Return Dispersion, Counterintuitive Correlation:

The Role of Diversification in CTA Portfolios

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INTRODUCTION

2014 is the year that has been proclaimed the return of trend. As divergence spread across financial markets, commodity trading advisors ("CTAs") were poised to capture momentum's rewards. Despite this, the range in performance across CTAs was remarkable. Performance ranged from less than 0% to over 100%. Because most large trend following managers maintain a high correlation with each other, investors are left wondering why managers they perceived as similar could perform so drastically differently in such an important moment for the strategy.

This paper returns to the basic tenets of portfolio theory for equity portfolios to examine the origin of return dispersion and cross-manager correlation for CTAs. Similar to how idiosyncratic risks in stocks are reduced by diversification in equity portfolios, the idiosyncratic differences in signal construction, parameter selection, and risk management are reduced by diversification in CTA portfolios. A closer look at performance and return dispersion demonstrates that CTA strategies have more return dispersion on the upside. Despite the high inter-manager correlation in the CTA space, during moments when there are opportunities in momentum, subtle differences in CTA strategy construction seem to matter. This explains why correlation to momentum is easy to replicate while replicating performance in momentum remains somewhat more elusive. CTA diversification is best demonstrated on the upside.

IDIOSYNCRATIC SYSTEMATIC: PORTFOLIO THEORY REVISITED

Behavioral psychologists, sociologists, ecologists, and evolutionary biologists all understand the diversification heuristic and our natural interest in variety. Why do we diversify? – To increase our chances of survival as spreading risk allows us to reduce risks. Turning to portfolio theory, there are both idiosyncratic (diversifiable, those we are not paid for taking) and systematic risks (undiversifiable, those we receive a risk premium for taking). Individual stocks can be quite volatile, but as more stocks are added to a portfolio, idiosyncratic risk can be reduced via diversification. The risk which remains is systematic risk. For equities, systematic risk is derived from a common equity "market" factor. This classic relationship is plotted in Figure 1. Due to an exposure to a common equity factor, a diversified basket of stocks should provide a risk premium (i.e. the "equity risk premium") over time.

Figure 1

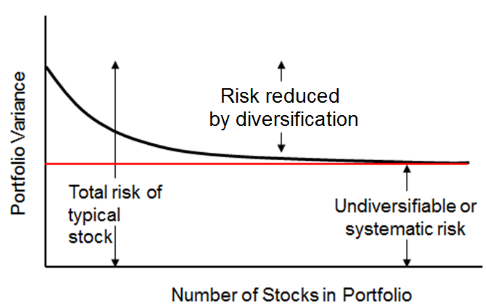

Figure 1: Portfolio Diversification Schematic.

If a long-only investment in equities provides a risk premium, how is this premium realized and how difficult is it to capture? Is there substantial variation (return dispersion)? Consider an equity universe of 1000 liquid US stocks.[1] Figure 2 plots return dispersion against the average return from 1980-2014. Over this time period, there tends to be larger variation in individual stock returns during times when the overall market is either going up or down strongly.

Figure 2

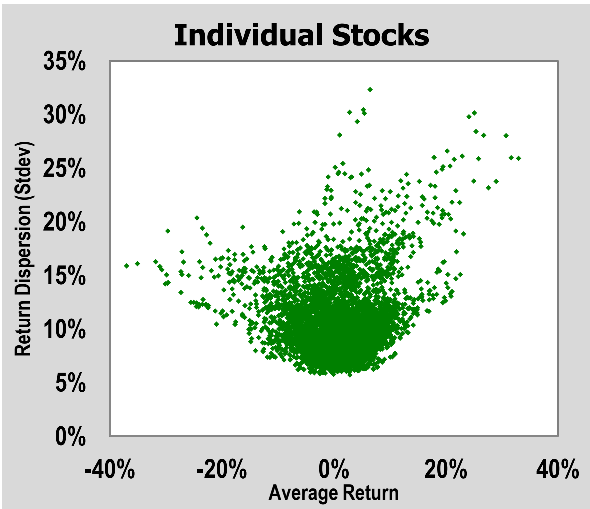

Figure 3

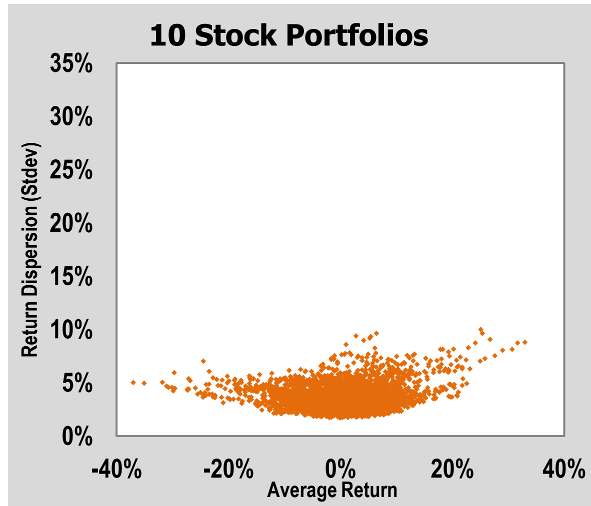

Figure 2: (lhs) Individual stock return dispersion (21-day standard deviation across all 1000 stocks at each point in time) vs. average return (21-day rolling percentage return averaged across all 1000 stocks at each point in time).

Figure 3: (rhs) 10-stock portfolio return dispersion (21-day standard deviation across all 100 (10 stock) portfolios at each point in time) vs. average return (21-day sample rolling percentage return averaged across all 100 (10 stock) portfolios at each point in time). Data from 1980-2014. Source: Bloomberg, Campbell.

Would diversification have been beneficial during the extreme market scenarios? Following the same approach as in Figure 2, the 1000 stock universe can be partitioned into 100 unique portfolios each with 10 stocks.[2] Figure 3 plots return dispersion for 10-stock portfolios against the average portfolio return. When compared with Figure 2, return dispersion decreases substantially from around 25% to 8%. However, despite the overall decrease in idiosyncratic risk, larger return dispersion still remains for both large positive and negative market movements.

CTAs primarily seek to capture a momentum premium.[3] Just as with equities, the same questions are also relevant. How is the momentum premium realized over time? Is there substantial variation in how it is captured? The earlier analogy with individual stocks can be extended to CTA portfolios. One individual trend following strategy based on one signal is conceptually similar to one stock. The strategy roughly

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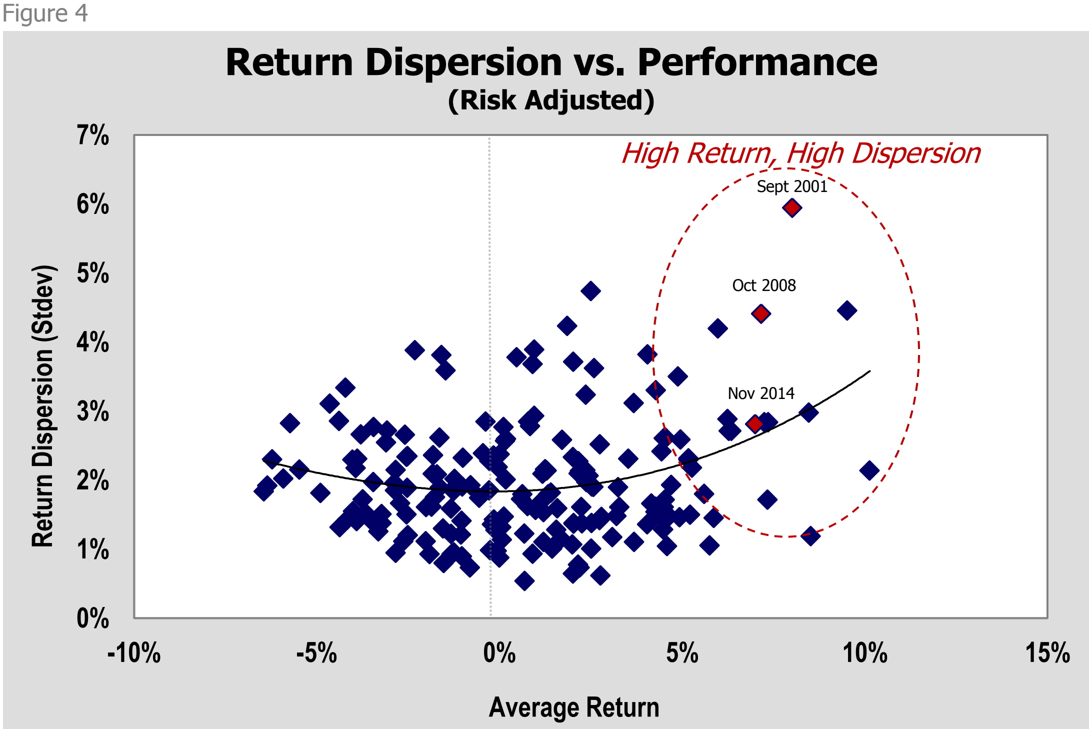
1 Liquidity is defined by dollar volume. The universe is re-evaluated at the beginning of each calendar year.

2 Each of the 100 (10 stock) portfolios includes 10 stocks which are approximately liquidity matched (based on dollar volumes).

3 The predominant strategy in Managed Futures is trend following. Moskowitz, Ooi, and Pedersen (2012) document the presence of time series momentum. Classic discussions of momentum (beginning with Jegadeesh and Titman 1993) discuss cross-sectional momentum which is momentum in the cross section of one asset class. Time series momentum is momentum across asset classes over time where the cross section is the space of all aggregate asset classes, using futures contracts (stock indices, commodities, metals, fixed income, short rates and currencies). Other return premiums in the CTA space can be driven by dislocation from no-arbitrage relationships (See Pasquariello 2014), carry strategies, hedging premiums, and other futures based strategies.

captures momentum, but it contains substantial idiosyncratic effects due to individual parameter choices. Similar to building portfolios of stocks, CTA portfolios are collections of strategies, largely capturing time-varying momentum. To examine how these returns are captured over time, return dispersion (or cross-sectional variation in performance across CTA portfolios) can be compared with the average performance. Using monthly returns from managers in the Newedge Trend Index, Figure 4 plots return dispersion (cross-sectional standard deviation) versus the average return from 2000-2014. CTA portfolios capture returns with substantial variation and this variation is more pronounced during periods when momentum strategies are performing strongly.[4] Put more simply, key moments for CTA performance are also moments when the range in performance across managers varies the most. Drawing once again from the stock analogy, CTAs can be viewed as being exposed to a common "momentum" factor. During extreme returns for this factor (especially on the upside), different managers will have different exposures to this factor.[5] Put in another light, when CTAs perform their best they tend to be the most different from one another.

Figure 4



When CTAs perform their best they are the MOST different from one another.

Figure 4: Return dispersion (standard deviation across managers in the Newedge Trend index) vs. average return (sample average across managers in the Newedge Trend index) from 2000-2014. Performance data is used for 7 of 10 Newedge Trend Index constituents due to data availability. All returns are risk adjusted to 4 percent monthly. Source: Stark & Company.

4 A simple example illustrating the relationship between momentum opportunities and return dispersion is detailed in the appendix.

5 Greyserman, Kaminski, Lo, and Yan (2013) derive a style framework for comparing trend following CTAs including a baseline strategy, market size factor, equity bias factor, and trading speed factor. They propose a structure similar to Fama and French (1993). Their model explains that differences in performance over time can be derived from different construction styles across CTAs. Their model puts forth a quantitative framework to explain return dispersion in CTAs. This method is also outlined in Chapter 12-13 of Greyserman and Kaminski (2014).

COUNTERINTUITIVE CORRELATION

Correlation is an important measure for understanding portfolio diversification, but it doesn't always tell the entire story. High inter-strategy correlations in the CTA space are often interpreted as all CTAs being the same. In theory, just as a long-only equity portfolio is a basket of individual stocks, a CTA portfolio is a basket of strategies applied across futures markets to capture momentum premiums.[6] The average correlation across CTA managers is akin to comparing baskets of stocks with other baskets of stocks. Correlation between baskets of stocks increases with the number of stocks in a basket. For demonstrative purposes, Figure 5 plots the cross-portfolio correlation (average pairwise correlation) between stock portfolios of various sizes (1 to 500 stocks) from 1980-2014.[7] It is clear from this figure that as the diversification in these portfolios increases the correlation across portfolios increases in step.

Figure 5

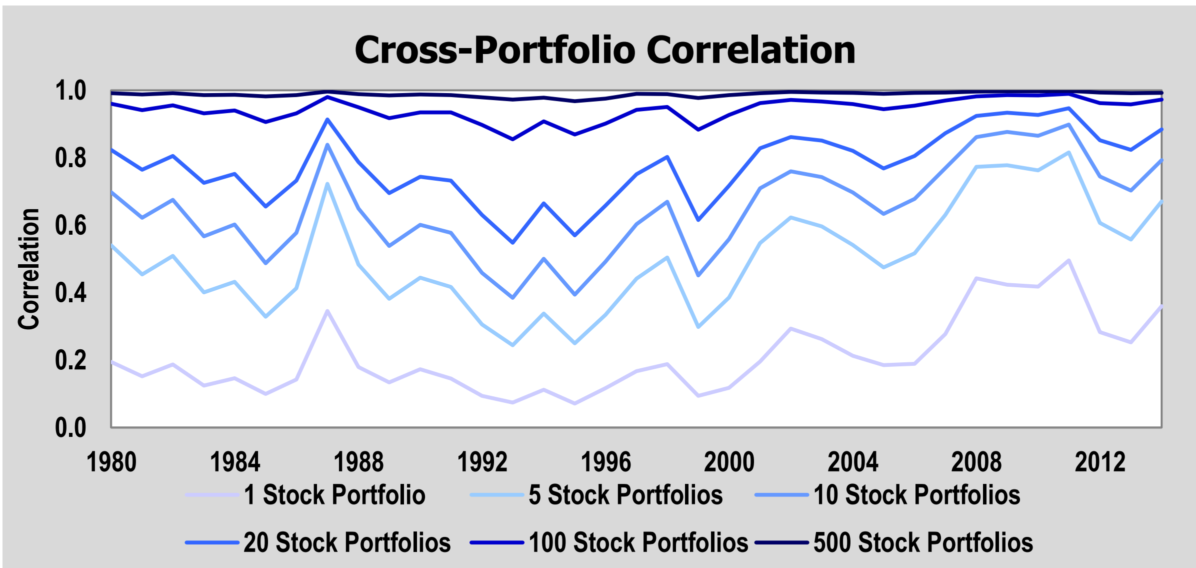


Figure 5: Cross-portfolio correlation (average pairwise correlation) for equal weighted stock portfolios from size 1 to 500. The universe of stocks includes the 1000 most liquid stocks per year from 1980-2014. Source: Bloomberg, Campbell.

The same conclusions are also true for CTAs. For any basket of CTA strategies (or a CTA portfolio), as more strategies are introduced into a portfolio, the level of diversification and the amount of cross-portfolio correlation should be expected to increase. The relationship between managers can be examined in two ways. The first way is to measure rolling average pair-wise correlation. This approach examines the relationships between portfolios over a certain time horizon. Second, the level of return dispersion across managers can be used to estimate implied correlation for each individual month (or the implied point in time estimate of relationships between portfolios).[8] When return dispersion is high (low), this would imply that managers are less (more) similar to one another. Using the managers in the Newedge Trend Index, Figure 6 plots cross-portfolio correlation (rolling twelve month average pairwise

6 For CTA strategies which include non-trend strategies this includes other premiums as well. For example, carry strategies, mean reversion, relative value, fundamental value, macro effects, etc.

7 Similar to Figure 3, each portfolio is approximately liquidity-matched and the portfolios do not have overlapping constituents. Each portfolio is selected with n stocks from the 1000 names resulting in a sample of $1000/n$ portfolios for $n = 1,5,10,20,100,500$.

8 To estimate implied correlation, all portfolios must be assumed to have the same Sharpe ratio. Given this assumption, there is an implied correlation which can explain the total return dispersion in the cross section at each period in time. This estimate allows for point-in-time estimates of correlation using cross-sectional return dispersion. Chapter 11 in Greyserman and Kaminski (2014) details a two-asset characterization of this relationship. This paper utilizes the corresponding (n)-dimensional characterization.

correlation) and implied correlation (point estimates and twelve month smoothed point estimates).[9] The managers in this set are large and highly diversified, and they tend to focus on trend following strategies. For this set of managers, average pair-wise correlation fluctuates around 70% and is time-varying. This measure can indicate a relatively high degree of similarity between CTAs (consistent with 10 or 20 stock portfolios). Implied correlation tells a markedly different story. The smoothed version of implied correlation is roughly similar to average pairwise correlation, but point estimates for implied correlation demonstrate periods of severe correlation breakdown between CTAs. This observation suggests that most of the time these managers are similar but during certain moments appear to be drastically different. In a world focused on month to month performance, the actual investor experience may be better represented by the red line (monthly implied correlation) as opposed to black or gray lines (rolling pairwise correlation and smoothed implied correlation). Figure 7 plots the conditional performance for 7 CTA managers during extreme correlation breakdowns (negative implied correlation) and in normal times (positive implied correlation). Subtle differences in CTA strategy construction have the largest impact during extreme correlation breakdowns.

Subtle differences in CTA strategy construction have the largest impact during extreme correlation breakdowns.

Figure 6

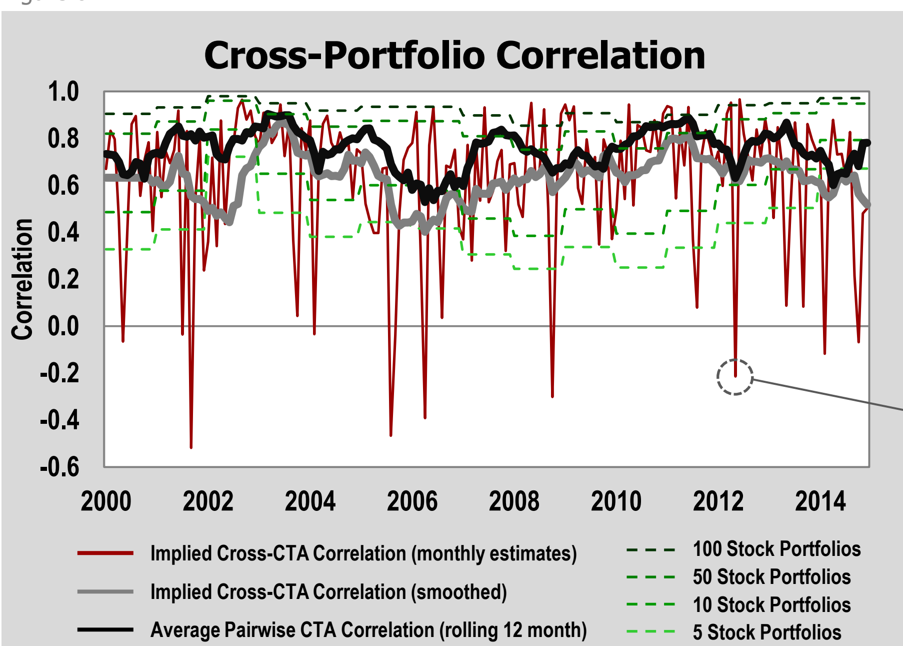


Figure 7

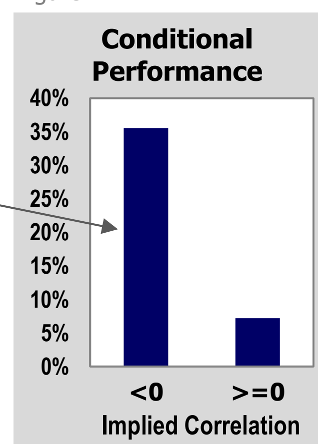


Figure 6: Cross-portfolio correlation: implied correlation (monthly estimates, inferred by return dispersion), smoothed implied correlation (12 month rolling), and average pairwise CTA correlation (rolling 12 month). The CTA universe is 7 managers in the Newedge Trend Index (selected based on data availability). Cross-portfolio correlation for stock portfolios from Figure 5 is plotted for comparison. Source: Bloomberg, Campbell, Stark & Company.

Figure 7: Conditional performance (annualized average return) for time periods when implied correlation is negative or positive. The data set includes 7 large CTAs from the Newedge Trend Index. Source: Stark & Company.

PORTFOLIO IMPLICATIONS

Through the efficient use of index products, most equity investors can select portfolios roughly the same size as the S&P500. A 500 stock portfolio has cross correlation with other 500 stock portfolios greater than 99%. Even a 100 stock portfolio has cross correlation with other 100 stock portfolios at roughly

[9] The implied correlation estimates are implied by the cross-sectional standard deviation across managers in the Newedge Trend Index. For this Figure, 7 Large CTAs were used due to data availability.

95%. If CTA managers have an average cross-manager correlation of 70% under some simple assumptions, roughly 7-8 CTA managers would be required to create a portfolio with the same level of diversification as an equity index.[10] There are currently 10 managers in the Newedge Trend index. The 70% cross correlation between managers in the CTA space is often interpreted as a high level of similarity between managers. This correlation measure may cause investors to under-diversify, something which will be more noticeable during months with large positive returns.

When performance is very high, return dispersion tends to be high for CTAs. This implies a breakdown in correlation between managers.[11] Intuitively this suggests that under normal scenarios with moderate opportunities for CTAs, subtle differences in system construction, parameter selection, and risk management seem to be less important. A closer look at implied correlation (as seen in Figure 6) demonstrates that when there are opportunities for momentum strategies, the subtle differences between systems seem to become important. This leads naturally to two follow-up questions: Which managers perform the best during these periods? And is this predictable? Considering the same universe of CTAs, Figure 8 plots the risk adjusted performance of these 7 CTAs during the periods where CTA correlation seems to break down.[12] Despite being similar in aggregate pairwise correlation, performance across these highly correlated CTAs is markedly dissimilar during these moments. This figure demonstrates why understanding CTA correlation may be somewhat counterintuitive. High pair-wise correlations may underestimate the importance of diversification in CTA portfolios, leaving portfolios undiversified in critical moments for performance.

Figure 8

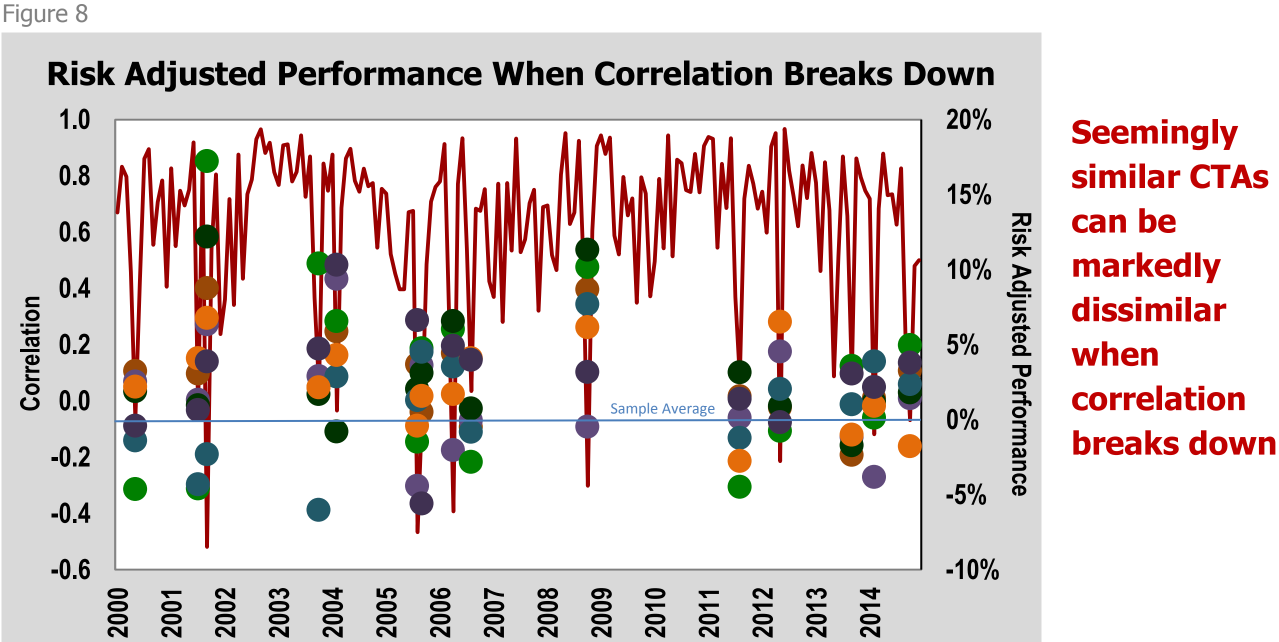


Figure 8: Implied correlation (derived from return dispersion across 7 large CTA managers in the Newedge Trend index). Risk adjusted performance (rhs) for each of the 7 CTAs is plotted for the periods with correlation breakdown. Correlation breakdown is defined as implied correlation dropping below 30%. Source: Bloomberg, Campbell, Stark & Company.

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[10] For a portfolio with N assets with stable correlation (ρ), the portfolio correlation (ρ_P) for an equal volatility weighted portfolio is $\rho_P = \rho N/(\rho(N-1)+1)$. For the average large CTA is $\rho = 0.7$, to get a portfolio with a cross correlation of 0.95, N must be roughly 7-8 CTAs.

[11] Similar to equity portfolios, differences in manager performance could be explained by different beta exposures to momentum and other factors.

[12] 7 CTAs are used due to their return series spanning the entire time horizon.

SUMMARY AND CONCLUSIONS

Using classic parallels to portfolio theory for stock portfolios, this paper examines return dispersion and cross-manager correlation for CTA strategies. There are two main conclusions of this study. First, consistent with results for stock portfolios, diversification has clear benefits in the CTA space. Better diversification improves the capture of return premiums for CTA strategies. Second, cross-manager correlation in the CTA space may be high, but this correlation seems to be weaker when there are opportunities for momentum. This suggests that CTA diversification may be best demonstrated on the upside.

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APPENDIX

Trend following strategies are designed to systematically capture momentum in market prices. These strategies use a set of parameters to determine the trend and take positions. Each set of parameters determines one strategy and the performance of these strategies will vary based on the type of trend in question. To demonstrate how return dispersion may be high when price behavior deviates from a random walk, a simple example is presented. This example mirrors a shock to a particular market which is temporary, yet measurable. Figure A.1 presents three different hypothetical price series: a pure trend (which does not exist), a clear trend (which is desirable for systematic trading strategies) and a noisy trend (which is less desirable for systematic trading strategies).

Figure A.1

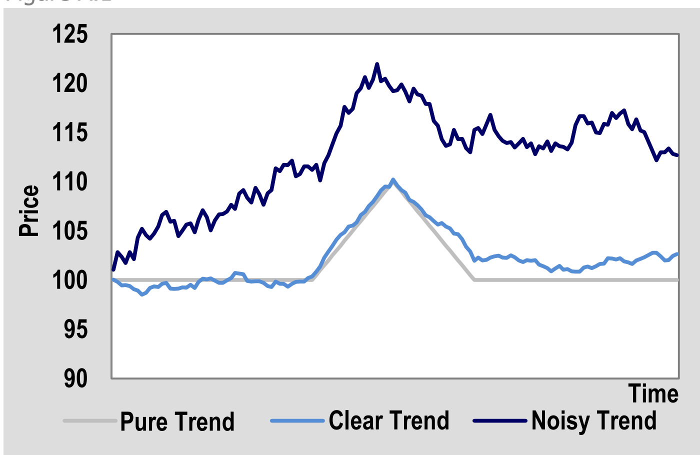

Figure A.1 Three hypothetical price series: a clean trend, a clear trend and a noisy trend. Source: Campbell.

Consider 10 simple trend following systems based on simple moving average crossover pairs. These strategies buy when the short moving average is above the longer term moving average and vice versa. For the case of the clear trend (an opportunity to capture momentum), overall the general performance for all strategies is very positive (ranging from very positive to flat). Despite positive average performance, return dispersion is very high. In this simple case, clearly the idiosyncratic differences in parameter selection create huge differences in performance. For the noisy trend, most strategies perform moderately well but in a tighter band (lower return dispersion). When momentum is strong (clear trend), diversification across strategies would provide a decent return of around 9%. One individual strategy would range from 0 to 18%. This simple example demonstrates why diversification across parameter choices, risk management techniques, and models is so important for capturing momentum.

Figure A.2

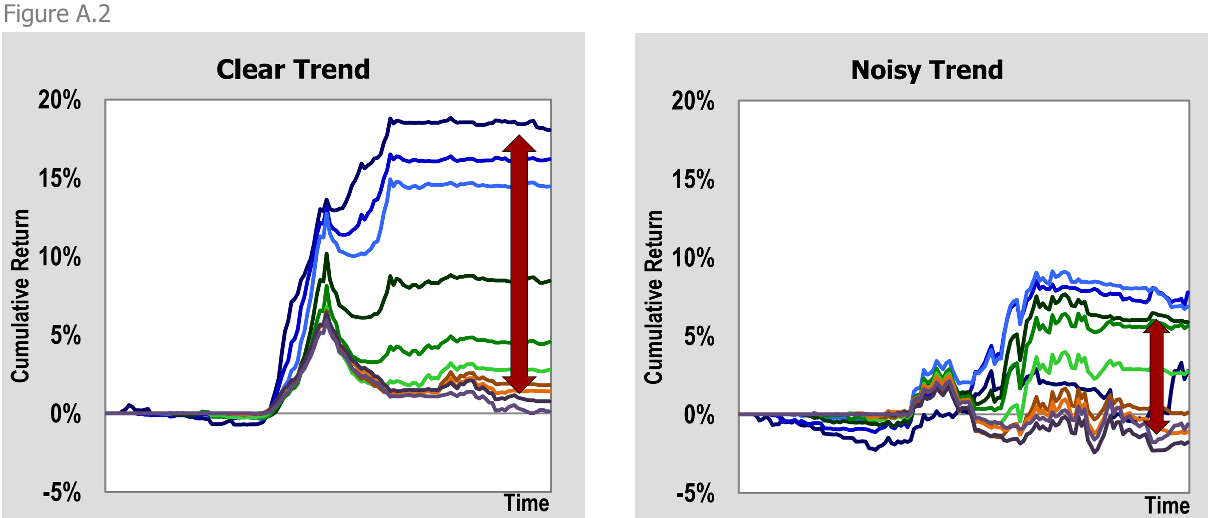

Figure A.2 Clear Trend (lhs) and Noisy Trend (rhs) cumulative performance for 10 moving average crossover trend following strategies. Price series are based on hypothetical data and parameter selection for the moving average strategies are set over a range of reasonable parameters. Source: Campbell.

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