AlternativeEdge® Note
ALTERNATIVE INVESTMENT SOLUTIONS

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Capacity of the managed futures industry

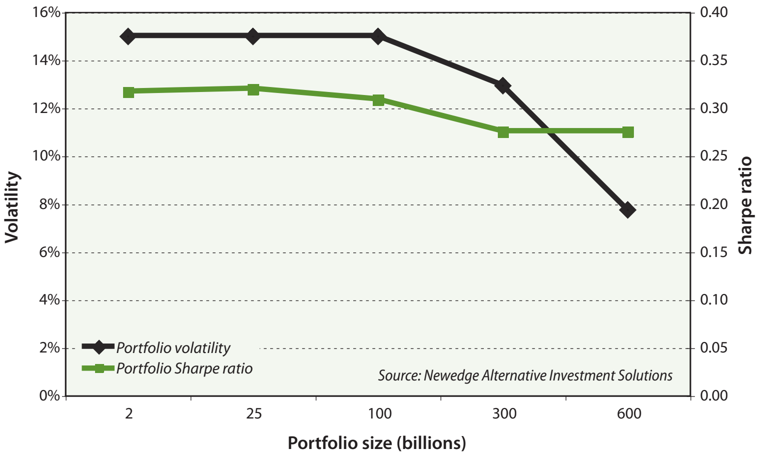
Our purpose in writing *Managed Futures for Institutional Investors* in 2011 was to help clear the way for the possibility of doubling the size of the industry. While ambitious, the goal seems well within reach. Since then, the industry has grown somewhat and now manages roughly $330 billion. At the same time, the industry finds itself in a drawdown that is, by the industry's standards, relatively deep and relatively long. The current drawdown at this writing is two years long. And at its worst (so far), the drawdown was -9.3%.

The growth in assets combined with the current drawdown has prompted investors to ask three related questions. What is the industry's capacity to deliver uncorrelated returns with a reasonably high Sharpe ratio? How large can an individual manager be? And, a truly interesting question for a large institutional investor, how large an investor can I be?

This note mainly addresses the first question, although the framework we work with allows one to think about the second two questions as well. To do this, we explore the position sizes that an industry dominated by trend following would require to meet a return volatility of 15% and compare them with open interest in a wide range of markets.

Probably the most useful insight gleaned from this exercise is that if open interest constrains the industry's positions, we can conclude that the first thing to suffer from growth in assets under management would be the industry's Sharpe ratio. But, as shown in Exhibit 1, the degradation of the industry's Sharpe ratio would bottom out once maximum position sizes had been reached in all tradable markets. At this point, increases in the size of industry would serve only to dilute the industry's returns and, as a result, its return volatilities. Every dollar added to the denominator of the industry's return calculation, with no increase in the returns that constitute the numerator, simply spreads the industry's returns over a broader asset base.

Exhibit 1
Performance of trend following portfolios



The work described here is meant to be a framework for thinking about the problem of capacity. The final product should be useful in a number of ways.

- We illustrate the fluid and complex structure of open interest in futures markets. We discuss the relatively large importance of over-the-counter currency trading for CTAs.
- We describe the kind of portfolio that a typical trend following CTA would build given volatility and diversification targets that are within reasonable bounds for the industry.
- We reveal the likely stress points for the industry and identify those markets that are more likely to constrain the industry than others. We also explore the way a large and growing CTA would deal with capacity constraints by reallocating risk to less constrained markets.

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We conclude with a discussion of three points that we think would mitigate concerns about capacity constraints. These are:

- The relatively small role that futures play in the markets they represent. Equity and government futures represent roughly 2% of their broadly defined underlying cash markets, and even within the commodity sector, the markets for crude oil, natural gas, corn, soybeans, and gold are all highly liquid.
- The industry's current drawdown, when viewed through an excess return lens, is nowhere near as bad as it appears when viewed through a total return lens. We see no evidence that the CTA model is in any way broken.
- Futures markets are generally very liquid and likely would have no trouble accommodating a much larger industry's positions or the trading that would accompany changes in market direction.

The single medium-term trend following manager approach

For the purposes of this discussion, we will assume that the entire industry can be treated as if it were a single manager who employs a medium trend following model – in particular, the Newedge Trend Indicator model – that uses a single set of look-back parameters over a broad set of markets and that is always in the market.[1] Using a slightly modified version of this model, we can calculate hypothetical position sizes for the industry at various levels of assets under management, compare them with the sizes of the various futures markets, and consider how the model's performance characteristics would decay if its position sizes are constrained by open interest in those markets.

The main argument for such an approach is that the industry is dominated by trend following – much of which can be described as medium-term to long-term trend following. Trend following returns are the dominant signal in any index of CTA returns. Perhaps the single greatest strength of the Newedge Trend Indicator model – or any similar medium-term trend following model that trades a wide range of markets – is that it allows us to approximate the sizes of the positions that trend following CTAs take in various markets. Thus, even though trend followers tend to enter and exit markets at different times, at some point, most successful trend followers' positions sizes and market directions will overlap much of the time. And at these times, the approximations afforded by the Trend Indicator will allow us to glean insights into where the stress points might be.

The arguments against such an approach are several.

- First, it is overly simplistic. The industry comprises thousands of managers who employ a complex variety of trading strategies. Even within the trend following subset of managers, the models vary in complexity and subtlety.
- Second, it both overstates and understates the amount of money that is committed to trend following. Within the managed futures industry, it overstates the influence of trend following. But in the world at large, it is impossible to know how much it understates the financial industry's use of trend following trading strategies. Because trend following is relatively easy to implement, one finds the strategy embedded in the trading portfolios of pension funds, banks, hedge funds, and dealers all over the world.
- Third, it assumes a static world in which nothing changes as the industry grows – the size of the futures market, the industry's trading practices, or the volatility of the markets traded.

Even so, as we have been reminded many times, if one doesn't assume something, one cannot even begin to answer questions about the industry's capacity. In fact, the assumption that underpins this discussion is hardly the worst and has the redeeming virtue of allowing us to learn something useful

1 A description of the Newedge Trend Indicator model can be found in *Two benchmarks for momentum trading*, which is Chapter 5 in Burghardt and Walls, *Managed Futures for Institutional Investors* (Bloomberg Press, 2011).

about how the industry's growth may influence its risk-adjusted returns and return volatilities. For that matter, a simple model allows you to get some insight into a more complex problem. The Universe may not be one sun and one planet, and they may not be point masses, but this simple model can give you a great deal of insight into the more complex Universe.

A broadly diversified trend following portfolio

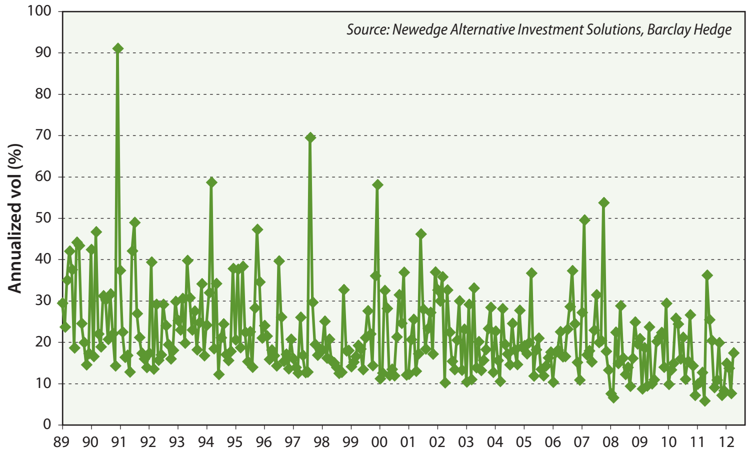
The key elements of any trend following model are the markets that it trades, the momentum rules that it employs to trade those markets, the risk that it allocates to each market, and the overall risk that the portfolio strives to achieve. For the purposes of this work, we use the same 55 markets that are used in the construction of the Newedge Trend Indicator. This is a broad and representative set of markets that cover currencies, interest rates, equities, and commodities.

We also use the same momentum rule – a 20-day/120-day moving average model – that we use for the Trend Indicator. Our choice of this model is described at length in *Two benchmarks for momentum trading*, but in a nutshell, we chose it because it seemed to produce returns that were well and robustly correlated with the returns of CTAs who would both describe themselves and be recognized by investors as trend followers. As for risk allocation across sectors, we also use the allocations used by the Trend Indicator, which are:

- Interest rates 30%
- Currencies 30%
- Equities 15%
- Commodities 25%

And within these sectors, we strive to allocate equal amounts of risk to each market traded within a sector. Our experience suggests that these allocations vary widely across trend following CTAs, but that the set we have chosen yield portfolio returns that are reasonably well correlated with trend followers' returns.

Exhibit 2
Volatility history for trend following CTAs



The last piece of the puzzle is the overall risk target, for which we have chosen a 15% annualized return volatility. As shown in Exhibit 2, such a target falls roughly in the middle of the range of return volatilities that trend followers have delivered for the past decade or so.

To finish the job of constructing the portfolio, we chose a notional portfolio size of $2 billion and used the estimated 2012 covariance matrix for the model returns of the 55 markets for evaluating risk. The resulting portfolio of futures contracts is shown in Exhibit 3. In this portfolio, we have assigned nearly equal risk – measured in dollar standard deviations of gains and losses – to each market within each sector. Taken together, the standard deviation of dollar gains and losses should, when divided by $2 billion, produce an annualized portfolio return volatility of 15%.

Before leaving this section, we should note that the position sizes shown in Exhibit 3 are the product of two kinds of volatilities. One, of course, is the portfolio's volatility target of 15%. The other, though, is the expected volatilities of the 55 markets traded. The portfolio shown here is based on 2012 market volatilities, which were relatively low when compared with many earlier years. One consequence of an increase in market volatility would be a decrease in overall position sizes to maintain a target volatility of 15%.

Exhibit 3

Market selection and portfolio weights

Sector		Market	Annual $ Volatility per Contract	Number of Contracts	Annual $ Volatility	Annual Sector Volatility ($)
Commodity	1	Soybean Oil	6,170	3,000	18,509,671	
	2	Corn	9,683	1,912	18,514,029	
	3	Cocoa	7,299	2,536	18,510,577	
	4	Crude Oil	23,362	792	18,502,324	
	5	Cotton #2	10,338	1,791	18,516,008	
	6	Gold	26,648	695	18,520,024	
	7	Copper	19,429	953	18,515,597	
	8	Heating Oil	24,620	752	18,513,979	
	9	Coffee	20,115	920	18,506,115	117,478,423
	10	Live Cattle	5,885	3,145	18,509,173	
	11	Lean Hog	6,207	2,982	18,509,767	
	12	Natural Gas	13,459	1,375	18,506,581	
	13	Soybeans	17,108	1,082	18,510,680	
	14	Sugar #11	6,063	3,053	18,510,458	
	15	Silver	47,175	392	18,492,675	
	16	Wheat	11,918	1,553	18,508,744	
	17	RBOB	26,825	690	18,509,386	
Equity	18	CAC 40	8,534	786	6,707,764	
	19	DJIA Mini	7,727	868	6,706,936	
	20	S&P 500 E-mini	9,074	739	6,705,357	
	21	DAX	38,740	173	6,702,102	
	22	Hang Seng	23,092	290	6,696,662	
	23	IBEX 35	25,315	265	6,708,421	
	24	KOSPI	19,077	351	6,696,146	
	25	Nikkei 225	18,501	362	6,697,430	70,473,141
	26	NASDAQ 100 Mini	8,139	824	6,706,760	
	27	Swedish OMX	2,959	2,266	6,705,773	
	28	Russell 2000 Mini	13,896	482	6,698,021	
	29	MIB	25,599	262	6,706,940	
	30	Euro STOXX 50	5,989	1,119	6,701,946	
	31	SPI 200	13,193	508	6,702,166	
	32	FTSE 100	12,247	547	6,699,001	
Foreign Currency	33	Australia Dollar	9,488	3,108	29,489,866	
	34	British Pound	6,244	4,722	29,484,910	
	35	Canadian Dollar	6,416	4,595	29,483,157	
	36	Euro	13,421	2,197	29,485,436	140,985,869
	37	Japanese Yen	11,720	2,516	29,488,368	
	38	New Zealand $	8,209	3,592	29,487,885	
	39	Mexican Peso	3,889	7,582	29,485,372	
	40	Swiss Franc	11,032	2,673	29,488,874	
Interest Rate	41	German 2-Y SCHATZ	963	20,764	19,988,564	
	42	US 3-M Eurodollar	469	42,602	19,988,559	
	43	Euro 3-M Euribor	923	21,654	19,988,263	
	44	US 5 Year	2,639	7,575	19,989,096	
	45	UK 10 Year Gilt	12,682	1,576	19,987,218	
	46	Australian 3 Month	1,875	10,662	19,989,336	
	47	Japan 10-Y JGB	30,346	659	19,998,268	
	48	UK Short Sterling	768	26,021	19,988,607	140,987,233
	49	German 5-Y BOBL	5,093	3,925	19,989,008	
	50	German 10-Y BUND	11,332	1,764	19,989,053	
	51	US 2 Year	832	24,027	19,988,354	
	52	US 10 Year	5,679	3,520	19,988,537	
	53	US 30 Year	13,114	1,524	19,986,286	
	54	Australian 10-Y	12,756	1,567	19,989,370	
	55	Japan 3 Month	196	101,862	19,988,590	

Source: Newedge Alternative Investment Solutions, Bloomberg

Open interest

Open interest in futures markets measures the open long (or short) positions at any given moment and represent, in a sense, the amount of risk that traders – both long and short – choose to take in the form of futures contracts. Before embarking on the work of seeing how CTA returns might be affected by a substantial increase in assets under management, we would like to touch on three matters that merit consideration. These are: (1) the fluid nature of open interest; (2) the varied distributions of open interest across contract months; and (3) the CTA industry's preference for trading currencies in the over-the-counter forward market.

The fluid nature of open interest

In practice, the number of open positions is fluid rather than fixed and varies over time as new positions are taken or old positions are offset and closed out. Unlike a market for equities or bonds, where the total amount of risk that must be taken is determined by the value of equities or bonds outstanding, the amount of risk taken in futures markets – as measured by open interest – is a matter of choice. And any given trade can produce either an increase, decrease, or no change in open interest. For example, if someone who is already long futures buys futures from someone who is already short futures, open interest will increase. If someone who is already long futures sells to someone who is already short futures, open interest will decrease. And if someone who is already long futures sells to someone who is also already long futures, the result will be no change in open interest. [2]

To illustrate this point, we have provided open interest histories for four commodities in Exhibit 4 – one for crude oil, one for British pounds, one for the S&P500, and one for 10-year treasuries. All four have been normalized so that open interest in 1995 is indexed at 1.0.

Notice first that open interest in all four markets has grown substantially over the period shown, although the path taken by 10-year treasury futures has been radically different from the other three. With the exception of the equity futures contract, open interest today is substantially larger than it was ten years ago. It is a bit odd that open interest in equity futures has fallen over the past five years, but as we will find, equity futures markets will prove to be the least constraining in this exercise.

The distribution of open interest across contract months

In government bond, equity index, and currency futures, nearly 100 percent of the open interest will be either in the "lead" contract (i.e., the contract that is about to expire) or in the "first deferred" contract (i.e., that contract that is about to become the lead contract). An example of what the distribution of

2 Perhaps the closest analogy one can find in securities markets is the practice of shorting stocks or bonds. These trades create the appearance of a larger quantity of the security. It is not possible, however, to reduce the apparent supply of a security.

Exhibit 4

Growth of aggregate open interests of futures markets

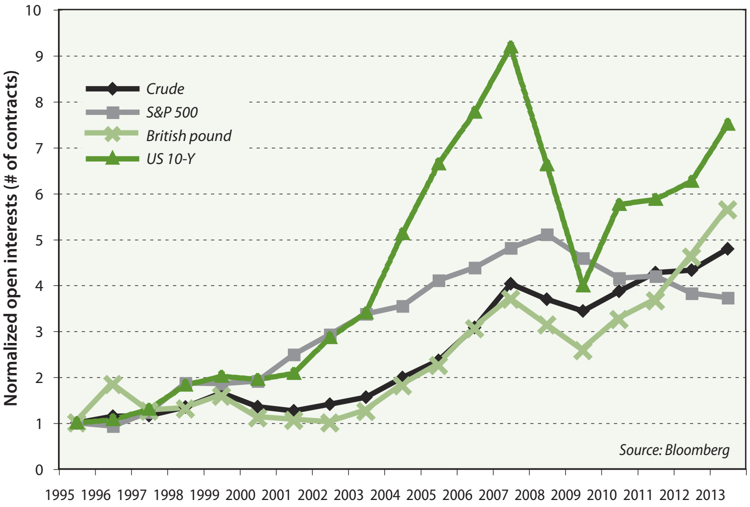


Exhibit 5

Open interests of E-mini S&P futures contracts as of 3/28/2013

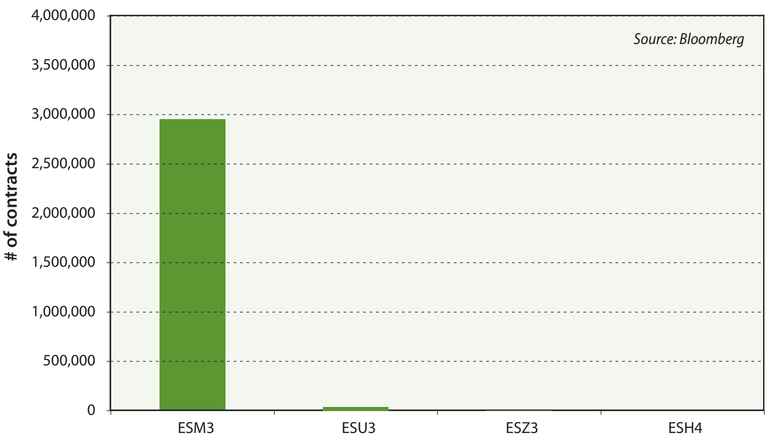
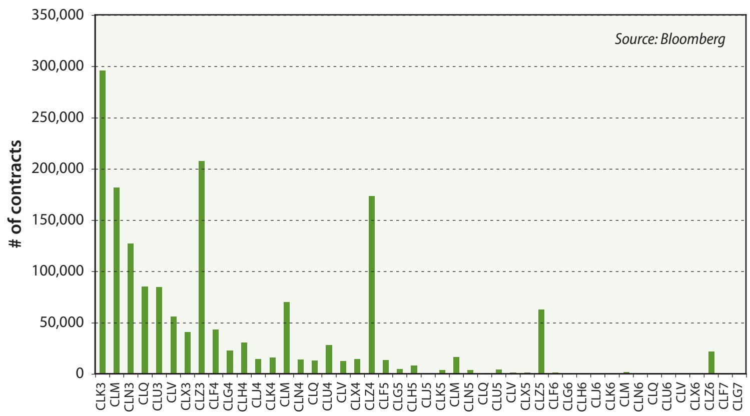


Exhibit 6

Open interests of crude futures contracts as of 3/28/2013



open interest in e-mini S&P500 futures looked like on March 28, 2013, is provided in Exhibit 5. This pattern will hold until market participants want to shift their risk taking to the next most active contract month. In the case of equity index and currency futures, this shift typically takes place in the week before the lead contract expires. In government bond and note futures, the shift depends on the market. In the case of U.S. Treasury futures, the shift takes place during a few days toward the end of the month before the lead contract expires – chiefly because most futures participants want to avoid any possibility of taking delivery of actual bonds. In the European and Asian markets, where delivery rules are different, the shift tends to take place closer to the lead contract's scheduled expiration.

Commodity futures, on the other hand, make much fuller use of deferred contracts. Exhibit 6 provides an example of the distribution of open interest in crude oil futures across contract months. As you can see, there are ample open positions in many of the deferred contracts. And it is apparent that this market concentrates much of its trading in contract months such as December and, to a lesser extent, in June. One also finds a broad distribution of open interest over contract months in money market contracts such as Eurodollar and Euribor futures.

A summary of these patterns is provided in Exhibit 7, which shows the ratio of total open interest to lead contract open interest for the 55 markets traded by the Newedge Trend Indicator. In the work that follows, we use each market's total open interest.

Foreign currency markets

Perhaps the only market in which transaction economics favor over-the-counter trading over futures trading is the currency market. For this reason, the greater part of currency trading done by CTAs is done in the forward market. This raises a practical problem for us because there is no analog for open interest in the over-the-counter market. At least no analog for which there is a useable measure.

To deal with this, rather than trading the currency market as a boundless source of trading positions, we applied the following logic. First, we can compare open interest and trading in the futures market. Exhibit 8 provides average values for 2012. Second, we can compare futures trading with spot and forward trading using a survey that BIS coordinates once every three years. Exhibit 9 shows the April 2010 ratios of over-the-counter spot and forward trading to futures trading for the currency markets in our model portfolio. Then, with these two sources of data, we apply the ratio of open interest to trading volume that we observe for futures to the trading that we observe in the over-the-counter forward market. The result is a synthetic open interest value for over-the-counter currency trading that we can express

Exhibit 7

Distribution of open interest across lead and deferred contracts, 2012

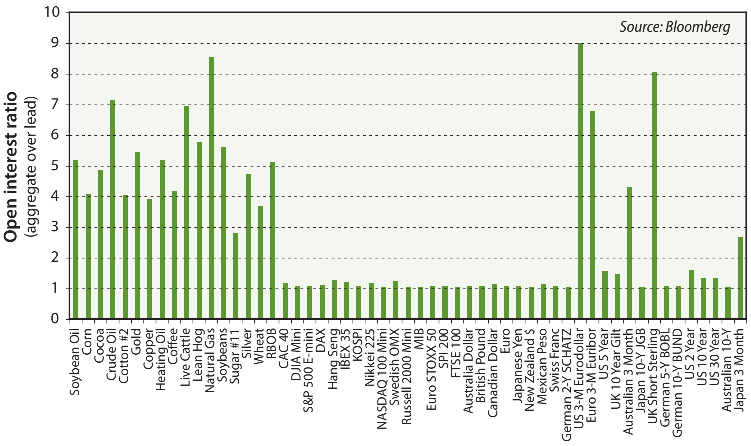


Exhibit 8

Averages of open interests and daily volumes for FX futures markets for 2012

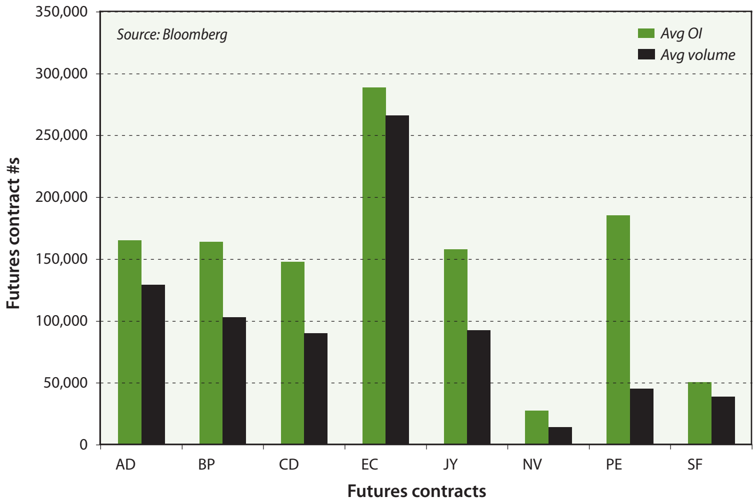
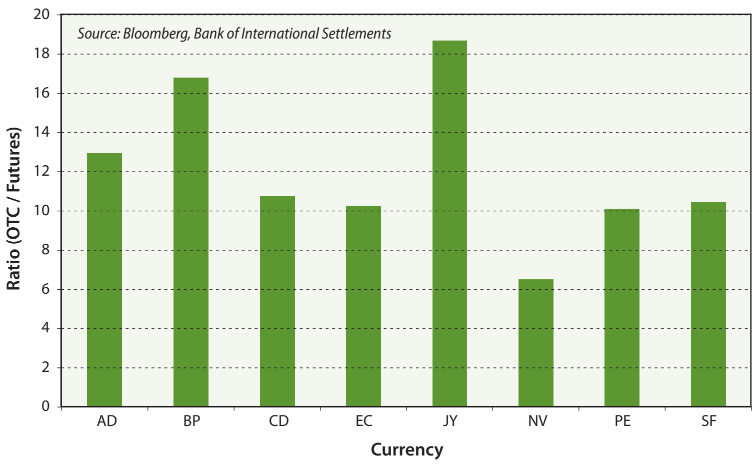


Exhibit 9

Comparison of $ values traded on OTC and Futures markets (BIS April 2010)



in futures contract equivalents. While this is a bit of an approximation, for the purposes of this paper, it seems both reasonable and robust.

Confronting the model with open interest constraints

We are now ready to consider what would happen with the trend following model if it were to confront the open interest constraints developed in the previous section. We want to be clear, though, that we are treating open interest as a constraint solely for the purposes of this exercise. Even so, we think that the lessons of this section are worth considering. First, the exercise shows which markets are more likely to be crowded than others as the industry grows. Second, the exercise traces out the sequence of effects of growth on CTAs' risk-adjusted returns and on their return volatilities.

Consider the sequence of Exhibits 10, 11, and 12. In each case, we have chosen (arbitrarily) to limit the model's share of any one market to 25% of that market's open interest. Exhibit 10 corresponds to assets under management of $100 billion, Exhibit 11 to $200 billion, and Exhibit 12 to $300 billion. In these exhibits, the least constrained markets are on the left, while the most constrained markets are on the right.

Allowing for risk reallocation

Perhaps the most interesting insight to be gained from this work is the CTA industry's likely response to crowding. It is important to know that most, if not all, CTAs strive for two things – a high risk-adjusted return and a target return volatility. Thus, if a CTA reaches what it considers to be the limit of risk it can take in any given market, its most likely response is to allocate any unmet risk to other, less crowded markets, first within the same market sector, second to other market sectors.

Exhibit 10 begins with a $100 billion portfolio and shows the positions taken in each market as the sum of two decisions. The bottom portion of each vertical bar shows how much the model would want to allocate to that market up to the 25% constraint. The top portion of each bar shows much risk the model has reallocated to each market in an effort to maintain the portfolio's risk allocation across sectors and the portfolio's overall risk objective of 15% volatility. In a sense, the markets on the left are the shock absorbers, shouldering any risk that the constrained markets are not allowed to bear. Note that four of the markets are capped out because of risk that has been reallocated to them – the UK gilt contract, Swiss francs, Sugar, and the Australian 10-year note contract.

Exhibit 11 moves to a $200 billion portfolio, for which a greater number of markets are constrained, both outright and because of risk overflow. Even so, there are a number of markets on the left that re-

Exhibit 10

% of total capacity reached with spill-over effect for 100 billion portfolio

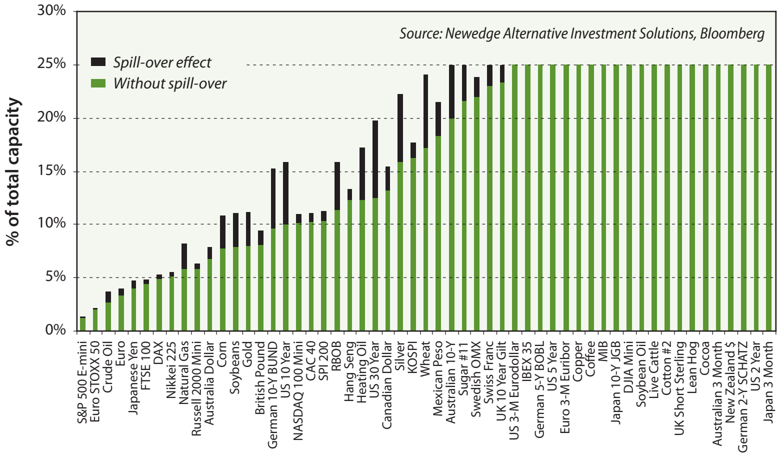


Exhibit 11

% of total capacity reached with spill-over effect for 200 billion portfolio

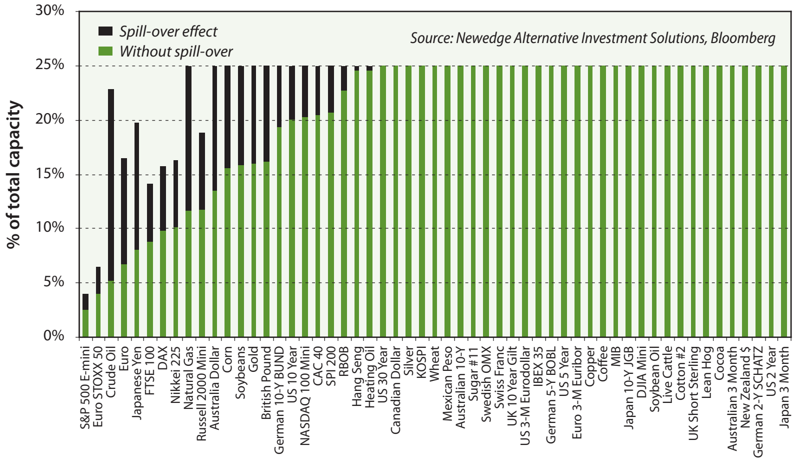
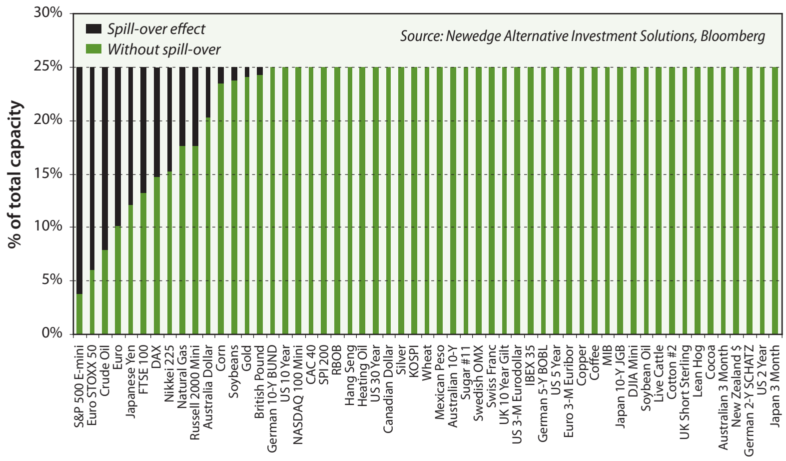


Exhibit 12

% of total capacity reached with spill-over effect for 300 billion portfolio



main unconstrained.

At $300 billion, however, as shown in Exhibit 12, the 25% limit has been reached for all 55 markets, either because the model's position exceeded the limit, or because the model has allocated more risk to the remaining markets than can be accommodated by the market.

At this point, the portfolio has nowhere to turn. Diversification is limited by the size of the market. For that matter, as the position size has grown, the portfolio has gravitated more and more to what would be called a market portfolio.

The progression from relatively unconstrained to fully constrained portfolio is illustrated in slightly different ways in Exhibits 13 and 14. In Exhibit 13, you can follow the fractions of markets within each sector that are capped as the portfolio grows from $2 billion to $300 billion. At $2 billion, which would represent a reasonably large CTA, almost nothing is constrained, while at $25 billion a relatively large fraction of interest rate markets are constrained. By the time we reach $100 billion, some markets in all four sectors are capped. And, as we know from Exhibit 16, once the portfolio reached $300 billion, all markets in all four sectors are capped.

In Exhibit 14, you can see the difference between the portfolio's target weights and the market weights that would result from constraining the portfolio to hold no more than 25% of the open interest in each market. The point of this exhibit is not that the target weights are necessarily the correct ones, but rather than the market portfolio likely is different from the industry's target portfolio. This leads to the question of how the industry's returns and risk would be affected by open interest constraints.

Effects of constraints on returns and volatilities

To follow the effects of increasingly binding constraints on the portfolio's performance, one needs one more assumption in addition to the estimated covariance matrix that we used to construct the trend following model's initial portfolio. That is, we need to assume something about the Sharpe ratio of the returns that the trend following model would produce in each market that it trades. For the purposes of this exercise, we assume simply that the Sharpe ratio for each of the 55 markets – that is, the ratio of excess return to its own volatility – is 0.1. Whether this seems high or low will depend on your own experience with trend following models. And whether one should assume the same value for every market is arguable as well. But for now, it's our assumption and we're sticking with it. In any case, the purpose of this exercise is to shed light on the way increases in the size of the industry would play out in terms

Exhibit 13

Fraction of markets capped within a sector

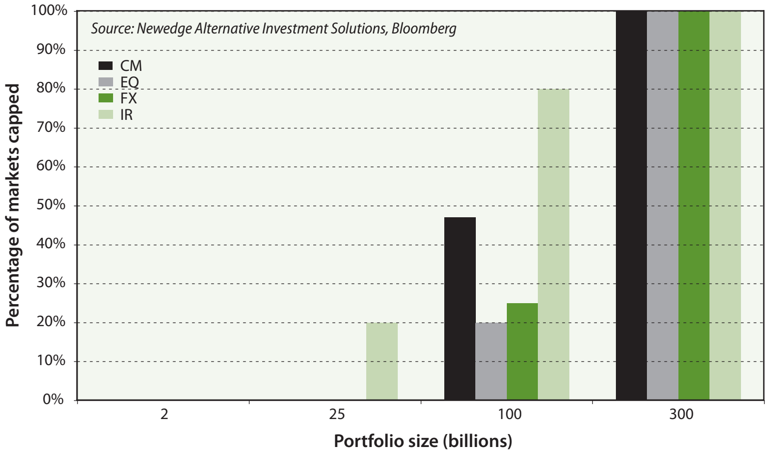
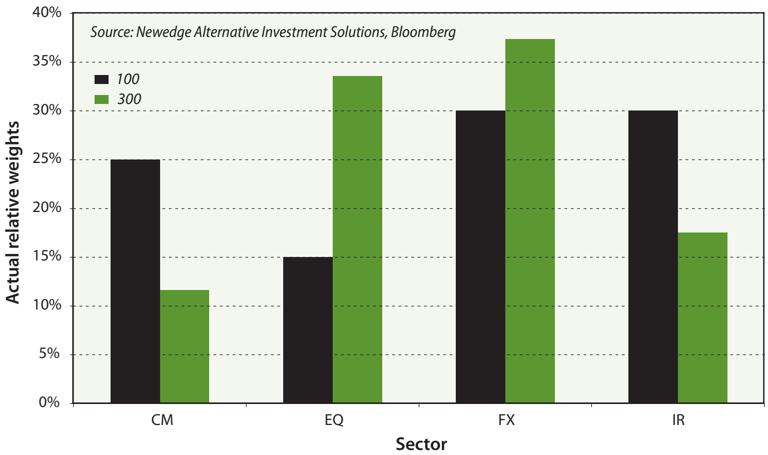


Exhibit 14

Actual sector relative weights for 100 and 300 billion portfolios



of risks and returns.

Using this assumption, we find in Exhibit 15 (a reproduction of Exhibit 1) that the fully unconstrained portfolio would produce a Sharpe ratio of 0.32. At $25 billion, the Sharpe ratio is still 0.32, mainly because the constraints that this portfolio faces do not do serious damage to diversification. By the time the portfolio reaches $100 billion, however, the constraints are more binding and diversification does in fact begin to suffer. The loss in Sharpe ratio is not great – the Sharpe ratio is now 0.31 – but the consequences are beginning to be noticeable. At $300 billion, where the model is now maxed out in every market, the Sharpe ratio has fallen to 0.28, which is what the market portfolio allows the industry to deliver. In a way, the good news is that this is as low as the Sharpe ratio can go under the assumptions we've made.

We can also follow the way return volatilities would be affected by increasingly binding constraints. Notice, for example, that at $100 billion, the industry can still achieve all of the volatility it wants, albeit at a lower Sharpe ratio. At $300 billion, however, where all positions have been maxed out, the industry also finds that it cannot achieve its target return volatility. In this case, return volatilities (and with them a proportional decrease in returns) will have fallen from 15% to 13%. And at $300 billion, the most the industry could achieve would be a volatility of 8%.

Mitigating forces

Before wrapping up, we think it is important to focus some attention on three questions that will come up in any discussion of the potential capacity of the managed futures industry.

- How binding is open interest as a constraint on growth?
- How bad is the current drawdown?
- What about liquidity in futures markets?

Please consider each in turn.

How binding are the open interest constraints?

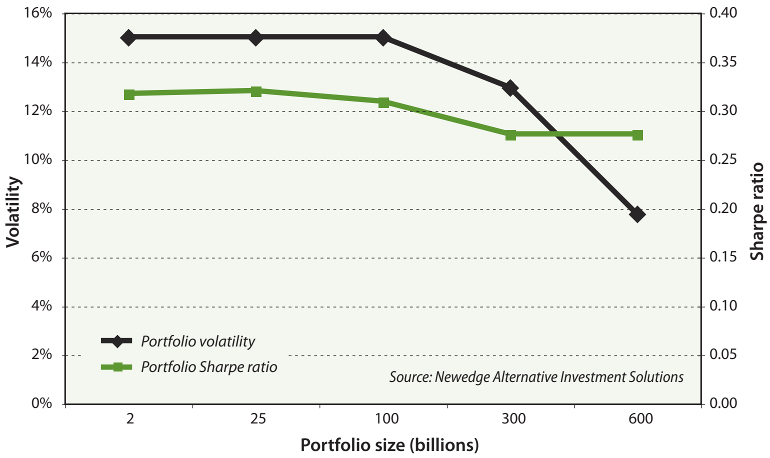
We already know that open interest is a highly flexible number. It is worth knowing, too, that open interest in equity index and government bond futures constitutes a very small fraction of the markets they represent.

Consider the market for Treasury futures. At the end of April, 2013, the total notional value of Treasury futures across all maturities was $914 billion. The distribution of this value across contract is provided in Exhibit 16. At the same time, the value of outstanding Treasury notes and bonds of all maturities was $9.6 trillion (of which $1.3 trillion matured within one year). The distribution of Treasury notes and bonds across all maturities is shown in Exhibit 17.

Given these values, we see that Treasury futures represent about 10% of the total value of Treasury notes and bonds. But the Treasury market, in turn, represents about ¼ of total marketable debt in the

Exhibit 15

Performance of trend following portfolios



United States. This means that Treasury futures, in the broadest sense, represent only about 2.5% of the market for debt in the United States.

We find a similar set of values for equity index futures. At the end of April 2013, the total notional value of S&P500 futures (both E-minis and the "big" contract) was $315 billion. At the same time, the total market capitalization of the S&P500 stocks was $15 trillion, and the total capitalization of all U.S. stocks was $19 trillion. So, depending on which you choose as the denominator, S&P500 futures represent either 2.1% or 1.7% of the market they represent. Neither is a large number, and both leave a lot of room for growth.

Commodity futures, however, probably make up a much larger fraction of the markets they represent. The lack of reliable cash market information for these markets makes it impossible to document, but it is our impression that futures markets are where most of the world's trading in commodities is focused. So it may well be that commodity futures markets would be as constraining as this exercise suggests. If so, the loss of diversification that would accompany a growth in the size of the CTA industry would be felt in the form of a reduced overall Sharpe ratio for the industry.

Exhibit 16

Futures open interest as of April 30, 2013

Maturity	Contracts	Portfolio equivalent value ($ billions)
2s	952,444	210.13
5s	1,909,627	238.02
10s	2,208,463	294.52
bonds	717,378	106.44
ultra	396,857	65.22
Total	6,184,769	914.33

Source: Newedge Alternative Investment Solutions, Bloomberg

Exhibit 17

Total marketable US treasuries outstanding as of April 30, 2013

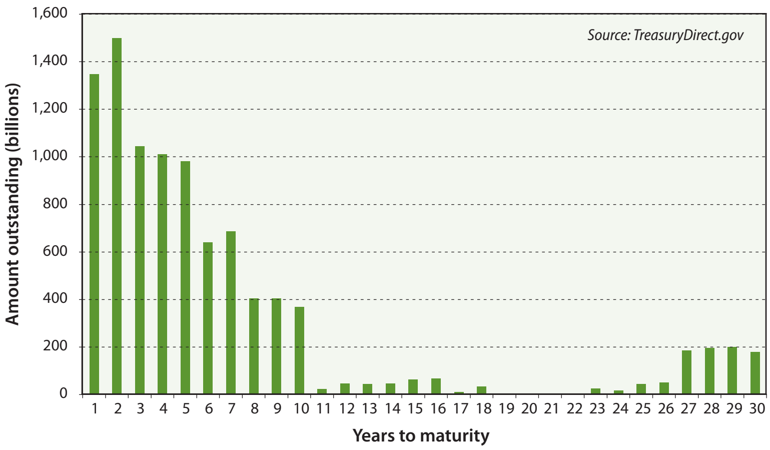
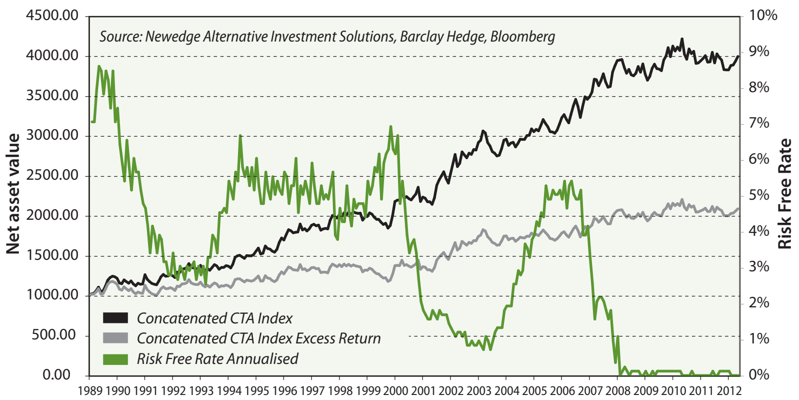


Exhibit 18

Net asset values (total and excess) and the risk-free rate



How bad is the current drawdown?

The industry's long standing practice of including interest income in its fund returns has produced the perception that the current drawdown is the longest and nearly the deepest that it has ever experienced. A correct analysis of CTA returns, however, would focus only on excess returns, or the alpha, that the industry produces. And if we do this, the current drawdown is neither the longest nor the worst.

Exhibit 18 overlays a history of the risk free rate of interest on two CTA net asset values series – one that includes interest income and one that is net of interest income. The importance of the tail wind that interest income generates for the industry's total returns is apparent in the difference between the two series. It is also apparent, though, that this tail wind has been more helpful at some times than at others. And that now, the risk free rate has been nearly zero for almost five years. As shown in Exhibit 19, stripping out interest income reduces the industry's risk adjusted returns from 0.67 to 0.35. But it is the latter number that represents the industry's true historical Sharpe ratio.

Exhibit 20 provides an historical perspective on the industry's rolling excess returns over horizons of 1, 3 and 5 years. And in all cases, it is apparent that the current experience is well within the bounds of what the industry has gone through several times in the past. Indeed, CTAs' excess returns have gone through much

Exhibit 19

CTA returns (total and excess)

	CTA returns	
	CTA Index	Excess
Total for the 23 years	298.72%	108.18%
Annualized compound	6.08%	3.18%
Average monthly	0.53%	0.35%
Annualized volatility	9.10%	9.08%
Maximum drawdown	-10.30%	-15.54%
Risk-adjusted returns	0.67	0.35

Source: Newedge Alternative Investment Solutions, Barclay Hedge

Exhibit 20

Rolling Annualized Excess CTA Returns
(concatenated CTA index)

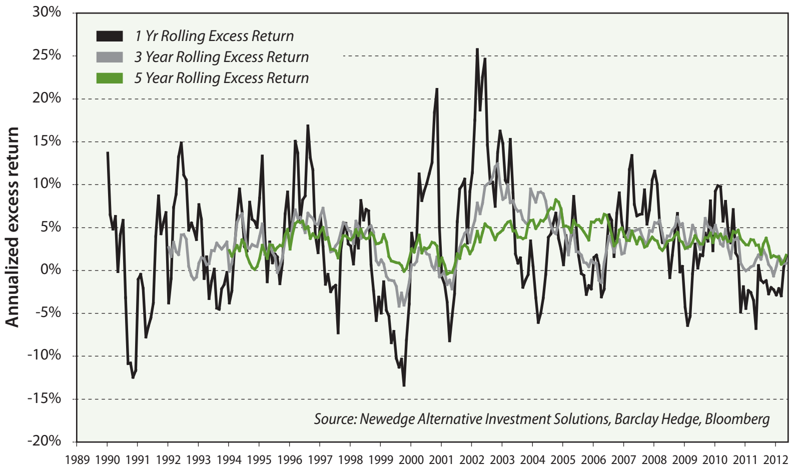


Exhibit 21

10 Worst Drawdown (by Depth) Statistics

*Using excess returns**

Drawdown	Length of Drawdown (Months)	DD End
-15.54%	24	31-Mar-01
-14.96%	32	31-Jul-93
-10.71%	38	31-May-07
-9.80%	14	30-Jun-02
-9.29%	24	
-8.30%	19	31-Mar-95
-7.34%	13	30-Sep-98
-7.23%	6	31-Jan-08
-6.62%	18	30-Sep-10
-6.08%	5	31-Oct-96

** -9.29% represents the maximum depth of the current drawdown which started in April 2011. The current depth of the drawdown is -5.30%*

*Using reported total returns**

Drawdown	Length of Drawdown (Months)	DD End
-10.30%	20	30-Nov-05
-10.10%	7	31-Aug-92
-10.00%	17	31-Dec-00
-9.50%	13	31-Dec-91
-9.25%	24	
-9.08%	7	30-Jun-02
-6.56%	18	30-Sep-10
-6.55%	3	31-Oct-07
-6.13%	19	31-Mar-95
-5.58%	3	31-Jan-03

** -9.25% represents the maximum depth of the current drawdown which started in April 2011. The current depth of the drawdown is -5.24%*

Source: Newedge Alternative Investment Solutions

worse periods in the past, but at times when low excess returns were masked partially by the presence of interest income.

Exhibit 21 shows how different the current drawdown experience seems if one focuses only on excess returns rather than total returns. If the customary practice is to work with total returns, then the current drawdown would, at 24 months, be the longest and, at -9.25%, nearly the deepest. When we work with excess returns, though, we find that two drawdowns have lasted much longer (34 and 38 months respectively) and that two have been much deeper.

To be sure, until the industry has reached a new high water mark, we won't know how this drawdown experience will compare with other episodes. It could still become the longest and the deepest. But for now, it would be hard to conclude that it is anything other than the kind of drawdown one would expect from an industry in which individual CTAs produce 5% *excess* returns on average with 15% volatility.

How liquid are futures markets?

And how serious a problem might it be for the industry to reverse direction? These kinds of questions stem from concerns about the costs of moving large positions or the challenge of an entire industry wanting to change direction at the same time. The hedge fund industry has accumulated enough ugly episodes to make these questions legitimate concerns.

The good news comes in two forms. First, futures markets are built for speed and efficiency of execution and tend to be more liquid given their size than their underlying cash markets. Second, because of the rich variety of trend following models that the industry uses to direct its trading, and because the trading programs are systematic and disciplined, the managed futures industry typically would change direction over a period of days, weeks, or months depending on the nature of a trend reversal.

The first point – the relative liquidity of futures markets – is illustrated by Exhibit 22, which shows the ratio of average daily volume to average open interest for the 55 markets used in this exercise. The average ratio of volume to open interest for these 55 markets was 0.44, which means that open interest turns over once every 2.3 days. In some markets, the rate of turnover is much higher. For example, the ratio of volume to open interest for DAX futures was 0.84 and for E-mini S&P500 futures was 0.64, which means that open interest in these markets turns over every 1.2 or 1.6 days.

This kind of information can be used to develop rules of thumb for how much time would be required to accomplish an orderly change in position direction. In our exercise, for example, we have capped out positions at 25% of open interest. If we then assume that the industry could buy or sell 5% of average daily volume without noticeable impact, then the average number of days required to change position would be about 23 days [= 2 x 0.25 / (0.40 x 0.05)], 11.5 days to reduce a current position to zero and 11.5 days to establish an equally large position in the opposite direction. Markets with higher

Exhibit 22

Volume/open-int ratio for 55 futures markets in 2012

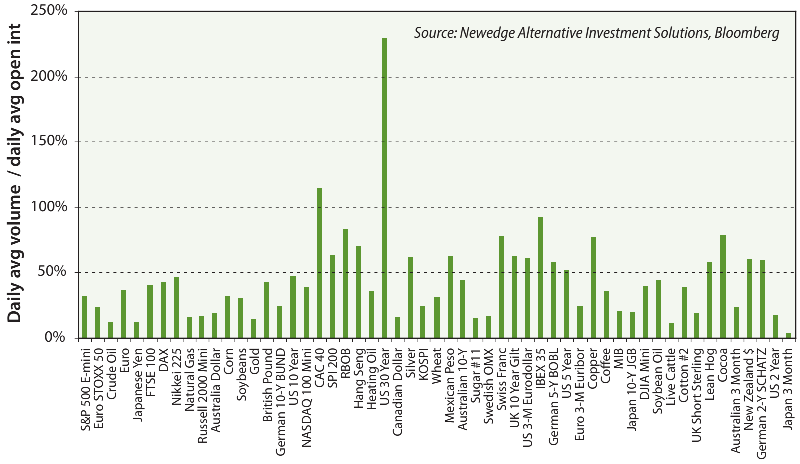


Exhibit 23

Stock Trading Relative to Capitalization

Company Name	Capitalization ($ millions)	Daily trading volume ($ millions)	Daily turnover (%)
Exxon Mobil Corp	415,914	1,163	0.3%
Apple Inc	398,381	4,270	1.1%
Google Inc	303,881	1,566	0.5%
Microsoft Corp	293,667	1,065	0.4%
Berkshire Hathaway Inc	287,069	305	0.1%
Wal-Mart Stores Inc	254,236	399	0.2%
Johnson & Johnson	251,452	634	0.3%
General Electric Co	245,578	680	0.3%
Chevron Corp	239,057	688	0.3%
Procter & Gamble Co	220,769	558	0.3%
Wells Fargo & Co	220,082	1,064	0.5%
IBM	214,878	758	0.4%
JPMorgan Chase & Co	207,693	932	0.4%
Pfizer Inc	203,966	782	0.4%
AT&T Inc	193,303	643	0.3%
Coca-Cola Co/The	182,070	393	0.2%
Citigroup Inc	151,901	1,189	0.8%
Philip Morris International Inc	148,643	455	0.3%
Oracle Corp	147,862	906	0.6%
Merck & Co Inc	145,998	376	0.3%
Verizon	145,911	429	0.3%
Bank of America	145,050	1,393	1.0%
Cisco Systems	138,003	980	0.7%
Amazon.com Inc	135,048	545	0.4%
PepsiCo Inc	129,914	478	0.4%

Source: Bloomberg

turnover rates would require less time, while markets with lower turnover rates would require more.

Also, the relative rates of turnover in futures are in sharp contrast with what we know, for example, about equity markets, where the rate of turnover is relatively slow. Exhibit 23 shows market capitalization and average daily trading for the 25 largest stocks in the U.S. equity market. For these stocks, the average ratio of volume to capitalization was 0.42%. Of the 25, Apple had the highest rate of turnover at 1.1%, which represented daily trading volume of $4.3 billion against a total market capitalization of $398 billion.

Against this backdrop, consider a market like that for crude oil futures. In this market, the notional market value of average open interest is "only" $160 billion, but the notional value of average daily trading volume was $54 billion for a turnover rate of 39%. Thus, if one compares the notional value of crude oil futures with the market capitalization of Apple, crude oil would look like the smaller market. But if one compares daily trading volume, the crude oil futures market would be 13 times larger.

It's worth noting, too, that many futures markets have become hugely more liquid over the past several years. Since 2000, the industry has gravitated almost completely to electronic trading platforms, which have radically improved transparency and liquidity. An idea of just how much liquidity has evolved for some important markets is provided by Exhibit 24, which shows implied bid/ask histories for two equity markets (E-mini S&Ps and Eurostoxx), two government bond markets (10-year Treasury notes and Eurobunds), and crude oil.[3] Although the paths taken are different for the different commodities, all five of these markets are more liquid now than they were in 2000. Four of the five markets are more than twice as liquid as they were in 2000. The cost of trading Eurostoxx futures is only 5% of what they cost to trade in 2000. The only market that is only marginally more liquid now than it was in 2000 is Eurobunds, and these were already liquid because they were early beneficiaries of electronic trading.

What next?

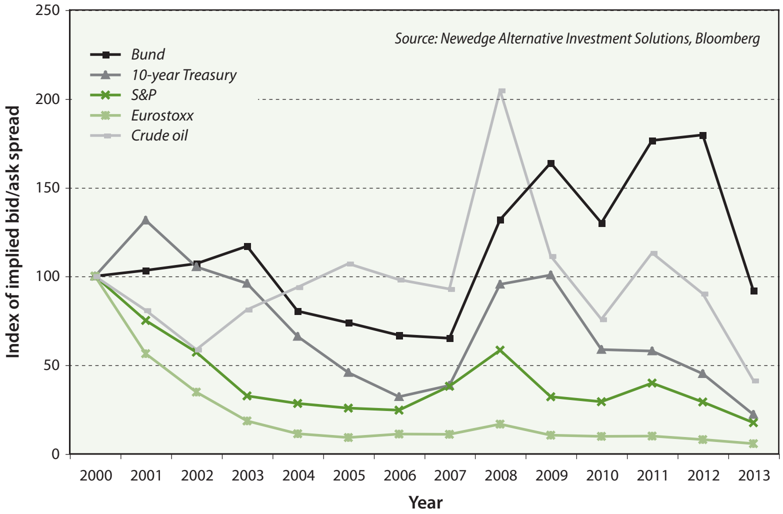
We knew going into this exercise that the question of capacity involves a lot of moving parts. We also knew that we approached the problem with heroic assumptions about the structure of the industry and a static world in which futures markets would not evolve either in size or liquidity.

But we found the work worthwhile. First, we cannot find any evidence that the industry at its current size is suffering from capacity constraints. While the current drawdown is long and relatively deep, it is completely within the range of what one would expect from an industry that works at the volatility it

3 The index of bid/ask spreads used here is simply a running history of the ratio of price volatility to the square root of trading volume for each of the markets. Although such a simple measure does not produce true bid/ask spreads – for that, one needs to fit the model to the market – it works very well if one wants to compare changes in a market's liquidity over time. The logic behind this measure can be found in *Measuring market impact and liquidity*, which is Chapter 11 in Burghardt and Walls, *Managed Futures for Institutional Investors*.

Exhibit 24

Index of implied bid/ask spreads



does. Second, futures markets have in fact grown in size and liquidity over the past several years, and it would be unreasonable to suppose that they could not continue to grow.

Also, the work afforded us an opportunity to review some of the working realities of futures markets – the forces that work on open interest, trading volumes, and liquidity – as well as some of the working realities of the CTA industry – how managers build portfolios and how they likely would deal with capacity constraints.

We are also confident that while the locations of actual constraints and stress points are impossible to pinpoint, we believe the story about how a large growth in assets under management would play out is a good one. It seems very likely that the first thing to suffer from growth of assets under management would be diversification and, with it, the industry's overall Sharpe ratio. The second would be a decrease in the overall volatility of the industry's returns, but with no further degradation in its Sharpe ratio. Neither of these is the worst thing that could happen. We have already established that as long as the industry can promise uncorrelated returns with even a modest overall Sharpe ratio, institutional portfolios will derive substantial benefits from including CTAs in their portfolios of stocks and bonds. [4]

Acknowledgement

We want to thank Ewan Kirk of Cantab Capital Partners both for encouraging us to pursue this question of the industry's capacity and for his active participation in the research. It is a thorny topic with no clear solution in sight, so his confidence that a simple model could yield useful insights into the question of capacity and into the rich complexities of the markets involved inspired in us the confidence to press forward with the work and publish this note. It has been a satisfying and lively collaboration for which we are truly thankful.

4 See Burghardt and Walls, *Managed Futures and Pension Funds: A Post-Crisis Assessment*, Futures Industry, November 2011. What we found there was that the industry's Sharpe ratio of 0.30 plus would justify allocations to CTAs of anywhere from 0 to 50%. If anything, in light of what we have learned about the role of autocorrelation in estimating return volatilities, the results reported in that note would be much more favorable than they were.