Brunnermeier and Pedersen 2009).
11. Investors are generally prepared to pay a premium for assets that pay-off in bad times. This is considered to be insurance. This is one of the reasons why pension funds still invest in high quality fixed income instruments. Another reason is their need to comply with the requirements of the Dutch financial assessment framework (FTK).
12. Liquidity can be measured in different ways. Measures based on turnover or autocorrelation in returns are widely used.
13. The Barclays LCS is an indication of the cost of trading a bond, measured as a percent of the bond's price.
14. Harvard decided not to liquidate part of its endowment but to issue bonds and to reduce its payout in 2009.
15. Khandani and Lo (2011) relate the level of illiquidity to the autocorrelation of the returns; the higher the autocorrelation the more illiquid the hedge fund strategy is. The liquidity premiums are lower if they are based on the raw returns. Their approach first ranks each of the funds in the specific asset class into five quintiles based on the autocorrelations. Subsequently the average (risk adjusted) returns of the equal weighted portfolios is calculated. Finally the spread between the most and the least liquid portfolios is estimated in order to derive an estimate for the liquidity premium.
16. David Swensen has been chief investment officer of the Yale Endowment Fund since 1985. His views on asset allocation caused many endowment funds to start investing in illiquid alternative asset classes.

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Important Information

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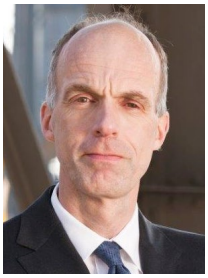

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Black Ice: Low-Volatility Investing in Theory and Practice

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Equity investors have endured two extreme market downturns since the turn of the century. The broad U.S. market, represented by the S&P 500 Index, fell by 44% in the aftermath of the dot-com bubble and 51% in the great recession. These devastating experiences reawakened institutional and individual investors to the downside of market volatility and, for a while, prompted great interest in low-volatility investing. Over the last six years, however, the market has been climbing; at the end of July 2015, the price level of the S&P 500 was over 200% higher than its trough in March 2009.[1] Low-volatility strategies have languished, and many investors appear to be sleepwalking again—possibly toward a cliff.

While human nature conditions us to chase whatever has been working best—a strategy that we know will backfire badly for the long-term investor—we also know that inertia generally doesn't pay off. Given the immense gains of this bull market, it may be timely to take some profits off the table, and to dampen our overall portfolio risk through exposure to the well-documented low-volatility effect.[2] But, like most things that sound inviting, not all low-volatility portfolio strategies are equally attractive. It pays to understand the differences. Let's focus first on issues surrounding the implementation of minimum-variance strategies. The same challenges arise for heuristic low-volatility portfolio construction; we consider their impact below.

The Need for Constraints

There are essentially two approaches to low-volatility investing. One of them, called minimum-variance investing, is based on quantitative optimization techniques,[3] while the other employs heuristic portfolio construction rules. Some products use combinations of the two approaches, but for this purpose, we will focus on the two primary approaches.

- The minimum-variance portfolio approach uses a numerical optimizer to select a set of non-negative stock weights such that the resulting predicted portfolio volatility is minimized.
- A heuristic approach to low-volatility investing typically uses a common risk measure (e.g., beta or volatility) to screen out volatile companies, and assigns weights to the remaining securities by their market capitalizations or the inverse of the company-specific risk measure.

Solidly grounded in finance theory, the minimum-variance method is clearly a sound approach to constructing a low-volatility portfolio. Nonetheless, implementing this method may be more problematic than many investors realize, and the chosen solutions unavoidably affect investment results.[4] The challenges relate to "implementation shortfall," including disappointing out-of-sample performance due to estimation errors,[5] extreme and unstable portfolio characteristics, and high transaction costs.[6]

In addition to applying advanced statistical techniques,[7] asset managers and index providers often mitigate estimation errors—and address other minimum-variance implementation issues—by imposing constraints on the optimization process. They typically apply minimum and maximum weight constraints to avoid over-concentration in individual stocks; sector and regional weight constraints to forestall excessive allocations to any one industry group or geographical area; and turnover constraints to control trading costs.

These restrictions are successful in fixing the identified problems, and as a result, they make minimum-variance portfolios more investable. But the improvements come at a price. The constraints progressively nudge the portfolio closer to the market-cap-weighted index and, more importantly, introduce a link between the price of a stock and its weight in our portfolio. As we (and others) have demonstrated, the link between stock price and the portfolio weight has a cost; indeed, severing that link is the main source of alpha for fundamentally weighted and other non-cap-weighted strategies. As a practical matter, it appears that optimization-based minimum-variance strategies cannot be implemented without meaningful slippage.

Empirical Study

To evaluate the impact of typical constraints, we constructed three hypothetical long-only minimum variance portfolios[8] from the 1,000 stocks with the highest market capitalization in our universe: a U.S. portfolio, a developed markets portfolio, and an emerging markets portfolio. The baseline minimum-variance portfolios, which were rebalanced annually over the simulation periods, incorporated minimum and maximum weight constraints on individual stock positions. Then we serially applied a capacity constraint related to the stocks' weights in the market-cap-weighted benchmark; sector and regional concentration constraints; and a ceiling on one-way turnover. (See the Appendix for details on the constraints and regional makeup.)

In Exhibit 1, we see that the stepwise imposition of constraints decreases turnover, increases weighted-average market capitalization (WAMC), increases the effective number of stocks,[9] and decreases the aggregate weight of the top 10 names. Just as intended, the constraints limit trading and give the minimum-variance portfolios greater liquidity, higher capacity, and lower concentration.

In Panel A of Exhibit 2, we see how performance drops, risk rises, and the Sharpe ratio falters, as we apply more constraints to the simulated U.S. portfolio. Interestingly, the capacity constraint helps performance in the hypothetical developed markets (Panel B) and emerging markets (Panel C) portfolios. In all markets, tracking error against the cap-weighted benchmark decreases monotonically with each new constraint. By partially reversing

Panel A: United States (September 1967–2014)	Turnover	WAMC Ratio**	Price-to-Book	Price-to-Sales	Price-to-Earnings	Price-to-Cash Flow	Dividend Yield	Effective *N*	Weight in Top 10 Holdings
Simulated Baseline Minimum Variance Portfolio	49.5%	20.5%	2.01	1.00	15.08	5.72	3.8%	34	44.7%
Add Capacity Constraint	36.7%	33.1%	2.08	0.99	15.11	5.66	3.8%	89	15.0%
Add Sector Concentration Constraint	38.2%	43.8%	2.26	0.98	15.80	6.15	3.2%	89	15.0%
Add Turnover Constraint	20.0%	45.2%	2.21	0.94	15.63	6.05	3.2%	105	15.0%
Cap-Weighted Benchmark	4.7%	100.0%	2.36	1.08	16.28	6.13	2.7%	150	19.4%
Panel B: Developed Markets (September 1987–2014)	**Turnover**	**WAMC Ratio****	**Price-to-Book**	**Price-to-Sales**	**Price-to-Earnings**	**Price-to-Cash Flow**	**Dividend Yield**	**Effective *N***	**Weight in Top 10 Holdings**
Simulated Baseline Minimum Variance Portfolio	49.7%	27.1%	2.23	1.20	18.05	6.74	2.8%	42	39.6%
Add Capacity Constraint	40.4%	38.0%	2.34	1.19	18.35	6.59	2.8%	92	15.0%
Add Region Concentration Constraint	42.7%	39.5%	2.47	1.21	19.11	7.00	2.6%	93	15.0%
Add Sector Concentration Constraint	45.2%	42.8%	2.57	1.20	19.60	7.62	2.3%	93	15.0%
Add Turnover Constraint	20.2%	43.0%	2.56	1.19	19.62	7.54	2.3%	111	14.8%
Cap-Weighted Benchmark	6.5%	100.0%	2.63	1.20	19.78	8.08	2.0%	329	10.6%
Panel C: Emerging Markets (September 2002–2014)	**Turnover**	**WAMC Ratio****	**Price-to-Book**	**Price-to-Sales**	**Price-to-Earnings**	**Price-to-Cash Flow**	**Dividend Yield**	**Effective *N***	**Weight in Top 10 Holdings**
Simulated Baseline Minimum Variance Portfolio	43.6%	17.6%	2.27	1.62	15.20	8.49	3.8%	33	45.7%
Add Capacity Constraint	36.5%	21.1%	2.07	1.46	13.82	7.43	3.9%	97	15.0%
Add Region Concentration Constraint	39.1%	24.8%	1.92	1.32	13.14	7.18	3.9%	96	15.0%
Add Sector Concentration Constraint	41.0%	26.5%	1.94	1.24	12.90	7.55	3.8%	98	15.0%
Add Turnover Constraint	20.2%	26.4%	1.97	1.23	13.30	7.64	3.6%	109	15.0%
Cap-Weighted Benchmark	8.4%	100.0%	1.79	1.12	11.52	6.00	3.0%	218	14.7%

*This table was revised after the article first appeared on the Research Affiliates website.
**The WAMC ratio expresses the portfolios' WAMC as a percentage of the cap-weighted benchmark's WAMC.

Exhibit 1: Effect of Constraints on Simulated Portfolio Charcateristics*
Source: Research Affiliates, LLC. using data from Compustat, CRSP, Worldscope, and Datastream

Panel A: United States (January 1967–September 2014)	Return	Volatility	Sharpe Ratio	Return in Excess of Benchmark	Tracking Error	Information Ratio
Simulated Baseline Minimum Variance Portfolio	12.0%	12.1%	0.57	1.6%	9.2%	0.18
Add Capacity Constraint	11.2%	12.3%	0.50	0.9%	7.5%	0.12
Add Sector Concentration Constraint	11.7%	12.9%	0.51	1.4%	6.0%	0.23
Add Turnover Constraint	11.6%	13.0%	0.50	1.3%	5.5%	0.23
Cap-Weighted Benchmark	**10.3%**	**15.4%**	**0.34**	**0.0%**	**0.0%**	
Panel B: Developed Markets (January 1987–September 2014)	**Return**	**Volatility**	**Sharpe Ratio**	**Return in Excess of Benchmark**	**Tracking Error**	**Information Ratio**
Simulated Baseline Minimum Variance Portfolio	7.4%	10.3%	0.38	−0.3%	10.7%	−0.03
Add Capacity Constraint	8.5%	10.9%	0.46	0.7%	9.3%	0.08
Add Region Concentration Constraint	8.2%	11.5%	0.41	0.5%	8.5%	0.06
Add Sector Concentration Constraint	8.2%	12.1%	0.39	0.5%	7.2%	0.06
Add Turnover Constraint	8.4%	12.4%	0.40	0.7%	6.4%	0.11
Cap-Weighted Benchmark	**7.7%**	**15.6%**	**0.27**	**0.0%**	**0.0%**	
Panel C: Emerging Markets (January 2002–September 2014)	**Return**	**Volatility**	**Sharpe Ratio**	**Return in Excess of Benchmark**	**Tracking Error**	**Information Ratio**
Simulated Baseline Minimum Variance Portfolio	16.4%	12.1%	1.24	3.2%	15.0%	0.21
Add Capacity Constraint	19.1%	14.5%	1.22	5.9%	11.7%	0.51
Add Region Concentration Constraint	17.6%	15.2%	1.06	4.4%	10.0%	0.44
Add Sector Concentration Constraint	16.4%	15.6%	0.96	3.2%	9.5%	0.34
Add Turnover Constraint	16.9%	16.2%	0.95	3.8%	8.6%	0.44
Cap-Weighted Benchmark	**13.2%**	**22.2%**	**0.53**	**0.0%**	**0.0%**	

Exhibit 2: Performance of Simulated Minimum Varience Portfolios
Source: Research Affiliates, LLC. using data from Bloomberg, MSCI, Compustat, CRSP, Worldscope, Datastream, and Kenneth French

the optimization, the added constraints move the portfolios away from the theoretical minimum-variance baseline toward the cap-weighted benchmark.

The effect of constraints on the ratios of excess return to volatility and value added to tracking error can be seen in Exhibit 3. Taken together, the constraints push the U.S. minimum-variance portfolio in the direction of the cap-weighted benchmark.

We also observe that the U.S. minimum-variance portfolio's sector allocation more closely resembles that of the cap-weighted benchmark when all constraints are in effect. Exhibits 4–6 display simulated three-month smoothed sector weights using Kenneth French's 12-industry classification. In the baseline case, shown in Exhibit 4, the utilities sector has a very large allocation over most of the measurement period. The fully constrained portfolio (Exhibit 5) has a more balanced allocation to economic sectors, much like the cap-weighted benchmark (Exhibit 6).

So far, we have studied the optimization-based approach to low-volatility investing. We confirm that the optimization process must be constrained to assure the minimum-variance portfolio is implementable. These constraints are also necessary to obtain reasonable portfolio characteristics such as diversification and capacity. But they have a cost. The portfolio becomes more like the market, and the risk increases, with mixed effects on risk-adjusted performance over the simulation periods. Let's now turn to the heuristic approach to low-volatility investing.

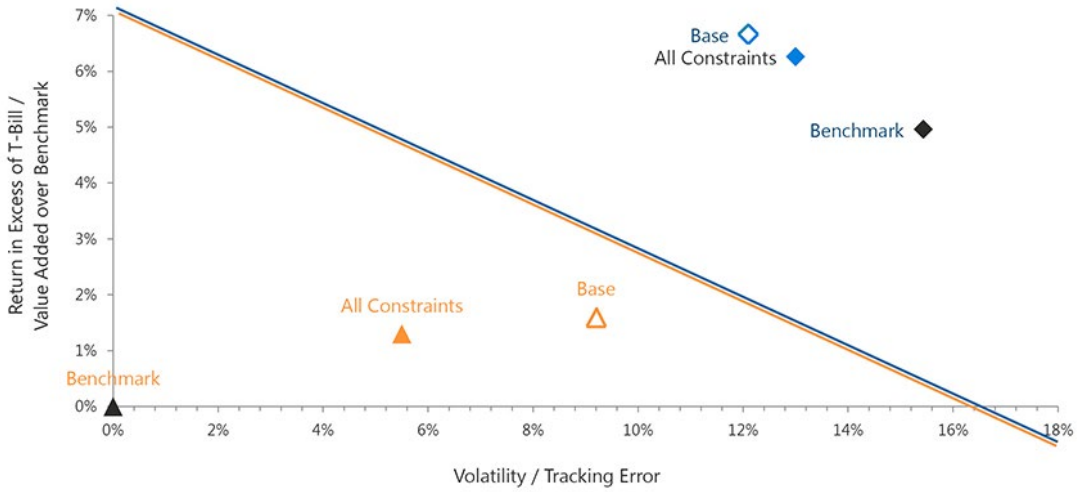

Exhibit 3: Impace of Constraints on U.S. Minimum-Varience Portfolio (Jan. 1967-Sept. 2014)
Source: Research Affiliates, LLC. using data from Compustat, CRSP, Worldscope, Datastream, and Kenneth French

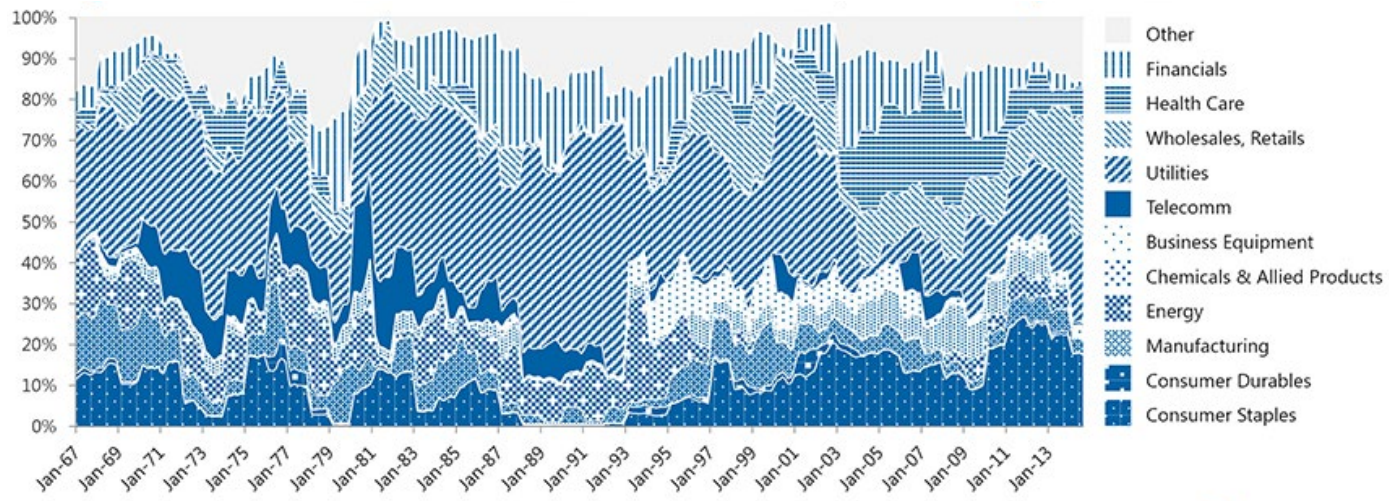

Exhibit 4: U.S. Sector Allocations (Baseline Portfolio, Jan. 1967-Sept. 2014)
Source: Research Affiliates, LLC. using data from Compustat, CRSP, Worldscope, and Datastream

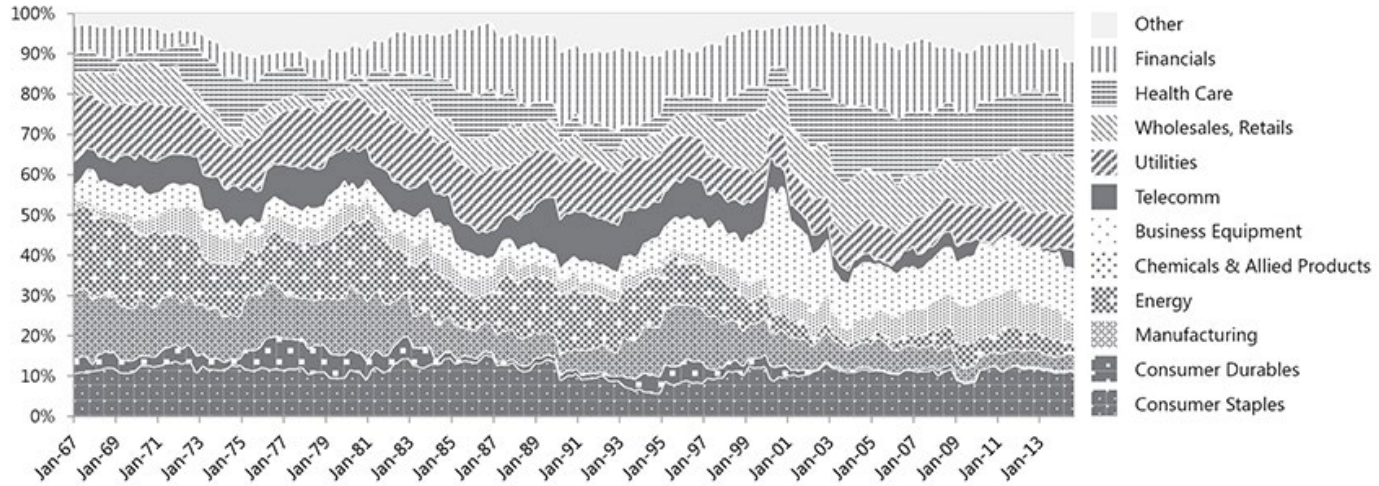

Exhibit 5: U.S. Sector Allocations (Fully Constrained Portfolio, Jan. 1967-Sept. 2014)
Source: Research Affiliates, LLC. using data from Compustat, CRSP, Worldscope, and Datastream

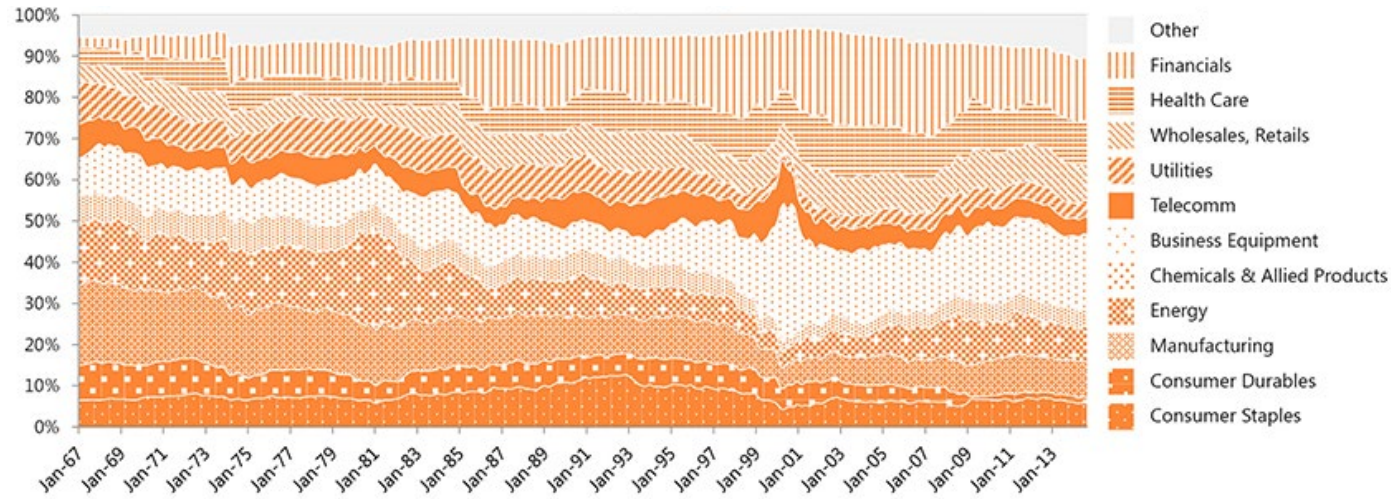

Exhibit 6: U.S. Sector Allocations (Cap-Weighted Benchmark, Jan. 1967-Sept. 2014)
Source: Research Affiliates, LLC. using data from Compustat, CRSP, Worldscope, Datastream, and Kenneth French

Panel A: United States (January 1967–September 2014)	Return	Volatility	Sharpe Ratio	Return in Excess of Benchmark	Tracking Error	Information Ratio
Baseline Heuristic Portfolio	12.0%	12.5%	0.55	1.6%	8.4%	0.19
Add Sector Concentration Constraint	11.6%	12.8%	0.51	1.2%	6.6%	0.19
Add Volatility Banding	11.7%	12.8%	0.51	1.3%	6.7%	0.19
Fundamental Index	**12.3%**	**15.5%**	**0.47**	**1.9%**	**4.6%**	**0.42**
Cap-Weighted Benchmark	**10.3%**	**15.4%**	**0.34**	**0.0%**	**0.0%**	
Panel B: Developed Markets (January 1987–September 2014)	**Return**	**Volatility**	**Sharpe Ratio**	**Value Added**	**Tracking Error**	**Information Ratio**
Baseline Heuristic Portfolio	11.2%	11.5%	0.68	3.6%	9.8%	0.37
Add Region Concentration Constraint	10.7%	11.4%	0.63	3.0%	8.5%	0.36
Add Sector Concentration Constraint	10.8%	12.1%	0.61	3.2%	7.5%	0.42
Add Volatility Banding	11.0%	12.2%	0.62	3.3%	7.5%	0.44
Fundamental Index	**10.8%**	**15.4%**	**0.48**	**3.2%**	**5.4%**	**0.59**
Cap-Weighted Benchmark	**7.7%**	**15.6%**	**0.27**	**0.0%**	**0.0%**	
Panel C: Emerging Markets (January 2002–September 2014)	**Return**	**Volatility**	**Sharpe Ratio**	**Value Added**	**Tracking Error**	**Information Ratio**
Baseline Heuristic Portfolio	18.1%	16.0%	1.05	5.7%	9.4%	0.60
Add Region Concentration Constraint	17.8%	19.4%	0.85	5.4%	6.6%	0.81
Add Sector Concentration Constraint	17.0%	18.6%	0.84	4.6%	6.3%	0.72
Add Volatility Banding	17.8%	18.7%	0.88	5.4%	6.3%	0.86
Fundamental Index	**18.2%**	**23.1%**	**0.73**	**5.8%**	**4.1%**	**1.44**
Cap-Weighted Benchmark	**13.2%**	**22.2%**	**0.53**	**0.0%**	**0.0%**	

Exhibit 7:Performance of Simulated Heuristic Low-Volatility Portfolios
Source: Research Affiliates, LLC. using data from Bloomberg, MSCI, Compustat, CRSP, Worldscope, Datastream, and Kenneth French

Panel A: United States (January 1967–September 2014)	Turnover	WAMC Ratio	Price to Book	Price to Sales	Price to Earnings	Price to Cash Flow	Dividend Yield
Baseline Heuristic Portfolio	18.2%	111.3%	1.76	0.92	13.29	4.86	4.6%
Add Sector Concentration Constraint	17.3%	126.7%	1.81	0.84	13.57	4.90	4.2%
Add Volatility Banding	15.1%	125.8%	1.80	0.84	13.57	4.89	4.2%
Fundamental Index	**11.6%**	**94.5%**	**1.61**	**0.58**	**12.97**	**4.33**	**3.7%**
Cap-Weighted Benchmark	**4.7%**	**100.0%**	**2.36**	**1.08**	**16.28**	**6.13**	**2.7%**
Panel B: Developed Markets (January 1987–September 2014)	**Turnover**	**WAMC Ratio**	**Price to Book**	**Price to Sales**	**Price to Earnings**	**Price to Cash Flow**	**Dividend Yield**
Baseline Heuristic Portfolio	21.5%	133.7%	1.95	0.94	14.39	5.26	3.8%
Add Region Concentration Constraint	23.6%	121.1%	1.87	0.85	15.27	5.21	3.7%
Add Sector Concentration Constraint	21.5%	134.6%	1.90	0.80	14.76	5.26	3.5%
Add Volatility Banding	18.5%	135.0%	1.89	0.80	14.80	5.25	3.5%
Fundamental Index	**12.9%**	**103.4%**	**1.60**	**0.52**	**14.10**	**4.05**	**3.3%**
Cap-Weighted Benchmark	**6.5%**	**100.0%**	**2.63**	**1.20**	**19.78**	**8.08**	**2.0%**
Panel C: Emerging Markets (January 2002–September 2014)	**Turnover**	**WAMC Ratio**	**Price to Book**	**Price to Sales**	**Price to Earnings**	**Price to Cash Flow**	**Dividend Yield**
Baseline Heuristic Portfolio	27.7%	63.0%	1.53	0.97	10.98	4.85	5.4%
Add Region Concentration Constraint	28.0%	117.4%	0.91	0.58	6.48	2.77	7.2%
Add Sector Concentration Constraint	26.1%	108.1%	1.02	0.64	7.05	3.11	6.7%
Add Volatility Banding	23.2%	103.0%	1.01	0.62	7.05	3.09	6.6%
Fundamental Index	**16.3%**	**91.8%**	**0.86**	**0.41**	**6.10**	**2.64**	**6.7%**
Cap-Weighted Benchmark	**8.4%**	**100.0%**	**1.79**	**1.12**	**11.52**	**6.00**	**3.0%**

Exhibit 8:Performance of Simulated Heuristic Low-Volatility Portfolios
Source: Research Affiliates, LLC. using data from Bloomberg, MSCI, Compustat, CRSP, Worldscope, Datastream, and Kenneth French

The Heuristic Approach

We conducted a similar analysis of a heuristic approach to low-volatility portfolio construction. To construct the simulated baseline heuristic portfolios, we selected the 200 stocks with the lowest volatility from fundamentally weighted indices for the U.S., developed, and emerging markets. To construct region- and sector-constrained portfolios, we selected from the fundamentally weighted indices' constituents the 20% of stocks with the lowest volatility within each region and sector, thereby conserving the original allocations. Finally, to incorporate a turnover constraint, we limited trading to removing stocks whose volatility moves outside a pre-established band and adding previously ineligible stocks whose volatility now falls within the band. This approach to turnover control suits heuristically constructed portfolios better than the explicit turnover constraints used in minimum-variance portfolios. Performance statistics for the baseline and constrained low-volatility portfolios are presented in Exhibit 7. (We showed the same measures for the simulated minimum-variance portfolios in Exhibit 2.) In the United States, the minimum-variance and heuristic low-volatility portfolios have roughly comparable absolute and risk-adjusted returns. In the developed markets, the heuristic strategy has higher absolute returns and higher Sharpe ratios; in the emerging markets, the minimum-variance approach has lower absolute returns but higher Sharpe ratios. Neither approach prevails in all regions.

The heuristic approach is, however, significantly superior in terms of transaction costs and valuation features. In **Exhibit 8**, we see that, across regions, the baseline and constrained heuristic portfolios have substantially higher weighted-average market cap, lower price multiples, and higher dividend yields. (Exhibit 1 displayed the same measures for the minimum-variance portfolios.) In addition, the heuristically constructed portfolios have lower turnover in the U.S. and developed markets. These characteristics make the heuristic approach cheaper in terms of fundamental valuations and, outside the emerging markets, more efficient in terms of trading activity.

In Closing

As the study summarized here demonstrates, constraints like those that index providers typically introduce in the optimization and portfolio construction process succeed in making minimum-variance portfolios more investable by improving liquidity, avoiding extreme allocations, and controlling transaction costs. All the same, there are side effects. In general, the constraints tend to make minimum-variance portfolios look a little more like cap-weighted indices. In so doing, the constraints increase portfolio volatility, compromising a key feature (and rendering the term "minimum variance" technically inaccurate). In comparison, constraints similarly designed to improve the investability of heuristically constructed low-volatility portfolios tend to preserve the intended portfolio characteristics. When evaluating smart beta alternatives, it clearly pays to understand the trade-offs that come into play in the transition from theory to practice.

Endnotes

1. The S&P 500 Index closing price level was 676.53 on March 9, 2009, and 2103.84 on July 31, 2015, a change of 211%.
2. See Chow, Hsu, Kuo, and Li (2014); Soe (2012); Blitz, Pang, and van Vliet (2012).
3. The minimum-variance method is offered by several influential market providers, such as MSCI.
4. See Behr, Guettler, and Miebs (2008).
5. See Jagannathan and Ma (2003); Kempf and Memmel (2003); AGIC Systematic Investment Team (2012).
6. See Chow, Hsu, Kuo, and Li (2014), and Arnott (2006).
7. Methods available to mitigate the estimation errors inherent in sample covariance matrices include the Sharpe (1964) factor-based approach, the Elton and Gruber (1973) constant correlation approach, and the Ledoit and Wolf (2004) statistical shrinkage approach.
8. In brief, we employed an optimization routine to find a numerical solution of portfolio weights that minimizes portfolio variance under constraints. To ensure that the covariance structure inputs were positive definite, we applied principal component analysis to the covariance matrix, which was estimated using up to five years of monthly excess returns.
9. See the Appendix for the mathematical definition of effective N (here, the effective number of stocks).

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Appendix

A. PORTFOLIO CONSTRAINTS

1. Minimum weight constraint. Weights smaller than 0.05% are forced to zero.
2. Maximum weight constraint. Individual stock weights are capped at 5%.
3. Capacity constraint. The weight of a stock is capped at the lower of 1.5% or 20 times its weight in the corresponding cap-weighted portfolio. Note that this constraint dominates the maximum weight constraint.
4. Sector concentration constraint. Sector weights are not allowed to deviate more than ±5% from the corresponding cap-weighted sector weights.
5. Region concentration constraint. If the cap-weighted region weights are less than 2.5%, the minimum-variance region weights are capped at three times their weight in the cap-weighted portfolio. Otherwise, they are not allowed to deviate more than ±5% from the corresponding cap-weighted region weights.
6. Turnover constraint. The maximum allowable one-way index turnover is 20%.

B. MARKET AND REGION DEFINITIONS

Developed Markets

Region 1 = DevEME, which includes Austria, Belgium, Denmark, Finland, Greece, Ireland, Israel, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and Switzerland

Region 2 = DevAPAC, which includes Australia, Hong Kong, New Zealand, and Singapore

Region 3 = France

Region 4 = Germany

Region 5 = United Kingdom

Region 6 = Japan

Region 7 = Canada

Region 8 = United States

Emerging Markets

Region 1 = EMEMEA, which includes Czech Republic, Egypt, Hungary, Morocco, Poland, and Turkey

Region 2 = EMAPAC, which includes Indonesia, Malaysia, Philippines, and Thailand

Region 3 = EMAME, which includes Chile, Colombia, Mexico, and Peru

Region 4 = South Africa

Region 5 = Russian Federation

Region 6 = India

Region 7 = China

Region 8 = Taiwan

Region 9 = South Korea

Region 10 = Brazil

C. EFFECTIVE NUMBER OF STOCKS

This is the reciprocal of the Herfindahl ratio, which was developed to gauge monopoly concentration in industry, repurposed for investment management. Hypothetically a portfolio of 100% weight in 1 stock has an Effective N of 1; a portfolio of equal weight to 1,000 stocks has an Effective N of 1,000. In another words, these minimum variance portfolios are as diversified as equally weighting only 30–40 stocks.

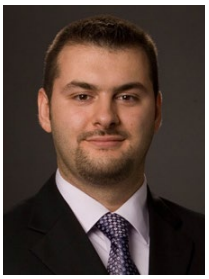
Authors' Bios

Feifei Li, Ph.D., FRM
Director
Head of Investment Management

Feifei Li leads the Investment Management group comprising three teams: Product Research, Portfolio Construction, and Investment Systems. She works closely with researchers in designing all the investment strategies offered by Research Affiliates. She supervises the execution of the approved methodology for our strategies, construction and delivery of model portfolios, as well as risk attributions and analytic support.

Feifei has taught undergraduate and MBA finance classes at the California Institute of Technology and University of California, Irvine. She conducts investment related research and has published numerous articles in both academic and practitioner journals, as well as chapters in investment related books. In 2015, Feifei and her co-authors won a Bernstein Fabozzi/Jacobs Levy "Outstanding Article" award for "A Study of Low-Volatility Portfolio Construction Methods," published in the Journal of Portfolio Management. She holds the Financial Risk Manager designation.

Feifei earned a BA from Tsinghua University's School of Management and Economics in Beijing. She earned her Ph.D. in finance at the University of California, Los Angeles, where she has conducted empirical research on corporate finance and event-driven investment strategies.



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Concentrated vs. Diversified Managers: Challenging What You Thought You Knew About "High Conviction"

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Introduction

The general rationale for concentrated portfolios suggests managers can't possibly have equal conviction about a large number of stocks. Under this school of thought, investors want a portfolio of "best ideas," rather than a diversified portfolio that could only represent diluted alpha information. Stock portfolios with many stocks and relatively lower tracking errors to benchmarks are often considered "closet indexers," not worth active management fees or the effort relative to a passive approach. The work of Cremers and Petajisto (2009)[1] gave credence to these biases with the introduction of the measure known as Active Share.

In simple terms, Active Share is a holdings-based calculation that measures the deviation of a portfolio from a benchmark in percentage terms. A portfolio with a score of 0% is the exact same as the benchmark, while a portfolio with an Active Share of 100% has no overlap in holdings with the benchmark. The original paper provided evidence among mutual funds of a relationship between a fund's deviation from a benchmark and its excess return. The Cremers and Petajisto (2009) paper added another manager analysis tool to plan sponsors' toolboxes, but it perpetuated a notion that high Active Share (and/or concentration) results in higher excess returns.

Review of Prior Work

Since the publishing of their original paper, there have been many articles, including work from AQR,[2] Fidelity,[3] and Axioma,[4] challenging any positive relationship between Active Share and excess return. Recent work from Andre Frazzini at AQR uses the same dataset as the original paper to obtain different results when mutual funds are grouped by and measured against more appropriate benchmarks. The original work organized all managers, from large-cap to small-cap, into one large data set. Their results were driven much more by the variation across capitalizations and benchmarks

than from differences in managers versus their relevant benchmarks.

Specifically, small-cap managers measured against a broad large-cap benchmark, such as the S&P 500 Index, will exhibit much higher Active Share than large-cap managers. Frazzini's work finds the empirical spread between high and low Active Share managers to have roughly equal numbers of positive and negative observations, depending on the specific benchmark. In other words, the results are largely random, and there is no measurable or statistically significant relationship between Active Share and excess return during that time period.

A 2014 paper from Fidelity similarly concludes that higher Active Share leads to higher dispersion and downside risk, attributing most of the positive relationship between Active Share and excess return to small-cap size exposure for managers.[5] In this view, Active Share merely becomes a proxy for small-cap exposure. Recently, the markets experienced a small-cap super-cycle that provided excess returns over large-cap stocks. This super-cycle was similar in duration and magnitude to 1975-83. This latest small-cap run largely encompassed the data set covered in the Active Share papers, which inflated the returns of high Active Share small-cap strategies measured against the broad market cap weighted benchmark.

Even the latest paper from Petajisto (2013),[6] building on the earlier framework of Cremers and Petajisto (2009), suggests the problem with most managers with low Active Share and lower tracking error is simply that the fee structure is too high. With high fee burdens, higher return potential is required for net of fee excess returns. In other words, with a lower fee structure, even lower-risk managers could potentially add value; it's not necessarily a function of alpha information related to the number of names. Moreover, the threshold as relevant for Active Share to add value is a relatively low 60%. The vast majority of active large-cap strategies satisfy this threshold — even those with relatively low tracking errors. (See the work from Fidelity for distributions of managers by Active Share). The average large-cap strategy has an Active Share of 75%, while it is 95% for small-cap strategies, according to the Fidelity paper.

Our Analysis

As with much of our prior work on the value of active management, we explored an institutional manager data set, rather than the retail mutual fund universe. We examined gross of fee returns for institutional managers, which are of primary interest to most plan sponsors. We used gross returns because institutional fees vary across mandates of varying sizes, allowing the reader to adjust the results based on their own appropriate fee assumption.

We grouped and categorized our analysis by the number of stocks, rather than Active Share. We classified large-cap portfolios with up to 40 stocks as concentrated and those of 100 stocks or more as highly diversified, with the remainder constituting the third group that rests in between. The number of stocks in representative separate account portfolios is accurately and readily available from Morningstar and other manager databases. This simple metric is highly intuitive for most investors, while Active Share percentage is not. Moreover, Active Share is a point in time measure that requires detailed portfolio holdings and benchmark designation, which is information not readily available to investors for most managers. The Active Share metrics that do show up in databases are often self-reported manager statistics, rather than metrics that are independently calculated.

There can be a theoretical deviation between Active Share and the number of stocks for portfolios that hold a few highly concentrated bets along with a large number of small diversified stock holdings, but this is not typical. Empirically, we found a high degree of association between the number of stocks held and Active Share — an average correlation near -0.5 as of March 31, 2015, across large-cap and small-cap datasets (see appendix for details).

In the work of Petajisto (2013), the average number of holdings for the group classified as 'concentrated' was nearly 60 stocks, only slightly fewer than the group labeled as 'stock pickers.' Moreover, the concentrated group contained managers that held 107 stocks at just one standard deviation above the average of the group. This broad view of "concentration" strains most common definitions of the term. Furthermore, the Active Share calculation is highly dependent upon the benchmark selected. In our analysis, we avoided this benchmark-relative problem by using concentration measures based on number of stocks.

We grouped large-cap managers by style into growth, value, and blend. This style grouping rectified the benchmark-variation problem identified by Frazzini (2015). We removed composites that were passive, global, and/or contained bond holdings, short positions or leverage, sector strategies, and buy-write or covered call options strategies. We also removed any managers classified by institutional category with something other than large-cap domestic equity mandates. The style boxes had to be large cap and part of the institutional Morningstar category.

As a robustness check, we duplicated the analysis in Evestment for large-cap and small-cap managers without the style box consistency criteria or analytic output detail. The number of stocks for small-cap managers was slightly different to achieve similar population breakdowns between groups. With this second dataset, we achieved similar results, which appear in the appendix of this paper.

The results shown here are for the five-year period ended March 31, 2015, addressing most survivorship bias issues that long-term time windows of measurement entail. Moreover, this five-year time period is particularly relevant because it covers the out-of-sample period from the original Cremers and Petajisto (2009) paper published in the Financial Analyst Journal.

Results

When examining large-cap institutional managers grouped by style, we did not find an inverse relationship between the number of stocks in a manager's portfolio and returns, as would be implied in the Cremers and Petajisto papers. We did not find significant underperformance or outperformance of the category median, but we did find some underperformance of respective benchmarks in some styles for concentrated strategies. In sharp contrast, our results showed outperformance for diversified strategies relative to concentrated peers in all three style groups.

# Stock Holdings	# of Managers	3Yr Total Return	3 Yr % Rank	5 Yr Total Return	5 Yr % Rank	3 Yr Tracking Error	5 Yr Tracking Error	3 Yr Info Ratio	5 Yr Info Ratio	3 Yr Batting Avg	5 Yr Batting Avg	Avg # of Stock Holdings
Fewer than 40	123	14.70%	52nd	13.19%	54th	3.72%	4.13%	-0.37	-.031	46.74%	47.04%	30
41 to 99	200	15.72%	47th	13.63%	51st	2.98	3.25	-0.17	-0.22	48.51%	47.75%	60
More than 100	66	16.81%	29th	14.99%	26th	1.81	1.93	0.51	0.38	55.47%	55.05%	249

Exhibit 1: Active Large Cap Blend Managers (For Periods Ended March 31, 2015)
Source: Morningstar. Risk statistics versus Russell 1000 Index. Russell Investment Group is the source and owner of the trademarks, service marks and copyrights related to the Russell Indexes. Russell® is a trademark of Russell Investment Group.

# Stock Holdings	# of Managers	3Yr Total Return	3 Yr % Rank	5 Yr Total Return	5 Yr % Rank	3 Yr Tracking Error	5 Yr Tracking Error	3 Yr Info Ratio	5 Yr Info Ratio	3 Yr Batting Avg	5 Yr Batting Avg	Avg # of Stock Holdings
Fewer than 40	92	13.68%	62nd	12.60%	58th	5.04	5.41	-0.40	-0.28	45.65%	46.25%	30
41 to 99	182	15.89%	48th	13.61%	53rd	3.22	3.48	-0.07	-0.24	48.12%	46.97%	62
More than 100	56	17.65%	25th	15.16%	26th	2.71	2.79	0.62	0.29	54.96%	52.50%	168

Exhibit 2: Active Large Cap Value Managers (For Periods Ended March 31, 2015)
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# Stock Holdings	# of Managers	3Yr Total Return	3 Yr % Rank	5 Yr Total Return	5 Yr % Rank	3 Yr Tracking Error	5 Yr Tracking Error	3 Yr Info Ratio	5 Yr Info Ratio	3 Yr Batting Avg	5 Yr Batting Avg	Avg # of Stock Holdings
Fewer than 40	154	16.04%	50th	15.03%	46th	5.06	5.40	-0.05	0.08	50.39%	51.34%	31
41 to 99	210	15.87%	52nd	14.69%	51st	4.37	4.61	-0.10	0.01	51.19%	51.22%	60
More than 100	41	17.40%	32nd	15.97%	32nd	3.65	3.84	0.37	0.37	56.37%	55.24%	157

Exhibit 3: Active Large Cap Growth Managers (For Periods Ended March 31, 2015)
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Over the five-year period, the information ratios for the managers holding 100 or more names were all near or above the statistical t-stat thresholds for 95% significance (t-stat = IR * sq rt (n)) before fees. That threshold t-stat is 2.00 for 60 months and 2.03 for 36 months. Those with a positive information ratio added value gross of fees versus the benchmark, while negative scores detracted value. The same general patterns and conclusions also held for peer group percentile rankings and monthly batting averages.

The majority of active managers in the Large Cap Blend Category held between 40 and 100 stocks, but there were nearly twice as many managers that held fewer than 40 stocks as those that held more than 100 stocks. The diversified managers were the only group that added value on average over the latest three and five year periods, beating the Russell 1000 Index in more than 55% of the months.

There were slightly fewer active managers in the large-cap value space, but the group distributions were similar, except there were slightly fewer concentrated managers on a relative basis. The peer-relative and benchmark-relative performance stats were similar. Once again, concentrated managers were below-median on average (as measured by percentile rank), with negative information ratios and batting averages less than 50%.

The Large Cap Growth Category demonstrated the highest absolute and relative number of concentrated strategies and the fewest diversified strategies. Although the average relative performance of the concentrated strategies was also best in the large-cap growth style, the benchmark-relative performance was essentially flat, and the peer-relative performance was median. These numbers were largely indistinguishable from the bulk of managers that hold between 40 and 100 stocks, whereas the diversified managers holding 100 stocks or more still stood out as adding more value during this period.

Overall, our results challenge and run counter to the findings of Cremers and Petajisto (2009) and Petajisto (2013) for the retail mutual fund universe. The original paper established a classification framework for managers based on the intersection of tracking error and Active Share, as shown in Exhibit 4 (below). Petajisto (2013) maintains the same classification framework, as does Frazzini (2015), in challenging the methodology of the original work.

Exhibit 4: Active Share to Tracking Error Quadrant
Source: Cremers and Petajisto (2009)

Our findings challenge even this basic framework, because we found outperformance in the less concentrated (which we use as proxy for low Active Share) and low tracking error strategies. We also challenge this framework's descriptions of "factor bets," "closet indexing," etc.

Our results clearly showed no outperformance, and even underperformance in some cases, for highly concentrated and high tracking error managers before fees. We also found consistent outperformance for low concentration /low tracking error managers across large-cap styles. It is possible these different results can be reconciled to some degree by differences in time period, relative tracking errors, and use of concentration/ Active Share metrics between our groupings and those shown in Petajisto (2013).

Exhibit 5 from that paper (below) shows the tracking error of "stock pickers," which would be the bulk group, is 8.5%. It also shows they hold 66 stocks on average. The "concentrated" group has a tracking error of 15.8%, on average, and 59 stocks. These large tracking errors can only be explained by the benchmark and grouping problems noted in Frazzini (2015) and Fidelity (2014).

In sharp contrast, our analysis resulted in tracking errors in the 3%-4% range for the "bulk" group and 4%-5% for the "concentrated" group. Despite the fact that the Active Share papers try to correct for misspecification in the analysis with 4-factor Fama-French-Carhart alphas, such grouping problems still severely compromise the empirical analysis. As previously mentioned, the average "concentrated" manager holds 59 stocks, while just one standard deviation higher in the same group holds 107 stocks. That definition of concentration is most likely based on benchmark misspecification. In this framework, for instance, a diversified small-cap core manager with a relatively low tracking error would show up as a high Active Share/high tracking error manager relative to a broad market benchmark and would be labeled as "concentrated."

Empirical performance statistics based on this type of faulty grouping scheme lack a legitimate interpretation. Would any investor truly consider data based on a manager grouping that has an average tracking error of 15.8%, as shown for the "concentrated" group? That level of tracking error isn't possible without benchmark misspecification. For example, in the Morningstar separate account composite universe, even the Small Cap Growth Category constituent returns measured against an S&P 500 Index only achieved an average tracking error of 9.2% over the five-year period ended March 31, 2015. Any manager grouping measured against a relevant benchmark should arrive at average tracking errors that are only a fraction of those displayed by Petajisto (2013).

Group	Label	# of Funds	Assets (Millions)	Active Share	Tracking Error	Turnover	Expense Ratio	# of Stocks
A. Mean Values								
5	Stock Pickers	180	$430	97%	8.5%	83%	1.41%	66
4	Concentrated	45	463	98	15.8	122	1.60	59
3	Factor Bets	179	1,412	79	10.4	104	1.34	107
2	Moderately Active	541	902	83	5.9	84	1.25	100
1	Closest Indexers	180	2,009	59	3.5	69	1.05	161
ALL		1,124	$1,067	81%	7.1%	87%	1.27%	104
B. Standard Deviations								
5	Stock Pickers		$858	1.4%	1.9%	78%	0.40%	40
4	Concentrated		1,164	1.5	4.3	132	0.66	48
3	Factor Bets		5,174	12.2	4.2	106	0.49	137
2	Moderately Active		2,575	7.5	1.5	74	0.40	98
1	Closest Indexers		6,003	9.3	0.9	54	0.39	177
All			$3,846	14.0%	3.7%	83%	0.45%	119

Exhibit 5: Samples Statistics Across Various Fund Categories
Source: Petajisto (2013), Sample Statistics for Fund Categories, 1990 - 2009
Notes: This table shows sample statistics for the fund categories defined in (Petajisto 2013 paper), and subsequently used in the performance tables. The equal-weighted mean and standard deviation of each variable are first computed for each month over the sample period, and the reported numbers are their time-series averages across all the months.

Our analysis provided a relevant benchmark specification and was not driven by comparing small-cap managers or value managers against a broad market benchmark. As such, our findings challenge the fundamental groupings shown in Exhibit 5, which are critical to the original paper's interpretation of manager classification. In particular, we believe the Petajisto definition of "Factor Bets" consistent with high tracking error and low Active Share is more a function of benchmark misspecification than anything else. Largely, our interpretation of this is evidence of diversified portfolios compared with improper benchmarks.

The diversified group in our analysis had similar numbers of stocks and similar tracking errors to their "Closet Indexing" group, and yet it was the only group that added significant value in recent years. Moreover, we believe it most likely that our diversified group is the primary group employing the systematic "Factor Bets" identified in the original classification scheme. Perhaps the problem is the broad definition of "Factor Bets" in the Petajisto paper. He describes factor bets as follows: "involves time-varying bets on broader factor portfolios—for example, overweighting particular sectors of the economy, having a temporary preference for value stocks, and even choosing to keep some assets in cash rather than invest in equities."

This definition is different than how we believe most market participants would define factor-based investing. Factor-based investing should build diversified stock portfolios, sampling from a broad set of stocks to remove stock- specific risk, and focusing on factor exposures. This approach achieves consistent factor bets at relatively low tracking errors, consistent with the Fundamental Law of Active Management.[7]

Based on the answers to investment process questions in Morningstar, more than two-thirds of the concentrated and bulk groups in our analysis are classified as either fundamental or technical, with less than one-third labeling their processes as quantitative. The results were inverted for the diversified stock group, however, with more than two-thirds classifying their process as quantitative.

Most market observers would likely agree that quantitative investing is generally associated with systematic factor bets, diversified stock portfolios, and lower tracking errors, which is inconsistent with the Petajiisto Active Share classification of the world.

Conclusion

The Active Share measure and the empirical evidence it is based on have had a strong influence on generational thinking about manager value-added and potential value-added. Most likely, this is because it gave empirical credence to biases that were already in place regarding high-conviction managers. Particularly, after 2007 and the relative short-term underperformance of quantitative approaches thereafter, it also gave a basis for criticism of such strategies in a formal framework. Recently, this entire framework has come under scrutiny from many different venues. The latest work challenges numerous fundamental points of the original paper, as well as its empirical findings and conclusions.

We have shown the empirical evidence for the Active Share papers is based on groupings with benchmark misspecification that do not stand up to logical scrutiny. Recent work, using the original Active Share dataset but with proper benchmark specification, shows no consistent long-term relationship between Active Share and outperformance.[8] Moreover, the Active Share measure will be clustered above 95% for most small-cap managers, which allows for little delineation in many manager data sets. Yet, these same managers still can have large differences in numbers of stocks held, tracking error, and other meaningful measures.

Most institutional investors are interested in separate account composite returns of institutional managers and not retail mutual funds. There is also some question as to whether the groupings arrived at in prior Active Share papers and classified as concentrated, high conviction approaches are accurate descriptions. We use an institutional manager dataset and a number of stocks to ascertain any outperformance of clearly concentrated, high conviction strategies. Our results indicate clearly there is no associated outperformance for concentrated strategies in recent years. Our time period of analysis represents a time frame that is out of sample from the original Cremers and Petajisto (2009).

Interestingly, our results do show statistically significant outperformance of diversified strategies. Moreover, the grouping tracking errors and number of stocks challenge the classification scheme of Cremers and Petajisto (2009) and Petajisto (2013). The classification of "factor bets" as high tracking error with low Active Share seems unfounded. There is no reason to assume that a portfolio cannot deploy systematic factor bets that have the potential to add value, while achieving such with a diversified portfolio of stocks at a relatively low tracking error. In fact, the recent appetite for Smart Beta products, whether active or passive, is predicated on just that supposition.

Active Share measures active deviation from a benchmark. As with any benchmark-relative measure, the choice of benchmark matters a great deal. The measure does not take into account where the active bets come from —whether industry deviation or factor bets — so it reflects little qualitative information. Active Share is one measure among many in an analytical toolbox for evaluating managers, but we find little to no information on implications for potential alpha.

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Appendix

Data shown here represent correlations between number of stocks and Active Share (which is self-reported by managers relative to their own preferred benchmark) in each Evestment dataset. Correlations would be negative if as the number of portfolio holdings increased the Active Share reported decreased, indicating a positive relationship between concentration and Active Share.

3/31/15	Correlations
ALL LCC	-0.3965
ALL LCG	-0.5473
ALL LCV	-0.4930
ALL SCC	-0.4565
ALL SCG	-0.4455
ALL SCV	-0.5583

Data shown here represent correlations between number of stocks and excess return to their appropriately specified benchmarks in the Evestment dataset. Correlations would be negative if concentrated strategies were associated with excess returns and positive if diversified strategies were associated with excess returns.

3/31/15 Correlations	# of Managers	3 Yr	5 Yr
All LCC	304	0.0819	0.0804
ALL LCG	311	0.1337	0.0710
ALL LCV	350	0.0841	0.0529
ALL SCC	168	0.2021	0.1283
ALL SCG	180	0.0680	-0.0077
ALL SCV	230	0.0885	0.0387

Data shown here represent averages for groups drawn from the Evestment universe. Returns are average total returns for three- and five-year trailing returns and % rank represents percentile ranks, with 1 being best and 100 being worst. The results are consistent to those found in the Morningstar universe as described above.

3/31/15 Averages	# of Managers	3 Yr Total Return	3 Yr % Rank	5 Yr Total Return	5Yr % Rank
LCC: <=40	54	15.58	55	14.27	54
LCC: 41-99	144	16.18	53	14.26	53
LCC: >=100	106	16.73	38	14.87	39
LCG: <=40	102	15.83	51	15.28	47
LCG: 41-99	163	16.00	52	15.04	52
LCG: >=100	46	17.28	33	14.78	38
LCV: <=40	109	15.62	53	13.59	51
LCV: 41-99	182	16.07	48	13.69	50
LCV: >=100	59	17.03	36	14.35	39
SCC: <=60	42	15.11	65	14.77	63
SCC: 61-139	73	16.76	53	15.97	51
SCC: >=100	53	18.44	35	17.07	39
SCG: <=60	45	16.62	58	17.38	51
SCG: 61-139	107	17.39	50	17.18	52
SCG: >-140	28	18.51	39	17.92	42
SCV: <=60	74	15.46	55	14.73	48
SCV: 61-139	109	15.99	50	14.35	53
SCV: >=140	47	17.09	41	15.36	41

Authors' Bios

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Mr. Gustafson is a member of Chicago Equity Partners' quantitative analysis group, which is responsible for the firm's proprietary quantitative model and its ongoing developmental efforts. Prior to joining our firm, he held positions at Ibbotson Associates and SEI Corporation. Mr. Gustafson earned bachelor's degrees in history and economics from University of Pennsylvania, an MBA from Loyola University Chicago, and a master's degree in financial economics from the University of London. He holds the Chartered Financial Analyst (CFA) designation, and is a member of the CFA Institute, the CFA Society of Chicago, the Chicago Quantitative Alliance, the American Finance Association, and the American Economics Association.

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Ms. Halper is a member of Chicago Equity Partners' quantitative analysis group, which is responsible for the firm's proprietary quantitative model and its ongoing developmental efforts. Prior to joining our firm, she worked at the institutional futures sales desk at Paine Webber. Ms. Halper holds a bachelor's degree in mathematics from Loyola University Chicago and a master's degree in financial mathematics from the University of Chicago. She holds the Chartered Financial Analyst (CFA) designation, and is a member of the CFA Institute, the Chicago Quantitative Alliance, and the Economic Club of Chicago. Additionally, she is on the Board of Trustees for La Rabida Children's Hospital, and is a board member of the CFA Society of Chicago.

VC-PE Index

A Look at North American Private Equity as of Q3 2015

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North American median returns were mixed in Q3 2015. Focusing on the seven vintage years from 2007 through 2013, we found that median TVPI figures for North America All PE averaged a 0.52% increase. This was driven by the venture capital industry.

Median TVPI figures for venture capital saw positive changes in five of the seven vintage years in our analysis. The average increase in median TVPI for venture capital was 5.9%. This is in comparison to North American buyouts, which only saw positive changes in three of the seven vintage years. The average change in median TVPI for buyouts was -1%.

Median DPI figures for the venture capital industry jumped noticeably in several vintage years. For the 2008 through 2010 vintage years, median DPI figures in venture capital jumped at least 25%. On an absolute basis, venture capital distributions are still lagging behind the buyout industry for most vintage years. This is not unexpected given venture's longer maturation period but it also means venture capital funds are more exposed to fluctuating valuations.

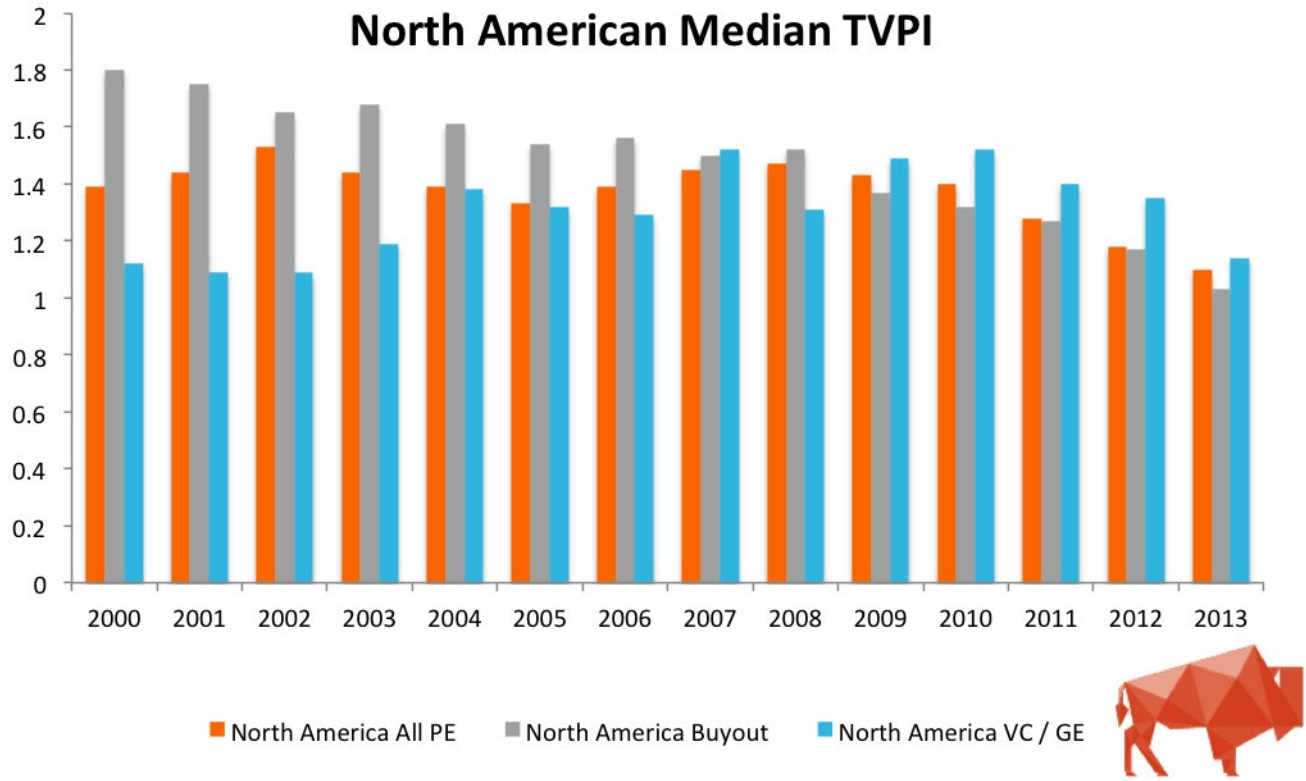

Exhibit 1: North American TVPI
Source: Bison

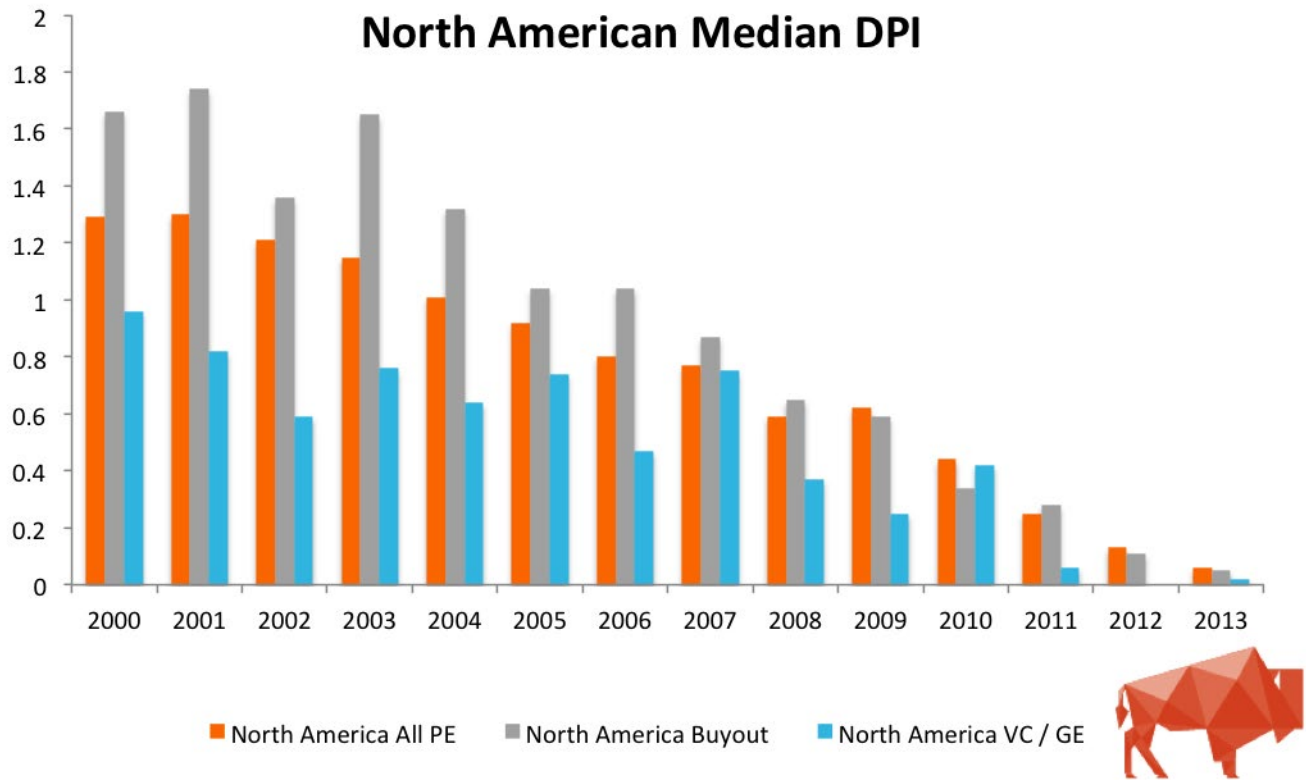

Exhibit 2: North American Median DPI
Source: Bison

Authors' Bios

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Prior to founding Bison, Mike Nugent held senior roles at SVG Advisers, LP Capital Advisors and HarbourVest Partners, and has more than $3B in private market commitments to his credit. Mike started his career in the public markets with the NASDAQ Stock Market, and also gained significant operating experience while running operations for a textiles manufacturer. He received his MBA from Boston College, and his BA from St. Bonaventure University. Mike lives on the North Shore of Massachusetts with his wife and two sons.

Mike Roth
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Mike Roth is the Research Manager at Bison and oversees the data collection and content production. Before Bison, Mike spent six years on the investment team at SVG Advisers. There, he conducted research and due diligence on buyout and venture capital funds in the Americas. Mike received his BA in Economics from Boston College and is a CFA Charterholder.

Global Property Performance

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Summary

Global property held directly by private investors delivered a total return of 10.7% in 2015, marking the sixth consecutive year of positive performance since the global financial crisis (GFC) and the strongest annual return since 2007. Global performance edged modestly upward from 10.0% in 2014, to reach its highest level since 2007. Ireland continued to lead global markets, though returns moderated from near 40% in 2015 to 25.0% in 2015. Ireland's performance was followed by Spain, at 15.3%, and Sweden, at 14.1%. The UK (13.1%) and USA (12.1%) also provided double-digit returns above their long-term averages and above the global index in 2015.

The cyclical and structural dynamics of real estate attracted a wave of capital in this cycle that has propelled the asset class through a period of strong performance. The appeal was initially cyclical, as depressed prices attracted capital in the immediate aftermath of the GFC. In a typical cycle, tightening real estate yields would slow the flow of capital, but in recent years, record-low bond yields and financing costs have kept spreads attractive. The atypical nature of this cycle continues to keep investors on alert for the inevitable inflection point that, at least in 2015, remained illusory.

Six Consecutive Years of Strong Global Performance

The *IPD* Global Annual Property Index registered a total return of 10.7% in 2015, the sixth consecutive year of strong returns since the GFC, and the best performance since 2007. Global performance has remained remarkably steady through the post-recession years, with fewer than 350 basis points of variation in the headline number since 2010.

Capital Growth Returns to Pre-Recession Levels

Over the long term, real estate generates most of its performance through income, with over

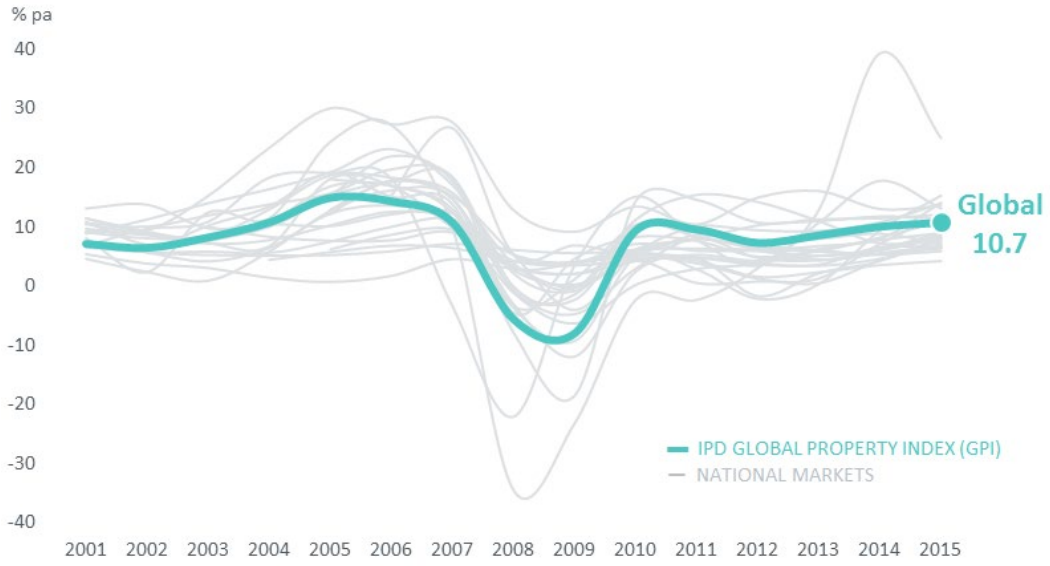

Exhibit 1: Total Returns to 2015 Across National Markets
Source: MSCI; KTI
All property annual returns in local currency

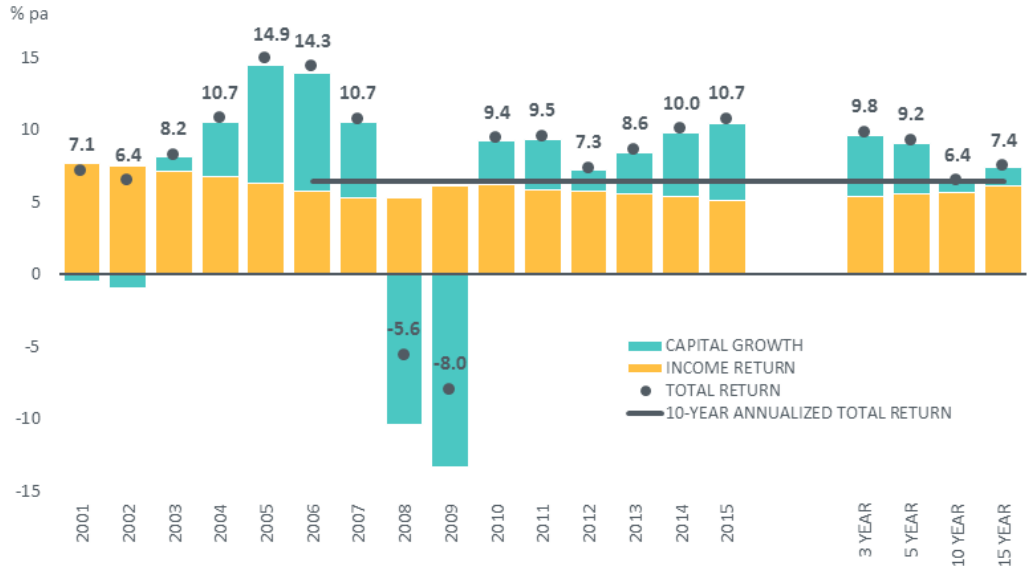

Exhibit 2: Global All Property Total Return History
Source: MSCI; KTI
Including contributing components of total return

80% of total return sourced through the income stream over the past 15 years. In 2015, the global income return narrowed to just 5.1%, with value growth representing more than half of total return for the first time since 2006. This recent trend has been driven by the weight of capital moving into real estate and with it, yield compression. Although income return has fallen over the last five years it held above 5%, still significantly higher than for equities and bonds.

Volatile, Opportunistic Markets Lag Pre-Recession Value Peaks

As investors weigh important tactical considerations for new acquisitions and for existing portfolios, they are likely to reflect on the cyclical position of individual markets. Through the most recent cycle, a few countries have fully recovered value lost during the downturn, including Canada, Sweden, and Australia. Others such as Switzerland and South Korea showed resilience during the worst years of the GFC and had little if any significant losses to be recovered. Large markets like the USA and UK had recovered nearly all of their lost value by 2015 while the year's best performers—the volatile markets of Ireland and Spain—intrigued opportunistic investors, in part, because they remained, even in 2015, well below the capital value levels experienced in 2015.

In the Long View, Real Estate Remains an Income Play

The squeezing of the income yield across so many global markets is notable but it is nonetheless cyclical, not structural, and it obscures the fact that, on average, roughly 80% of the total return in real estate investments is derived from rents, not from value growth. Looking backward and annualizing the components of total return incrementally through the GFC and into prior years,

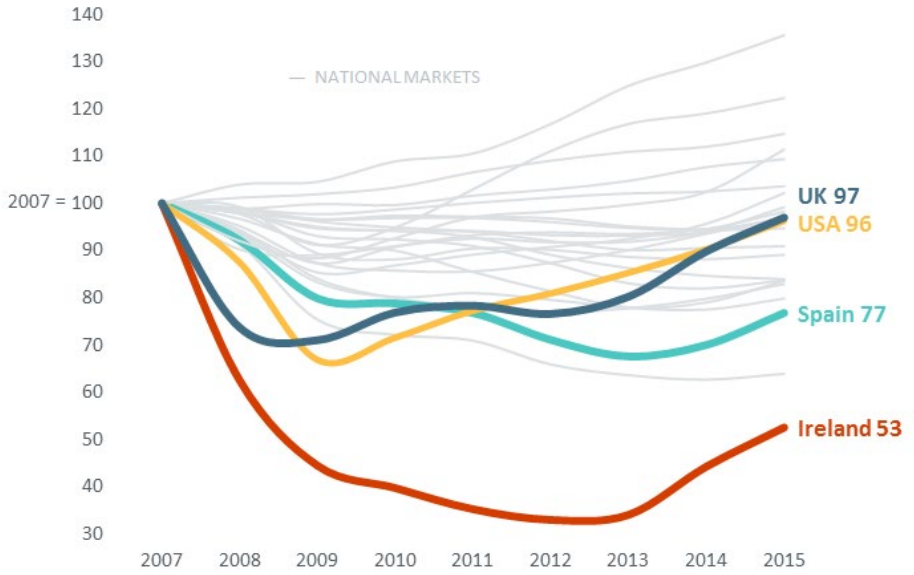

Exhibit 3: Capital Value Growth Across Markets, 2007-2015
Source: MSCI; KTI
2007 indexed to 100

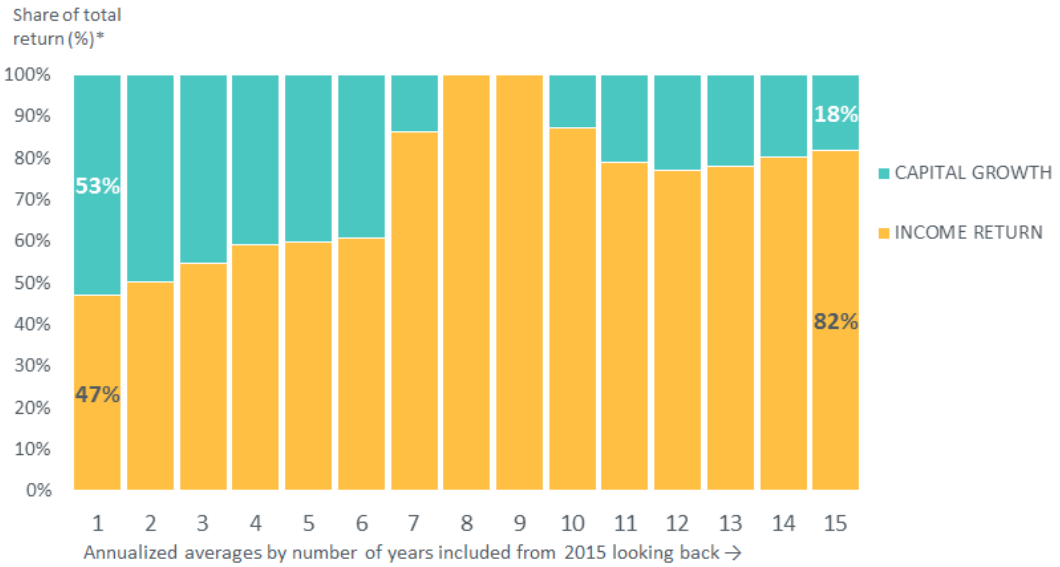

Exhibit 4: Cumulative Contributions to Global Total Return Over Time
Source: MSCI; KTI
Composition of global total return over annualized periods of 1 to 15 years as of 2015
*Note: Approximate shares exclude residual effects. Income return shown as 100% where capital growth is negative.

the components eventually begin to level out, with income return roughly 80% of total performance.

Real Estate Has Performed well in the Post-Recession Period

The attractiveness of wide spreads can be seen more clearly when placed in the broader perspective of the global investment environment. The post-GFC period of capital flows to real estate is part of a long-term trend of investors moving toward alternative investments. Cumulative annual reviews of pension asset allocations in seven key global markets by Willis Towers Watson shows that investors in 2015 allocated 24% to alternatives, a percentage that has moved up incrementally from a level of 5%-7% in the 1990s (Willis Towers Watson, 2016 (and prior years)).

Unlisted direct real estate outpaced both equities and bonds during 2015 by wide margins, though over the longer periods of three, five, and ten years, this degree of outperformance was less visible. A close examination of multi-asset class returns below also shows that unlisted *fund level* real estate outperformed unlisted direct or *asset level* real estate over the one, three, and five year periods where the series is available. The strong performance at the fund level has much to do with the timing of the real estate cycle as funds benefited strongly from the use of leverage at low interest rates. By contrast, the unlisted total returns of directly owned assets are calculated on an unlevered basis.

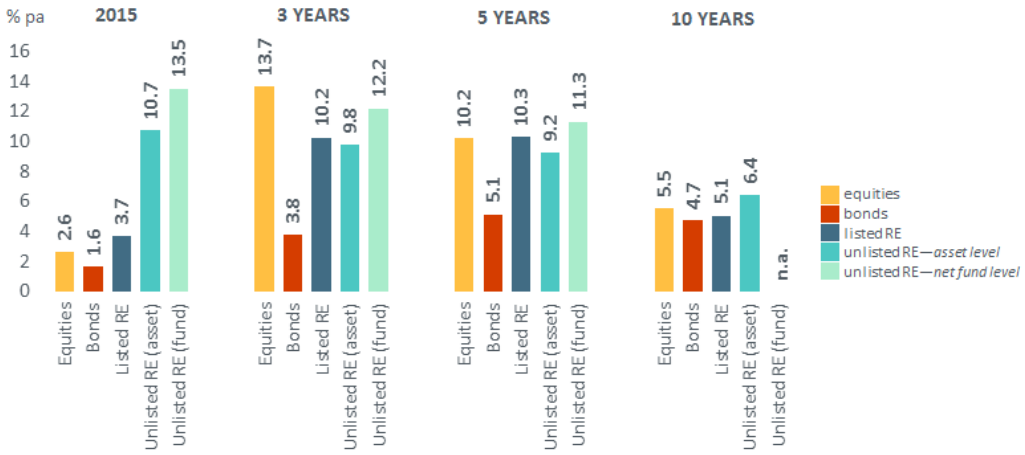

Exhibit 5: Comparative Global Performance across Asset Classes
Source: MSCI World Index (EQUITIES); J.P. Morgan, GBI Global (BONDS); MSCI World Real Estate index (LISTED PROPERTY); IPD Annual Global Property Index (UNLISTED PROPERTY - ASSET LEVEL); IPD Quarterly Global Property Fund Index (UNLISTED PROPERTY - NET FUND LEVEL)
Annualized results at 1, 3, 5, and 10 years

Exhibit 6: Total All Property Returns by Domestic Market
Source: MSCI; KTI
Note: Scale of chart excludes Ireland.

Improving Performance in 2015 Extended into Core Europe

A more explicit way of demonstrating the movements of markets through their cycles is to compare the most recent year's performance against the average over the past five years. This cross-plot, with the axes representing the global index at one and five years belies the recovering markets in continental Europe. Investors in Germany, for example, enjoyed an all property total return of 8.1% in 2015, the highest level achieved in that market in the last 15 years. In a global context, Germany's performance may appear sluggish as the exhibit implies, but some of this may be due to the process of German property valuations which can distort the shape of cycles more than appraisals in other countries (Crosby, 2007). In fact, the majority of European markets performed better in 2015 than they did on average over the past five years.

Even Within Countries, Cities Varied in Performance in 2015

City-specific variations in performance can be significant, even within national markets. In 2015, more than 1000 bps separated the best and worst performing cities in the USA, Canada, and Australia. Even in the smaller, more densely populated European markets, spreads exceeding 500 bps between the top and bottom performing cities in 2015 could be found in the UK, Germany, and Belgium.

For a property investor, the implication is a two-level approach to geographic allocations. The macroeconomic issues of interest rates, currency rates, market transparency, etc., represent the first level of consideration. These are variables that impact national markets, and in many ways, they represent relatively straightforward concepts, with associated risks that can be generally understood and effectively monitored and measured.

Exhibit 7: Performance of Cities within Countries, 2015
Source: MSCI
All property annual total returns

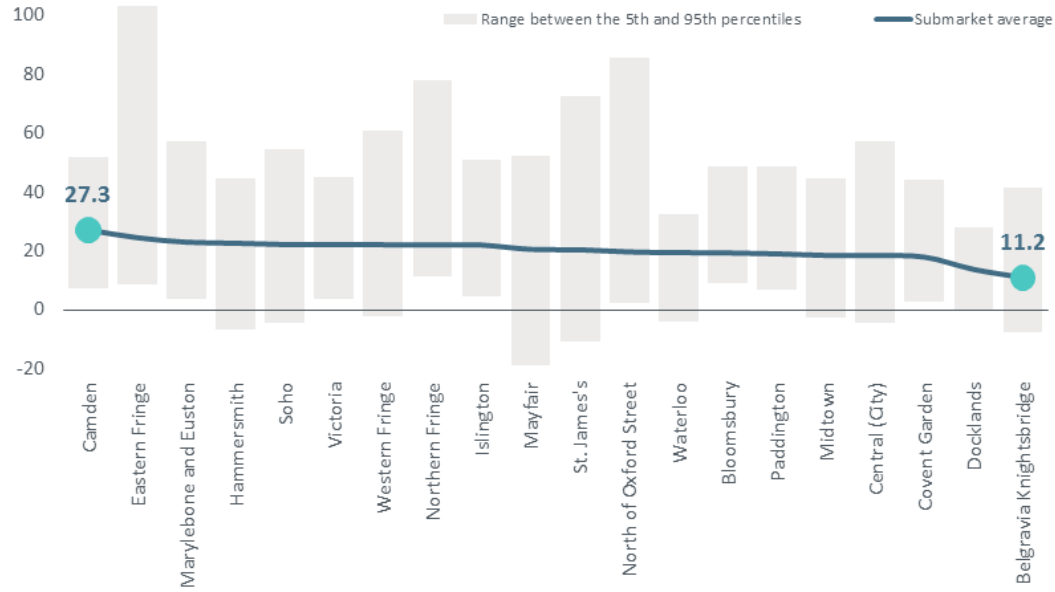

Exhibit 8: Range of Asset Level Total Returns across London Submarkets
Source: MSCI
Annual total return (%), 2015

But from inside a national market, city-level economic structures, strategic location, demographic trends, land use policies and constraints, and supply fundamentals can all lead to differences in cyclical performance and investment opportunities from one metropolitan area to the next. At this subnational level of allocation, the nuances can become more difficult to grasp as well as to measure. The underlying drivers and property type compositions of Las Vegas and Washington, DC, for example, are not necessarily comparable, nor are Tokyo and Sapporo, Munich and Dusseldorf, or Vancouver and Montreal.

And Asset Selection Mattered Too

So if an investor's allocation decisions had led incrementally, first to real estate, then to the UK, then to London, and from there, specifically to Camden, the next step would be the selection of the asset. A review of 2015 total returns of individual assets in each submarket shows a wide range of performance, so wide in fact that the asset performing at the 95th percentile in London's worst performing submarket (Belgravia Knightsbridge) provided a return of more than five times the asset in the 5th percentile in the best performing submarket (Camden).

The drilldown into results in 2015 from the global index all the way to an individual asset in London provides anecdotal evidence to corroborate earlier findings. Previous research suggests that around 50% of the variation in real estate performance relates to property specific factors rather than strategic choices of markets and property types.

Conclusion

In 2015, global real estate experienced its sixth consecutive year of steady, positive returns since the GFC. The headline global return of 10.7% was supported by significant variations in performance and cyclical movements across countries, property types, and cities. These variations represent opportunities for investors and managers but, as markets move through their performance cycles, the challenge of maintaining consistent and strong real estate performance rises. As the results of 2015 show, income returns are being squeezed to record lows across most markets. Meanwhile, strong global performance has recently been pulled up by the two largest countries in the global index, the UK and USA, both of which have a history of volatility in real estate performance. These two markets together contributed 6.4% of the total 10.7% global return in 2015. The UK and USA cannot continue to generate such strong performance indefinitely, and our overview of income security issues in these two markets (along with Sweden and Ireland) illustrates how vulnerable seemingly strong markets can be in their income security.

Against this backdrop, the global appetite for real estate continues to be strong, driven by the wide spreads between real estate and bond yields, even in the UK and USA where spreads, though a bit narrower than a year earlier, still exceeded 250 bps at year-end 2015. The difficulty of gauging the current pricing and prospects for real estate markets represents a major challenge for investors and managers of existing portfolios in their deployment of new capital to real estate. It also relates to more asset-specific considerations such as levels of development and the approach to vacant space, credit quality, and lease length. These challenges are not new for real estate investors, but they become more complex during periods of macroeconomic uncertainty.

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Max Arkey works in product management at MSCI Real Estate where he heads up indexes and market information products. These analytics are mission critical to the investment process for 19 of the top 20 largest global asset managers, all the way through to specialized domestic investors.

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