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Alternative Investment Analyst Review

Editor's Letter

With this issue of the *Alternative Investment Analyst Review (AIAR),* we enter our third year of publication. We began this publication with the goal of exposing our members to practical articles written by leading practitioners and academics. We have seen increased participation by our members in sharing their ideas and publications with us. This is essential to the growth of this publication and its ability to serve the professional needs of our members.

The current issue of *AIAR* contains five articles covering private equity, commodities, wealth management, and asset allocation. Apollon Fragkiskos's article discusses a topic that is at the heart of the modern portfolio management and finance – diversification. What do we mean by diversification, how do we measure it, and how do we create diversified portfolios? These are some of the fundamental questions that this article discusses. Recent introductions of financial products that attempt to offer "better diversified" portfolios is a sign that this old question is far from settled. For example, risk parity products, tail risk management tools, and even fundamental indices are just a few of the new products in this area. Fragkiskos examines the various approaches to portfolio diversification, discussing recent developments in this area. The paper highlights the most commonly used methods, provides the motivation behind each approach, and shows how they compare with real data.

Florian Schock's paper summarizes findings from a large number of studies that examine the characteristics of private equity investments in technology companies. The life cycle of private equity investments is used to organize the studies covered in this paper. The paper provides a summary of findings on the impact of private equity investment on a target firm's innovative capabilities, entrepreneurial orientation, productivity, and its ability to make long-term investments in intangible assets through R&D, as well as intangible assets through capital expenditures. In addition, the paper points out differences across industries and among the subsequent waves of private equity transactions in the '80s, '90s, and '00s.

The third article is by Daniel Ung, CAIA, and Xiaowei Kang. It extends the relatively new idea of factor diversification to commodities. According to factor diversification approach, returns on asset classes are affected by a set of common factors. Therefore, a more effective approach to diversification is to consider diversification among factors, rather than among asset classes. The reason for this increased focus factor diversification was the experience of portfolio managers during the 2008 financial crisis, which brought into sharp focus the lack of diversification of many investment portfolios, despite appearances

to the contrary. During the crisis, seemingly unrelated assets moved in lockstep, and portfolios once thought to be diversified did not weather the storm well. This has led some investors to explore risk-factor-based asset allocation as a potential new framework for portfolio construction and to look at alternative beta strategies in an effort to rectify the 'defects' of conventional market portfolios. Ung and Kang explore both risk-based and factor-based alternative beta indices in commodities, with a particular focus on the latter. They provide some new empirical evidence and survey existing commodity indices. They assess the merit of combining multiple systematic risk factors, either as part of a multi-asset portfolio or as a stand-alone commodity allocation.

In "The Valley of Opportunity: Rethinking Venture Capital for Long-Term Institutional Investors," Jagdeep Bachher, Gordon Clark, Ashby Monk, and Kiran Sridhar observe that investing in venture capital has been an unsatisfactory experience for many long-term institutional investors, as it has not performed in-line with their expectations for more than a decade. Consequently, many investors have been scaling back their venture commitments. The authors argue that venture capital still offers attractive opportunities for intrepid institutional investors and they outline a mechanism by which institutional investors can bring venture-backed, capital-intensive companies to commercial scale and, in turn, assist in their success over the long term. They identify an opportunity whereby institutional investors can leverage their experience in direct private equity and direct infrastructure so as to realize direct venture investing in creative ways.

Our own board member, Thomas Schneeweis, argues that educated investors can indeed benefit from the variety of investment products that are available in the market place. He argues that transparency and full-disclosure are the keys to gaining the confidence of investors and allowing them to invest in products that meet their financial needs. Through a series of questions and answers, Thomas Schneeweis addresses some of the myths that have been perpetuated in the investment industry and suggests that while investment can be a complex process, its understanding is essential if investors are to avoid some common mistakes.

Finally, we are happy to provide you with an update of the IR&M Momentum Monitor, which is produced by Alexander Ineichen, a CAIA member.

Hossein Kazemi, Editor

Call for Articles

Article submissions for future issues of *Alternative Investment Analyst Review* are always welcome. Articles should cover a topic of interest to CAIA members and should be single-spaced. Additional information on submissions can be found at the end of this issue. Please email your submission or any questions to **AIAR@CAIA.org**.

Chosen pieces will be featured in future issues of *AIAR*, archived on **CAIA.org**, and promoted throughout the CAIA community.

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ABSTRACT: Recent crises have highlighted the lack of diversification of portfolios constructed based on the 'diversification' of asset classes, and this has led to investors exploring risk-factor based asset allocation as a potential solution. While factors-based investing in equities is fairly established, there has been less discussion on how this approach can be applied to commodities. In this article, we seek to discuss the systematic risk factors that appear to exist in commodities and assess the merit of combining multiple risk factors in a portfolio.

ABSTRACT: Investing in venture capital has been an unsatisfactory experience for many long-term institutional investors, as it has not performed in-line with their expectations for more than a decade. Consequently, many investors have been scaling back their venture commitments and, instead, have been focusing on alternative asset classes that offer the benefits associated with economies of scale. In this paper, however, we argue that venture capital still offers attractive opportunities for intrepid institutional investors. Indeed, we outline a mechanism by which institutional investors can bring venture-backed, capital-intensive companies to commercial scale and, in turn, assist in their success over the long term. Specifically, we identify an opportunity whereby institutional investors can leverage their experience in direct private equity and direct infrastructure so as to realize direct venture investing in creative ways. Rather than being held hostage to the 'valley of death' when investing in capital-intensive VC-backed companies, we explain why there may be a 'valley of opportunity.'

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ABSTRACT: Growing wealth in a complex world need not be all that complex. For the average investor it is about understanding the pros and the cons of various investment actions as well as the structure of the investment world in which those actions are made. I believe that investors have a fundamental understanding of what is possible in the investment world but that they are also unsure of what they do not know. As a result, many investors rely on the investment knowledge of others who, unfortunately, often have a set of priorities that may conflict with those of the investor. In this article, I have attempted to provide a condensed review of several primary questions that are often posed by investors. Note that this article contains no math and no equations. They are not necessary. Even in a complex investment world, what is necessary is that most investors must simply take the time to understand the driving forces behind the risk and return characteristics of their investment decisions and to understand that those decisions cannot and should not be left solely to others. This responsibility is not costless; it takes a process of continuous education. The questions and answers addressed in this article hopefully will help in that process.

ABSTRACT: Risk is often defined as exposure to change. Spotting change, therefore, is important. There are essentially three approaches to change: 1. Displaying complete ignorance, 2. Having a wild guess as to what it means, or 3. Measuring it in a systematic fashion with an applicable methodology and adapting to it. The author recommends choice number 3.

Momentum can be perceived as a philosophy. The author recommends the Momentum Monitor (MOM) as a risk management tool. If risk is defined as "exposure to change," then one ought to spot the change.

What is Portfolio Diversification?

Apollon Fragkiskos
Vice President, Analytics, Head of Research, State Street Global Exchange

1. Introduction

Since the arithmetic average return of a portfolio is simply a linear function of the arithmetic average returns of the portfolio constituents, the benefits of diversification lie not in return enhancement, but in risk reduction.[1] Thus, the true benefits of diversification are sensitive to the choice of risk measure. While there are many alternatives, such as expected drawdown and VaR, most research and financial theory tends to focus on standard deviation or beta as measures of risk.

2. Market portfolio

One of the first definitions of a well-diversified portfolio is the market portfolio. Based on the Capital Asset Pricing Model, there exists a linear relationship between systematic risk and portfolio return. In this context, the market portfolio exists and consists of all risky assets traded in the market (Lintner 1965, Mossin 1966), where each asset is weighted by market value. The market portfolio is deemed as being completely diversified and its risk is non-diversifiable. However, the market portfolio can only be approximated by indices like Russell 3000 or MSCI World, since such indices do not contain all tradable assets such as stamps, real estate, and commodities. Furthermore, there are viable alternatives to pure market value weighting, such as fundamental indexing. Proponents of fundamental indexing argue that fundamental analysis can provide a more relevant estimate of firm value for market weighting than the firm's stock price. Fundamental indexing typically considers factors such as sales, earnings, or cash flows in the determination of value.

3. Number of securities

Another common way to think about a diversified portfolio is to analyze one that contains a large number of securities N. The return variance of a portfolio of a group of securities is lower than the average variance of the individual securities, unless all of the securities are perfectly correlated.[2] This was first examined in detail by Evans and Archer (1968), who showed the impact on the variance of a portfolio's return as the number of securities increases. Using 470 of the securities listed in Standard & Poor's Index, with semi-annual observations between January 1958 and July 1967, they calculated the geometric mean and standard deviation of the return for each security. They then formulated portfolios by randomly picking securities among the group of 470. Starting with one security and sequentially adding additional securities, they calculated each portfolio's variance and discovered a strong linear relationship between the variance of the formulated portfolios and the inverse of the portfolio size. They noted that the variance of the formulated portfolios asymptotically approached the variance of the market portfolio (consisting of all 470 securities) as the portfolio size increased. The market portfolio variance was well approximated with only 10 securities.

The benefit of holding a large number of securities was clearly demonstrated in a more recent study, where Sankaran and Patil (1999) created a set of portfolios where each portfolio can hold a maximum of *N* stocks. Using a specific algorithm, Sankaran and Patil demonstrated how portfolios with an increasing number of securities are able to achieve higher Sharpe ratios. However, the marginal benefit from diversification decreases with the number of securities. Their findings are based on no constraints on short-selling and the same pairwise correlations.

Focusing on the return profile of multiple stock portfolios, de Vassal (2001) examined the performance of portfolios with an increasing number of stocks. De Vassal calculated the returns of the constituents of the Russell 1000 during the seven-year period between 1992 and 1999, and subsequently used these returns to simulate multiple random portfolios that spanned all sizes between 3 and 100 stocks. De Vassal reported that portfolios with bigger sizes demonstrated returns that had lower variance or downside risk. In particular, single stock portfolios exhibited an 18% probability of a negative return, while portfolios with 10 or more stocks exhibited 0% probability over the bull market period examined. The author confirmed previous findings from Evans and Archer (1968) suggesting that the portfolio variance is inversely related to the number of securities.

The studies mentioned above refer to naïve diversification. While naïve diversification provides benefits by indiscriminately adding additional securities to portfolios, further diversification benefits or more efficient diversification can be achieved by any number of portfolio optimization methodologies, including Modern Portfolio Theory.

4. Fund of hedge funds

Denvir and Hutson (2006) mentioned diversification in the context of funds of hedge funds (FOHF) correlation to other indices. Using monthly hedge fund and FOHF

returns for the period January 1990 to May 2003 from Hedge Fund Research, they found that although FOHF have lower Sharpe ratios than hedge funds, they also exhibited lower correlations with equity indices. The lower correlation persisted when focusing either on the bull or bear markets during that time period. The authors concluded that FOHFs are a better diversification tool than hedge funds due to their lower correlation to equity indices.

5. Factor diversification

Bender, Briand, Nielsen, and Stefek (2010) looked at diversification in the context of correlations across bull and bear markets. They examined factors constructed to represent a specific risk premium, classified by asset class, style, and strategy characteristics. For example, the MSCI Value Minus Growth index is able to capture the exposure only to the value premium. Style and strategy factors exhibited low correlations with one another, hence offering diversification benefits to investors. Furthermore, the data exhibited very low correlations with various asset classes, particularly the bond premium. The authors compare the Sharpe ratios of a traditional 60/40 equity/bond mix with an equally weighted mix of risk premia. Both portfolios were rebalanced on a monthly basis between May 1995 and September 2009. The risk premia portfolio exhibited similar returns with less than a third of the volatility. During the most recent five financial crises, diversification enabled the risk premia portfolio to avoid extreme losses, in sharp contrast to the traditional portfolio. Similarly, Page and Taborsky (2011) stated that even if a combination of risky and risk-free assets seems to offer diversification benefits in most periods, such combinations perform poorly during periods of financial crises, when correlations between asset classes increase. By following a regime approach, investors can achieve lower correlations across risk factors and hence better diversification.

6. Time varying correlation

The issue of correlation asymmetry was more formally established in Ang and Chen (2001). Using weekly equity portfolio returns over the period July 1963 to December 1998, the authors find that correlations are lower in bear markets than in regular markets, while correlations are higher in bull markets than both calm and bear markets. In contrast, the normal distribution predicts that both bull and bear markets exhibit lower correlations than calm periods. This constitutes a contradiction between what the data indicates and the normal distribution predicts.

As a result, any diversification benefit implied by a normal distribution is overstated during bear markets and understated in bull markets. Such correlation measures exhibit higher asymmetry for small, value, past-loser, and lower-beta stocks. They stated that regime-switching models are more capable of capturing such asymmetry. Butler and Joaquin (2011) later reported similar findings in the context of international stock portfolios.

In an updated study, Chua, Kritzman, and Page (2009) reinforced such findings across most asset classes using data for the period 1970 to 2008. They compared portfolios based on downside, upside, and full sample correlations and reported that portfolios constructed based on downside correlations maximize utility. The critical contribution of the paper is what they call full-scale optimization. By assigning a utility function that abruptly penalizes large losses, they implicitly took into account correlation asymmetries. They then reported that portfolios constructed in this way achieved better diversification, defined in terms of lower downside correlation and higher upside correlation, as well as higher utility, than portfolios based on mean-variance optimization.

7. Tail measures

The way portfolio risk is measured is the foundation upon which portfolios are optimized and portfolio diversification is measured. While variance has been widely used as such a measure, distortion risk measures provide an alternative. In a portfolio optimization context, they offer a different way to assign greater weight on the tails (Adam, Houkari, Laurent, 2008). Such measures can place greater weight on high losses and deflate the weight put on positive events. Distortion risk measures are equivalent to spectral risk measures; an example of a spectral risk measure is the expected shortfall. Adam et al. examined 16 hedge funds with monthly returns from January 1990 to July 2001. They first minimized the risk of a portfolio invested in those funds by using distortion, i.e., moment-based and spectral risk measures for a given level of return and constraints. They found high rank correlations between the formed portfolios, which showed the robustness of optimal allocations relative to the risk measure chosen. This was confirmed by the fact that the first principal component of the returns of these portfolios accounted for more than 90% of the total risk. Similar robustness was found when minimizing expected shortfall for different thresholds ranging from

-5% to 40%. It is only when examining the worst-case scenario that allocations change compared to the previous thresholds. With the 10% threshold, the Herfindahl diversification index

$$\text{Herfindahl index} = \sum_{i=1}^{N} w_i^2 \qquad (1)$$

started to decrease under a certain level of expected portfolio return, showing that in extremely demanding risk constraints, portfolios are concentrated on fewer funds with less catastrophic risk characteristics.

Brandtner (2013) criticizes spectral risk measures as a portfolio selection tool when used together with spectral utility functions. He begins by noting that current literature lacks an integrated framework that analyzes both the determination of efficient frontiers and the choice of optimal portfolios. He proceeds to define a framework that is based on decision theory and takes into account any dependence structure among the assets.

Assuming an investor maximizes a spectral utility function, then for two co-monotonic risky assets, he shows that the efficient frontier is a straight line between the risky assets and therefore, contrary to using variance, diversification is never optimal. Instead, the investor will prefer an exclusive investment in one of the risky assets. Similarly, if there are only two states of the world, then all or nothing decisions hold, irrespective of the dependence structure. If a risk free asset is added to the portfolio, then the investor obtains either the risk free asset or the tangency portfolio as the optimal solution, hence diversification is still not preferable. If spectral utility functions are used in accordance with spectral risk measures, then maximizing utility is equivalent to maximizing return, and as a result, only corner solutions are obtained.

The latter argument was formally established by Ibragimov (2007) for VaR, where he showed that diversification, defined in terms of VaR subadditivity, does not always work as expected. In a world of extremely heavy tail risks with unbounded distribution support, VaR can become super-additive. From a utility perspective, Samuelson (1967) showed that any investor with a strictly concave utility function will uniformly diversify among independently and identically distributed risks with finite second moments. In that case, the portfolio will have equal weights. However, Ibragimov points out that if there is a point far out in the tails beyond which the utility is not concave but convex, then diversification may not be optimal.

In a similar context, Cholette, Pena, and Lu (2011) defined diversification in terms of several measures related to correlation. First, they examined the level of dependence between financial indices with regard to Pearson or Spearman correlations.

$$\rho_{Pearson} = \frac{Cov(X,Y)}{\sqrt{Var(X)\cdot Var(Y)}}$$
$$\rho_{Spearman} = \frac{Cov(F_X(X),F_Y(Y))}{\sqrt{Var(F_X(X))\cdot Var(F_Y(Y))}} \qquad (2)$$

They showed that lower dependence implies greater diversification. Using weekly returns from international stock market indices over the period January 1990 to May 2006, they first measured asymmetric dependence and found that Pearson and rank correlations do not always provide consistent results, particularly for East Asian and Latin American country indices. They then considered six copulas and used them to fit each group of countries. The shape of the best fit copula described positive or negative tail dependence for each set of countries and its parameter provided an estimate of such dependence. The authors found little evidence of asymmetric dependence in the East Asian countries and larger evidence in the G5 and Latin America. They also found that over time, average tail dependence increased for each region, which was true whether using symmetric or asymmetric copulas. They then measured how left and right tail dependence, as well as Kendall's τ relate to returns of each country group for each of the six copulas examined.

$$\tau = P\left[(X-\tilde{X})(Y-\tilde{Y})>0\right] - P\left[(X-\tilde{X})(Y-\tilde{Y})<0\right] \qquad (3)$$

where tilde denotes independent copies of the relevant random variable. They found that Latin American indices exhibited the highest returns while having the lowest dependence, whereas the G5 exhibited the opposite

behavior. The fact that diversification is not present during extreme tail dependence confirms the theoretical findings of Ibragimov (2007) and Adam, Houkari, and Laurent (2008).

8. Return

Showing the impact to return, Booth and Fama (1992) proved that a portfolio's compound return is higher than the weighted average of the compound returns on the assets in the portfolio. This is due to the fact that the contribution of each asset to the portfolio return is greater than its compound return. The justification for this is that the contribution of each asset and portfolio variance is less than its own variance due to less than perfect correlation. Examining seven asset classes for different time periods ranging between 1941 and 1990, the authors found that the incremental returns due to diversification are greater for small-cap stocks than for other assets. This is because small-cap stocks have volatile returns and their risk is easily diversified away, as they have low correlations with other assets. They further demonstrated the implications of active management to diversification. By generating 1,000 portfolios that randomly invested half the time in stocks and the rest in bonds over the period 1986-1990, they found that the average standard deviation of returns corresponded to a constant-mix portfolio invested 53% in stocks and 47% in bonds. The constant-mix portfolio achieved a compound return 14 basis points higher than the average random portfolio return and had a 52 basis point annual diversification return. Its volatility was also much lower than the average random portfolio.

A similar concept related to diversification, called the return gap, was introduced by Statman and Scheid (2007). They defined the return gap as the difference between the returns of two assets. Their justification was that return gaps take into account not just correlations but also standard deviations and are more intuitive than correlation.

$$Return\_gap = 2\sigma\sqrt{\frac{1-\rho}{2}} \qquad (4)$$

Two assets might exhibit a high correlation over a time period, but the realized returns might be very different. Such assets offer increased diversification, as viewed from the definition of return gaps.

Focusing on a group of hedge funds, Kinlaw, Kritzman, and Turkington (2013) show in a recent paper that diversification is not optimal when performance fees are taken into account. They provide an example based on a Monte Carlo simulation of an equally weighted investment across ten funds, each with an expected return of 7%, standard deviation 15%, and benchmark return of 4%. The base fee each fund charges is 2% and the performance fee is 20%. Assuming no correlation among the funds, they find a reduction in the collective expected fund return of about 0.7%. Such reduction is due to the fact that investors always pay a fee when funds outperform the benchmark or risk free rate, but they are not reimbursed for underperformance. As correlation increases and the funds become less diversified, the reduction in the investment decreases. In practice, this effect is less pronounced due to claw back provisions, termination of underperforming funds, or reset of performance fees without loss reimbursement to investors.

9. International diversification

Diversification can be beneficial across countries from the perspective of a local investor (Driessen and Laeven, 2007). Using monthly data from 1985-2002 across 52 countries, investors were first allowed to trade in regional equity markets based on the fact that investors prefer familiar investing opportunities (Huberman, 2001; Grinblatt and Keloharju, 2001). Then they were allowed to invest in global equity indices. For the first case, the authors regressed each of possible three global indices or one regional index against a local index in order to measure the statistical significance of diversification possibilities. If the regression alpha is zero and beta equal to one, it means that the global or regional indices do not add to the expected return, but rather only to the variance of the portfolio spanned by the local index. In that case, the optimal mean-variance portfolio consists only of the local index. To measure the economic significance of diversification, Driessen and Laeven first calculated by how much the Sharpe ratio of a mean-variance portfolio based only on local indices changed versus the Sharpe ratio of a mean-variance portfolio that included global indices. In addition, they measured the change in expected return when adding these global indices, given the same variance as for the optimal portfolio of the local indices, and assuming no risk-free asset. Driessen and Laeven found that the benefits of diversification as measured by all of these crite-

ria were greater for developing countries relative to developed ones and this was mainly due to their increased country risk. Over their sample period, diversification benefits have decreased as country risk has decreased.

10. Risk contribution

Another way to define diversification is in terms of risk contribution, which is equivalent to the beta of a security to the portfolio. It closely relates to loss contribution and, under certain instances, the two measures are identical (Qian 2005). One such example is a portfolio that is optimal from a mean-variance perspective. In that case, risk contribution is equal to the expected return contribution. To the extent that a portfolio is not mean-variance efficient, loss contribution will dominate risk contribution, which will in turn dominate return contribution. For extreme losses, loss and risk contributions will be equal.

Under this concept, diversification can be defined as the uniformity of risk contributions across a portfolio's components (Maillard, Roncalli, Teiletche, 2009). Equally weighted risk portfolios ensure that all portfolio components contribute the same amount to the total risk. In contrast, the minimum variance portfolio equalizes marginal risk contributions. This means that a small increase in any component will increase the total risk by the same amount as a small increase in any other component. The risk contributions, however, will be unequal and the portfolio will be highly concentrated. Consequently, a portfolio with equal risk contributions may be viewed as a portfolio located between the *1/N* and the minimum variance portfolios, with the latter having the lowest variance and *1/N* having the highest variance.

As the Lee (2011) study indicates, the portfolio weights of the equal risk contribution (ERC) portfolio are inversely proportional to the portfolio's betas with respect to the assets. That means that high volatility or correlation of an asset to the portfolio will result in lower weights. In order for the ERC portfolio to be efficient, all assets must possess identical Sharpe ratios and exhibit the same correlations among all other assets. Using data for the top 10 US industry sectors between January 1973 and December 2008, the authors found that the performance and risk statistics of the ERC portfolio were very close to the *1/N* strategy. The ERC portfolio was more concentrated in terms of weights, but the *1/N* portfolio was concentrated in terms of risk contributions. The MV portfolio had better risk-adjusted performance, but worse diversification. Repeating the process for agricultural commodities over a similar period, the authors found that ERC dominated *1/N* both in terms of return and risk. MV dominated over all, but showed larger drawdowns and tail risk. Finally, looking at global asset classes, the ERC portfolio had superior Sharpe ratios and average returns. The authors noted that the solution obtained for the ERC portfolio is numerically challenging and a global optimum cannot be always guaranteed.

11. Risk ratio

Another commonly used measure is formalized by Tasche (2006, definition 4.1). For an arbitrary risk measure ρ, position weight w_i with return r_i, Tasche calculates the following ratio:

$$DF_{\rho,i} = \frac{\rho_i}{\sum_j \rho\left(w_j r_j\right)} \tag{5}$$

Based on this, the study considers the diversification ratio defined as the ratio of the weighted average volatilities divided by the portfolio volatility (Choueifaty and Coignard 2008).

$$DR(w) = \frac{\sum_i w_i \sigma_i}{\sigma_w} \tag{6}$$

If the expected returns of portfolio components are proportional to their risks, then maximizing the expected return is equivalent to maximizing risk. In that case, the most diversified portfolio (MDP) is also the mean-variance optimal portfolio. This is also the case in a universe where all portfolio components have the same volatility. Any stock not belonging in the most diversified portfolio is more correlated to that portfolio than any stock that belongs in it. Furthermore, all stocks have the same correlation to the portfolio. Using U.S. and European stock return data between December 1991 and 2008, the authors demonstrated that the maximum diversification portfolio was consistently less risky than market cap-weighted indices and had a higher Sharpe ratio than the market cap benchmarks, minimum variance portfolio, and the equally weighted portfolio.

Following up in 2011, and using standard deviation as the risk measure, Choueifaty and Coignard decom-

posed the diversification ratio in terms of the volatility-weighted average correlation and the concentration ratio, defined as the sum of variances divided by the sum of weighted volatilities squared.

$$DR(w) = \left[\rho(w)(1 - CR(w)) + CR(w)\right]^{-1/2}$$
$$\rho(w) = \frac{\sum_{i \neq j} w_i \sigma_i w_j \sigma_j \rho_{i,j}}{\sum_{i \neq j} w_i \sigma_i w_j \sigma_j} \qquad (7)$$
$$CR(w) = \frac{\sum_i \left(w_i \sigma_i\right)^2}{\left(\sum_i w_i \sigma_i\right)^2}$$

The latter is a generalization of the Herfindahl-Hischman index. They also showed that the portfolio diversification ratio can be decomposed into the volatility-weighted average of its components' diversification ratios divided by its volatility. The diversification ratio equals the number of independent factors necessary for a portfolio that allocates risk to these factors in order to achieve the same *DR*. It is therefore equal to the effective number of uncorrelated factors. The authors further showed that any stock not belonging in the most diversified portfolio is more correlated to that portfolio than any stock that belongs in it.

Assuming that *X* and *Y* are two assets with identical Sharpe ratios, a new company *Z* can be created by holding shares of *X* and *Y* in the balance sheet. The Sharpe ratio of *Z* is higher than *X* and *Y*, unless the correlation between *X* and *Y* is 1. The existence of assets with non-identical Sharpe ratio to others makes the most diversified portfolio nonefficient in the mean-variance space. As Meucci (2009) points out, this is a differential and not an absolute diversification measure. Focusing on a portfolio of 10 U.S. sectors in the Russell 1000 universe and using 10 years of monthly returns as of March 2010, Lee (2011) demonstrated that the MDP was more concentrated relative to the market capitalization-weighted portfolio in terms of risk contributions. In terms of cumulative risk contribution, Lee showed that the minimum variance portfolio (MVP) was the most concentrated, followed by the MDP. The market capitalization-weighted portfolio was again found to be more diversified in that context than the MDP.

Frahm and Wiechers (2013) proposed the ratio of the smallest possible variance among the portfolio constituents divided by the actual variance of the portfolio as an alternative diversification measure.

$$\rho(w) = \frac{\sigma_{MVP}}{\sigma_w} \qquad (8)$$

It shows how much removable variation is still contained in the portfolio.

Pérignon and Smith (2010) examined VaR results reported from major banks in the U.S. on a quarterly basis between the end of 2001 and beginning of 2007 and tried to calculate the diversification benefit of individual VaR across broad risk categories (equity, interest rate, commodity, credit spread, foreign exchange) to the aggregate VaR. Having access only to individual risk VaRs, they proxied each category to major market indices and used the correlation between these indices to aggregate the individual VaRs. Defining the diversification measure as:

$$\delta = \frac{\sum_i^N VaR_i - VaR}{\sum_i^N VaR_i} \qquad (9)$$

Pérignon and Smith reported that their proxies closely approximated the aggregate VaR reported.

12. Information theory

Using the number of portfolio constituents as a measure of diversification has been criticized, since it only provides an adequate picture if the portfolio is equally weighted. Information theory provides diversification measures that focus on the quantification of the disorder of a random variable. Using monthly returns between 1965 and 1985 from 483 U.S. companies, Woerheide and Persson (1993) repeated the experiment of Evans and Archer (1968) to determine which diversification index related to information theory or economic concentration is mostly related to volatility reduction in the case of unequally and positively weighted portfolios. They found that the complement of the Herfindahl index was the best performer with an R_2 of 0.548.

$$\text{Compliment of Herfindahl index} = 1 - \sum_{i=1}^{N} w_i^2 \qquad (10)$$

Thus they recommended that specific index as a measure of diversification. The study was repeated later by Frahm and Wiechers (2013) with updated data providing with similar results.

Another popular measure from information theory is the Shannon entropy. It was used by Bouchaud et al. (1997), Bera and Park (2008), and Meucci (2009) and is revisited below.

13. Principal portfolios

Rudin and Morgan (2006) examined equally weighted portfolios and constructed the principal portfolios, namely the components of a portfolio that are uncorrelated linear combinations of the original portfolio constituents. To see how this is done, consider a set of N securities in a portfolio. The portfolio variance is given by:

$$Variance = W^{'}\Sigma W \tag{11}$$

where Σ is the covariance among the securities and can be further decomposed as:

$$\Sigma = \mathrm{E}\Lambda\mathrm{E}^{'} \tag{12}$$

where E^{NxN} contains the eigenvectors of Σ and Λ^{NxN} is a diagonal matrix that contains the eigenvalues of Σ. The portfolio variance can then be written as:

$$Variance = W^{'}\mathrm{E}\Lambda\mathrm{E}^{'}W \tag{13}$$

Instead of working with the original security weights $\tilde{W} = E^{-1}W$, we can instead choose weights W.

These form the principal portfolios. Note that while the original securities had returns R, the principal portfolios have returns $\tilde{R} = E^{-1}R$.

The portfolio variance is finally written as:

$$Variance = \tilde{W}\,\Lambda\,\tilde{W} \tag{14}$$

Denoting λ as the eigenvalue of each principal portfolio, and hence its variance, Rudin and Morgan formed the diversification index:

$$DI = 2\sum_{k=1}^{N} kw_i - 1 \quad where\ w_i = \frac{\lambda_i}{\sum_i \lambda_i} \tag{15}$$

This index measures the relative importance of principal components in a portfolio. If the original constituents have a high correlation with each other, the first few principal portfolios will account for most of the variance; hence the index will be small. If all assets are uncorrelated, then the index will equal N, since in that case each w_i will equal $1/N$.

Meucci (2009) followed the same approach of constructing principal portfolios, but refined the diversification measure. In the spirit of Tasche, he first defined the diversification distribution, with ρ being the variance of a principal portfolio.

$$p_i = \frac{\tilde{w}_i^2 \lambda_i^2}{\sum_i \tilde{w}_i^2 \lambda_i^2} \tag{16}$$

He then applied the exponential of the Shannon entropy on that diversification distribution to form the below diversification measure:

$$N_{Ent} = \exp\left(-\sum_i p_i \ln(p_i)\right) \tag{17}$$

A low number means that the effective number of uncorrelated risk factors is low and hence the portfolio is not diversified. The defined entropy of the principal portfolios can achieve its maximum value equal to the number of portfolio constituents. This means that the portfolio is fully diversified. Portfolios can be then constructed on the mean-diversification frontier.

Meucci's approach, also called diversified risk parity, was compared against the equal risk contribution portfolio, the minimum variance portfolio, and the equally weighted portfolio in a paper by Lohre, Opfer, and Orszag (2011). Using global indices that represented broad asset classes between December 1987 and September 2011 and long-only constraints, they found all strategies yielding similar returns. The *1/N* strategy showed a slightly higher return, with a much higher volatility and drawdown. The minimum variance strategy exhibited the lowest return, with a much lower vola-

tility and hence the highest Sharpe ratio. It also had the lowest drawdown. The equal risk contribution strategy was in between the *1/N* and minimum variance.

The diversified risk parity approach displayed a low Sharpe ratio, while its drawdown was between the *1/N* and risk parity strategy. In terms of tracking error, the diversified risk parity was similar to the risk parity strategy. The diversified risk parity strategy was the most resilient to the 2008 crisis, when using a rolling window. However, that came at the expense of higher turnover. In terms of diversification, the risk parity strategy was not evenly distributed across the principal portfolios. The diversified risk parity was evenly distributed across three out of five asset classes and was found to react more timely in terms of allocation shifts, when calculating with a rolling window. Relaxing the long-only constraints allows the diversified risk parity to be more homogeneous across all assets.

In a recent paper, Meucci, Santangelo, and Deguest (2014) explain that using principal components to measure diversification presents various drawbacks. The principal components are statistically unstable, they are not invariant under transformations, they are not unique, they are not easy to interpret, and they can give rise to counter-intuitive results. The authors propose instead to look for the zero-correlation transformation of the original factors that disrupts these factors as little as possible. Such transformation is called minimum torsion linear transformation and is formally achieved by minimizing the tracking error between the torsion and the original factors. They then derive the effective number of minimum torsion bets, similar to the effective number of uncorrelated risk factors from Meucci's previous paper (2009). This approach overcomes these limitations, based on principal components.

14. Conclusion

The quest for diversification is never ending; its definition is not unique and diversification measures are continuously evolving. It is important to understand the advantages and limitations of diversification and the context in which it is applied. While there is significant research behind this concept, going back many decades, more studies are needed in order for investors to better understand the potential impact of diversification on their portfolios.

Endnotes

1. In contrast, geometric returns are expected to increase for a given level of arithmetic returns as diversification increases.

2. See Markowitz (1952), Sharpe (1964), Lintner (1965), Mossin (1966) and Samuelson (1967).

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Private Equity Financing of Technology Firms: A Literature Review

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1. Introduction

"The publicly held corporation has outlived its usefulness in many sectors of the economy. [...]Active investors are creating a new model of general management. These investors include LBO partnerships such as Kohlberg Kravis Roberts and Clayton & Dubalier."

—Michael C. Jensen, The eclipse of the public corporation, Harvard Business Review, 1989

"The big private equity funds have proven to be a menace to healthy companies, to workers' rights, and to the European Union's Lisbon Agenda […] These LBOs leave the company saddled with debt and interest payments, its workers are laid off, and its assets are sold. A once profitable and healthy company is milked for short-term profits, benefiting neither workers nor the real economy."

—Poul Nyrup Rasmussen, "Taming the Private Equity Locusts" Project Syndicate/Europe's World, 2008.

Private equity (PE) investment activity and more specifically the perceived economic impacts of the investment activity have received considerable attention in academic literature as well as in popular media. Since the early 1980s, and arguably even before that, scholars have analyzed the characteristics of PE investment behavior from many different angles and contributed to a broad body of literature. This work aims to give an overview of the current status of research that relates to PE financing of technology firms. Specifically, it focuses on the branch of literature that primarily addresses the impact of PE investments on firms in technology intensive industries, by influencing the firm's innovative capabilities, its entrepreneurial orientation (EO), its productivity, and its ability to make long term investments. In this process, two main streams of literature are provided. First, the paper covers literature concerned with agency theory and moral hazard (Bergemann & Hege, 1998; Eisenhardt, 1989; Jensen & Meckling, 1976) to interpret the role of PE firms as financial intermediaries in general, and PE firms investing in the technology sector in particular. Second, it covers the body of literature that addresses PE transactions before the background of innovation theory (Schumpeter, 1912, 1942), EO (Lumpkin & Dess, 1996), and the resource-based view of the firm as a source of competitive advantage (Ireland, Hitt, & Sirmon, 2003). Similar to work produced by other researchers which has integrated agency and resource based theories (Castanias & Helfat, 1991; Mahoney & Pandian, 1992), this work summarizes findings covering the PE business model and the behavior of PE firms and integrates these findings with studies that have investigated PE transactions in the context of innovation and entrepreneurship. By gathering evidence from several different studies, it is possible to shed light on aspects that have been both praised and criticized in the context of PE investments in technology companies (Zahra, 1995).

During the past 30 years, the PE industry itself has evolved. Empirical evidence indicates that the focus has shifted away from financial leverage as a main source of value creation to operational improvement and value generation through product development, innovation, and commercialization among others (Kaplan & Strömberg, 2009; Lerner, Sorensen, & Strömberg, 2011; Wright, Hoskisson, & Busenitz, 2001; Wright, Hoskisson, Busenitz, & Dial, 2000). The shift in PE investment behavior has implications on the competitiveness of technology companies which obtain capital from PE firms. Still, a large portion of academic research relates to PE transaction conducted in the 80s (Wright, Gilligan, & Amess, 2009). Therefore, a second goal of this paper is to investigate if academic research covering PE investments during different periods of time provides evidence of changes in behavior.

The terminology in PE is not always used unambiguously. In order to clarify the scope of this paper more precisely, I define the areas covered under the topic of this paper, specifically PE finance as well as technology firm, as follows: When addressing the concept of PE finance, I follow the rationale that venture capital (VC) investments in the earlier stages of the corporate life cycle and (leveraged) buyout (BO or LBO) investments in the more later stages are both members of the same PE asset class which share many of the same basic characteristics (Diller & Kaserer, 2009; Koryak & Smolarski, 2008; Metrick & Yasuda, 2011). In that sense, I also emphasize the role of VC as a provider of growth capital as opposed to start-up capital (Bruining & Wright, 2008). Still, the differences between VC and BO remain pronounced in many aspects of their investment activity. For instance, whereas around 80-90% of VC investments in the U.S. are made in the technology sector (Cumming, 2007; Gompers, Kovner, & Lerner, 2009), BO firms have a more broad industry coverage (NVCA, 2012). In the following chapters, I will use the term VC to refer to findings from literature that are specific to

early stage investments and the term BO or LBO to refer to later stage investments. Moreover, I will use the term PE to refer to aspects that relate to both VC and BO irrespective of the stage within the corporate life cycle that investments are made in. Similarly to PE, the terminology with respect to technology firms is almost defined equally wide and captures a continuum from business services/software to classical manufacturing/production. In the PE context, this continuum is often referred to as "asset light" (i.e. business services/software) and "asset heavy" (i.e. manufacturing/production). In this analysis, I will include the whole continuum of business that can be categorized as technology firm. Still, I will strive to emphasize differences in the findings in literature as they relate to PE investments in asset light and asset heavy technology firms.

The remainder of the paper is structured to follow the PE investment life cycle and present findings from literature that relate to the individual phases within the investment life cycle: From market screening and investment decision making, to the operative management of PE portfolio companies, and to exiting from a portfolio company. First, I review the screening process through which PE firms identify and assess portfolio companies. In this context, I present evidence on the firm specific criteria that influence the investment decision by PE firms to provide technology firms with capital and include information on the fit of certain markets and/or industries with the PE business model. Second, I elaborate on the impacts of PE investment activity on the portfolio company's competitive capabilities. Specifically, I focus on the impact of PE ownership on the target firm's innovative capabilities, on its strategies to commercialize new products, and on the EO, productivity and asset utilization within the firm. Moreover, I will present findings that address the effect of PE ownership on a firm's ability to make long term investments in R&D and its tangible asset base. Third, research covering the possible exit routes for technology firms in PE portfolios is presented along with the implications of the different exit routes for the PE firm as well as for the portfolio company. Last, I present conclusions to be drawn from literature with respect to PE investments in technology firms and identify future areas of research in this specific field.

2. Screening & Selection

Preceding a capital commitment, PE firms apply very specific screens and evaluation procedures in order to minimize risk and maximize returns from their investments. The topic has attracted significant interest from academics and consequently a broad body of literature exists that covers screening criteria and decision making by VC and/or BO firms (Kaplan & Strömberg, 2001; MacMillan, Siegel, & Narasimha, 1985; Muzyka & Birley, 1996; Petty & Gruber, 2011; Tyebjee & Bruno, 1984a). The interest in this topic stems not only from a theoretical perspective, but also from its implications for the PE investment community. For instance, Hege et al. (2009) compare the performance of US VCs with the performance of European VCs using firm level data of 146 European and 233 US VC backed companies. The results of their analysis suggest that the outperformance of U.S. VC relative to their European counterparts is partly explained by superior screening abilities of U.S.-based VCs. Moreover, research conducted by Nielsen (2011) for the Danish market provides evidence that the screening and selection skills by PE firms are not easily replicated. Specifically, Nielsen shows that albeit being sophisticated investors, pension funds making direct investment in private companies have underperformed the PE market with their investments by at least 3.9% per year during the period from 1995 to 2004. Overall, the results yielded by Nielsen are similar to evidence on institutional investment activity in private companies for the U.S. market (Lerner, Schoar, & Wongsunwai, 2007).

When analyzing screening and selection criteria of PE firms, academics frequently group individual criteria into categories. For instance, in their paper on VC decision making, Petty and Gruber (2011) cluster their analysis according to the following five major categories: (1) market, (2) management team, (3) product, (4) financials, and (5) investor specific criteria. Other studies include categories such as competitive environment, strategic orientation, or similar criteria. Still, the categories (1)-(4) are virtually always included in some variant that mirrors their relevance in the screening and investment phase. Interestingly, the relative importance of each of these categories varies widely, even across experienced and successful investors. According to Gompers and Lerner (2001), some VCs (such as Tom Kleiner of Kleiner Perkins) focused on a company's proprietary technology/product, some VCs (such as Don Valentine of Sequoia) emphasized the importance of the market and again others (such as Arthur Rock of Davis & Rock) viewed the management team as being the most decisive factor.

In the following chapter, I will focus on the findings from literature attributable to the 4 broad categories (1) market, (2) management team, (3) product, and (4) financials that are most frequently addressed in the context of PE investment decision making and which are subject to a controversial debate among academics and professionals.

2.1 Market

At its core, the PE business model is based on investing in companies and selling their stake at a profit to another acquirer (through trade-sale or IPO) at some point in the future. In order to follow this business model, it is first necessary to identify potential investment targets or "deals". The process to identify and generate deals can either be driven by the PE firm itself (active deal sourcing), or by parties outside of the PE firm (passive deal sourcing), such as firms seeking funding, or M&A advisors mandated with the sale of a company or a business division. Early evidence on VC deal origination during the 1980s shows that VCs rarely follow an active deal sourcing approach (Tyebjee & Bruno, 1984a). Instead, most deals are referred to the VCs by third parties and/or VCs are invited by other VCs to participate in a deal as a syndication partner. A decade later, analyses initially conducted in the UK suggest that VC behavior with respect to active deal sourcing might have changed (Sweeting, 1991). UK VCs interviewed by Sweeting responded that they preferred seeking out investments proactively. Specifically, the VCs examined markets which experienced a high degree of fragmentation, but at the same time exhibited good growth prospects. These markets were screened for companies with a relevant technology, but were underfunded and/or poorly managed. Further evidence towards a more active deal sourcing stance, as compared to the early '80s, was collected by the author through follow-up interviews with VCs in the U.S.

As evidenced by responses from VC professionals in Sweeting's study, the nature of the deal sourcing process is often closely connected with the type of analysis – top-down vs. bottom-up – performed to evaluate a deal opportunity. Active deal sourcing, in which PE firms take the initiative to approach a company is typically performed through a top-down analysis (i.e. searching for attractive industries and markets first before targeting individual companies), whereas a bottom-up analysis is conducted when PE professionals are presented with a deal opportunity through a passive deal sourcing channel such as an M&A advisor. Since the majority of PE deals comprise of private-to-private transactions (Strömberg, 2008), information on products, financials, and management teams of these private, non-listed firms is often scarce and/or exhibits significant limitations. In order to identify attractive deal opportunities, PE firms applying an active deal sourcing approach often resort to the performance of individual industries or markets to prescreen for potential investment targets.

Early evidence of the importance of market characteristics in the VC decision process is provided by Wells (1974), and Tyebjee and Bruno (1984a). In the two studies, the importance of specific decision criteria is assessed by VC professionals; Wells personally interviews eight VCs whereas Tyebjee and Bruno conduct telephone interviews with 46 VCs. Wells ranks the attractiveness of the market at number three of twelve, Tyebjee and Bruno record market growth/size at number two of twelve and market niche/position and number four of twelve.

MacMillan et al. (1985) were also among the early researchers who systematically examined determinants of VC investment behavior. In their paper, the authors conducted a survey with 102 U.S. VC principals which identified and weighted their decision criteria of whether to invest in a firm or not according to six categories: (1) the personality of the entrepreneur, (2) the experience of the entrepreneur, (3) characteristics of the product or service, (4) characteristics of the market, (5) financial considerations, and (6) the composition of the venture team. Among the characteristics of the market, market growth was considered to be the single most important criterion. However, in a follow on study by MacMillan et al. (1987) aimed at identifying successful and unsuccessful ventures, relatively more importance was attributed to market dynamics and market-product criteria, such as competitive threat and market acceptance of the product as opposed to market growth. The study was conducted as a survey in which 67 U.S. VC principals were asked to assess several successful and unsuccessful ventures. The results of this survey were used in a regression analysis to identify criteria with predictive power on venture success as measured by performance criteria such as profit, ROI, sales, and market share.

The importance of the market, specifically for growth PE investments, is emphasized in a study by Siegel et al. (1993). In order to examine which criteria define a high growth venture, the authors analyze two distinct data-

bases consisting of (a) early stage ventures (1,600 firms in the state of Pennsylvania with an average revenue of approximately $1.4m) and of (b) later stage ventures (105 U.S. firms with an average revenue of approximately $10.7m). For their samples, the authors gathered information on firm characteristics such as experience of management team in the same industry, strategy, utilization of new technology, leanness of operations, market growth, diversification, customer contracts, and funding relationships. These characteristics were then tested for their power to predict high-growth firms in the model developed by the authors. Especially for sample (b), containing larger firms in terms of revenue, market growth proved to be the most important criteria to distinguish low-growth from high-growth firms.

In a study of 149 U.S. VCs, Elango et al (1995) examine criteria that distinguish individual VC firms including the preference for ventures in certain stages of the corporate life cycle. The authors then examine the implications of the distinguishing factors on VC behavior. Among other results, the analysis provides evidence that VC firms with a preference for investments in early stage ventures value high market growth. Conversely, VC firms with a preference in later stage ventures put relatively more emphasis on demonstrated market acceptance than on high market growth. Going beyond the characteristics of the market in the VC decision making process, Gompers et al. (2009) examine the importance of market/industry know-how for the VC firm itself. In their analysis building on 24,331 U.S. VC investments during the period from 1975 to 2003, the authors compare the performance of VC specialists with focused industry/market know-how vs. VC generalists. Gompers et al. measure the difference between specialists and generalists by applying a variation of the Herfindahl-Hirschman index, usually used to assess market concentration, on individual VC managers. That is, a VC investment professional with a Herfindahl score of 1 has only invested in a single industry, whereas investment in several industries lower the professionals Herfindahl score. The authors calculate Herfindahl scores on a VC investment professional as well as on a VC firm level. Results of the analysis provide evidence for a positive relation between the specialization of individual VC professionals and the profitability of the VC firm. They conclude that "the poorer performance by generalists appears to be due to both an inefficient allocation of funding across industries and poor selection of investments within industries."

In a similar context, Dimov et al. (2012) find that the characteristics of the VC as well as their learning patterns also influence the type of markets that are entered. In a study of 4,446 U.S. VC firms during the time period from 1962 to 2004, Dimov and Martin de Holan (2010) analyze the market entry decision by VCs based on the three dimensions: Depth of investment experience, breadth of investment experience, and distance from the subject market. The authors distinguish between First-Round Entries, in which the VC is the first to invest in a firm positioned in a new market, and Later-Round Entries, in which the VC invests in a firm positioned in a new market that has already received VC. The researchers find that VCs are not likely to invest in distant markets. They also find that VC with the greatest breadth of investment experience are the most likely to invest in First-Round Entries and that VC with a large depth of investment experience are likely to invest in First-Round Entries in proximate markets.

Attributable to the comparatively greater uncertainty associated with VC investments as opposed to later stage BO investments, the boundary conditions of the markets play an important role in determining the success of VC backed firms (Hargadon & Kenney, 2012). Specifically, the later identify three conditions that have to be met in order for a market to be suitable for VC investment: (1) The market has to be large and growing rapidly, (2) the technology has to be scalable, and (3) buyer behavior in the exit market should have a high likelihood of large and rapid payoffs. In addition, findings from Lerner (2009) suggest that the stage of the market in the business life cycle influences the suitability of certain high-technology ventures; Lerner argues that ventures centered around disruptive innovations are most suitable in less mature markets whereas ventures with a lower degree of innovation face lower barriers to enter more mature markets with established incumbents. Overall, the growth characteristics of the market are relatively more important for venture capital and growth PE firms and less vital for BO firms investing in more mature stages. Instead of focusing on market growth, the latter put relatively more focus on free cash flow (Bull, 1989). Consequently, investments in high technology industries with high R&D exposure have not been very common for LBOs in the past (Hall, 1990; Opler & Titman, 1993). However, recent studies report a gradual shift of PE investment activity into more high-tech industries (Lerner et al., 2011; Strömberg, 2008).

2.2 Management Team

According to early research on VC decision making, management team related criteria are unanimously ranked as the single most important criteria in the VC selection process. In the rankings compiled by Wells (Wells, 1974), Tyebjee and Bruno (1984a), and Poindexter (1976), who utilized responses from 97 VCs to a mailed questionnaire, the most important criteria are management commitment, the quality of management, and management skills and history, respectively. In their work, Tyebjee and Bruno (1984a) show that the expected return of an investments is determined by market attractiveness and product differentiation, whereas the perceived riskiness of the investment in the view of the VC is determined by management capabilities and environmental threat resistance. In this view, the relative high importance of management team can be interpreted that risk aversion and mitigation is valued higher than expected return by the majority of VCs taking part in the authors' analysis. Similar observations in this regard have been made by (Lerner, 2012; Taeube, Migendt, Schock, & von Flotow, 2014).

A study conducted by MacMillan et al. (1985) finds that five of the ten most important criteria to evaluate an investment target involve the entrepreneur's capabilities. The was conducted by questioning 102 U.S. VC principals which identified and weighted their decision criteria of whether to invest in a firm or not according to 6 categories: (1) the personality of the entrepreneur, (2) the experience of the entrepreneur, (3) characteristics of the product or service, (4) characteristics of the market, (5) financial considerations, and (6) the composition of the venture team. Overall, evidence of staying power and the ability to mitigate risk by the entrepreneur were the most highly weighted criteria. In the words of Tyebjee and Bruno (1981), "There is no question that irrespective of the horse (product), horse race (market), or odds (financial criteria), it is the jockey (entrepreneur) who fundamentally determines whether the venture capitalist will place a bet at all." Analyzing the results of the study by factor analysis, the authors find that VCs evaluate deals based on several categories of risk to be managed. In line with arguments brought forth by Tyebjee and Bruno (1984a) in a later study, the emphasis on risk (as opposed to return) in the assessment concurs with the entrepreneur's capabilities as most important selection criteria. The importance of the management team in connection with the perceived risk of the venture is confirmed by a survey of 49 U.S. VC firms in 1984 conducted by Gorman and Sahlman (1989). They find that weak senior management is perceived as the most important cause for failure of a venture by the VCs participating in the survey.

Similarly, through surveying 73 European VCs involving 53 pairwise trade-off decisions, Muzyka et al. (1996) find that among a number of VC decision criteria including, (1) financial criteria, (2) product-market criteria, (3) strategic-competitive criteria, (4) management team criteria, (5) management competence criteria, (6) fund criteria, and (7) deal criteria, management team criteria are regarded as the most important. The authors conclude that "venture capitalists interviewed would, as a group, prefer to select an opportunity that offers a good management team and reasonable financial and product-market characteristics, even if the opportunity does not meet the overall fund and deal requirements."

In the context of their study on the effects of changing management and ownership on corporate restructuring, Robbie and Wright (1995) provide evidence on the importance of the management team in the eyes of the VC firm. Specifically, Robbie and Wright point to the considerable effort that is made by the VC to assess the entrepreneurial skills of the managers taking part in a buy-out or buy-in. Evidence from industries such as local area networking and biotechnology also suggests, that in the early stages of yet opaque, emerging high-technology industries, VC investors place comparatively greater emphasis on the perceived competencies of the management team (von Burg & Kenney, 2000).

More recently, Kaplan et al. (2009) analyzed 50 VC financed firms in the period from 1975 to 2006 and followed them throughout their life cycle from the early business plan to IPO to three years as a public company. Firms in their sample were mostly comprised of high-technology firms (around 90%), with a strong weight on biotechnology and information technology. Among other goals, the authors follow up on the question of whether the management team or the business/market is more influential on the success prospects of an individual firm. Notwithstanding the anecdote from VCs that a great management team can eventually seize a good opportunity "even if they have to make a huge leap from the market they currently occupy," Kaplan et al. find that firms in their sample rarely change their initial business proposition or line of business. However, the

authors also find that firms frequently exhibit changes in top management. At the time of the IPO, only 72% of the CEOs stated in the business plans were still present whereas only 50% of the next four top managers were still present. At the time of the annual report, only 44% of the CEOs stated in the business plans along with only 25% of the next four top managers. The authors conclude that although it is important for VCs to select both good managers and good businesses/markets, the selection of the business/market should be given relatively more weight. According to Kaplan et al. "poor or inappropriate management is much more likely to be remedied by new management than a poor or inappropriate business idea is to be remedied by a new idea."

2.3 Product and Technology

Despite many entrepreneurs, especially in the high-technology sector, placing a lot of emphasis on product or technology related criteria, early research on VC decision making does not provide evidence for an equal emphasis on the side of the investors. Among the three studies conducted by Wells (1974), Poindexter (1976), and Tyebjee and Bruno (1984a), only Wells places the criterion "product" at number three of his ranking. Neither VCs surveyed by Poindexter nor VCs questioned by Tyebjee and Bruno explicitly rank product related criteria among the top decision criteria. However, in a follow-up on a study by Tyebjee and Bruno, several product differentiation related criteria such as profit margins determined by the product, uniqueness of the product, and patentability of the product were used by VCs to evaluate a potential investment target. The authors conclude that together with market attractiveness, product differentiation determines the expected return of an investment in a target company although its impact on the expected returns and consequently the investment decision is considered weaker than market attractiveness.

Taking on a more aggregate view on VC investment activity, Florida and Kenney (1988) examine the relation between characteristics of regional VC complexes and investments in high-technology firms by VC. In their study focusing on seven large U.S. VC complexes, namely Silicon Valley/San Francisco, Boston, New York, Chicago, Minneapolis, and Texas, the authors provide insight on the relationship between VC and high-technology entrepreneurship. The results show that technology based complexes characterized by the presence of a large number of technology intense firms attract VC investors which then invest in local technology companies. Conversely, finance based complexes characterized by the presence of financial institutions and their VC subsidiaries tend to export their investment funds to other regions. The authors conclude that "despite its importance in premier high-technology regions, the availability of VC does not necessarily translate into high technology entrepreneurship." Instead, innovative high technology companies seem to attract VC from other regions.

The results by Florida and Kenney find support by analyses conducted by Engel and Keilbach (2007). Studying firm-level evidence of VC investments on growth and patent output for a sample of 142 VC funded German firms founded between 1995 to 1998, the authors find that VC funded companies exhibit significantly more patent issues than their industry peers. However, the authors show that patent issues at target firms were surpassing their industry competitors even before the VC investment. They therefore conclude that innovative capabilities of technology firms serve as selection criteria for VC in their investment decision process. The findings are in line with Hellmann and Puri (2000), who find that imitators are less likely to obtain VC than the initial innovators.

In an analysis on UK VCs, Sweeting (1991) studies the VC deal creation model developed in the U.S. market by Tyebjee and Bruno (1985) to examine the applicability of the model in the UK. His sample include in depth analyses of four VC firms accompanied by the evaluation of broad VC industry data. Among other evidence, Sweeting finds a "slackening of interest in innovative, technology-based businesses, particularly those in their early stages of development." Still, all managers at VC firms interviewed for his study expressed interest and experience in investing in high-technology companies. Moreover, the author also finds evidence that performance characteristics of technology heavy investments can have a significant impact on future activity in high-technology areas. Specifically, after experiencing poor performance from investing in new technology based companies, one VC fund pulled out from these type of technology investments altogether. Recent research on VC activity in the clean technology sector also provides evidence for this behavior (Taeube et al., 2014).

In addition, the investment stage focus of VC firms has been shown to impact the relative importance of prod-

uct and technology. In their study on differences among VC firms, Elango et al (1995) find that VC firms which prefer to invest in early stage ventures emphasize product related criteria such as proprietary product features and product uniqueness. Compared to early stage investors, VC investors with a focus on later stages ventures examined by Elango et al. place more relevance on demonstrated market acceptance.

2.4 Financials

Unsurprisingly, research focused on early stage PE investments as evidenced by studies on VC decision making hardly attribute particular emphasis of VCs on target firm financial data. Among the three early studies conducted by Wells (1974), Poindexter (1976), and Tyebjee and Bruno (1984a) only the latter report that the financial history of a firm is taken into account by VCs in their decision making process. Even then, the criteria "financial history" is ranked at number five, behind management skills, market size/growth, rate of return, and market niche/position. The lacking emphasis on a company's financial data in this stage of investment can mostly be attributed to the fact that the majority of companies at this stage simply do not have any meaningful financial history. Above that, the anticipated financials presented in the business plan frequently exhibit a considerable degree of uncertainty and/or are often overly optimistic. As a response, VCs stage their investments in order to manage risk, incentivize management, and gain a better understanding of the target company and its ultimate success prospects (Bergemann & Hege, 1998; Gompers, 1995; Tykvová, 2007). Nevertheless, Wright and Robbie (1997) provide evidence that accounting information is an important part of the VC's decision making process. In order to analyze the implications of financial expertise and focus on the part of the VC on investment behavior, Dimov et al. (2007) examine the investment decision of 108 US VCs in the wireless communications industry in the period from 1997 to 2002. The authors find that VCs with higher financial expertise make fewer investments in early stage ventures. Again, this result implicates that VC professionals with a focus on a target company's financials are comparatively uncomfortable with making investments in early stage ventures, in which financial data is hardly suited to serve as a basis for an investment decision. Still, Dimov et al. also find that high VC reputation weakens the aversion of VC firms with higher financial expertise to invest in early stage ventures, whereas high VC status strengthens the aversion.

In comparison to early stage VC investments, target financials play a much more prominent role in BO investment in the later stages of the corporate life cycle. In their analysis of manufacturing LBOs during the period from 1980 to 1990, Opler and Titman 1993 (1993) capture the determinants of LBO activity using a sample of 180 LBO transactions. The firms included in the sample are then compared to a control group of all manufacturing companies in the same period of time. The authors find that firms targeted by an LBO exhibit both low growth prospects (as measured by Tobin's q) and high free cash-flow (CF) illustrating the relatively high importance that PE investor attribute to FCF. In addition, the authors provide evidence that LBO investors during the '80s shunned companies with high expected cost of financial distress such as companies with high R&D expenses. As Titman and Wessels (1988) have shown, R&D intensive companies are frequently high growth companies with unique products which are associated with high costs of financial distress. Moreover, the regression results also show that firms in the machinery and equipment industry are not usually targeted by LBOs for the same reason.

3. Operative Management

As mentioned in the introductory chapter, the PE industry has evolved and over time put more emphasis on operational improvement of portfolio companies and less emphasis on financial leverage to generate value in the course of their transactions. At least in part, this development has been driven by institutional investors, which have included operational value-adding criteria in their selection process to allocate capital to individual PE firms (Taeube et al., 2014). In a study analyzing the impact of VC value-adding measures on fundraising, Cumming et al. (2005) identify specific criteria that influence the success of VC firms to attract capital from institutional investors. His sample includes data on the Australian VC market during the period from 1999-2000. In their analysis, the authors distinguish between the following value-adding measures: (1) financial, (2) administrative, (3) marketing, (4) strategic/management. Their results show that VC funds which provide relatively more financial and strategic/management assistance to their portfolio firms receive more capital commitments. This is in contrast to funds that provide relatively more administrative and marketing assistance, while controlling for VC performance, risk, investment activity as well as management and perfor-

mance fees. Naturally, VC firms that exhibit higher internal rates of return (IRR), higher performance fees, lower management fees and a higher portion of exited investments also receive larger commitments.

But even without this recent push from institutional investors, value-adding activities have always been an important criterion that has distinguished PE from other sources of capital, such as bank loans and public equity (Gompers & Lerner, 2001; Jensen, 1989; Sahlman, 1990). Still, especially in the case of later stage BOs, the recent shift in the investment focus from mature, slow-growing CF driven businesses towards younger, faster-growing businesses demands different angles towards operational management. Whereas a classical LBO model as described by Jensen (1989) exhibits a focus on corporate restructuring and the alignment of interest, many BO investments in the late '90s and '00s exhibit a focus on growth and operational improvement (Alvarez & Jenkins, 2007). An analysis conducted by Achleitner et al. (2010) examines value generation drivers in European BOs in the period from 1991 to 2005. Their sample includes data on 206 BOs in the UK, France, Sweden, Germany, and the Netherlands. They find that leverage contributes around one-third of returns with two-thirds stemming from operational management and market driven valuation effects. In addition the relevance of the leverage effect seems to be more pronounced for large transactions above €100m, whereas in smaller transactions operational management and revenue growth is at the center of attention. As the research presented above indicates, many different drivers influence if, to which extent, and by which measures PE firms engage in operational management at the portfolio company level. Consequently, the following discussion is limited to areas which are particularly important for technology companies under PE ownership. Specifically, the following chapters summarize research on the impact of PE on (1) R&D and innovation, (2) commercialization and entrepreneurial orientation, (3) productivity, efficiency, and asset utilization, and (4) investments in physical assets.

3.1 R&D and Innovation

Both R&D and innovative capabilities are widely regarded as important factors influencing firm competitiveness in the world market. For the purpose of scientific analyses, the R&D effort can be approximated by looking at R&D expenses. Their economic relevance can be characterized by two main features. First, R&D expenses exhibit characteristics of long-run investments (Meulbroek & Mitchell, 1990). Initially they represent expenses whereas the benefits are typically not earned in the near future. Second, R&D expenses are generally associated with a positive contribution to the market value of a firm (Griliches, 1984; Hall & Oriani, 2006; Oriani & Sobrero, 2003).

Closely linked with R&D efforts, innovation is typically assessed by examining the number of new patents issued, as well as the citations received by each patent. The use of patent citations as a proxy for the economic importance of the subject patents is wide-spread in academic research. The use of patent citations is founded, among others, on Hall et al. (2005), who investigated the impact of patent citations on the market value of a firm's intangible assets. Their analysis measures the impact of R&D expenses, patents, and patent citations in the US during the period from 1963 to 1995. Specifically, the authors test the impact on three ratios, R&D expenses to book value of assets (R&D Input), the number of patents to R&D expenses (R&D Output), and patent citations to the number of patents (Quality of R&D Output) on Tobin's q. The results of the analysis support the positive impact of all three ratios on the market value of a firm, thereby confirming that the market acknowledges the importance of R&D expenses, the number of patents and patent citations on the future performance of companies. Moreover, the authors find that on average, an additional citation per patent increases the market value by 3%. Overall, despite having shortcomings (e.g. due to the protection of innovations through trade secrets instead of patents), several publications have shown that the number of new patents issued combined with the number of citations as a proxy for patent quality represents a good indication of a firm's innovative and technological capabilities (Bottazzi & Peri, 2007; Hall et al., 2005; Trajtenberg, 2001).

Based on the economic relevance of patent data, Kortum and Lerner (2000) published a paper discussing the impact of VC on patented inventions in the U.S. In their work covering the time period from 1965 to 1992, the authors find that VC investment activity is associated with significant increases in patenting activity. The analysis estimates that while VC investments amount to less than 3% of the volume of capital spent by industrial (corporate) R&D, the contribution of VC to industrial innovation is around 8% for the same time period. Stated another way, one dollar of VC capital is as effective

in spurring innovation (as measured by patents granted) as three dollars spent by corporate R&D. Similarly, Tykvová (2000) also finds a positive relation between VC investments and the number of patents issued in the German market. Following a detailed case study analysis of two VC backed companies, Bruining and Wright (2008) find evidence of both increased incremental as well as strategic innovation.

Building on the work performed by Kortum and Lerner, Hirukawa and Ueda (2011) address the causality between VC investments and innovation. Specifically, they investigate whether innovations follow VC investments (VC-First) or VC investments follow innovations (Innovation-First). In their study covering U.S. data on 19 industries from 1968 to 2001, the authors measure innovation using growth in total factor productivity as well as patent counts. The rationale behind this definition being that total factor productivity growth captures the adoption of new technologies, whereas patent count captures the generation of new ideas-both of which are important factors to innovation. The authors find support for the Innovation-First thesis, constituted by a significant relation between total factor productivity growth and VC investment. They find little support for the VC-First thesis. Results from other studies also suggest that VCs invest in already innovative firms rather than the other way round (Hellmann & Puri, 2000; Engel & Keilbach, 2007; Caselli, Gatti, & Perrini, 2009).

Drawing on both the work of Kortum and Lerner as well as of Hirukawa and Ueda, Popov and Roosenboom (2012) analyze the impact of VC relative to corporate R&D on patent issues for a sample of 11 manufacturing industries in 21 European countries. Overall, their results show weaker support for the thesis that VC investments contribute comparatively more to innovative output compared to corporate R&D. In fact, the authors find significant contributions of European VCs only in countries which have a high VC propensity (measured by a VC to corporate R&D ratio of at least 3.9%). Moreover, they find the impact of VC on innovation is relatively more pronounced in countries that exhibit welcoming tax and regulatory regimes for VC as well as lower barriers to entrepreneurship.

As shown by studies mentioned above, a lot of research has been dedicated to analyzing the impact of relatively early stage VC investments on innovation, whereas research on later stage BO activity on innovation is less numerous or typically focusses on the relationship between R&D and financial leverage (see excerpt below). In one of the comparatively few studies on this topic, Green (1992) finds no support that the changes in ownership structure following a PE transaction trigger more innovative behavior and encourage owners to seek new innovative opportunities in his study of 30 UK PE investments during the '80s and early '90s. In a more recent study, Lerner et al. (2011) analyze the investment in long-run innovative capabilities by PE firms using a sample of 472 U.S. companies that were involved in a PE transaction from 1980 to 2005. In their sample, they specifically exclude any type of PE transaction that does not exhibits "textbook" BO characteristics such as early stage VC as well as private investments in public entities (PIPE) transactions, and therefore provide a very valuable assessment of BO specific investment behavior. In addition, the time period covered in the investigation stretches in the '00s and therefore includes characteristics of more recent PE transactions. In their analysis, the authors examine patenting behavior of firms three years prior and five years after being involved in a PE transaction. They find that after the PE investment, the quality of the patents and their economic impact increases as measured by the number of patent citations. They also find that the level of patenting remains unchanged following the PE transaction. In addition, their analysis shows that relatively more patents are issued in the core competencies of the firm leading to more concentrated patent and technology portfolio. Overall, their findings suggest that there is no evidence of reduced long-run investments in innovative capabilities among firms involved in a PE transaction. Instead, they argue that PE investments are more likely associated with refocusing on a firm's innovative capabilities.

Ferreira et al. (2010) provide a model to analyze, to which extent the form of equity finance (public or private) influences managers' incentive to engage in innovative projects. Their model suggests that "it is optimal to go public when firms wish to exploit the current technology and to go private when firms wish to explore new ideas." According to the authors, the option to choose an early exit in the case of bad news in private firms makes insiders more tolerant for failures. In contrast, in public firms, bad news are quickly reflected in the market value of the firm, making an early exit by insiders unprofitable. These circumstances result in private firm managers pursuing innovative but riskier projects, whereas public firm managers are more likely to pur-

sue conventional projects to cash in early once the good news spreads out. Implications that can be derived from the model are: (1) Through the decision to take a company private, PE investments can have a direct impact on innovative behavior, and (2) the optimal structure of ownership should evolve with the corporate life cycle from private in the early and growth phases to public in the later phases of the life cycle, and/or returning private during a restructuring phase.

There is also evidence that some governmental programs of establishing a VC and BO environment to fund high-technology firms in countries that don't exhibit a large PE community can be successful. Analyzing the properties of the Australian Innovation Investment Fund (IIF), Cumming (2007) finds that compared to commercial PE firms, the IIF is 34% more likely to finance companies in the biotech industry, 17% more likely to finance companies in the information technology industry, and 14% more likely to finance companies in the medical industry. He also shows that the activity in high-technology industries does not come at the cost of performance. Exit performance of the IIF is not statistically different from commercial PE firms.

3.2 Excerpt: Impact of corporate restructuring/debt/leverage on R&D and Innovation

As mentioned before, many later stage PE transactions at least in part incorporate a restructuring component that is associated with the operational improvement of the portfolio company. In this context, the question arises as to whether the restructuring is impacting investments in R&D and long-term investment projects in general. In a study of around 2,500 U.S. manufacturing firms during the period from 1959 to 1987, Hall (1990) analyzes the impact of takeovers, LBOs, and increases in debt levels on R&D spending. He finds that takeovers and LBOs cannot generally be attributed to lowering R&D spending. In this regard, Hall's results are in line with Lichtenberg and Siegel (1990), who find no evidence of reduced R&D expenses following a buyout. In their sample, R&D intensity of U.S. firms involved in a PE transaction increased at least as much as the non-PE owned peers during the time period from 1978 to 1986. However, Hall also finds that increasing debt levels can have a significant negative effect on R&D spending. In his sample, firms that exhibited a materially higher fraction of debt after the transaction than before the transaction experienced a decline of the mean R&D intensity by 0.8ppts (from a mean of 3.4% to a mean of 2.6%). In a follow-up study, Hall (1992) provides evidence that liquidity constraints are a likely contributor to the negative relationship between financial leverage and R&D expenditures. In addition, he observes that R&D intensive firms don't generally favor debt as a form of finance.

The results find support in the context of an earlier study conducted by Long and Malitz (1985). In their work, they analyze the impact of financial leverage on the investment behavior of 545 U.S. firms in a cross-sectional panel covering the years 1978-1980. The authors compare financials leverage to investment opportunities in intangible assets (as measured by R&D and advertising expenditures) and tangible assets (as measure by capital expenditures (CAPEX)). They find that investments in tangible assets – while risky (i.e. capital intensive) – are observable and therefore can support higher financial leverage. In contrast, the riskiness of investments in intangible assets is not readily assessable by outsiders, thereby limiting the availability of debt, and consequently the suitability of high financial leverage. The authors conclude that "while the availability of internal funds may be the most important determinant of whether or not a firm seeks external sources of funds, the moral hazard problem can still explain the choice of debt or equity."

Focusing specifically on small and medium sized firms in several high-technology industries, Himmelberg and Petersen (1994) examine the effects of the availability of internal finance on R&D, as well as on investments in physical assets. Their sample includes data on 179 U.S. small and medium sized companies (SMEs) in the time period from 1983 to 1987. They find that cash-flow as a measure of internal finance has a substantial effect on R&D investments for SME companies. The effect is also prevalent for investments in physical assets, but less significant in magnitude. Among the external sources of capital to finance R&D and innovation, the authors state that although VC is more suited to overcome the hurdles associated with information asymmetries and adverse selection, VC capital is expensive (Sahlman, 1990) and only available for a small fraction of SMEs (Acs & Audretsch, 1988; Barry, Muscarella, Peavy Iii, & Vetsuypens, 1990).

Drawing on the role of VC in funding R&D, Hall and Lerner (2009) examine the funding gap that presents itself when R&D projects are required to be financed

by sources of capital outside of the firm undertaking the actual R&D project. That is, the authors focus on financial market reasons for underinvestment in R&D as opposed to intellectual property reasons associated with the harvesting of gains from R&D. In their paper, the authors argue that for small innovative firms the financial market reasons for underinvestment can only partly be mitigated by the presence of VCs. Among the reasons for the limited effect of VC are: (1) VC investors tend to focus only on selective industries at one point in time, (2) In order to be able to realize certain performance targets, VC investors require a thick exit market in small and new firm stocks, (3) Establishing a new VC environment in an economy is difficult, since it requires the presence of institutional investors, experienced VC firms and functioning exit markets (e.g. IPO markets).

Analyzing a panel of 11,125 U.S. firms during the period from 1974 to 2000, Atanassov et al. (2007) investigate the impact of the type of financing on a firm's innovativeness as measured by the number and quality of patents. Controlling for R&D expenses, the measure can be interpreted as a proxy of the productivity of corporate research, depending on the sources of finance received. Their results show that capital inflows through arm's length financing (equity and public debt) lead to significantly increased innovative activities. In contrast, capital inflows through bank based financing (loans) exhibit no such impact on innovative activities. The authors argue that banks are often not able to correctly assess the potential of novel technologies and discourage investments in innovative projects. The results of the study suggest that equity based economies such as the U.S. or the UK clearly benefit from the existence of a well-developed PE community. Nevertheless, the transferability of the results to bank based economies such as Germany or Japan cannot be taken as given. Still, Acharya and Subramanian (2009) empirically demonstrate that innovation is more prevalent in countries with debtor-friendly bankruptcy codes (such as the U.S.) vs. countries with more creditor friendly bankruptcy codes (such as Germany). Using time-series changes within countries and changes across countries of patent data and bankruptcy codes, Acharya and Subramanian find that "creditor-friendly codes lead to a lower absolute level of innovation by firms, as well as relatively lower innovation by firms in technologically innovative industries."

3.3 Commercialization and Entrepreneurial Orientation

Following up on the impact of LBOs on target firms propensity to engage in innovation and new ventures, Zahra (1995) investigates the relationship between ownership chances and corporate entrepreneurship. From his sample of 47 U.S. LBOs, he concludes that although overall R&D spending did not change materially, the companies placed greater emphasis on the commercialization of technologies and on engaging in new ventures following the LBO transaction. In addition, quality and size of the R&D departments were also increased. As introduced by Zahra, the impact of PE on commercialization can be associated with the impact of PE on entrepreneurship and more specifically with EO within the target firm (Bruining & Wright, 2008). According to Lumpkin and Dess (1996), EO can be grouped into five dimensions comprised of (1) innovativeness, (2) proactiveness, (3) competitive aggressiveness, (4) risk taking, and (5) autonomy. In their paper the authors define the five dimensions. (1) Innovativeness is connected with supporting creative processes that yield novel products, services or technologies. (2) Proactiveness is defined as seizing new opportunities and introducing products ahead of the competition as well as eliminating declining business segments. (3) Competitive aggressiveness is associated with the ambition to outperform company peers in the relevant marketplace. (4) Risk taking predominately pertains to the propensity to make large and risky resource allocations. (5) Finally, autonomy represents the degree to which individuals or teams are free to act independently and implement actions based on their own ideas.

Utilizing the EO framework in a detailed case study of two VC backed transactions, Bruining and Wright (2008) find that entrepreneurial orientation of the target firm seems to progress significantly following the VC investment. In all cases, considerable focus on improving commercialization, evidenced by increased competitive aggressiveness, can be observed. Further examples that can be associated with other EO dimensions such as proactiveness and autonomy include introducing feedback loops to incorporate product ideas from customers/industry participants, actively seeking attractive niche markets for current product or variants of current products, and reducing time-to-market and competitive pricing of new product introductions. The findings can be interpreted in the light of studies conducted by Jovanovic and Rousseau (2002) which examine the influence of corporate takeovers on the diffu-

sion of new technologies. In their analysis, the authors compare to periods of the U.S. economy marked by significant technological progress: The spread of electricity and the internal combustion engine from 1890 to 1930 and the diffusion of information technologies in the period from 1971 to 2001. They find that in the periods under consideration, "takeovers have played a major role in speeding up the diffusion of new technology." In line with this finding, Hellmann and Puri (2000) provide evidence that "VC is associated with a significant reduction in the time to bring a product to market".

In a recent study, Bruining et. al (2013) investigate the impact of PE ownership on entrepreneurial activities using a framework of management practices developed by Stevenson and Gumpert (1985) and operationalized by Brown et al. (2001). In this framework, management practices are grouped into the six dimensions. (1) strategic orientation, (2) resource orientation, (3) management structure, (4) reward philosophy, (5) growth orientation, and (6) entrepreneurial culture. Differences in management practices among firms can be attributed to whether a dimension leans more towards an entrepreneurial focus or an administrative focus. Examining changes in management practices following a BO, Bruining et. al investigate a sample collected through surveying 108 CEOs of Dutch firms that were involved in a BO in the period from 1996 to 2004. They find that four of the six categories change towards an entrepreneurial focus following the BO transaction. Namely, strategic orientation, resource orientation, reward philosophy, and growth orientation. In economic terms, the change represents a shift towards a strategic direction which is driven by the recognition of opportunities in small steps with minimal commitment of resources (as opposed to driven by controlled resources in a single step), an episodic use or rent of required resources (as opposed to outright ownership), a reward philosophy that emphasizes value creation (as opposed to responsibility and seniority) as well as the acceptation of risk to realize rapid growth (as opposed to slow, safe and steady growth). Out of the two remaining dimensions, management structure exhibits no significant change following the PE transactions, whereas entrepreneurial culture evolves towards an administrative focus. That is, instead of a broad search for opportunities, the resources controlled by the firm serve as a basis for the search of opportunities. According to the authors, "buyout firms develop an administrative focus in their culture, showing that controlled resources seem to be the starting point for taking into consideration ideas about opportunities."

Moreover, it can be argued that PE firms influence commercialization through their advisory role which is especially important for investments by VCs in the earlier stages of the corporate life cycle. Analyzing the relationship between VC and their portfolio companies, Gorman and Sahlman (1989) examine the activities of 49 U.S. VCs in 1984. Strategic analysis and advice was named among the more frequent activities which incorporates the identification of new growth opportunities. The role of VC investors extends to structuring the marketing effort of new fast-growing high-technology ventures, for which a potential field of application is provided by Tyebjee et al. (1983) according to the four evolutionary phases of marketing: (1) Entrepreneurial marketing, (2) opportunistic marketing, (3) responsive marketing, and (4) diversified marketing.

3.4 Productivity and Efficiency

In a very comprehensive analysis of the impact of LBOs on total factor productivity involving over 12,000 US manufacturing firms in the period from 1981 to 1986, Lichtenberg and Siegel (1990) find significant productivity growth over a five year period at manufacturing plants involved in an LBO as opposed to non-LBO plants. On average, productivity growth rates are around 14% higher in LBO plants. In addition, the authors find statistically significant personnel reductions at manufacturing firms following the change in ownership via LBO and provide more detailed insight on the nature of the workforce reduction. Whereas white collar jobs were reduced, blue collar jobs remained unchanged, leading to the conclusion that workforce reduction predominately relate to administrative overhead. Focusing explicitly on the longer term effects of BOs, Wright, Wilson, and Robbie (1996) examine a sample of 251 BOs in the UK during the beginning of the UK BO market (1982 to 1984) using accounting information. Their analysis shows that firms involved in a BO exhibit significantly better financial ratios and productivity ratios, especially from year three onwards following the BO. Specifically, the productivity differential between BOs and the control group of non-BOs in the longer term amounts to around 9% on average.

Analyzing a sample of 78 UK MBOs in the machinery and equipment manufacturing industry against a matched sample of 156 control firms during the period

from 1986 to 1997, Amess (2002) measures the impact of MBOs on firm productivity. In his paper, the author captures the effects of MBOs on productivity using three measures: Hicks-neutral productivity, marginal productivity of labor, and marginal productivity of capital. His findings suggest that both Hicks-neutral productivity and marginal productivity of labor improve post BO. However, marginal productivity of capital as measured by fixed assets deteriorates following the BO. The author attributes the later result mainly to the poor malleability of the fixed assets and to fixed asset revaluations within the course of the BO.

Using plant level data, Harris et al. (2005) examine changes in the total factor productivity of 35,752 manufacturing facilities pre- and post-BO in the period from 1994 to 1998. Their analysis shows significant increases in total factor productivity following the BO transaction. Efficiency increases around +71% in the short run and around +90% in the long run. Representative plants under consideration experience reduced output following the BO, yet reduce their personnel comparatively stronger, achieving an overall increased labor and total factor productivity. According to Harris et al., possible explanations for this observation are measures put into place by the new owners or managers to enhance labor intensity of production through outsourcing intermediate goods, services, and materials.

In a study comprising of 5,000 (virtually all) U.S. BO transactions in the time period from 1980 to 2005, Davis et al. (2009) examine the changes in productivity, employment levels, and wages at PE targets compared to other matching firms with similar characteristics. In their sample, they specifically exclude VC investment and focus on later stage BO transactions. The authors measure the impact of the BO transactions on a firm level as well as on a facility level (i.e. plant, office). For the manufacturing subsector, the analysis includes 1,400 firms and around 14,000 facilities. Among the main findings of the study are: First, labor productivity of target firms at the time the transaction is already around 3.8% higher than at comparable firms in the same industry. Two years after the PE transaction, the lead in labor productivity at PE targets increases even further to 5.2%. The authors attribute this increase in labor productivity to the changes within facilities, as well as to changes across facilities within a company. Second, PE portfolio companies are much more likely to close down underperforming facilities as measure by labor productivity compared to their non-PE owned industry peers. Third, both PE owned firms as well as their industry peers both tend to share productivity gains with their employees through increased wages. Still, in line with Bruining et al. (2013) increases are slightly higher for firms under PE ownership.

In a response to the scrutiny of PE following the financial crisis of 2008/2009, Bernstein et al. (2010) examine the impact of PE investment on industry performance. Their sample distinguishes between 20 industries in 26 countries during the time period from 1991 to 2007. Overall, their findings suggest that industries which have received material PE funds in the past have grown more rapidly in terms of productivity and workforce. Above that, the authors find no support for increased cyclicality between industries that have received large PE funds and industries that have received comparatively less PE funds. Their results hold not only for common law countries such as the U.S. and the UK, but also for civil law countries in continental Europe. In addition, the authors find no evidence of reverse causality, i.e. the possibility that the results are driven by the fact that PE firms select to invest only in high-growth industries.

Studying performance, efficiency, and growth implications of different types of PE transactions, Meuleman et al. (2009) analyze 238 UK PE transactions in the period from 1993 to 2003. In their study, the authors distinguish between divisional BOs (i.e. spin-offs) and non-divisional BOs. They find that employee growth in divisional BOs is approximately 36% higher than in BOs that do not involve a spin-off. They also find relatively greater efficiency gains in divisional BOs, than in non-divisional BOs but do not find significant differences with respect to profitability. Independent of the type of BO, the authors find that higher PE firm experience does not generate higher profitability and efficiency at the target firm. However, PE firm experience exhibits a significant positive relationship with growth at the target firm following the transaction.

Applying a mix of qualitative and quantitative methods, Bloom et al. (2009) measure management practices of PE owned firms vs. management practices in government, family owned, privately owned, and publicly owned companies using a sample of 4,000 medium-sized manufacturing firms in Asia, Europe, and the U.S. In order to obtain unbiased data, the authors conducted double-blind interviews during which managers of the

firms in the sample are scored by the interviewers using a predefined practice score grid and open ended questions. The scoring result is then compared to performance measures such as productivity, profitability and sales growth. They find that PE-owned firms are better managed than government-owned, family-owned, and privately-owned firms, even after controlling for country, industry, size, and employee skills. PE firms also appear to be slightly better managed than publicly listed firms with dispersed owners, although the results are not statistically significant. In specific, the authors provide evidence that PE owned firms have better people management practices (such as hiring, firing, and promotions) and stronger operational management practices (such as lean manufacturing, continuous improvement, and monitoring).

In an analysis of 1,225 UK BOs covering the period 1980 to 2009, Jelic and Wright (2011) compare operating performance of PE backed firms immediately following the BO and at the point of exit to a control group of non-PE backed peers. Unlike earlier studies, the authors cannot find evidence for the outperformance of PE backed companies; however, they also find no evidence of underperformance compared to industry peers. In terms of exit channels, IPOs seem to be associated with improvements in employment and output, as well as with a lack of improvement with respect to profitability and efficiency. In the case of secondary BOs, initial performance declines in the course of the primary BO and stabilizes during the initial years of the secondary BO. Three years into the secondary BO, profitability and efficiency decreases while employment increases, similar to the development observed in the case of IPOs.

Covering 88 complete LBO investment cases which went from entry to exit during the period from 1999 to 2008, Alperovych et al. (2013) compare post BO efficiency during the first three years following the investment across different vendor sources (such as divisional BO, private BO, secondary BO). The analysis provides evidence that divisional BO and private BO exhibit greater than average efficiencies, whereas secondary BO exhibit below average efficiencies. Moreover, divisional BOs achieve greater efficiency improvements post BO than either private or secondary BOs. The authors also find a positive and significant relationship between PE firm experience and post BO efficiency with most of the efficiency gains happening in the first two years after entry of the PE firm.

3.5 Investments in physical assets

Prior research has provided evidence for a positive relationship between corporate investments (including investments in physical assets) and the availability of internal sources of capital and CF in several different countries such as the U.S. (Fazzari, Hubbard, & Petersen, 1988; Hubbard, 1998), the UK (Devereux & Schiantarelli, 1989), and Japan (Hoshi, Kashyap, & Scharfstein, 1991) among others. Analyzing 76 large U.S. LBOs of public firms conducted during the period from 1980 to 1986, Kaplan (1989) examines changes in operating results three years following the BO. Beyond the observation of increases in earnings before interest, taxes, depreciation, and amortization (EBITDA) and increases in net CF, he also observes decreases in CAPEX at the target firms as measure by the sales to CAPEX ratios. According to the FCF theory presented by Jensen (1986, 1988), public firms targeted by an LBO have been investing in negative NPV projects before the transaction. In this context, decreased CAPEX would represent a reduction in non-profitable investments and therefore improve the profitability of the target firm. More recently, evidence for the presence of overinvestment of FCF is provided by Richardson (2006). His sample includes data on 58,053 U.S. firms in the period from 1988 to 2002. For his analysis based on accounting data, Richardson decomposes total investment expenditures in 2 components: (1) replacement CAPEX, and (2) new investment CAPEX. The latter is again split up into the 2 sub-components (2a) expected investment CAPEX based on firm/industry growth opportunities and capital constraints, and (2b) overinvestment in negative NPV projects. His results show that "overinvestment is concentrated in firms with the highest levels of free CF." On average, firms with positive FCF overinvest around 20% of their FCF. The author also points out that "certain governance structures, such as the presence of activist shareholders, appear to mitigate overinvestment."

In a study of 25 U.S. PE investments in mostly asset heavy manufacturing industries during the 80s, Bull (1989) compares several accounting metrics two years before and two years after a PE transaction. He finds that average CAPEX from T-2 to T-1 decrease by around 25% and again from T-1 to T+1 by around 37%. From T+1 to T+2, average CAPEX increase by around 39%. It is likely that the decline of CAPEX before the PE investment is due to window-dressing of the target company before the transaction to present more impressive

earnings. The further reduction in CAPEX following the PE transaction could present an effort to streamline the company, whereas the following increase in CAPEX could either present (1) the reduction of maintenance backlog from underinvestment and/or (2) additional CAPEX to further growth and increase manufacturing efficiency. Additionally, Green (1992) notes in a study of 30 UK PE investments that the requirement to reduce financial leverage taken on within the scope of the transaction constrains CAPEX until leverage is reduced to industry specific levels. Still, he also finds that due to continuing replacement of CAPEX and increased project upgrades, companies were not "living off their existing capital through failing to reinvest in the business".

Analyzing the changes in accounting metrics of 72 U.S. firms that exhibited a reverse LBO in the time period from 1983 to 1990, Muscarella and Vetsuypens (1990) find a significant reduction in CAPEX compared to the control group not owned by PE. They also find increased production efficiency ratios as evidenced by operating margins, asset utilization and sales per employee. In addition, the authors provide an overview of the most frequently applied strategic and operational changes initiated by the PE firm after taking the company private. The measures include (in order of frequency): changes in product mix, product quality/pricing and customer service (44% of all cases), reorganization of production facilities and asset sales (43% of all cases), acquisitions (25% of all cases) and reductions in production cost (22% of all cases), reorganization of distribution channels (14% of all cases), reductions in personnel (14% of all cases), and productivity increases (10% of all cases). It is important to note that the sample exhibits strong characteristics typically found in restructuring/turnaround cases. This is not surprising as reverse LBOs in the U.S. often act as a form of corporate restructuring.

In a more detailed case study approach of two MBOs backed by PE firms, Bruining and Wright (2008) observe increased investment in production facilities at the expense of workforce. The reduction in workforce could also be observed in a study by Cressy et al. using a sample of 57 UK PE buyouts in the period from 1995-2000 (Cressy, Munari, & Malipiero, 2011). The authors show that during an initial period of rationalization following the buyout, PE portfolio firms exhibit statistically significant reductions in workforce compared to their industry peers. Still, the authors point to the positive relationship between post buyout profitability/ sales-growth and future employment growth, which may be a likely result of the efficiency gains through rationalization and automation.

In one of the more scarce studies using data outside of the U.S. or the UK, Boucly et al. (2011) examine a sample of 839 PE transactions in France during the period 1994 to 2004. They specifically focus on companies in financially constrained industries (Rajan & Zingales, 1998), and study the behavior of companies before and after the PE transaction using accounting data extracted from tax filings. The observations are then compared to a control group of industry peers not involved in a PE deal. With respect to investments in physical assets, their findings suggest a material increase in CAPEX in the years following the transaction which exceeds the industry peers by 24%. Assets at PE targets increase 12% more on average than at industry peers over a four year period following the transaction. In addition, the authors find statistically significant and economically large increases in profitability as well as employment growth (18% above control group) and sales growth (12% above control group).

The authors partly attribute these observations to the fact that PE investors assist target companies overcome credit restrictions observed in capital and credit markets which are smaller and less liquid than the markets in the U.S. or the UK. They also argue that monitoring activities of PE investors reassure banks to provide capital to their portfolio companies at more favorable terms. Findings from other researchers generally support the positive relation between PE involvement and bank loan terms (Citron, Robbie, & Wright, 1997; Ivashina & Kovner, 2011). In addition, reputation and financial expertise of PE investors also help portfolio companies overcome hurdles in the capital sourcing process and therefore gain access to further capital for growth investments. The findings of this study also point to the relevance of the nature of the PE transaction and its consequences. Whereas private-to-private transactions exhibit growth in employment, sales, assets, and profitability, divisional BO of large conglomerates and public-to-private BO lead to increased profitability but not to significant growth.

Similar findings with respect to private-to-private PE transactions have been observed in the UK. In a sample of 266 PE transaction in the period from 1998 to 2007 comprising of 169 private-to-private PE transac-

tions Chung (2009) analyses the impact of the change in ownership on target company characteristics following the transaction. His results implicate that after a LBO, target firms experience significant growth in firm size attributable to investments in fixed assets and to add-on acquisitions. The author concludes that "LBOs can be an important tool for private firms with large current and future growth opportunities, but with investment constraints […] imposed by highly concentrated ownership and the lack of financing."

4. Exit Routes

Ultimately, a PE company relies on profitable exits in order to achieve the returns desired by the PE firm and its investors. In the following chapter, I will therefore summarize findings from literature with respect to three main areas. First I will present research on the prominent PE exit channels and their respective importance. Second, I will elaborate on factors that have been found to determine the profitability of PE funds. Moreover, references with respect to the performance of PE relative to the public markets will be given. Third, I will present findings regarding the probability of default among PE investments and which strategies help PE firms to mitigate default risk.

4.1 Importance of Exit Channels

Among researchers as well as among PE practitioners, exits are frequently ranked according to the following scheme from most desirable to least desirable: IPO, trade sale, secondary BO by another PE firm, buyback on behalf of the entrepreneur, and write off (see for instance Ali-Yrkkö, Hyytinen, & Liukkonen, 2001; Cumming et al., 2005).

Analyzing IPOs from the perspective of IPO investors, Barry et al. (1990) examine a sample of 433 VC backed IPOs during the period from 1978 to 1987. In their paper, the authors provide a breakdown of industries most frequently experiencing IPOs backed by VC during the time period under consideration. These industries include: business services (21.8%), industrial/commercial machinery and computer equipment (18.9%), electronic equipment except computers (15.5%), and measuring, analyzing, and controlling instruments (7.6%). Among other results, the authors provide evidence that VC monitoring activities are valued by capital markets. Compared to their non-VC backed peers, VC backed IPOs exhibit significantly lower underpricings.

Although a majority of exits are conducted through a trade-sale (Kaplan & Strömberg, 2009), research suggests that for VC investors the possibility of an IPO is important when investing in a certain industry/market. Within the scope of analyzing VC financing of R&D intensive firms, Hall and Lerner (2009) note that the existence of an IPO exit route, as represented by a thick public market for high-technology stocks, limits the suitability of VCs to address the often quoted "funding gap" for innovative new companies. Similar evidence is provided by Hargadon and Kenney (2012), who provide evidence that part of the difficulties of VC investors investing in the clean technology sector are attributable to a lack of lucrative IPO exit routes.

In his analysis of 433 U.S. VC firms, Gompers (1996) underpins the importance which VC firms attribute to the IPO as an exit route. In his analysis, he finds that in order to establish a reputation among investors, young VC firms more frequently rush portfolio companies to an IPO (as measured by the age of the company at the time of the IPO and the relative IPO underpricing) compared to the more established VC firms. Examining feedback mechanisms between VC reputation, successful VC exits and future fundraising and investing, Ali-Yrkkö et al. (2001) find supporting evidence for findings yielded by Gompers. In their analysis of 30 Finnish VC firms and 630 portfolio companies, the authors confirm that IPOs and trade-sales exhibit a strong influence on future fundraising as well as on investment activity by VC in certain industries. According to responses from VC firms, the decision to exit via IPO or trade-sale in their sample is strongly affected by three factors: (1) the current condition of the public equity market, (2) the portfolio company's future profitability, and (3) the portfolio company's growth prospects. An analysis conducted by Balboa and Marti (2007) for the Spanish market extends the importance of IPOs and trade-sales to the general PE universe. Examining 101 Spanish PE firms (approximately 86% of the total population), the authors find a positive and significant relationship between PE firm reputation, future PE fundraising and the share of portfolio companies exited through an IPO or trade-sale. The value of the IPO to firm owners is also confirmed by a study conducted by Mantecon and Thistle (2011). In their study, the authors examine the IPO decision by analyzing 224 companies that filed for an IPO in the period from 1996 to 2008. Among other analyses, the authors then compare companies that withdrew their IPO before being acquired by another firm with those companies which retained

their IPO option after being acquired by another firm. The authors find that the option to go public led to an average selling price of $1.11 compared to a selling price of $0.54 of those companies which withdrew their IPO.

Despite the perceived importance of IPOs, recent research suggests that the relevance of IPOs as an exit route has decreased significantly during the last 40 years. In a very comprehensive analysis on global as well as U.S. PE investments during the period from 1970 to 2007, Kaplan and Strömberg (2009) illustrate this decline. Whereas IPOs accounted for around 28% of all exits from 1970 to 1984, their share decline to 11% from 1995 to 1999, and finally to 1% from 2006 to 2007. During the whole period under consideration, IPOs only account for around 14% of all PE exits. Unsurprisingly, the most frequently used exit route with around 38% of all exits from 1970 to 2007 is the trade-sale of a portfolio company to a strategic (corporate) investor. The share of trade-sales stays quite stable during the whole observation period and ranges from 31% (1970 to 1984) to 40% (1995 to 1999 and 2003 to 2005). Although the secondary trade-sale to another financial investor does not rank very high in the perception of many PE investors, this exit channel has gained importance over time. Secondary trade-sales have increased significantly from 5% from 1970 to 1984, to a peak of 31% from 2003 to 2005. Overall, secondary BOs account for around 24% of all exits during the time period under consideration.

4.2 Returns to Investors

One of the main areas of research in the field of PE has been concerned with the measurement of PE returns and their comparison with other asset classes such as public equity (Chen, Baierl, & Kaplan, 2002; Cochrane, 2005; Hwang, Quigley, & Woodward, 2005; Moskowitz & Vissing-Jørgensen, 2002). As indicated in the previous chapter, several researchers have confirmed that the performance of PE funds is among the most important determinants that influence the success of future fundraising activities (Black & Gilson, 1998; Gompers, 1996; Gompers & Lerner, 1998; Jeng & Wells, 2000). Notwithstanding their importance, measuring returns for PE funds is fraught with considerable difficulties due to a number of biases such as sample selection bias, survivorship bias, self-reporting bias, and self-valuation bias among others. Methods for addressing those biases and measuring returns and risks of PE funds are presented by Phalippou and Gottschalg (2009) and Driessen et al. (2012). Still, returns in the PE industry are far from uniform and differ widely depending on a number of criteria including (1) the timing of the fundraising, (2) the stage of investments, (3) the characteristics of the PE fund, (4) the type of limited partners who invest in PE funds, and (5) the exit channel.

In a study of U.S. PE investments including both VC and BO funds, Kaplan and Schoar (2005) calculate and compare fund returns to returns from the public market (as measured by the S&P500) during the period from 1980 to 2001. The authors perform their main analysis using data consisting of 746 funds that have been largely liquidated. Among other results, the authors show that performance of VC funds on aggregate underperformed the public markets during the '80s, whereas BO funds on aggregate outperformed the public markets during the same period. In the '90s, this trend reversed with VC funds outperforming the public markets on aggregate and BO funds underperforming the public markets on aggregate. More recently, Guo et al. (2011) address the performance development of LBO funds over time in their study focusing on value creation drivers in the PE industry. Their sample includes data on 192 LBOs during the period from 1990 to 2006. They find that the impact of LBOs on the profitability of target firms and consequently returns to investors have declined in the recent wave of LBOs when compared to LBOs in the '80s. In addition to the variation over time, academic literature as well as industry evidence suggests that PE performance is related to the timing of the fundraising of an individual PE firm relative to its industry peers. PE funds raised in boom times seem to be less likely to achieve above-average returns (Kaplan & Schoar, 2005; Wright et al., 2009). The effect may be attributed to the fact that in the case of multiple successful fundraisings in the industry, more money is chasing the deals available in the market which drives up prices and lowers returns to investors (Diller & Kaserer, 2009; Ljungqvist & Richardson, 2003).

In addition to the timing of the fundraising, the focus on specific stages in the corporate life cycle – VC in the early phases and BOs in the later stages – also has been shown to be an influencing factor on the performance that investors can expect from a PE fund. However, evidence from literature is mixed as to which investment model, VC or BO, outperformed the other. The relative performance strongly varies depending on the period of time under consideration, with VC outperforming BO in certain years and vice versa. Building on detailed

cash flow based data received from a large limited partner in PE funds, Ljungqvist and Richardson (2003) examine returns to U.S. VC and BO funds during the period from 1981 to 2001. In their analysis using individual cash flows to portfolio firms, management fees to PE fund managers as well as capital gains distributions to investors, the authors specifically focus on mature PE funds that exhibit a vintage year from 1981 to 1993. For this period, VC funds with an average return of 14% (25th percentile: 7%; 75th percentile 27%) underperformed BO funds with average returns of 22% (25th percentile: 10%; 75th percentile 28%). The authors also find during the average 10 year life span of a fund, the IRR of the average PE fund is negative until the 8th year at which time it turns positive.

In their analysis of 746 PE funds, Kaplan and Schoar (2005) find confirming evidence with respect to the relative outperformance of BO against VC. In the period from 1980 to 2001, VC fund returns average 17% (25th percentile: 3%; 75th percentile 19%) whereas BO fund returns average 19% (25th percentile: 6%; 75th percentile 24%). Drawing on data for US VC and BO funds during the period from 1980 to 2007, Ewens et al. (2013) find a slight outperformance of VC over BO funds, albeit at a higher risk (as measured by VC beta of 1.24 vs. BO beta of 0.72). In their sample comprising of 741 BO and 1040 VC funds, the authors calculate average VC returns at 15% and average BO returns at 14%. In addition, Ewens et al. suggest that while BO funds were able to outperform their benchmark (as measured by alpha of 4%), VC performed similar to their benchmark (as measured by alpha of 0%).

The considerable dispersion between PE funds as evidenced by the range of returns from the 25th percentile to the 75th percentile – even within the VC and BO categories – highlights the importance of the PE firm characteristics for fund performance. Unlike the situation in the public equity markets, where returns from mutual fund managers net of fees are not persistent, evidence from literature suggests that past performance is indicative of future performance in the PE market (Phalippou & Gottschalg, 2009; Wright et al., 2009). In their analysis of U.S. PE funds covering the years 1980 to 2001, Kaplan and Schoar (2005) point to the importance of individual general partners at the PE funds: "General partners whose funds outperform the industry in one fund are likely to outperform the industry in the next and vice versa." Following an approach frequently applied in the mutual fund industry in which returns are attributed to different areas such as security selection and market timing, Schmidt et al. (2006) examine a sample of 70 European PE funds in the period from 1971 to 1998. In their analysis, the authors focus on mature VC and BO funds in order to ensure an accurate performance assessment. The results provide evidence that market timing skills are important for VC funds, whereas BO fund returns are not significantly driven by market timing. Instead, in line with Kaplan and Schoar, returns from BO funds are positively related with the experience of general partners at BO funds. Moreover, in an analysis of 777 European PE funds, including both VC and BO funds, for the period 1980-2003 Diller and Kaserer (2009) suggest that both VC and BO returns are positively related with the skills of PE fund managers.

According the research conducted by Lerner et al. (2007), return characteristics of PE funds also vary according to the type of institutional investors that commit capital to PE funds. In their analysis of 838 U.S. PE funds raised during the period from 1991 to 1998 and a corresponding number of 352 limited partners (LPs), the authors find that endowments, and to a lesser extent public pension funds, are able to achieve higher returns from PE investments than other institutional investors such as banks, corporate pension funds, and insurance companies. Specifically, (university) endowments' returns from PE funds exceed the average PE return by almost 21%. Lerner et al. argue that the sophistication as well as the differing investment objectives among institutional investors can be a possible reason for the variations in returns. Other possible explanations point to the presence of "sweetheart" deals with strategically important investors, such as university endowments (Wright et al., 2009). In addition to the return variation among institutional investors, Ewens et al. (2013) show that the overall risk and return profiles with respect to target companies are influenced by the relationship between general partners (GPs) and LPs. Their analysis of U.S. PE funds from 1980 to 2007 specifically focuses on the impact of negotiations between GPs and LPs on the consequential negotiations between GP and portfolio company management. According to the authors, since the contract between the GP and LP is closed before the GP invests in any companies, the contract is based on the expected risk in the portfolio as opposed to the realized risk. Therefore, as the GP approaches a potential investment target he values not the expected average risk but the realized risk in the portfolio company, and

consequently requires the portfolio company to compensate for his personal risk. In effect, this mechanism requires the target company to reduce the price more than necessary if it just had to compensate the GP.

Finally, as indicated in chapter 4.1, the exit channels available to PE portfolio companies are often ranked according to their return hierarchy from high to low: IPO, trade sale to a strategic investor, trade sale to a secondary PE investor, trade sale via management buy-out, and write-off (Cumming et al., 2005; Wright et al., 2009). In this context, Jeng & Wells (2000) analyze VC investments in 21 countries during the period from 1986 to 1995. Their analysis shows a significant positive relationship between IPOs and VC investments. After assessing the impact of reverse causality, the regression results show that "IPOs are the strongest driver of VC investing".

Conversely, Black and Gilson (1998) analyze IPOs from the viewpoint of the portfolio company within the scope of comparing bank- and stock market-centered financial markets. In their analysis, they link the comparatively greater presence of VC in a stock market centered financial market to the market for corporate control associated with IPOs. The latter provides the VC and its LPs with a lucrative exit opportunity, which enables the portfolio company entrepreneur to regain control over her company. Still, analysis conducted by Hege et al. (2009) suggest that the performance gap observed between U.S. and European VCs cannot be fully explained by the differences in public equity market vitality between the two regions. Instead, the authors attribute the relatively worse performance of European VC mostly to the share of poorly performing companies. Studying performance drivers of PE transactions in the UK during the period from 1995 to 2004, Valkama, Maula, Nikoskelainen, and Wright (2013) examine the influence of deal- and industry-factors and macroeconomic factors on PE returns. The authors show that on a deal level, the use of leverage has a positive and significant impact on PE returns. In addition, other deal specific factors, such as transaction size and add-on acquisitions, impact PE performance. Moreover, the authors find that industry growth is a particular strong driver of PE returns from a macroeconomic perspective.

4.3 Defaults

Dimov and Sheperd (2005) examine the relationship between human capital at the VC firm level and the performance at the portfolio company level. Specifically, Dimov and Sheperd examine to which degree general human capital (as measured by education and experience in science and humanities) and specific human capital (as measured by education and experience in economics, law, finance, and consulting) at the VC firm impact the share of portfolio companies that go public (home run) and the share of portfolio companies that go bankrupt (strike out). They measure the effects with a sample of 112 U.S. VC firms and 749 VC firm top management members that have made investments in the wireless communication industry. Among other results, the authors find that VC firms with higher proportions of specific human capital have a lower share of companies in their portfolio that go bankrupt. Conversely, VC firms with a higher proportion of general human capital have a higher share of companies in their portfolio that go bankrupt.

Empirical research also suggests that a more diverse VC universe reduces the failure rate of VC portfolio companies. Studying the failure rate of 200 U.S. VC portfolio firms during the period from 1990-2001, Dimov and de Clercq (2006) find that specialization of VC in a certain development stage as well as syndication among VC firms significantly reduce the probability of default among portfolio companies. Since both specialization and syndication of VCs are more likely to occur if the number of active VCs in a certain region is higher, a diverse and thick VC environment strengthens the overall resilience of VC portfolio companies. Apart from the management team at the VC firm and the VC landscape, the overall performance of the public equity market has also been observed to impact the probability write-offs at the portfolio company level. In his analysis of 280 Australian PE firms and 845 portfolio companies during the period from 1982 to 2005, Cumming (2007) finds that the probability of write-offs at the portfolio company level are reduced by 2.5% if the overall capital market (as measured by the Australian MSCI Index) increases by 50% over the holding period. Additionally, the likelihood of an IPO increases by 4% given the same 50% increase of the MSCI.

In their analysis of global PE activity in the period from 1970 to 2007, Kaplan and Strömberg (2009) address the question of whether the high levels of debt associated with many PE transactions result in a higher frequency of bankruptcies among PE portfolio companies. The authors approximate the average default rate among

PE portfolio companies at 1.2% per annum compared to a slightly higher annual default rate of 1.6% for all U.S. corporate bond issuers in the same period. However, evidence from research on large public-to-private PE transactions suggests that the default rate among this specific type of transactions might be higher. For instance, building on data comprising of public-to-private LBOs during the '80s and early '90s, Andrade and Kaplan find that 31 of the 136 LBOs went bankrupt - a default rate of 23%. Still, on aggregate, the default rate of all PE transaction in the almost 40 years covered by Kaplan and Strömberg amounts to 6%. Moreover, the default rate has generally been declining over time; from 7% in the period from 1970 to 1984 to 3% in the period from 2003 to 2007, with a slight setback in the period from 1995 to 1999 (8%).

Similarly, Tykvová and Borell (2012) examine the question of whether the financial distress risk of a portfolio company increases following a BO. In their analysis, the authors build on data covering 1,842 BOs in 15 European countries during the period from 2000 to 2008. Tykvová and Borell find that PE firms specifically target companies which are less financially distressed than their industry peers. They also find that after the BO transaction, financial distress risk at the target firm increases. Still, default rates among BO targets are not significantly different from the control group of non-BO firms. Moreover, when the BO is conducted by an experienced PE fund (as measured by the number of transactions prior to the subject BO), default rates are in fact lower than those experienced at the control group.

5. Conclusions

The evidence presented by the body of literature mentioned above indicates that significant aspects of the PE business model went through a dynamic development during the last 30 years. The adaptation of PE firm behavior to the business environment and macroeconomic developments affects all stages of the PE investment cycle, from screening and selection, operational management of portfolio companies to targeting specific exit routes. When screening for potential investment in entrepreneurial firms, literature suggest that VC often put relatively more emphasis on reducing risk than they put on return opportunities. In practice, the risk weighted approach is characterized by the strong influence attributed to the entrepreneur and the management team in the decision making process of the VC as opposed to market and product specific factors. Moreover, literature shows that VCs with a technology and product centered investment approach are frequently associated with more early stage heavy investments which in turn are more risky than investments in later stages of the business life cycle. Put another way, the earlier the focus of the VC company in the business life cycle, the more likely it is that the VC emphasizes technology/product related criteria in their selection process. Still, evidence from literature suggests that despite being sophisticated investors, new high tech and asset heavy industries are challenging for VCs. Historically, VCs have been successful by investing in software and IT related business models which are particularly well suited for the VC business model due to the low capital requirements and short holding periods. Asset and technology heavy business models demand for larger amounts of capital, specific market/technology know-how, and longer holding periods, which typically exceed the capacity of a single VC. Consequently, syndication and co-investments are important methods for VCs to overcome some of these limitations.

The dynamic development of the PE investment model is probably most prominent with respect to the operational management of portfolio companies and here specifically for later stage BOs. Whereas in the '80s, financial leverage and changes in corporate governance and incentive structure were the most important operational value drivers, the situation has changed. Successively, relatively more importance is attributed to operational improvements of the portfolio companies regarding strategic development, productivity, and distributions/sales among others. This shift is partly attributable to a more mature PE industry in which more PE firms are searching for investment opportunities and competition among PE firms for attractive deals is strong. Overall, the typical (L)BO model experienced a gradual shift towards more growth PE oriented investment and management criteria. The evidence from literature is supported by the fact that many large BO firms, such as KKR, Carlyle, and Blackstone, have established management consulting branches within their organization which are specifically occupied with leveraging operational potential within the portfolio companies.

Nevertheless, there are also indications that some of the prejudices which have been attributed to PE firms are in fact warranted, although the context in which these developments occur is highly important. In particular, it is important to distinguish between PE investments

in profitable, growing companies on the one hand and investments in companies that experience difficulties and/or are in financial distress on the other hand. Many of the prejudices associated with PE investors, such as laying off workers and reducing CAPEX, are frequently associated with restructuring portfolio companies that have previously experienced difficulties. This also pertains to public-to-private BOs, which have been the early focus of researchers. Often, applying much needed changes to the business model (which are hardly possible as a public entity) is the reason behind taking a public company private and making it profitable again in the long term.

In terms of exits routes, evidence from literature shows that the number of IPOs and thus their relevance for PE companies has diminished quite substantially over time, although IPOs are generally considered to be the most profitable exit channel for PE investors. Consequently, the lack of IPOs among PE portfolio companies can be attributed to an increasingly smaller window of opportunity to bring private companies public. This development has implications for policy makers which try to recreate the U.S. VC model and use it as a tool to strengthen innovation and growth of high technology companies. In order for the VC investment model to be successful, several prerequisites are required such as a sufficiently large body of innovative high technology companies as well as local VC firms. According to evidence from research, VC firms are less drivers of innovation but investors in companies which are already innovative. A major contribution of VC lies in the focused approach to drive the commercialization of innovative products into new and existing markets. Ultimately, the performance of VC (and BO) firms is dependent on the presence of accessible exit markets in the form of IPO and trade sale opportunities. As the literature suggests, successful exits are among the most important factors that determine the positive outcome of VC fundraising activities among institutional investors. Consequently, policy measures aimed at establishing a VC culture in countries outside of the US frequently fall short of their goal due to the complexity of the interrelations of the participants in the VC investment model.

A possible avenue for future research in this context could focus on successful PE clusters outside of the U.S. and analyze whether local policy measures and regulatory frameworks contributed to the establishment of a PE industry. Moreover, although some studies in extant literature relate to specific industries or to manufacturing companies in general, relatively little evidence is available that analyses the specific characteristics of PE investments on a more detailed industry level. In this regard, research could provide further insight as to why PE firms frequently focus their investment activity on narrow industrial sectors, and what determines the decision to get active in specific industries.

Moreover, research on PE investments in general and PE investments in technology companies in specific points to the existence of several interrelations between different types of capital along the PE investment model. Specifically, public and private R&D and angel finance contribute to the development of new technologies and consequently to the establishment of companies based on new technologies. The availability of debt determines the amount of capital that can be deployed to leverage a transaction and enhance PE returns, and the activity of the public equity and M&A markets determines exit performance of portfolio companies which in turn influences future PE fundraising. Future research could elaborate on these interrelations in order to provide a better understanding of the consequences associated with shifts in supply and demand among different types of capital.

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Endnotes

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ii. Investor specific criteria include factors such as VC industry focus, VC regional focus, VC company lifecycle, and funding status and/or portfolio related issues among others.

iii. Quote attributed to Arthur Rock, a successful U.S. VC

iv. Tobin's q measures the ratio of the market value of a company's assets to the replacement value of the same assets. It is often referred to as follows: Tobin^' s q= ((Market Value of Equity+Market Value of Liabilities))/

((Book Value of Equity+Book Value of Liabilities))

v. In their study, Cumming et al. used the number of days per month spent with sharing financial, administrative, marketing, and strategic/management expertise by the VC as a proxy of the magnitude of value-adding efforts.

vi. Industries included in this study were comprised of: chemicals and drugs, machinery, electrical equipment and communications, and instruments

vii. Double-blind interviews incorporate two main aspects. First, interviewers are not told anything about the performance of the firm they are interviewing (i.e. interviewers are performance-blind). Second, managers that are interviewed are not told they are being scored (i.e. managers are scoring-blind).

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Alternative Beta Strategies in Commodities

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Ever since the publication of Professor Harry Markowitz's work in 1952, modern portfolio theory has been one of the cornerstones of asset allocation and portfolio construction. Until recently, the principal building blocks used to construct investment portfolios have always been individual assets or asset classes. However, recent crises have brought into sharp relief the lack of diversification of many investment portfolios, despite appearances to the contrary. In reality, the correlation between traditional asset classes has increased steadily over the past decade, surging to alarmingly elevated levels during the 2008-09 financial crisis. Indeed, seemingly unrelated assets moved in lockstep, and portfolios once thought to be diversified did not weather the storm. This has led to some investors exploring risk-factor-based asset allocation as a potential new framework for portfolio construction, and looking at alternative beta strategies in an effort to rectify the 'defects' of conventional market portfolios.

Alternative beta strategies can take many different forms, with a variety of objectives. They can simply aim at reducing risks (the "risk-based approach") or enhancing returns through exposure to systematic factors (the "factor-based" approach). These strategies have become part of equity investing, owing to the swath of strategy indices that have come to market. However, the popularity of these strategies stems from not only a desire for diversification, but also an awareness that systematic risk factors explain the majority of long-term portfolio returns. In fact, many investors no longer consider their opportunity set as consisting solely of single assets or individual asset classes, but as risk premium that can be harvested systematically. In addition, the growing demand for transparency and a continued push to understand the different sources of return mean that investors have increasingly shown a predilection for such strategies.

In response to investor interest in the subject, we explore both risk-based and factor-based alternative beta indices in commodities, with a particular focus on the latter. This is conducted using both empirical research and surveys of existing indices. We also assess

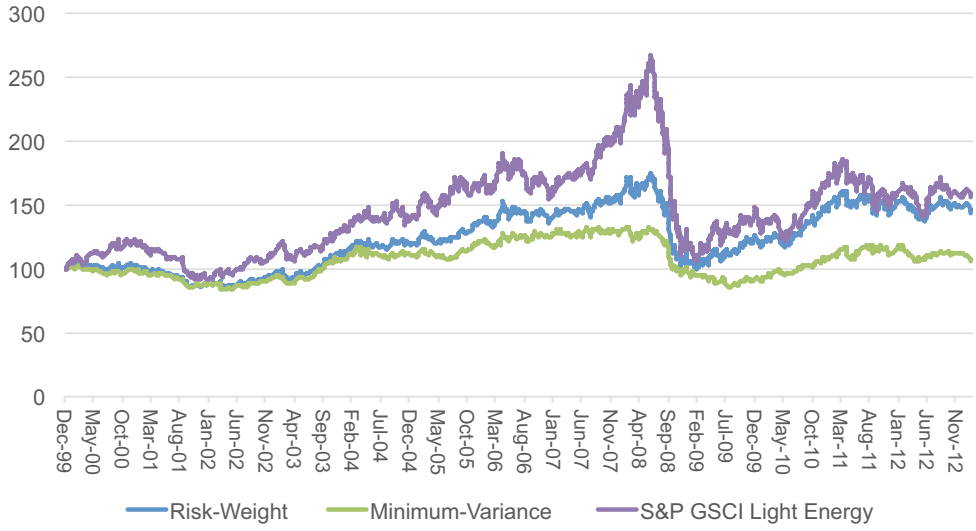

Exhibit 1a Performance of a Selection of Risk-Based Strategies

	Risk-Weight	*Minimum-Variance*	*S&P GSCI Light Energy*
Return	3.09%	0.85%	3.55%
Volatility	12.59%	10.56%	18.34%
Return per unit Risk	0.25	0.08	0.19
Maximum Drawdown	-43.4%	-36.6%	-60.7%

Exhibit 1b: Risk-Based Strategies - Historical Annualized and Return
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

the merit of combining multiple systematic risk factors, either as part of a multi-asset portfolio or as a stand-alone commodity allocation.

1. Assessing Alternative Beta Strategies

1.1 Risk-Based Approach

Traditional indices, such as the S&P GSCI and the Dow-Jones UBS Commodity Index, primarily use global production and trading liquidity as primary determinants for assigning weights to sectors and commodities. In spite of having five distinct sectors, the S&P GSCI is heavily tilted towards energy, the sector that has seen the highest risk historically. Very often, its weighting reaches as high as 60-70%, equating to roughly 80-90% of the total risk in the index. In addition, of the 24 commodities composing the index, the smallest 10 components only have a token representation, collectively comprising less than 10% of the index.

On the other hand, the Dow-Jones UBS was designed with sector constraints that restrict the sector exposure to no more than a third of the index. However, energy is usually at this limit, and often makes up about 50% of the total risk exposure; this limit is often breached because of energy price rises in between annual rebalancings.

In light of the high-energy exposure in most major commodity indices and the recent upheaval in the financial markets, investors have become more conscious of the need to manage risks. As some market participants do not possess the capacity or information to forecast expected return accurately, a cautious passive approach may be to concentrate on reducing the risks of the commodity allocation. Here, we analyze two common approaches, represented in Figure 1a as the Risk-Weight portfolio and the Minimum-Variance portfolio. Essentially, the Risk-Weight index aims to allocate a similar risk budget to each of the five commodity sectors, whereas the Minimum-Variance index seeks to minimize the volatility of the index as a whole.

The results of the analysis in Figures 1a and 1b indicate that both risk-based strategies have succeeded in lowering risk. Given that the purpose of the Minimum-Variance strategy is specifically to minimize volatility, it is therefore, not astonishing that this index has achieved the lowest risk amongst all three indices. Equally unsurprising is that both risk-based strategies have yielded a lower annualized return than the S&P GSCI Light Energy benchmark, which is largely the result of having less exposure to energy,[1] one of the best-performing sectors during the examined period.

In addition, it is also apparent from the results that the Risk-Weight strategy was far superior to the Minimum-Variance when seen through the prism of risk and return trade-off. Indeed, commodity prices and volatility often go hand in hand with each other, particularly during periods of supply shortage, when both will spike upwards; this is why the distribution of commodity returns tends to be positively skewed. For this reason, merely targeting the lowest level of volatility appears counterintuitive, and a more satisfactory approach would be to target risk reduction by assigning a risk budget across different commodities and sectors.

1.2 Factor-Based Approach

A factor-based approach entails enhancing return by earning potential risk premium linked to systematic factors. In commodities, the most-well-known factors are value, curve, momentum, and liquidity, all of which are discussed in detail in the following sections.

1.2.1 Value Strategies

Value strategies generally seek to generate excess returns by selecting commodities whose prices are believed to be out of kilter with their supply-demand dynamics. At their most basic, they entail purchasing a portfolio of undervalued commodities, with the expectation that their prices will soar and eventually converge to a higher level. In combination with buying cheap commodities, additional return may also be harvested for investors able to sell overvalued commodities.

By implication, these strategies attempt to target commodities with the lowest inventories, which, due to the difficulty in replenishing supplies instantaneously, are expected to experience price appreciation. Generally speaking, shortages take time to be addressed through extra production, demand destruction, or both. How rapidly this adjustment occurs obviously depends on the commodity in question and the speed at which physical stocks can be replaced. Because of this, there is evidence of persistence in stock levels and physical stocks that should be seen as a 'cushion' to which commercial users can use in emergencies. Of course, if increases in supply outpace demand continually, inventories will eventually be depleted and they will no longer serve as a buffer. Therefore, an incentive must be offered to storage

holders for reserves to be built up again, resulting in the term structure of the futures curve moving from backwardation to contango.

Many theories have been put forward to explicate the relationship between the term structure of the commodity futures markets and physical stock reserves, starting with Nicholas Kaldor's [1939] work in which he surmises that the differences between spot and futures prices (or the futures basis) can be ascribed to warehousing costs, interest foregone in storing a commodity and a convenience yield on inventory. A term coined by Kaldor, convenience yield, represents the benefit accrued to holders of physical inventories, rather than futures contracts, and reflects the market expectations about the future availability of a commodity.

In general, when a commodity is perceived to be scarce, the convenience yield strengthens as there is benefit from holding physical stocks, which minimizes the possibility of industrial stoppages caused by a dearth of relevant inputs to the production process.

An alternative theory revolves around the risk premium hypothesis popularized by Breeden [1980] and Jagannathan [1985] who view futures prices as encompassing a forecast of the future spot price and a risk premium. More recently, Gorton, Hayashi, and Rouwenhorst [2007] have attempted to link these two theories together. In their work, they have provided empirical evidence of the negative, non-linear relationship between convenience yield and the level of stocks, confirming that the inverse relationship becomes markedly more pronounced when there is a positive demand or negative supply shock. In addition to this, future spot prices will strengthen as there is more interest in hedging against future price risk, which in turn drives up the futures risk premium. The authors also argue that prior futures returns, spot price changes, and the futures basis carry pertinent information about the state of current inventories, and are thus correlated to futures risk premium. It is for this reason that the state of inventories can often be used to predict future

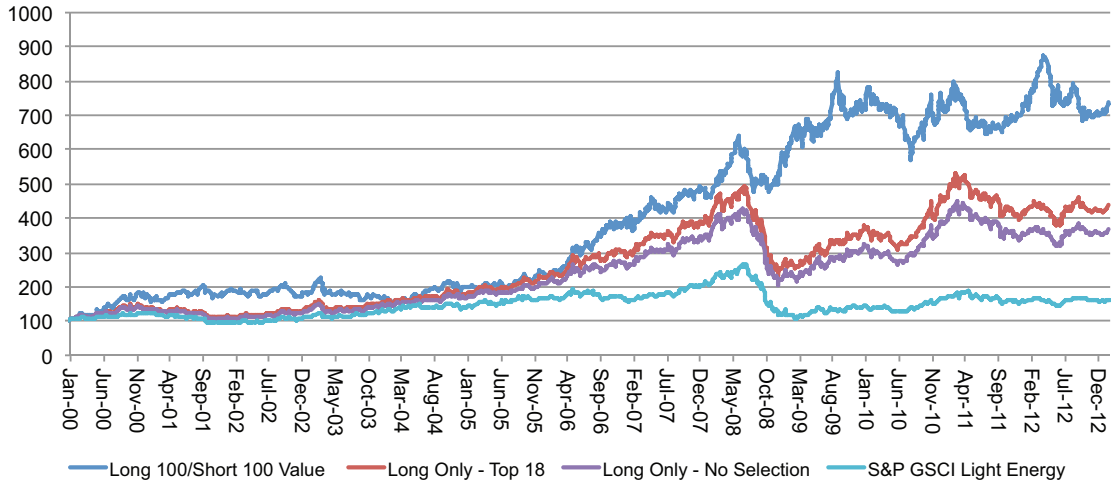

Exhibit 2a: Performance of a Selection of Value Strategies

	Long Only – No selection	*Long Only – Top 18*	*Long 100/Short 100 Value*	*S&P GSCI Light Energy*
Return	10.21%	11.68%	16.21%	3.62%
Volatility	17.93%	18.79%	20.40%	18.34%
Sharpe Ratio	0.43	0.49	0.67	0.06
Maximum Drawdown	-52.4%	-53.2%	-31.3%	-60.7%

Exhibit 2b: Value Strategies: Historical Annualized Risk and Return
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes.
Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

excess return.

With stock levels being so fundamental in price formation, it is reasonable to question the wisdom of using a price-based proxy rather than the actual inventory levels. Aside from the onerousness associated with gathering the data, it is often impractical to do so, simply because they are published at different times of the year and are often plagued with inaccuracies and time lags. A case in point is when the U.S. Department of Agriculture had to commission a study on its estimate of U.S. corn stockpiles following widespread industry concerns about the accuracy of the Bellwether Quarterly Report (Stebbins, 2013). For lack of a better alternative, analyzing the futures basis remains the most effective and transparent gauge of the interaction between supply and demand.

Typically, when the market anticipates a supply shortage, the prices of the futures contracts across many (if not all) maturities increase, inducing an upward, parallel shift of the entire futures curve. This is usually accompanied by a steepening of the front end of the curve as short-term contracts will continue to be pricey, until such time as the shortage is eased. In the face of such uncertainty, investors may avail themselves of the opportunity to earn compensation for bearing the volatility of future spot prices.

A number of indexes have been launched in recent years to harvest this 'risk premium'. They involve equal-weighting a small number of commodities selected based on their perceived scarcity. Whilst they have overall delivered strong returns, their exposure tends to be fairly concentrated, owing to the small number of commodities included in the index. Furthermore, once the commodities are selected, they are given equivalent weights, regardless of their valuation in relation to others in the universe.

In view of this, we attempt to assess the efficacy of adopting a scheme that assigns different weights to commodities based on their respective valuation, and the necessity of active selection for these strategies to perform. To ensure the rigorousness of the study, we have not applied any individual commodity or sector exposure cap. The investigation starts by computing the front-year slope of all the commodities within the S&P GSCI Light Energy Index. They are then ranked from smallest to largest, with the smallest accorded the highest weighting because these are considered to be the cheapest. A number of iterations have been conducted to test whether a persistent effect exists, with the most relevant results displayed in Figures 2a and 2b.

For the long-only versions of the simulation, we simply weight each commodity in the S&P GSCI Light Energy Index by the gradient of its front-year futures slope. Next, we examine whether active selection improved the performance by targeting only the cheapest 18 commodities. Choosing 18 commodities is by no means fortuitous.[2] Rather, it is the result of striking a balance between having sufficient constituents in the indices and recognizing that commodities in the top quartiles, sorted by their average slope, have historically outperformed. Lastly, we appraise long-short strategies using a long 100/short 100 strategy, in which the cheapest 10 commodities are bought and the most expensive 10 commodities are sold simultaneously.

The analysis above shows that value strategies have performed well over the period under investigation, with all of them achieving a higher Sharpe ratio than their benchmark, the S&P GSCI Light Energy Index. It should be pointed out that a simple change in the weighting scheme applied to the same underlying universe as the benchmark already allows some benefits to be reaped, whilst keeping the overall risk at bay. Active selection through eliminating the most overvalued commodities also appears advantageous. This is not unexpected because the ability to sell short overvalued assets usually enhances the performance of relative value strategies. For this reason, the long 100/short 100 version has achieved the best return overall, but this enhanced return comes at the risk of assuming higher active risks. Another important observation from Figure 2b is that all three strategies have suffered lower maximum drawdowns than the benchmark.

Despite the attractiveness of value strategies, they can experience periods of underperformance too, especially in periods where commodity fundamentals play a secondary role in the general macroeconomic environment in influencing prices. This was the case in 2011 and 2012, when commodities—like most other risk assets—suffered as a result of the Eurozone crisis; both long-only value strategies underperformed the benchmark by about 2% per annum. It follows from this that such strategies are the most effective when the fundamentals of different commodities are divergent,

enabling value to be extracted via active selection.

1.2.2 Curve Strategies

Broadly speaking, first-generation indices are long-only passive indices that roll their front-month futures position on a regular basis in order to maintain exposure to commodities. During periods of backwardation, positive carry can be earned through the simultaneous sale of a more expensive expiring contract and the purchase of a cheaper subsequent contract. Conversely, during periods of contango, investors suffer from negative carry, which erodes their overall return. Though not stated explicitly, these indices by construction assume that backwardation is the norm in commodity markets.

However, for some time since the onset of the financial maelstrom, the futures curves of many commodities have been in contango. This has inspired the development of a variety of curve strategies that attempt to mitigate the negative effect of this term structure by rolling into contracts with a longer maturity. By far the most popular means to generate excess returns over conventional benchmarks, these strategies aim to capture a risk premium for taking greater price uncertainty associated with futures contracts on the long end of the curve. According to the "Theory of Normal Backwardation" by Keynes (1930), this is the consequence of producers being willing to sell futures at a lower price than spot so as to transfer the price risk. In so doing, they exert enormous pressure on the supply side of the futures

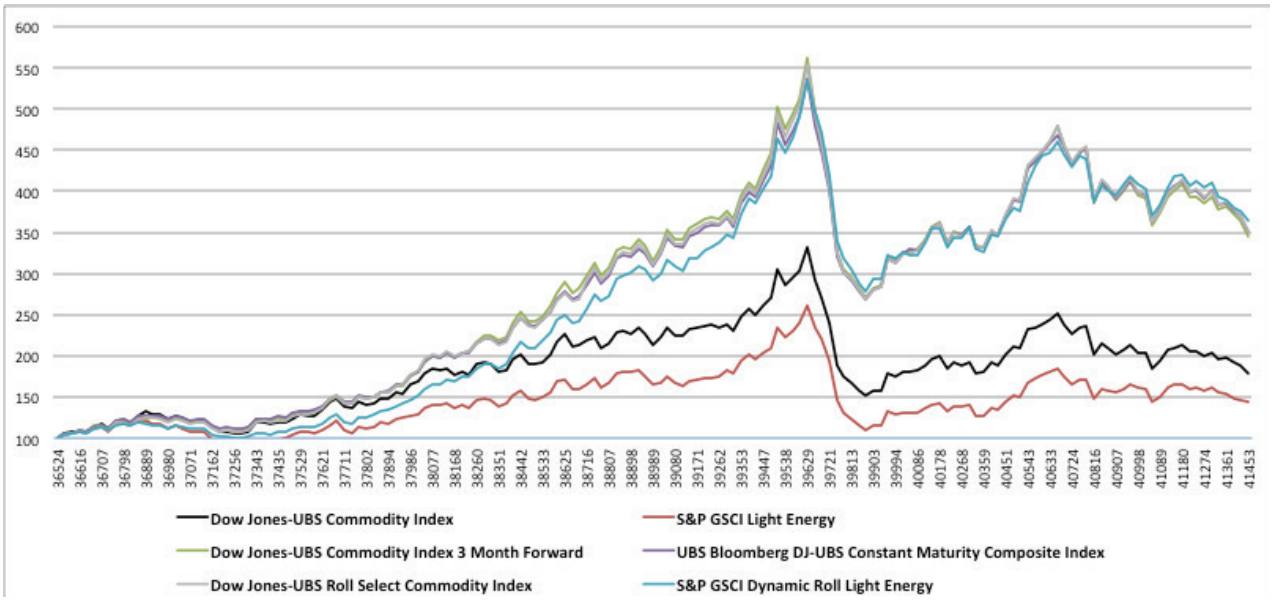

Exhibit 3a: Performance of a Selection of Curve Strategies

	Dow Jones-UBS Commodity Index	*S&P GSCI Light Energy*	*Dow Jones-UBS Commodity Index 3 Month Forward*	*Dow Jones-UBS Roll Select Commodity Index*	*S&P GSCI Dynamic Roll Light Energy*
Return	4.4%	2.7%	9.6%	9.7%	10.1%
Volatility	17.3%	17.5%	16.4%	16.5%	15.0%
Sharpe Ratio	0.11	0.01	0.43	0.44	0.51
Active Return (w.r.t. the Corresponding Base Index)	-	-	5.2%	5.4%	7.3%
Tracking Error	-	-	3.3%	3.0%	4.6%
Information Ratio	-	-	1.57	1.76	1.58

Exhibit 3b: Curve Strategies: Historical Annualized Risk and Return
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

market, making them more vulnerable than consumers.

In theory, commodity producers sell long-dated contracts at a discount in order to hedge their output, whereas consumers often buy short-dated contracts at a premium in order to secure near-time consumption. It has been argued that such structural characteristics may allow investors to capture a systematic risk premium by purchasing long-dated contracts. However, although these assertions may hold true in theory, it is more complex in practice. In reality, different consumers and producers are likely to pursue an amalgam of hedging strategies, which must conform to their price expectations and the company's policy. Obviously, these strategies will invariably change depending on the commodity in question, and it would be a facile generalization to refer to producers and consumers as though they were always acting in concert in their respective groups.

A further complexity arises from the number of non-industrial participants in the futures market, such as index investors and hedge funds, and it would therefore be more accurate to suggest that the shape of the curve is determined by the overall impact emanating from the interaction of different market participants, all of whom have different goals and time horizon. For example, for most of 2011, the LME copper market traded in backwardation. This was due to the strength of Chinese demand[3] rather than significant hedging activity by miners—many of which elected not to hedge, as they were enjoying record prices for their metal.

The simplest implementation of curve strategies involves systematically rolling into forward contracts of a pre-defined maturity, such as the three-month contract. For instance, the Dow Jones-UBS Commodity Index 3-Month Forward and the S&P GSCI 3-Month Forward Index employ this strategy. Other static strategies, such as the S&P GSCI Enhanced Index, accord slightly more flexibility to the rolling process by utilizing a broader part of the forward curve whilst taking into consideration the specificities of different commodity markets in the choice of expiry contracts. Another way of implementing the curve strategy is to invest in contracts of different tenors. For instance, instead of opting for a single contract, the JPMorgan Commodity Curve Index holds contracts across different maturities in accordance with the open interest or liquidity of each tenor.

Even more dynamic strategies—such as the S&P GSCI Dynamic Roll and the Dow Jones-UBS Roll Select indices—have also garnered much interest in recent years. Unlike their static counterparts, the objective is not only to minimize the effect of contango, but to maximize the effect of backwardation by adopting a different roll strategy with respect to the term structure of the commodity concerned. In practice, they roll into futures contracts with the lowest implied roll cost when a commodity trades in contango, and roll into futures contracts with the highest implied roll benefit when a commodity trades in backwardation.

Over the long term, all four curve-strategies have delivered higher returns than their respective benchmarks, despite the many methods that can be used to implement such strategies (see Figures 3a and 3b). This may suggest that a sizable portion of the outperformance from these strategies derives from a systematic source of return. To investigate this, we attempt to attribute the return of these strategies to three

Index	*Regression Alpha*	*Market Factor*	*Systematic Curve Factor*	*R-Squared*
Dow Jones-UBS Roll Select Commodity Index	1.6%	0.99	0.69	0.99
P-Value	*(0.5%)*	*(0.0%)*	*(0.0%)*	
S&P GSCI Dynamic Roll Light Energy	2.3%	0.87	0.82	0.97
P-Value	*(0.6%)*	*(0.0%)*	*(0.0%)*	

Exhibit 3c: Performance Attribution of Curve Strategies
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

sources of return; namely, market factor, systematic curve factor, and dynamic alpha factor (see Figure 3c).

In the analysis, the market factor is represented by its corresponding benchmark index whilst the curve factor is estimated as the difference between the monthly returns of the three-month forward index and its benchmark index. The last factor—dynamic alpha—is approximated by the regression alpha that cannot be explained either by the market factor or the systematic curve factor and thus may represent the additional return generated from the dynamic nature of the strategy. The results in Figure 3 show that both dynamic strategies have significant exposure to the systematic curve factor, with their coefficient of determination (R2) being very close to one. Both the dynamic alpha factor and the tracking error are higher for the S&P GSCI Dynamic Roll Light Energy Index than the Dow-Jones UBS Roll Select Index. This may indicate that the former index is more dynamic in nature and deviates more from the benchmark, allowing it to make a more substantial return (7.3% versus 5.4% per annum). All in all, both dynamic strategies have realized a high return, but whereas static strategies roll only forwards, dynamic strategies can roll both forwards and backwards, potentially giving them an edge over static strategies.

Notwithstanding the similarity of the return achieved by different curve strategies over the long run, they are likely to behave quite differently over the short run. In particular, curve strategies will underperform when the term structure of most commodities trades in backwardation and in this instance, it would be more desirable to be positioned at the front month of the curve in order to take full advantage of the positive carry. Both static and dynamic curve strategies should perform well in respect to their benchmarks in periods of contango, but the latter should reign supreme in periods where the term structure of different commodities is dissimilar, which lends itself to a more flexible rolling mechanism.

1.2.3 Momentum Strategies

Momentum strategies generally aim to exploit the persistence in commodity returns, which are believed to derive from psychological biases exhibited by investors and behaviors displayed by industrial market participants. This may explain why commodity returns tend to exhibit high degrees of positive autocorrelation (Kat and Oomen, 2006).

Psychological research has explored a variety of biases and irrationalities that are believed to affect investment decisions. These biases are fundamental parts of human nature and have been well-documented in the behavioral finance literature. They are not peculiar to commodities, applying equally to other asset classes. One such bias, known as the 'disposition effect', relates to the tendency for investors to sell appreciating assets too quickly and keeping depreciating assets for too long. This stems from the brain's tendency to make mental shortcuts rather than engage in longer analytical processing (Chen et al. 2007) and may partially explain why momentum return exists. Besides investor psychology, the behavior of industrial market participants may also bring about price trends. Taking Kansas wheat as an example, consumer demand remains fairly stable throughout the year whilst production can vary immensely, as planting usually begins in September of the previous year. If during harvest in June and July there is a sudden surge in demand, and this is not satisfied by imports, prices will inevitably go up, giving rise to positive price momentum. The behavior of industrial hedgers can equally cause prices to trend, such as when metal mining conglomerates execute large hedging programs. Momentum strategies can be implemented in a variety of ways and, depending on the method chosen, can have markedly different replication costs. In general, they take both long and short positions and consist of at least two steps; the first of which is to determine what position to take for each commodity; the second is to decide on an appropriate weighting scheme. An example of a simple momentum strategy is the Morningstar Long/Short Commodity Index, which uses a simple moving average signal to determine the trading position of each commodity, which is then weighted by the open interest of its futures. In comparison, the S&P Systematic Global Macro Commodities Index is more complex. It first establishes the trend of each commodity and employs statistical tests to verify the stability of that trend. It then gives equal risk capital allowance to each sector and then equal weight to the constituents within that sector. The resulting portfolio is then geared up to a target volatility level adopted by the average managed futures/CTA fund.

An important advantage of momentum strategies is that they may provide downside protection during sharp market corrections, whilst maintaining upside participation during bull markets. For instance, Figures 4a and 4b show that the S&P GSCI Light Energy Index

lost more than 50% during the 2008-09 crash. In contrast, the S&P Systematic Global Macro Commodities Index and the Morningstar Long/Short Commodity Index were not only more resilient over the same period, but they managed to capture some upside during the 2010-11 price rebound.

Undoubtedly, these strategies also experience periods of subpar performance. In range-bound markets where there is no clear trend, they are unlikely to generate returns. For instance, in the oscillating markets over the last two years or so, momentum strategies—irrespective of their construction—posted disappointing results as compared with their benchmarks. This underscores the danger of relying on a single strategy to structure an investment portfolio.

1.2.4 Liquidity Strategies

Financial investors have long assumed the role of providing liquidity to other market participants in the futures market. In recent years, as they have become more accustomed to commodities as an asset class and grown in sophistication, much innovation has been witnessed in the development of indices fulfilling a wide variety of objectives. In spite of this, first-generation indices—especially the S&P GSCI and the Dow Jones-UBS Index—still take the lion's share of the assets under management (roughly USD 78 billion apiece) for passive investors seeking commodity exposure via passive funds or structured products.

An important characteristic of these first-generation indices is that they roll over a similar window. For instance, the S&P GSCI rolls over five days between the fifth and ninth business day, whereas the Dow Jones-UBS Index rolls between the sixth and tenth. As a result,

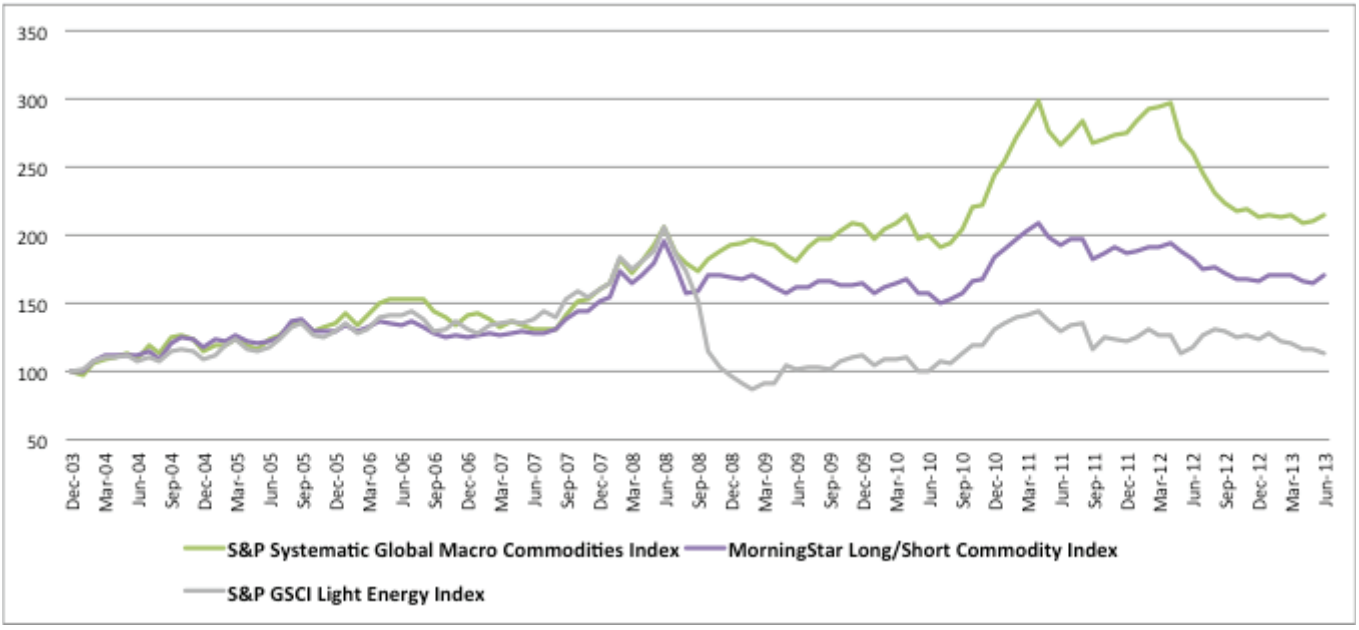

Exhibit 4a: Performance of a Selection of Momentum Strategies

	S&P GSCI Light Energy Index	*MorningStar Long/Short Commodity Index*	*S&P Systematic Global Macro Commodities Index*
Return	1.3%	5.8%	8.3%
Volatility	19.2%	13.1%	15.3%
Sharpe Ratio	-0.04	0.28	0.40

Exhibit 4b: Momentum Strategies - Historical Annualized Risk and Return
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

sizable investment flows go into simultaneously selling the front-month and purchasing the following nearby-month contracts, and the rigidness with which the indices must perform the roll may give rise to a liquidity premium that can be harvested.

In view of this, we evaluate whether a persistent source of return is present if the roll takes place outside of the standard window, and also assess whether modifying the length of the roll period can also contribute to higher levels of return. The probe starts by adopting the same methodology as the S&P GSCI Light Energy Index, albeit with a variety of rolling schedules. In order to visualize clearly the return of the factor, a market-neutral portfolio is created by going long the newly created portfolios and short the standard S&P GSCI Light Energy Index. The results of this can be found in Figures 5a and b.

The analysis above shows that there may be value in adopting a different rolling schedule. Prior to 2007, adopting any of the five liquidity strategies would have yielded a reasonable return, though with slightly higher volatility. However, as more innovative indices came to market, this benefit seemed to have somewhat dissipated and the return from these strategies decreased. In 2010, the erstwhile outperformer—Strategy 1—started posting poor performance, and since 2008, outperformance came from strategies that commenced the roll from day nine and they delivered, on average, an alpha of between 0.4-0.5% per annum.

In light of the changing liquidity conditions, a possible improvement to the static approach explored above would be to adopt a dynamic rolling schedule in which the roll would occur over a rolling window that is determined on an ongoing basis, rather than defined in advance. This sounds reasonable as, based on Figures 5a and b, adopting different roll schedules can produce very different returns depending on the time period in question. Obviously, this would come at the expense of transparency. Finally, the analysis finds no evidence to

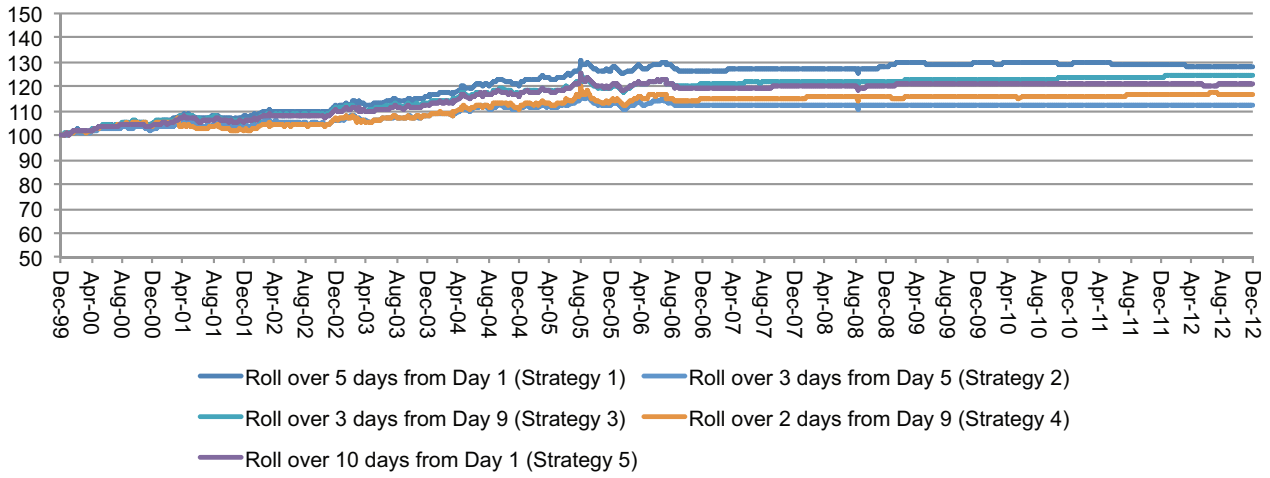

Exhibit 5a: Performance of a Selection of Momentum Strategies

	Strategy 1	*Strategy 2*	*Strategy 3*	*Strategy 4*	*Strategy 5*
Return	1.92%	0.89%	1.72%	1.22%	1.46%
Volatility	2.13%	2.15%	2.34%	2.46%	2.15%
Return per unit Risk	0.90	0.41	0.73	0.50	0.68

Exhibit 5b: Liquidity Factor Return: Historical Annualized Risk and Return
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

show that lengthening or shortening the rolling window enhances or reduces return on a consistent basis.

Unquestionably, liquidity is by far the smallest source of return, compared to the other sources discussed in this paper, but it is nonetheless unique to the commodity markets.

2. Combining the Different Sources of Risk Premia

Factor-based strategies provide independent sources of risk premia in the commodity markets, and can serve as building blocks for combinations of different commodity strategies and asset allocations in multi-asset portfolios. In general, their periods of underperformance do not always coincide with each other (see Figure 6a). This may imply that they may offer the potential to diversify risk, as their return may be driven by mostly different risk factors.

From Figure 6b, it is also clear that the correlation between the strategies is low and that the correlation between these strategies and the broad index is low to negative, with the exception of the momentum factor. This is expected because commodities on an upward price trend automatically increase their representation in the broad index, but unlike the broad index, momentum

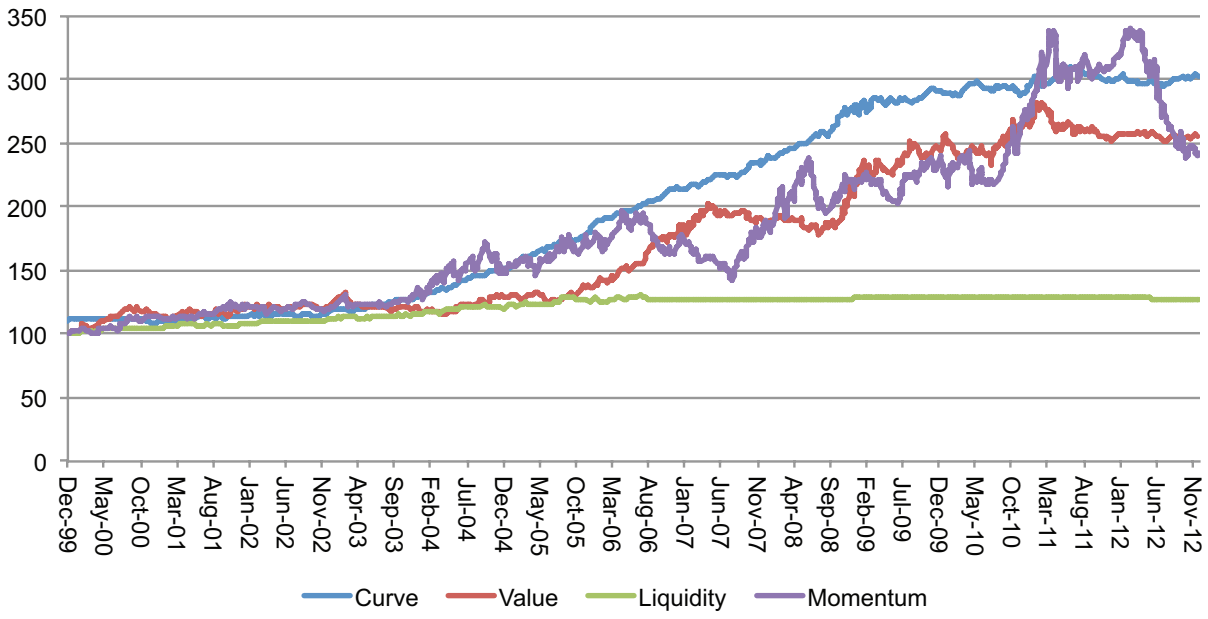

Exhibit 6a: Historical Performance of Systematic Commodity Factors

	Curve Factor	*Value Factor*	*Momentum Factor*	*Liquidity Factor*	*S&P GSCI Light Energy*
Curve Factor	1	0.145	0.128	0.055	-0.056
Value Factor		1	0.108	0.056	-0.017
Momentum Factor			1	0.287	0.428
Liquidity Factor				1	0.250
Broad Index					1

Exhibit 6b: Correlation of Matrix of Commodity Risk Factors

strategies allow commodities on a downward trend to be shorted, and this may generate additional value for the strategies.

It should be borne in mind that factor returns do not represent a source of riskless return, and can sometimes experience significant drawdowns (see Figure 6c). It is simply another way to construct an investment portfolio.

Having discussed the factors individually, we proceed to test the idea of combining them using two weighting schemes. For the purpose of this exercise, we look at the risk-weight and equal-weight approaches. Figures 6d and 6e present the results of the analysis and show that both strategies have outperformed the benchmark index on an absolute basis. However, despite recent underperformance, the risk-weight has performed better overall because it has a lower level of risk, suggesting that there may be an advantage in properly managing risks when creating a factors portfolio. Overall, regardless of the strategy chosen, they both have a low correlation with the benchmark and may act as a good portfolio diversifier.

The last step consists in investigating the potential benefits of combining the risk-weight factors portfolio with two versions of long-only commodity indices. Based on three hypothetical multi-asset portfolios consisting of 50% equity, 30% fixed income, and 20% commodi-

	Curve Factor	*Value Factor*	*Momentum Factor*	*Liquidity Factor*	*S&P GSCI Light Energy*
Standard Deviation	3.22%	8.33%	13.88%[5]	2.13%	18.32%
Maximum Drawdown	-5.40%	-24.89%	-30.03%	-54.97%	-68.78%

Exhibit 6c: Annualized Volatility and Maximum Drawdown of Commodity Risk Factors
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

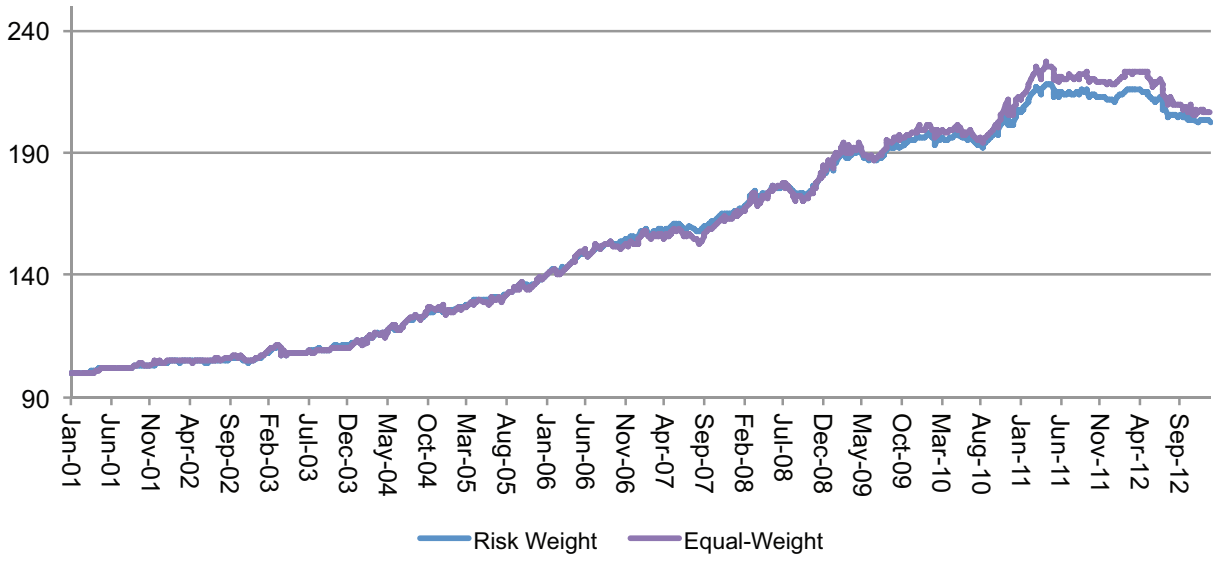

Exhibit 6d: Historical Performance of Compromise Factor Strategies

ties, the results in Figure 6f show that with a 20% commodity allocation, overlaying a portfolio of factors on to the investment portfolio improves the overall return. The outcome is even more encouraging when the risk-weight commodity index is used in lieu of the conventional long-only index.

3. Conclusion

Alternative beta strategies can serve a variety of different investment objectives, which may include reducing volatility or achieving tilts to systematic risk exposures. It is therefore essential for investors to examine whether these strategies meet their own investment objectives and risk-taking preferences.

Two main approaches to alternative beta are reviewed in this paper: the 'risk-based approach,' which entails reducing portfolio risk, and the 'factor-based approach,' which involves enhancing return through earning systematic risk premia with a focus on the latter. Whilst alternative beta is fairly well established in equity strategy investing, it is still a nascent concept in commodities. However, as a result of investors' pursuit of better diversified portfolios and a recognition that systematic risk factors explain the majority of returns, the development of commodity alternative beta products is gathering pace. This is not entirely unforseen as investors now view their investment opportunity in the context of risk premia, rather than individual asset classes. From our investigation in this study, there appears to be potential benefit in allocating into alternative beta strategies as part of a portfolio's commodity allocation, and we find that combining risk-based and factor-based commodity strategies has historically delivered higher return and lower risk than passive long-only strategies on their own.

Finally, it should be borne in mind that alternative beta strategies often take substantial active risks, which are largely driven by factor exposures. Factor returns can be volatile, and all alternative beta strategies can experience considerable drawdown at times. However, as

	Risk-Weight	*Equal-Weight*	*S&P GSCI Light Energy*
Return	6.07%	6.21%	0.47%
Risk	3.55%	4.65%	18.73%
Sharpe Ratio	1.00	0.88	-0.11
Correlation with S&P GSCI Light Energy	0.209	0.241	1.000

Exhibit 6e: Composite Strategies Return: Historical Annualized Risk and Return

	S&P GSCI Light Energy Index	*S&P GSCI Light Energy Index + Factors Overlay*	*S&P GSCI Risk Weight Index + Factors Overlay*
Annualized Risk and Return of the Commodity Allocation			
Return	2.2%	8.2%	11.3%
Volatility	18.1%	19.3%	13.6%
Sharpe Ratio	-0.01	0.31	0.66
Annualized Risk and Return of 50% Equity / 30% Fixed Income / 20% Commodity Portfolio			
Total Return	4.4%	5.6%	6.1%
Volatility	11.5%	11.6%	10.8%
Sharpe Ratio	0.19	0.29	0.36

Exhibit 6f: Combining Different Commodity Allocations in a Multi-Asset Portfolio
Source: S&P Dow Jones Indices. Data from Dec. 31, 1999 to Dec. 31, 2012. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some data reflected in this chart may reflect hypothetical historical performance.

Endnotes

1. The S&P GSCI Energy Total Return Index went up by 101% between December 1999 and December 2012.

2. Our analysis shows that the return spread between the first and fourth quartile is about 40 percent per year, when commodities are ranked by their relative futures basis.

3. The source of this demand is contentious. Some commentators argue that it comes from real demand in the economy; others believe it is related to speculative demand brought about by cheap metal financing. [Kaminska, 2011]

4. Estimate for the year 2012, published on the S&P Dow Jones Indices website.

5. It should be noted that because momentum strategies take both long and short positions on different commodities, it is not market neutral; hence it explains why this factor is higher than the rest of the factors.

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"The Valley of Opportunity": Rethinking Venture Capital for Long-Term Institutional Investors

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1. Introduction

Venture capital (VC) investing has been an unsatisfactory experience for many long-term institutional investors (LTIs), such as pension funds and sovereign wealth funds. First, the asset class has not performed in line with expectations for more than a decade. For example, LTIs have invested more money in venture capitalists (VCs) since 1997, in aggregate, than VCs have returned to LTIs over that same period (Mulcahy et al. 2012). Second, there have been few opportunities for newer or slower moving LTIs to access the top (decile) managers that have demonstrated a consistent ability to outperform VC benchmarks. As such, VC as an asset class appears to work only for those LTIs that were first movers into the asset class, such as endowments and family offices. In large part, the challenges associated with this asset class stem from the fact that VC investing is not easy to bring to a scale consistent with the investment objectives of large institutions.

VC is an investment industry characterized by high labor intensity. This stems from the fact that venture investing is largely a services-business founded on 'high-touch' interaction with entrepreneurs through trusted (and hard earned) networks of interaction and reciprocity. Further, the best performing VC firms tend to view their roles in terms of business development rather than just an investment. Herein lies the irony of the VC industry: the best performing venture capitalists are capable of helping entrepreneurs scale-up their businesses, but they have not been able to bring scale to their own investment management sector without eroding financial performance (see Mulcahy et al. 2012).[1] In fact, many VCs have stopped trying to grow their businesses, purposely keeping the size of their funds relatively small in order to focus on their core area of expertise: helping entrepreneurs launch and build companies.

This 'keep-it-small' mentality, however, means that venture capital has not been able to accommodate the demands of LTIs for opportunities in terms of scale. After all, an allocation of $10 or $20 million to a top VC fund would not affect the overall return for a large pension or sovereign fund, even if the underlying VC investment were highly successful. Moreover, spreading a large VC allocation across a large number of asset managers would likely result in an institutional investor paying high fees for beta exposure to what is already an underperforming asset class. This is not desirable. As a result, a growing number of LTIs are disenchanted with the VC industry. Indeed, public pension funds and sovereign funds have been scaling back their venture capital commitments to external managers and, instead, have been focusing on alternative asset classes that can offer economies of scale, such as real estate, private equity, and infrastructure.

While we understand the reasons LTIs have become disaffected, nonetheless, there is an opportunity for them to re-engage with venture investing in a meaningful way. Consider that over the period, while venture capital returns have been relatively poor, innovation and technological development have not stopped. If anything, the rate of innovation has continued to accelerate, changing the lives of everyday people in meaningful ways.[2] Ultimately, value is still being created through technological innovation, which suggests that VC investing has enormous potential value to the broader community of LTIs. However, if LTIs are to participate in VC in successful ways, they should participate only in niches where they can add value.

There are two broad VC domains in which LTIs can add value. First, there is a compelling case for LTIs to participate in the VC of financial services (e.g., 'fintech') and asset management (e.g., seeding). Pensions and sovereigns not only have considerable expertise in these domains, but they also have the capacity to deliver cornerstone clients to the portfolio companies that VC firms are investing in. Second, LTIs should participate in venture investments for which they can serve as an important bridge to commercialization for growth stage companies. Making venture capital work for LTIs, such as pensions and sovereign funds, means finding opportunities where the target companies cannot rely on venture managers alone to reach commercial scale.[3] Clearly this has been the case in capital-intensive industries, such as energy innovation.

In the last decade, VCs added 'green' to their traditional staples of 'IT' and 'biotech' investments. What VCs found in making green investments was that the time horizon to profitability was far longer than they had anticipated. It has been observed that VCs often reached a point where their investee companies' futures were dependent on finding another set of investors that could 'take the baton' forward and develop the 'green infrastructure' that is often required for commercial scale. This has been a problem for VCs and ironically, it left many feeling like the entrepreneurs who approach

them: they have been forced to look to other investors to fund their big ideas through to commercial scale. In this sense, the green strategies of VCs have offered LTIs a chance to re-engage with the venture asset class on terms more conducive to their particular interests. In any event, it offers a way to engage the VC industry, particularly in the capital-intensive industries such as energy, materials, food, and water; where the time horizon and scale of LTIs affords the possibility of funding capital-intensive companies from initiation to commercial scale.

In this paper, we suggest that venture capital is a compelling option for LTIs that have the governance procedures and skills to realize such goals. The juxtaposition of large past losses coming from green investments with the potential for enormous future gains presents a challenge to LTIs' capabilities and resources. However, we contend that LTIs can serve as important bridges for venture-backed, capital-intensive companies seeking commercial scale. In turn, LTIs can participate in the success of these companies over the long term. Rather than retreating from the 'valley of death' for capital-intensive companies, this presents a 'valley of opportunity'.[4]

2. The 'Valley of Death'

At the earliest stages of launching a company, investors are asked to provide capital to a venture that has no products and sometimes no obvious market for future products. In effect, investors are asked to believe in an entrepreneur's vision for what the company can become and how the company can, in turn, generate acceptable returns. Assuming the entrepreneur secures funding to launch his or her company, it can take years before products come to market and cash flows turn from negative to positive. Before reaching commercial scale, these companies are entirely reliant on external financing to fund operations. This period, long or short, is sometimes referred to as the 'valley of death' (VoD). It is the period in which the vast majority of companies fail (see Gompers and Lerner 2001).

While the VoD is relevant to all companies, those operating in industries with high capital inputs are believed to be particularly vulnerable (see Nanda et al. 2013). In economic terms, the standard J-curve applicable to venture investments in sectors such as energy, food, and water, tend to run deeper and longer than is the case for generic venture investments in industries such as software and IT (Mathonet and Mayer 2008). It is perhaps not surprising then that 'green companies' relying on private financing find it difficult to get beyond the VoD (see Murphy and Edwards 2003), as the average green energy venture requires roughly $500 million from investors before successful commercialization (Hargadon and Kenney 2011). Given that companies only begin to exit the VoD when commercialization starts to take hold and entrepreneurs can demonstrate a clear path to profitability (and steady cash flows), companies in capital-intensive industries are more prone to failure in the VoD than those in less capital-intensive industries.

It is little wonder then that the promise of a 'green revolution,' which was embraced by the VC community over the last decade, has thus far generated so few success stories. In our view, the traditional model of VC does not lend itself as easily to capital-intensive industries, such as energy, as it does to capital-light industries, such as software. A traditional VC firm raises money from individuals and institutions in order to invest in early-stage ventures that are high-risk and have high-expected returns (see Sahlman 1990). Typically, the general partner (GP) raises between $300 and $600 million from limited partners (LPs) for an investment fund (see Kenney and Florida, 2000; and Lerner et al. 2007). With this capital, a VC fund will invest in 15 to 30 fledging companies, with initial investments ranging between $5 and $15 million. This then allows for as much as $20 to $30 million in follow-up funding for the most promising three to five ventures.

By necessity, the large majority of successful venture capital exits have been 'capital-light' (Wiltbank and Boeker 2007). In fact, the most successful venture investments tend to be those where less than $30 million was invested before commercial scale was achieved and cash flows turned positive. In fact, 79 of the 98 venture-capital backed exits in the 2nd quarter of 2013 were in the capital-light information technology sector (Cruz and Herman 2013). Google is the classic example of a successful capital-light venture; it raised only about $25 million before its IPO (Vise and Malseed 2006). If we compare Google's path to success to that of Tesla, the automobile company that is the darling of the green movement, it is easy to see the diametrically different cash flow profiles of these two companies. In year seven of operations, Tesla lost $396 million dollars. Overall, it has lost almost $1 billion in total. As for Google, it was profitable in year three and generated $1.4 billion in net

income in year seven (See Figure 1).

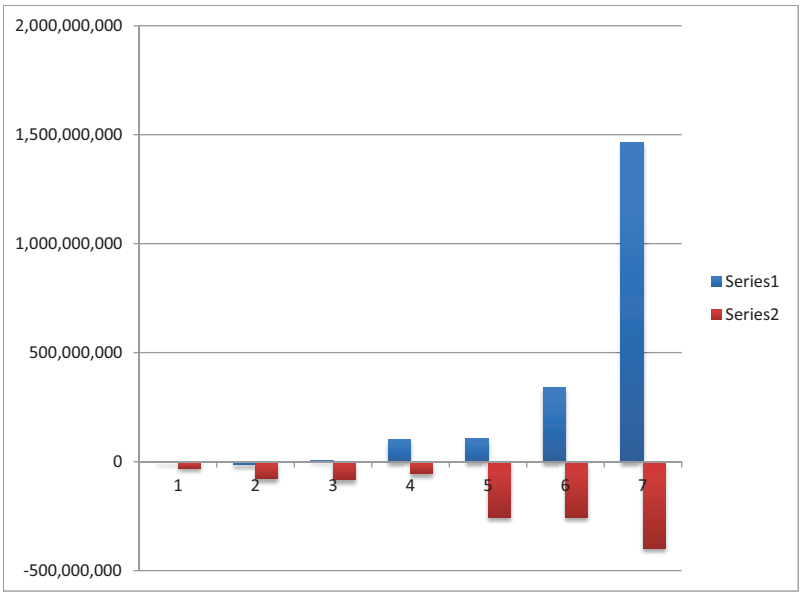
While the VC community is renowned for taking fledgling innovations and developing businesses around them (see Gompers and Lerner 1998; Kortum and Lerner 2000; Florida and Kenney 1988; Lerner 2002), this has not held true for capital-intensive green investments. This can be partially attributed to a mediocre IPO market, which has a strong influence on VC returns (Hall 2005). However, poor performance is also the result of fundamental incongruence between the characteristics of capital-intensive green investments and the monetary resources of VC funds. In short, the time horizon and capital intensity of green venture investments has rendered the traditional VC community much less effective at 'picking winners,' compared to their past performance with other industries (see Marcus et al. 2013; Kenney 2011; Petkova et al. 2011). To a large extent, VCs have sought to 'disrupt' the built infrastructure of our economy without recognizing that enormous pools of capital are required to do so. As such, they have had to rely on other parties and investors to help them bring their capital-intensive portfolio companies to commercial scale. Once again, this left VCs, like their portfolio companies, vulnerable to the VoD.

Given the disappointing returns VCs have reaped from green investments over the past decade (especially compared to the remarkable returns in decades prior), many VCs have sought to cultivate additional pools of external capital to help them bring their companies to scale. In general, they have turned to three main sources of capital for green companies:

Government: The U.S. government has traditionally been a key backer of technological innovation, especially at the riskiest levels of IP development. Therefore, many VCs actively cultivate relationships with the government in order to secure funding for their companies, even launching lobbying efforts and participating in government as key advisors. However, in the current political and economic climate, there is little appetite among taxpayers to support governments that seek to pick winners (and also wind up backing losers) by providing loan guarantees to private companies.[5]

Syndicates of VCs: Many VCs pooled capital commitments together with their peers for portfolio companies. However, even when deal syndication is successful, as suggested by Lerner (1994) and Lockett and Wright (2001), there can be significant funding gaps for capital-intensive companies seeking to scale-up. Indeed, the most successful cleantech and green energy companies have required a billion dollars or more, which is beyond the reach of even syndicates of VCs.

Syndicates of Other Investors: Syndicates of other types of investors can be effective when banks, growth-stage private equity (PE) investors, and project financiers are brought together in a transaction. However, the coordination and management of these disparate investors can be very challenging (see Pease and Westney 2010). Most of these investors bring with them different objective functions and incentives that can derail



Series 1: Google
Series 2: Tesla

Exhibit 1 Tesla and Google Net Income/Net Loss (First Seven Years of Operation)

the long-term plans of an investee company. Moreover, in an increasingly short-term market (see Aghion et al. 2012; Dallas 2011; Brochet et. al. 2013; Bernstein et al. 2009; World Economic Forum 2012; Kay 2011), most investors view capital-intensive investments as unattractive. In any event, some investors are constrained by their mandates from investing in specific segments, products, or strategies that are not obviously relevant to the green sector; consider that these types of investments often combine aspects of venture capital, private equity, and infrastructure in a single transaction.

3. The 'Valley of Opportunity'

Past failures notwithstanding, it is reasonable to suggest that a select number of capital-intensive ventures will revolutionize antiquated industries by becoming commercially viable and indeed scalable companies in the years ahead. Due to the combined impacts of climate change and resource scarcity, the green economy is almost certainly not just a passing fad. In fact, it is quite possible that a subset of the green energy and technology companies of this generation will go on to be the most profitable companies for generations to come.[6] This juxtaposition of large past losses next to the potential for future gains, we believe, creates a rather interesting opening for LTIs. We call this opening the 'valley of opportunity'.[7]

The problems that capital-intensive industries create for the VC industry actually serve the interests of LTIs. In fact, we see tangible examples of the LTI community, and in particular pension and sovereign funds, participating as key financiers of innovative companies and projects (with provision of equity and/or debt) that sit between venture capital, private equity, and infrastructure. (See the Innovation Alliance case study in #4.) Yet, in order for LTIs to take advantage of this situation, they need to re-conceptualize the way they access VC opportunities. Too many pensions or sovereign funds want VC to be easy. However, making VC work for LTIs requires far more than writing a check to Sand Hill Road and then crossing fingers. It requires meaningful engagement with the asset class and the companies therein.

Through interviews and case studies, three innovative mechanisms have been identified through which LTIs have sought VC opportunities in a more aligned and scalable manner.[8]

Direct: A few institutional investors have brought VC investing in-house, utilizing their experience in direct private equity and direct infrastructure in order to give effect to direct venture investing in creative ways. One fund that stands out in this regard is the Ontario Municipal Employees Retirement System (OMERS). OMERS has a 14-person investment team responsible for direct VC deals in the USA and Canada. They have made approximately 15 direct investments since launching a couple of years ago, and they have a reputation as one of the "go to VCs" for Canadian entrepreneurs. This is an attractive model. If funds can recruit the necessary talent to run such a program, it can solve the time-horizon problem; OMERS can continue to invest in the portfolio companies as the program expands. It also solves the scale problem, as the winners coming out of the VC portfolio will require ever-larger amounts of capital. Conceivably, the biggest winners coming out of the venture portfolio can be passed into the fund's public equity portfolios and even handed-off to fixed income teams.

Seeding: Some funds have taken to seeding new managers in order to achieve the alignment of interests and scale wanted from the asset class. An example that is relevant is the Wellcome Trust, which recently seeded a $325 million venture capital business that will back biotechnology startups. The new entity is called Syncona Partners. It has been designed as an "evergreen investment company." This approach offers many of the benefits of an in-house VC practice, while offering the flexibility required to attract top talent. In addition, this particular vehicle is interesting because it takes advantage of the unique skill set of the Wellcome Trust—a charity entirely focused on health care research. Building a venture practice around health care research enables the Trust to manage asymmetric information and deal flow.

Creative Collaboration: Some VCs and LTIs have actively sought to form ongoing relationships with one another. The VCs look to the pension funds and sovereign funds to help bring their most promising companies to market, while the funds look to the VCs to provide a more aligned access point to the asset class than they have had in the past. In addition, these pension and sovereign funds often work with each other in creative ways, recognizing that the success of these collaborative arrangements with GPs will only work if the former can credibly assess the companies presented by the latter.

In all cases, whether it's investing via an in-house portfolio, seeding a new manager, or working with peers and managers in creative ways to support growth-stage companies, LTIs that can find the talent to run a direct or hybrid program can claim access to a remarkable range of opportunities. Among these options, our research has focused upon understanding "creative collaboration." To that point, we offer a case study of this approach, demonstrating how VC can work for LTIs through a real-world example.

4. Case Study: The Innovation Alliance

In late 2012, three sovereign funds signed a memorandum of understanding to jointly invest in growth capital opportunities globally. This group was called the Innovation Alliance ("Alliance") and included the New Zealand Super Fund (NZSF), the Alberta Investment Management Corporation (AIMCo), and the Abu Dhabi Investment Authority (ADIA). The Alliance was established to take advantage of the members' long-term investment horizons, global networks, and large pools of capital to help build companies in capital-starved industries. This was one of the first formal co-investment vehicles created to offer sovereign funds the chance to cherry-pick the best opportunities in top VC portfolios. By committing to the Alliance, members sought to increase their investment options by aligning interests and reducing costs. The Alliance thus represents an investment option (rather than an obligation) for the three SWFs.

Foundational Beliefs: In launching the Alliance, the members agreed to a set of investment beliefs relevant to a co-investment platform. These were as follows:

LTIs can use the VoD to their advantage, extracting investor-friendly terms from companies that could one day disrupt energy markets.

LTIs have a unique ability to make a long-term commitment to illiquid investments, resulting in higher returns.

LTIs can pool resources to vet opportunities, an especially important issue since venture capital tends to be a highly technical and non-standard asset class.

LTIs agree that making direct VC investments are risky and expensive; the Alliance, with like-minded and deeply resourced peers, is an attractive option in terms of facilitating asset diversification.

LTIs believe that forging strategic relationships with best-in-class VC managers could lead to compelling investment opportunities with sustainable, long-term returns.

Strategy: The Alliance seeks direct investments in high-quality, late-stage, private, venture-backed companies that are emerging as 'the next big thing' in the energy, food, and water industries. The Alliance will make sizeable commitments ($50-500M per company of initial and follow-on capital) in a concentrated portfolio of companies (5-10). The Alliance pays no fees.

Implementation: One Alliance member has had a close relationship with two top-decile VCs. These VCs were approached to see if a formal collaboration with the Alliance would be agreed. The Alliance was offered unique and privileged access to opportunities. The Alliance solidified these relationships through letters of intent to build companies in industries with high capital requirements, long-term advantages, and market-validated growth. These agreements came with no (explicit or implicit) fees or costs; the VCs and LTIs viewed the arrangement as a division of labor. That is, the VCs de-risk portfolio companies' business models, and the Alliance actively helps the companies achieve commercial scale.

Administration: On a semi-annual basis, the Alliance meets in Silicon Valley with its peers and VC partners. There are routine calls among the staff of the Alliance and the VCs to keep abreast of developments in portfolio companies. The Alliance members share costs and expenses for due diligence as well as administration. The Alliance has been kept small (three funds) to ensure effective and efficient execution. The Alliance may add a small number of new partners in the years ahead, based on unanimous agreement among the founders. Investment decisions are made on a case-by-case basis, and Alliance members share the responsibility of the analysis and due diligence.

Commitment: The three funds have made in total a notional commitment of $1 billion to the Alliance. The commitment, even if only notional, was a mechanism to trigger internal resourcing and planning by each fund. To date, the Alliance has deployed over $450 million directly into 'green' companies.

Key Success Factors: What makes this model work is that the LTIs are not naïve about the GPs' motives, even if, in the end, the motives end up being pure. The partnership with the GPs only works if the Alliance has the in-house talent to properly vet the opportunities that the VCs bring. There are serious principal-agent problems in helping VCs salvage their underperforming companies. With this in mind, the three funds decided to team-up, pooling their venture resources into a single cohesive team. Opportunities are run through this team with a focus on executing a rigorous and meticulous evaluation of opportunities.[9] In addition, by focusing on industries that touch upon infrastructure, the three SWFs can utilize their deep expertise in direct infrastructure investments. This has also been critical in vetting some of the opportunities presented to the Alliance. To date, this creative collaboration amongst peers and GPs has been rewarding. Nonetheless, given the time frame, the investment program has many years to run.

5. Lessons Learned

In this section, we distill the lessons learned from our case studies and experience working with LTIs looking to take advantage of the valley of opportunity. Here, we set out the principles and policies that LTIs should consider when reviewing (or managing the process of) investing in capital-intensive ventures. Readers will notice that the principles below highlight the cultural and theoretical challenges facing LTIs, while the policies focus on resolving operational and implementation challenges.

5.1 Principles

Making direct venture investments means asking LTIs to step outside of their comfort zones. The nature of the risks embedded in small capital-intensive companies places them beyond the reach of traditional investors. As such, various cultural and organizational adjustments may be required for institutional investors to be successful in financing green innovations. The following principles are deemed fundamental for LTIs investing in green VC opportunities:[10]

Responsibility: The most challenging cultural issues facing LTIs are, ironically, the need to take more responsibility for, and ownership of, the investments in their portfolio. Typically, institutional investors work through a long chain of intermediaries before their capital is actually deployed in companies (see Colombo and Grilli 2010; Gillan and Starks 2003; Levich et al. 1999). While intermediation may make an allocator's job relatively easy, it also serves to neuter the competitive advantages of LTIs in this domain. Investing via external asset managers serves to shrink the time-horizon of the investment decision-making and distort the incentives and objectives of the ultimate asset owners (Clark and Monk 2013a; Clark and Monk 2013b). In short, LTIs need to be willing and able to make direct investments in green companies, which means they have to build in-house teams and capability. In this regard, governance is critical (see Clark and Urwin 2008; Marathon Club 2007).

Theory: For investors relying on conventional portfolio and investment theories, it can be very hard to justify growth stage investing in green companies. As such, LTIs may have to go beyond the tenets of modern portfolio theory, as modern portfolio theory will not be able to capture and articulate the value of these long-horizon innovations. In large part, this stems from the fact that truly game-changing technologies create new industries, not just new firms. Entrepreneur(s) have to build a whole set of vendors and suppliers to help the company scale-up. Thus, the rigid metrics of modern portfolio theory are not easily applied to these ventures, as modern portfolio theory does not take into account future increased earnings stemming from the opportunities to capture value along the path of building an entire industry (see Müller 1988; Elton et al. 2009). Therefore, LTIs have begun to use a hybrid model that combines venture capital style assessment with more traditional PE and infrastructure metrics (see Baum and Silverman 2004).

Risk: When it comes to green ventures, LTIs have to adopt a different belief system about risk. In all likelihood, cash flows do not yet exist on a level that justifies existing valuations (see Bürer and Wüstenhagen 2009; Horwitch and Mulloth 2010), especially when compared to comparable companies in other industries (see Gompers and Metrick 2001; McConnell and Servaes 1990). What is required is an ability to look beyond risk and focus on 'what's possible'; LTIs must view risks in a similar manner to venture capitalists (see Moore and Wüstenhagen 2004). This qualitative and subjective framing leaves many LTIs uncomfortable. Nonetheless, it is required when investing in companies like Amazon, which required enormous financial backing before

finally turning a profit (due to the infrastructure that had to be built by the firm before profitability). Note that qualitative judgment need not imply a lack of rigor. Rather, it implies bottom-up analysis and in-depth due diligence. This is an approach that requires more discipline than some of the more traditional top-down models of investment decision-making.

Engagement: It is crucial that LTIs recognize the importance and value of their engagement in portfolio companies. Many target companies view the manner in which institutional investors add value to be more critical than the cost of capital (Bygrave and Timmons 1992). While LTIs believe that they have little value to add, there are various ways of assisting in commercialization. Since LTIs have a large network of peers, LTIs can provide introductions to peers that can provide cash injections, reducing the need to be in a continuous fund-raising mode. The LTIs can also provide introductions to potential customers and vendors. Critically, LTIs can provide support and capital to help with transformations similar to those articulated by Christensen (1987) in *The Innovator's Dilemma*. Often initial business models need to be changed for businesses to remain competitive. Both VCs and LTIs can add value at different stages of a venture's lifespan.

5.2 Policies

The following operational and strategic factors are deemed to be important for all LTIs looking at this type of investing:

Direct Investing: In order for LTIs to be active and engaged in their investments and to have the capability to assess which green ventures have the most promise, LTIs need organizational and human resources that match-up against even the most sophisticated growth-stage investors. This implies the presence of strong in-house management and deliberate efforts to recruit and retain qualified staff and advisors (see Bachher and Monk 2013). The creative collaboration model, which brings LTIs together with VCs, only works when the LTIs are proactive and not naïve about the GPs' motives. This means LTIs need the requisite in-house talent.

External Partnerships: VCs often fail to maintain interest alignment and deliver adequate returns to LPs (see Mulcahy et al. 2012; Sensoy et al. 2013; Cumming and Johan 2009). Still, the specialized knowledge of VCs is difficult to replicate in-house, which means that VCs have an important role to play in the investment process. As such, LTIs tend to develop a handful of relationships with VCs so as to source direct deals in green companies. In some cases, LTIs become "partners" with VCs rather than competitors.

Trusted Peers: Since it is difficult to build investment capabilities in-house, collaborative vehicles that bring direct investors together are also required. As noted above, collaborative vehicles can help long-term investors mobilize the resources and capabilities necessary to judge which green opportunities are, in fact, commercially viable over the long term. Syndicating deals among LTIs allows these organizations access to a broad array of talent, insight, and expertise. Because some of these investments will fail, pension and sovereign funds are best served by pooling capital with other like-minded investors to capture the benefits of diversification. The LTIs we have studied have screened green opportunities through the collaborative team and have focused on executing a rigorous and meticulous evaluation of opportunities.

6. Conclusions

Venture capital has been out of favor for the past decade among the largest institutional investors in the world. Much of this stems from the poor returns generated by external managers, as the large majority of VC funds have not out-performed public markets. A majority of VC funds have failed to even return investors' capital. As a result, many LTIs have scaled back their VC commitments to external managers and, instead, have focused on alternative asset classes that can offer economies of scale such as private equity, infrastructure, or real estate. In this paper, however, we have argued that VC still offers remarkable opportunities for well-positioned institutional investors.

Indeed, there is a unique opportunity for LTIs to carry venture-backed, capital-intensive companies to commercial scale and, in turn, participate in their success over the long term. Rather than a valley of death (VoD) for these companies, we see a valley of opportunity: the juxtaposition of large past losses from green investments with the potential for future gains presents an important investment opportunity for long-term investors. However, in order for LTIs to take advantage of this opportunity, they need to re-conceptualize the way they access VC opportunities. Thus far, the creative

collaborations have functioned effectively. But it is still early days, and the true value of these relationships may not be known for years to come.

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Endnotes

1. Size of a fund has been shown to influence performance over the long term (see Kaplan and Schoar 2005; Phalippou 2010).

2. Consider the examples of the iPhone®, iPad®, Facebook®, Android, Kindle®, Electric Car, Twitter®, and applications of all kinds.

3. In 2008, the traditional partners of VC GPs, such as endowments, demonstrated an inability to participate in co-investments due to liquidity constraints. This has opened up the opportunity to other long-term investors such as pension and sovereign funds.

4. This is based upon case studies with predetermined interview questions, as described by Richards and Morse (2006). As suggested by Clark (1998), we have granted anonymity to the people and the firms that have agreed to participate. We have also used a method called triangulation in which we back-up the ideas addressed by the interviewees with previous literature, news articles, and case studies; see Jick (1979) and Morse (1991).

5. The Obama Administration was embroiled in controversy over its $535 million loan guarantee given to the now bankrupt solar company Solyndra. The House Oversight Committee accused the U.S. Department of Energy of negligence and mismanagement in a Staff Report (2012). This has resulted in declining government support for capital-intensive green company initiatives; see Cahoy (2012).

6. A recent German government-sponsored study projected that the cleantech industry would be valued at as much as $5.8 trillion by 2025 (Dembicki 2012).

7. Institutional investors (LTIs) are, in theory, well suited to the characteristics of capital-intensive venture investments (see Graves and Waddock 1990; Bushee 1998; Hartzell and Starks 2003; Dahlquist and Robertsson 2001). For example, the time to commercialization of a typical green energy investment aligns quite well with the time horizon of pension funds and sovereign funds. In addition, the scale of investment required for a green company to commercialize fits reasonably into an institutional investors' set of resources. In fact, most LTIs don't even want to spend time and resources on investments under $50 million due to their own resourcing and needs.

8. Doing direct investments in venture stage companies within a public fund requires high levels of buy-in and understanding by the Board. Some of the investments will, inevitably, go to zero. In our view, that is simply the nature of the asset class. Boards need to understand this and be prepared for the possible negative and positive consequences of VC investment.

9. The Alliance has also routinely tapped Dr. Monk's colleagues at Stanford and Oxford universities to serve as expert consultants during due diligence.

10. Embedded in these principles is the economic theory of differentiation (see Krugman 1998; Buckley and Ghauri 2004). Economic differentiation states that in different industries, finance is required to serve dramatically different roles. Institutional investors have wide-ranging investments in many different industries (Schneeweiss and Georgiev 2002), making it challenging for the achievement of differentiation among strategies. However, this is what's required when focusing on "green" venture capital.

11. In order to make such risky investments, LTIs should develop risk budgets, such that these high-risk investments do not put a strain on the entire portfolio. Since disruptive companies have considerable idiosyncratic risk, these risks can be managed through diversification (see Campbell et al. 2001; Goyal and Santa-Clara 2003).

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Growing Wealth in a Complex World

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"The only sure thing about the future is that it may or may not be different from the past."

1. Introduction

Over the past several years, I have helped co-author several books on the current state of investment management. A central thesis of these books *The New Science of Asset Allocation* (John Wiley, 2010) and *Postmodern Investment* (John Wiley, 2012) was that individual investors must be aware that the basic underpinnings of modern portfolio theory are now over 60 years old, and that there now exists a wide range of new investment products and investment vehicles that have increased the investment opportunities in today's world, but have also made, for some, an investment world which seems increasingly complex. Each of these books attempted to simplify this investment world by emphasizing the underlying factors which drive the expected return of various investment strategies and asset classes. While I believe that the investment topics raised in these books are important to the educated investor, if too many ideas or too many concerns are raised about investment products, asset allocation programs, and risk management processes, the average American investor may simply freeze up in confusion and fear. As a result, criticism alone may provide no solution, but in fact, may prevent some investors from seeking one. When all is said and done, investment actions have to be taken. Growing wealth in a complex world is about understanding both the pros and cons of those actions, as well as understanding the structure of the investment world in which those actions are made.

For some it may be interesting to note that this article contains no math and no equations. A complex investment world does not necessitate a complex view or understanding of financial asset. It is my fundamental belief that there exists no financial product or risk management system, with all of its inherent promises and potential failures, that cannot be understood by the average investor with a basic understanding of addition and subtraction. As a collective, investors fundamentally realize that one cannot get something for nothing. For example, eight percent risk free interest rates do not exist in a two percent risk free world; an equal weighted stock and bond fund is not a balanced fund but, given the relative volatilities of stocks and bonds, is really a stock fund with a little bit of bonds; and, there is no such thing as an absolute return fund that makes money in all markets. To move forward in this new world, investors must simply demand transparency and insist upon a detailed analysis of the fundamental sources of return and risk of any product presented. Investors must also insist on a full explanation as to when a particular product will most likely perform well and under what conditions will the product most likely perform poorly.

However, for investors hope often trumps logic. In their search for new investment opportunities, investors are often dependent on the goodwill of others, and often that goodwill, in the form of knowledge, has to come from those very firms and individuals who are providing both the investment product and its embedded risk management tools. These firms or individuals have varying degrees of industry knowledge, training, education and/or experience. For the most part they hold a "business card" and often their personal priorities may be determined by the firm for whom they are working. Against this background, how do we ensure that an investor is receiving full and untainted information? For the most part, we cannot. Behind each investment product is a firm's business model, which provides or supports that product. An investor should know if his goals are well aligned with the individual or firm offering investment advice and if one's advisor is knowledgeable about the products they are selling. The most important investment and risk management decision is, therefore, the choice of whom to work with. What is the extent of their knowledge? What is the extent of their business experience? How are they compensated? What is the extent to which that person can service you in a way that mandates your concerns prevail in a world of competing interests. Perhaps one way is for investors to prepare themselves by reviewing a series of simple questions which may offer them the confidence that they can navigate this increasingly complex world of modern investments.

2. Question: How Can You Assure Me that This Product Will Work In All Economic Conditions?

Answer: No one can.

Outside of death and taxes, there are few sure things in life or investments. If the history of investment could be summarized in a simple statement, it would be "Things Change." Financial products change for a host of reasons: political upheavals, technology, regulation, mar-

ket structures, and so on. Even if a financial product is constructed to meet the economic concerns of the day, there is no assurance that it will be suitable for the economic conditions of the future. If change is difficult for individuals, it is even more difficult for most businesses and governmental entities. Corporations spend a considerable amount of time and effort designing new products and services. For the most part, these firms have the public's interest at heart. They have no institutional reason to sell what are essentially bad products. However, not all commercial products are suitable for all individuals. Similarly not all investment products are suitable for all individuals. Problems in some financial products are not known until well past their inception. In addition, there are hosts of regulatory restrictions and legal exposures on how investment firms present and monitor products. As a result, investment firms have often found that it is best to stay with the tried and true (and the popular), rather than exposing themselves to the potential problem of investor dissatisfaction or confusion as to new products and new investment ideas.

Governments, too, have conflicting priorities with current financial regulations designed to fit a past set of problems often taking precedence over regulation that is known to fit current conditions. Even worse, the very process of regulatory and legal change that is required to make adjustments to past laws so that they fit current processes is difficult. Often, government officials are not entirely honest when discussing the range of benefits and costs of financial regulation. When discussing the potential impacts of financial regulation they often commit a 'Washington Lie'. That is, these officials are lying. They know that we know that they are lying, and we know that they know that we know that they are lying.
Simply put, most part investors live in a world crafted by others. This is a world in which investment advisors spend more time discussing why an investment product works than why or when it will not. Historically, the investment map and its borders continue to be framed by what we describe as Modern Portfolio Theory (MPT). Within MPT, higher expected return is achieved for correspondingly higher expected risk. This risk is often stated and measured as an asset's standard deviation.

For those investors and investment advisors who are content to stay in the MPT world, many current products (e.g., conservative, moderate, or aggressive stock/bond based portfolios) may suffice. Historically, simple stock and bond portfolios based on the level of volatility the investor could expect were deemed adequate. However, as markets have evolved, simple stock/bond diversification has been shown not to provide investors with sufficient risk control (equity risk dominates portfolio risk and historical correlations may not reflect current return co-movements). In addition, historical stock and bond returns provide little information as to current expected returns (past bond returns may not reflect current yields and expected stock returns in a two percent GDP growth world cannot be based on a world in which historical GDP growth was between 4-5%).

As an alternative to simple risk-based portfolios based on stock and bond diversification, many of the financial changes over the past sixty years have resulted in new opportunities for risk and return management. More importantly, as new technologies, regulations and financial markets came into existence, new investment products offer both a new world of investment opportunity albeit with a new world of investment risk. However, this new world of investments often reminds us of the maritime charts of old which often showed monsters and sea dragons as symbols for unknown dangers and unpredictable outcomes. Using these charts, ancient mariners explored the seas and sometimes brought back tales of heroic adventures and noble voyages. Each voyage informed the next, and through these tales the seas became less forbidding.

What is often forgotten, however, is that the tales of adventure are the stories of the survivors. The stories of failure and the dangers they encountered are left untold. So as investors begin their pursuit of investment knowledge, they must be careful to understand that any chart or algorithm contains an element of the unknown and unknowable. Each of the following is a short story of various investment voyages. Not all of the risks are discussed, or even known, since sometimes the sailors never came back. However, for those who survived, we should at least be aware of the challenges met along the way.

3. Question: Why Not Just Equity and Fixed Income: The Traditional Pair?

Answer: Less is not necessarily better than more.

For most investors, the investment universe is dominated by two asset classes: stocks and bonds. The reasons for this dominance are many. First, their fundamental

sources of risk and return are generally, if not easily, understood. Second, they are often the most transparent, the easiest to trade, and the most liquid assets. Third, most individuals believe that stocks and bonds often differ in their sensitivity to changes in economic factors and provide a simple road to asset diversification. In sum, for many people, stocks and bonds make a perfect pair and since they have been married for such a long time, there is a long history of how they behave.

So the problem begins. Since stocks and bonds are regarded as the primary investment forms, investment firms consistently try to find new ways to use them. Within each portfolio, considerable effort is taken to show how these two subgroups could be joined to meet every investor's need. Over time, the concept of equity as an asset class evolved from the general to the specific. Sub-components such as growth and value, large and small capitalization, U.S. and non-U.S. have been suggested to have distinct and differing risk/return characteristics. Similarly, various parts of the fixed income market, such as U.S. Treasuries, U.S. corporate, U.S. high yield, non-U.S. government, emerging markets, have also been presented as having unique and distinct risk and return characteristics such that portfolios containing various combinations of the equity and fixed income sub groups would have different performance and risk outcomes.

The discovery of these new investment matrixes have led the average investor to believe that investment diversification was possible within the equity and fixed income groups. For those willing to combine equity and fixed income, they could consider even more investment opportunities such as strategic asset allocation (combining stocks and bonds to maximize return or minimize risk), tactical asset allocation (moving across stocks and bonds in a systematic fashion to maximize return), and ultimately dynamic asset allocation (managing each or both asset classes to maximize return or minimize risk under various market environments).

There is just enough truth in the benefits of diversification within equities and within fixed income as well as across equities and fixed income that the range of financial products built using these two asset group provided a reasonable set of investment opportunities for most investors. Given enough data, one could always come up with a time period or economic conditions where the benefits implied in the traditional stock and bond product literature could be obtained.

The fact that the use of historical data alone as a basis for how the assets will perform in the future may lead investors to believe in a world that no longer exists was not something that was stressed in the literature. Today's global equity markets differ in form and substance from the markets that existed in much of the historical analysis. The fact that the new forms of fixed income and equities products which have been structured and shown to provide unique return or risk opportunities in certain historical states of the world may not provide similar return and risk opportunities in the current market and regulatory environment is rarely discussed. The essential message for stocks and bond investors is that determining which stocks are good and which are bad (e.g., growth versus value), or when they are good (rising earnings market) and when they are bad (following a crash), is not as easy as looking to the past for clear and concise answers. Things change, and sometimes change quickly. For example, index products of today may differ fundamentally in their holdings from what they held just several years ago, and this works for bonds as well as stocks. Given the changing nature of global stock and bond markets, investors should be aware that that they should look not at how a strategy or asset class performed in some past world, but rather at how the current asset class (stock or bond) can be expected to perform in the next one. In short, although the past provides an interesting story, it is not necessarily a prologue for the future.

4. Question: If Not Stocks and Bonds, What?

Answer: What is ever in the sea?

As stated earlier, simple stock and bond diversification as a means to manage investor risk is now more than 60 years old. Today more modern and more dynamic approaches to the creation of investor's portfolios include a wider range of asset classes and rule based approaches to managing portfolio risk. If simple stock and bond diversification does not offer all the answers, what is the strongest foundation for allocating assets properly? The answer is that a deeper understanding of a broader set of trade-offs is required, as well as an appreciation of the distinct types of risks (e.g. under different states of the world, the risk of the past may not forecast the risk of the future). The fact is that simple risk-based stocks and bonds do not offer investors adequate means to reduce

risk or maximize returns in a certain states of the world (i.e., see 2008). For many investors, as well as investment managers, a possible answer could be found in an investment strategy that was over sixty years old; that is, hedge funds. Hedge funds were first sold as an investment strategy that offered an ability to minimize losses in down stock and bond markets while participating in the positive returns of up stock and bond markets. One reason for the supposed ability of hedge funds to offer unique returns not available in traditional stocks and bonds was that the products were being managed by the best and the brightest among managers; further these managers were not required by custom or regulation to track a stated benchmark.

Note that the use of benchmarks remains an essential part of the traditional stock and bond world. In fact, many traditional asset managers were required by law not to go off the reservation. However, for those with enough money (accredited investors), new investment opportunities were available for the simple fact that the government did not have to care if they lost money (they would always have enough left to get through the day). For these individuals, investment managers offered diverse sources of return based on unique investment strategies often not liquid or transparent enough to be sold to the normal retail investor. For many wealthy investors, the offer seemed irresistible: membership in a special club of absolute return. Unfortunately, the offer was more fiction than fact. The managers were good, but not special. Hedge funds were like traditional stock and bond investment in that certain hedge fund strategies (equity long-short, distressed securities) made money in the same economic markets as similar traditional long-only investments. Equity long-short generally makes money when equity markets rise and loses money when equity markets fall. Distressed securities lose money when high yield traditional fixed income lose money (credit spreads increase) and make money when high yield traditional fixed income makes money (credit spreads decrease). However, many hedge fund strategies differ just enough from traditional long-only stocks and bonds such that each hedge fund strategy can be used as building blocks to design one's own particular investment recipe.

Given the greater discretion in fund concentration and investment choice, hedge funds are shown to offer returns that are consistent with the market factors driving the underlying strategy, but they also offer an option on the manager's ability to modify the strategy in a way that may be more or less sensitive to changes in market conditions than that implied in the comparison traditional equity or fixed income benchmark. Hedge funds are shown to be both more and less special than is often presented to investors. Today, the underlying return opportunities in hedge fund strategies are available in a wide range of new 'hedge fund' investment vehicles (ETFs, mutual funds, tracking products). The question for investors remains the extent to which they should focus on more strategy benchmark-based hedge funds or search for a "great manager." One thing is known for certain, there is no all-inclusive hedge fund asset class. Each hedge fund's return depends on its unique set of assets traded (e.g., stocks and bonds) and how they are traded (hedged or unhedged). Yet, within a strategy, most managers are sensitive to the same economic factors. That is, most equity long-short managers make money in the same periods and lose money in the same periods.

Finally, investors should consider that the glory days of hedge funds were pre-internet, pre high frequency trading, pre Dodd Frank. A time when investment managers could create an information arbitrage based on fundamental research and analysis and when the information was at least somewhat proprietary is all but gone in a world of 24/7 cable news, social networks, blogs, and global dissemination of every fact, error, and suspicion relating to a company, its management, and its competitors within micro seconds. Hence, it should be of no surprise that the best performing hedge fund managers of today are at the two extremes; that is, essentially day traders with exceptionally low trading costs or those who invest in illiquid assets that often have to be held for lengthy periods before obtaining the "illiquidity premia".

5. Question: Do Absolute Return Investments Actually Exist?

Answer: No.

If hedge funds are not the answer in the quest for an asset class that has the potential for making positive returns across a wide range of market conditions, does such an asset class exist? Today one often sees advertisements for 'Absolute Return Funds'. These funds often claim that they are more agnostic as to which benchmark they are tracking (stocks or bonds); thus they of-

ten claim they are benchmark free and attempt to focus on 'Total Return" in contrast to benchmark return. That sounds good, but often all one is really doing is moving from one higher risk asset class to a lower risk asset class, based on one's forecast of risk and, as we all know, there is risk in forecasting risk. These 'Absolute Returns Funds' do not 'eliminate risk'. The funds may be 'benchmark agnostic,' but they are also generally 'asset class long bias' and generally lose money in markets in which both stocks and bonds fall together.

Is there an asset class that can make money when most asset markets are falling? For many, managed futures offer the opportunity of favorable returns in various market environments. The fact that they can go both long and short across a wide set of financial securities offers the hope that they may offer positive returns in both down and up stock, bond, commodity, or currency markets. For many investors though, managed futures are false hopes. Investing in a 'futures market' where, at the end of the day, the average return among all traders is zero seems like a foolish investment. However, some market players (e.g. agriculture firms, airlines) often have to reduce expected firm risk and must hold certain futures positions to offset their expected spot market needs (regardless of their own expectation of market movements). Even in a market where the average return among all traders is zero, positive expected returns are potentially available to traders who provide liquidity to corporate hedgers by taking the opposite futures position to the corporations that are using the futures markets as a risk offset to their traditional business needs.
When compared to many other investment vehicles, managed futures do, therefore, offer the potential for positive returns across a wide range of various states of the world. One world, however, in which they do not necessarily offer positive returns on a consistent basis is the one world in which investment managers often attempt to portray managed futures as the ultimate solution; that is, markets where equities themselves sometimes perform poorly. Equity markets are known to follow what is called a random walk, where past price patterns are a poor means of forecasting future price patterns. Managed futures traders who use past price patterns as a means to forecast futures price movements may find equity markets to be a poor choice as a primary trading market. This is not to say that managed futures trading strategies may not perform well in asset markets that are more trend following in nature. It shows only that a good story based on past historical performance is not necessarily a true story for the future. For investors, more important than a story being good is a story being valid for various states of the world. For many investors, historical performance becomes fact and if not fact at least hope. One can ask investors to know the difference. This does not mean that managed futures are not an absolute investment vehicle, which does not have a fixed sensitivity to various market factors (return or risk); it only means that an absolute return is not always 'absolute'. Investors may accept managed futures as a potential investment, but they must beware of false prophets who offer managed futures as the grail in the quest for absolute return.

6. Question: Is There A Traditional 'Long Only' Alternative to Managed Futures?

Answer: Commodities—an ever-changing balance.

Managed futures, by design, may be expected not to have a high positive correlation with traditional stocks and bonds. However, is there a world in which long-only asset exists which likewise can be expected also to provide low correlation with traditional stock and bond investment? Very few people have visited this world and some may question if this world even exists. For some investors, this world is commodities. Most investors view their commodity investment through equity holdings in firms that specialize in the production of various commodity products. However, calling an equity investment a commodity investment does not make it a commodity investment, and calling a commodity an investment opportunity does not make it an investment opportunity. In recent years, the investment community has seen the development of commodity investment from its beginnings as an individual investment to investment through benchmark/portfolio indices. Each of these commodity benchmarks is shown to provide somewhat distinct commodity investments, and each benchmark is shown to provide different diversification benefits to traditional stock and bond investments, as well as to other alternatives.

Commodities' place in active asset management is relatively new. Global markets have recently expanded to the point that supply and demand conditions may now favor long-term investment. However, even an investment in commodities may not reflect expectations based on historical data. Today, gold has become more of a

currency substitute, corn is seen as an energy replacement, and certain rare commodities are fundamental as technology inputs. These changes have increased institutional and investor interest in commodities as long-term investments. The properties of commodities as long-term investments, however, do not necessarily reflect their properties over shorter intervals. Given the changing demand and supply conditions, one may wish to consider them more as short-term investments when economic conditions warrant or, at the very least, to find a product that offers the ability to manage the product to benefit the changing states of the world. But ability to make money does not mean a certainty to make money. For example, energy prices may rise and fall with the rise and fall of economic conditions and correspondingly have a positive correlation with stock markets, which also may rise and fall with the changes in economic conditions. But the world is not always that simple. A fall in energy prices (reduced returns) may also reduce costs to corporations and resulting in a rise in equity prices, which then results in a negative correlation between energy and equity returns. In short, there is simply no constant correlation, high or low, between commodities and traditional assets. Since commodities are not structured to ensure low or negative correlation to traditional assets, perhaps they should be regarded more as return enhancers than as risk reducers.

7. Question: Are There Other 'Long Term' Risk Reducers?

Answer: The secret is long term.

Private equity and real estate (at least private commercial real estate) are often excluded from discussions of individual investor portfolios. Instead, these relatively less liquid investments are regarded as the private domain of institutional investors. It has been regarded as a world of little transparency and even less liquidity. However, private equity and real estate have an allure. If you had the price of admission, you could be invited into a special club in which public investment is worthless while private information has the potential for monopoly profits. Given the time commitment to the investment area, investors were not expected to demand immediate return to capital, or cash flows that reflected current economic conditions. In many ways, private equity/real estate investment was a high-cost option on a range of potential investment opportunities, some of which would pay off big, others of which would never be heard of again.

Investors who are entranced with the story of the private equity arena must be advised that the cost and form of investment has evolved over time. Once it was a playground for leverage buyout kings; later the land of the Internet entrepreneur; for a short time in the province of the quick in and out of the IPO artist. In recent years, it has become a market that is increasingly made available to smaller players and investors either through secondary offerings or direct investment in public offerings of major private equity players. What is surprising to some observers is the extent to which investors believed that this more liquid investible private equity is separate from the equity markets in general. The term "equity" in public equity (especially in its liquid form) should have given it away. For years, the public face of private equity was the self-reported returns to various consulting or data services. These accounting-based returns often provided evidence of over-the-top returns to individuals or institutions that were able to invest at opportune times. With the development of secondary market offerings and the public sale of private equity firms' equity shares, private equity took some of the "privacy" away in order to expand its market. In so doing, it exposed itself to a situation where its real value would be measured by the market. When the market dropped in value and the commensurate value of private equity fell with it, the fact that private equity was, in many cases, more equity than private was revealed. The message to investors is that the "wizards" of the private equity world are just men—often good men, many times talented men, but just men nonetheless. They offer real opportunities with real risk, and those expected returns and historical volatilities based on self-reported accounting returns provide only a limited view into the potential returns from future private equity investment. For investors, the fact that it was private did not protect the investor from changing market conditions. In the future, private equity whose returns are based on the ability of any new venture to convert quickly to a cash flow cycle and are continuously subject to the vagaries of various states of the world, are less risk reducers than return enhancers. One should not have to remind investors that private equity is not necessarily a bad investment—only a very risky one, even for those who are willing and able to play the game over a time frame outside the investment realm of the average investor.

Real estate brings up a similar host of issues for inves-

tors. Until recently, in fixed-income form was viewed as a secure, government-backed (or at least government-sponsored) investment opportunity, often with unique risk and return characteristics (such as early payback) not found in more common fixed-income securities. When structured as an equity investment (e.g., closed-end fund), it also offered access to a growing world of investment opportunities. The past five years have increased investment choices radically. Changes in financial technology and financial institutions have created conditions in which one's home and homes in general became something moved in and out of, through flipping and trading up. Likewise, homes became expendable items, used as much a short-term source of cash as a long-term investment. Somehow, the potential volatility in income streams and home values did not make it into the average investor's mean/variance conservative, moderate, or aggressive asset allocation scenario.

Today, real estate is now truly up for sale. In the stock market, REITs are divided into numerous U.S. and global segments. Similarly, residential and private commercial real estate is no longer based solely on estimates, but increasingly uses actual sales values as an attempt to determine current market prices. The veil of real estate having a value separate from the rest of the American economy has been lifted. Common forms of real estate, similar to more liquid forms of private equity, is more equity than private. Although the benefits of real estate are there (even if they require more work to find them), the diversification benefits in the current environment are limited to those forms of real estate (storage offices, rental properties) that thrive on the failures of traditional real estate, rather than the forms (new home development) that benefit from it.

8. Question: Asset Allocation: Is There A Simple Way?

Answer: No - only a hard way.

For most investors, asset allocation is modern investment. Walk into any financial advisor's office, pick up a financial institution's family office circular, or read the ads in any investment magazine, and all of them claim to offer the newest and best means to ensure that their investment expertise meets the unique needs of every potential individual or institutional investor. What is amazing is that much of this advice is seemingly done for pennies on the dollar and is equally available for all investors. Of course, we all know that this is not possible. General Motors, Ford, and the other car makers attempt to maintain that each car is special for each driver, but they do not pretend that each car is built to the unique specifications of each driver. Sure, the drivers themselves have the ability to adjust certain parts of the vehicle (move the seat forward and back, listen to the music they want on the speakers they desire), but at the heart of it, each car is the same within the brand and price range given. More expensive cars are designed to run smoother, accelerate faster, and change lanes more quickly, thus offering greater returns in the driving experience. However, not everyone needs bigger, faster cars. For many people, smaller, cheaper, and easily serviced vehicles are just fine. A twenty thousand dollar car is not a sixty thousand dollar car, and if they are buying a twenty thousand dollar car, the dealer does not have the time, money, or resources to make it perform like a sixty thousand dollar car.

Investors need to understand the differential nature of most asset allocation programs. At one end are programs that use traditional asset groupings (stocks and bonds) and at the other end are programs that insert traditional alternatives and modern alternatives into them. Investors must ask if the data they consider and the risks they review are likely to be historical anomalies. How often should you review your investment picture? Monthly? Weekly? Daily? And if you review it daily, would the results be the same if you reviewed it monthly? When you receive information from your asset allocator, how often do you receive it (monthly or weekly?), and to what degree is that information updated, given that the market and your asset position may change more quickly than is reflected in your monthly circular?

There is no complete answer to these questions because the solution for any individual is just that, individual, and asset allocation solutions for more complex and larger portfolios require resources that most individuals cannot or would not be willing to pay for. In the world of asset allocation, as in the world of investment choice, you get what you pay for. If you want greater certainty of return, you have to pay for it, and buying an asset allocation system does not necessarily do it alone (unless it is specifically created to provide a range of insurance products, such as options). Cheaper, less inclusive asset allocation models may be adequate for the situation, but do not mistake a free asset allocation model for one that costs thousands of dollars more. The more expensive model may not be what you need, and in many cases it

will not provide a better solution to your problem than the least expensive one; it should, to offer the possibility of doing more.

9. Question: What is an Asset Allocation Model?

Answer: It is all about risk management.

One of the fundamental truths, if not the fundamental truth, of investment theory is that return is a function of risk and not the other way around. In short, if one wishes to manage return, one may best look to manage risk, which is the source of return. If an investor looks to an asset allocation model which focuses on direct estimation of return rather than focusing on risk management as an answer to his investment decisions, it is only a matter of time before he will be disappointed. At one level, risk management may be regarded as a relatively simple exercise—that is, an attempt to reduce the risk of loss surrounding an investment. For more complex portfolios, if an investor has the money, he has access to a greater range of alternatives. However, for each and every one of those alternatives comes with its own risk and return. There is risk in risk management.

At the end of the day, where does risk management (e.g., asset allocation) take the investor? Is there an easy-to-follow list of questions and answers to determine which method is best? The answer is no. The reason is simple. An investor should not place his complete faith in any one approach to risk management, in any single letter grade, or in any government assurance. It was investors' willingness to believe in such models that led to the financial crisis that still surrounds us today. Individuals continued to use bond ratings as a basis for investment thirty years after the New York City default crisis. Since we lack timely market-based information, we looked to ratings with the false belief that the ratings firms have full access to private information that we do not have. Of course, ratings firms do not have full access to private information and they were never riskless. Similarly, the data that risk management firms use to evaluate risk is not riskless. The algorithmic models that they use to measure risk are not perfect, and further, by claiming to offer fact-based solutions, they may even encourage more risky activity.

So, what may be concluded here? On one side, government and professional associations' concern over the expansion of new product forms into more retail-like products, marketed to less sophisticated investors, will reduce the chance that one is exposed to misleading marketing information and accounting details that are focused on the sale of products that may not be well-suited to your unique needs. At the same time, from an academic perspective, it is difficult to argue that retail investors should not have access to any of the more risky investments that benefit wealthier investors. One can debate if regulatory concerns over pricing, accounting, and investor fraud are, by themselves, a basis for preventing investor access to certain types of funds. Recent problems with security pricing and accounting are found in most markets. Deceitful communications and unscrupulous sales are present in both traditional and alternative investment markets. The question remains why retail investors should not be afforded the same risk diversification and return benefits that a wider range of investment alternatives provide affluent investors, as long as legal restrictions on certain actions are followed diligently.

If you take the time and effort to review, purchase, and even use one of the many risk management systems in the market, you must remember that they were created in a certain place at a certain time and, given the pace of the financial markets today, will be dated by the time you receive them. If you are going to continue to use such systems, make sure that you obtain current updates and realize that for all that the system does, you must also have a clear picture of what it does not do. These systems do not protect your investment from loss in all market conditions. At their best, they can only tell you when you might lose it. After that, it is all up to you. No promises.

10. Final Question: What is the Central Message of Growing Wealth in A Complex World?

Final Answer: There is always a little truth in every myth and a bit of myth in every truth.

In the previous sections, we have attempted to provide a condensed review of several primary questions that are often posed by investors. We are torn between the often simple, easy-to-act-on yet incorrect answer, and the more complex, costly, misunderstood, but correct one. If truth comes at a price, it could well be an expensive one. Many members of the financial community believe that they are offering investors products, asset allocations, and risk management tools that are based on the

perceived needs of the investor. They seek to provide products and services that fulfill these needs within the context of their firm's overall business operations and under the watchful eyes of regulators. However, even within the best investment market, mistakes happen. Critical points are misunderstood. Wealth is lost. The financial industry is both to be blamed for whom it did not protect and to be credited for the benefits that it has produced. As noted previously, there may be some iteration of the world where riskless assets can produce riskless returns, but there is typically no free lunch. One cannot guarantee excess return to one set of investors without often taking returns from others. The inextricable fact of investing is that sometimes you will lose money—this is simply the flip side of the ability to make money.

While convenient, there is a strong argument that the onus of protection extends beyond these governmental and financial institutions and shifts onto the investor. In the end, investors should take responsibility for their own investment actions. That responsibility is not costless; it takes continuous education and the ability to embrace failure. The fact is that while many of us welcome the make money part of investments, we do not wish to accept the losing part. Unfortunately, investors continue to look to others for our financial salvation. In so doing, investors often accept simple solutions for complex problems. Target date funds based on simple age based glide paths which, depending on the age of the investor, may systematically overweight equities in a non-equity friendly market environment or overweight fixed income in a rising interest rate environments is but one example. At the other extreme, investors often blindly accept seemingly complex investment solutions which offer promises that can never be reasonably fulfilled. Dynamic asset allocation programs which promise absolute returns performance centered on a variety of historically successful asset reallocation algorithms but which are often ineffective in multiple market environments may fall into this variety. The very fact that investors are surprised when these programs fail to perform as promised is the real surprise. In conclusion, there may always be a little bit of fiction in the truth embedded in alternative approaches to growing wealth, as there is always a bit of truth in the myths of various investments. Whether investors directly manage their wealth or pass this responsibility over to others, investors have the responsibility of at least asking and understanding the underlying investment programs and processes. Simply put, whether you make or lose money, you should at least know why. Growing wealth in a complex world is not impossible—difficult—but not impossible. To believe or to behave otherwise is to subject your future wealth to hope over history and hope is not a plan.

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Author Bio

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Professionally, he has more than forty years of experience in investment management. He has been involved in the creation and development of a range of investment vehicles, including fund-based investment structures, for an approximately $4 billion hedge-fund-managed account platform (Lyra Capital/Ursa). He has also been involved in the creation and development of a series of commodity-based products (ABCI –formerly Bache Commodity Indices) and a series of investible managed futures and mutual fund/hedge fund tracking products (White Bear Partners). He is currently a principal at S Capital Management, LLC, which specializes in private wealth management, and a managing partner at Quantitative Investment Technologies LLC, which specializes in risk-based asset allocation and investment strategy tracking/ programs. To find a list of his past and current publications, commentaries, and working papers, visit: www.trs-assoc.com.

IR&M Momentum Monitor

Alexander Ineichen, CAIA
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IR&M

Price Momentum

Earnings Momentum

	Price Momentum: Medium-term				Price Momentum: Long-term				Earnings Momentum: Medium-term				Earnings Momentum: Long-term			
Calendar Week:	**19**	**20**	**21**	**22**	**19**	**20**	**21**	**22**	**19**	**20**	**21**	**22**	**19**	**20**	**21**	**22**
Equities by region																
MSCI World	13	14	15	16	91	92	93	94	20	21	22	23	66	67	68	69
Europe (STOXX 600)	7	8	9	10	92	93	94	95	-14	1	2	3	-14	-15	-16	-17
MSCI Emerging Markets	7	8	9	10	2	3	4	5	8	9	10	11	-45	1	2	3
MSCI Asia Pacific ex Japan	7	8	9	10	6	7	8	9	9	10	11	12	27	28	29	30
Equities by country																
USA (S&P 500)	4	5	6	7	120	121	122	123	75	76	77	78	114	115	116	117
Canada (SPTSX 60)	43	44	45	46	37	38	39	40	9	10	11	12	4	5	6	7
Brazil (Bovespa)	7	8	9	10	-19	-20	1	2	6	7	-1	-2	21	22	23	24
France (CAC 40)	13	14	15	16	91	92	93	94	-2	-3	-4	-5	-138	-139	-140	-141
Germany (DAX 30)	2	3	4	5	93	94	95	96	21	22	23	24	55	56	57	58
Italy (FTSE MIB)	20	-1	-2	1	37	38	39	40	-12	-13	-14	-15	-4	-5	-6	-7
Switzerland (SMI)	7	8	9	10	95	96	97	98	1	2	3	4	-16	-17	-18	-19
UK (FTSE100)	3	4	5	6	91	92	93	94	-7	-8	-9	-10	-36	-37	-38	-39
Australia (S&P/ASX)	13	14	15	16	89	90	91	92	2	3	4	5	57	58	59	60
China (Shanghai Composite)	-3	-4	-5	-6	-18	-19	-20	-21	-6	-7	-8	-9	61	62	63	64
Hong Kong (Hang Seng)	-2	1	2	3	-9	-10	-11	-12	-11	-12	-13	1	-2	-3	-4	-5
India (Nifty)	11	12	13	14	29	30	31	32	12	13	14	15	25	26	27	28
Japan (Nikkei 225)	-15	-16	-17	1	-6	-7	-8	-9	25	26	27	28	63	64	65	66
South Korea (Kospi)	-2	1	2	3	-12	-13	-14	1	-18	-19	-20	-21	-49	-50	-51	-52
Bonds																
Barclays Global Aggregate	17	18	19	20	28	29	30	31								
Barclays Global HY	35	36	37	38	36	37	38	39								
Barclays Euro Aggregate	33	34	35	36	28	29	30	31								
Barclays Asia Pacific Aggregate	35	36	37	38	31	32	33	34								
Barclays Global Emerging Markets	14	15	16	17	22	23	24	25								
Barclays US Aggregate	18	19	20	21	17	18	19	20								
Barclays US Corporate HY	35	36	37	38	124	125	126	127								
Hedge Funds																
HFRX Global Hedge Funds	-5	-6	-7	1	89	90	91	92								
HFRX Macro/CTA	-14	-15	-16	1	-46	-47	-48	-49								
HFRX Equity Hedge	-5	-6	-7	-8	89	90	91	92								
HFRX Event Driven	-1	-2	1	2	88	89	90	91								
HFRX Relative Value Arbitrage	35	36	37	38	26	27	28	29								
HFRX Fixed Income - Credit	97	98	99	100	146	147	148	149								
Commodities																
Thomson Reuters/Jefferies CRB	16	17	18	19	12	13	14	15								
Gold (Comex)	-4	-5	-6	-7	8	9	10	11								
Copper (Comex)	-15	1	2	3	-9	-10	-11	-12								
Oil (WTI)	-2	1	2	3	5	6	7	8								
FX																
USD (trade-weighted, DXY)	-5	-6	1	2	-34	-35	-36	-37								
EURUSD	13	-1	-2	-3	42	43	44	45								
JPYUSD	5	6	7	8	-76	-77	-78	-79								
Central banks' balance sheets																
Fed balance sheet	82	83	84	85	74	75	76	77								
ECB balance sheet	-1	1	-1	-2	-73	-74	-75	-76								
BoJ balance sheet	105	106	107	108	147	148	149	150								
BoE balance sheet	-3	-4	-5	-6	6	7	8	9								

Commentary

Nearly all stock markets remain in a long-term bull market with the exception of some markets in broader China and Japan.

Earnings momentum for the MSCI World and S&P 500 has been positive for a while.

Momentum in bonds is positive.

Momentum in hedge funds has been positive for nearly two years.

Commodities as a whole are in a bull market.

The Fed's balance sheet is expanding merrily.

Tutorial

The momentum numbers count the weeks of a trend based on moving averages. Green marks a positive trend, red a negative one. Example: In week 22, the S&P has been in a long-term bullish trend for 123 weeks. See www.ineichen-rm.com for more information and/or trial issue.

Purpose

The momentum monitor was designed to help investors with risk management, asset allocation, and position sizing. Tail events do not always happen out of the blue. They often occur when momentum is negative. Negative momentum makes hedging more important and suggests position sizing should be more conservative. In a bull market one ought to be long or flat but not short. In a bear market one ought to be short or flat but not long.

Source: IR&M, Bloomberg. Notes: Medium-term based on exponentially weighted average over 3 and 10 weeks. Long-term based on simply weighted average over 10 and 40 weeks. Earnings momentum is based on 12-month forward consesus EPS estimates.

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Alexander started his financial career in derivatives brokerage and origination of risk management products at Swiss Bank Corporation in 1988. From 1991 to 2005 he had various research functions within UBS Investment Bank in Zurich and London relating to equity derivatives, indices, capital flows, and alternative investments, since 2002 in the role of a Managing Director. From 2005 to 2008, he was a Senior Investment Officer with Alternative Investment Solutions, a fund of hedge funds within UBS Global Asset Management. In 2009, he was Head of Industry Research for the hedge fund platform at UBS Global Asset Management.

Alexander is the author of the two publications "In Search of Alpha: Investing in Hedge Funds" (October 2000) and "The Search for Alpha Continues: Do Fund of Hedge Funds Add Value?" (September 2001). These two documents were the most-often printed research publications in the documented history of UBS. He is also author of "Absolute Returns: The Risk and Opportunities of Hedge Fund Investing" (Wiley Finance, October 2002) and "Asymmetric Returns: The Future of Active Asset Management" (Wiley Finance, November 2006). Alexander has also written several research pieces pertaining to equity derivatives and hedge funds including AIMA's Roadmap to Hedge Funds (2008 and 2012), which has been translated into Chinese and was the most-often downloaded document from their website at the time.

Alexander holds a Bachelor of Science in Business Administration with Major in General Management from the University of Applied Sciences in Business Administration Zürich (HWZ) in Switzerland. Alexander also holds the Chartered Financial Analyst (CFA) and Chartered Alternative Investment Analyst (CAIA) designations and is a certified Financial Risk Manager (FRM). He is on the Board of Directors of the CAIA Association and is a member of the AIMA Research Committee.

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