

*REVOLUTION CAPITAL MANAGEMENT*

# *ALPHA OVERVIEW*

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Version 15.12.1.0



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PAST PERFORMANCE IS NOT NECESSARILY INDICATIVE OF FUTURE RESULTS.

# REVOLUTION'S OBJECTIVE

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Develop quantitative, statistically rigorous, and well-researched systematic trading systems that deliver superior risk-adjusted performance while exhibiting low correlations to existing managed futures offerings.



# WHO IS RCM?

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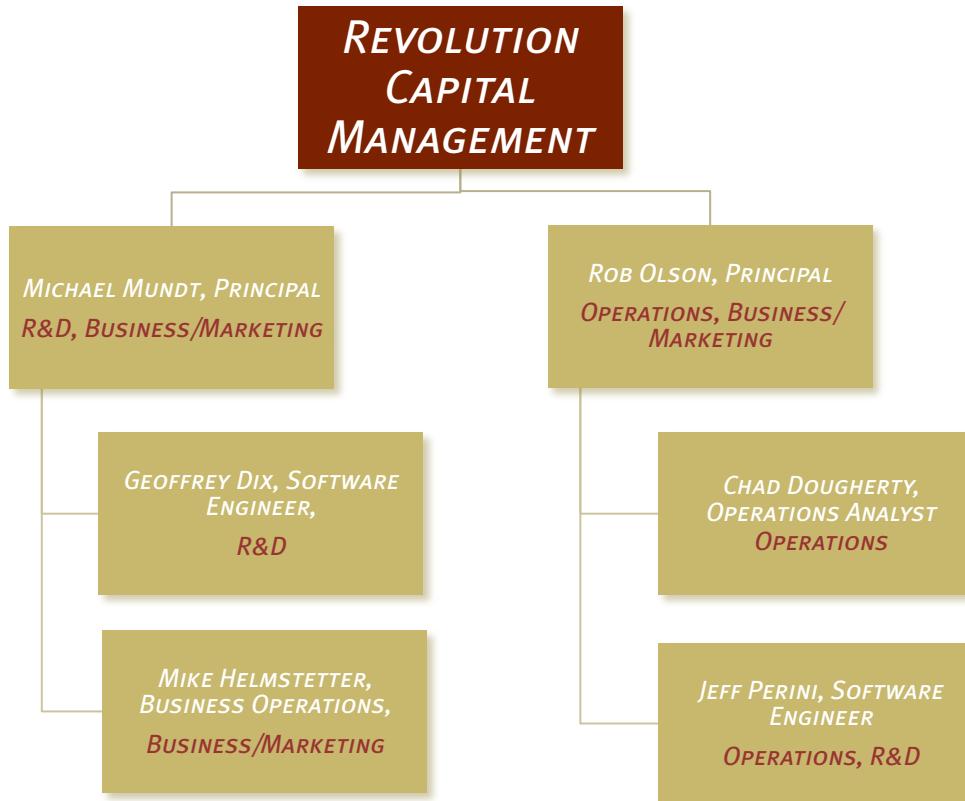
- Company details
  - Revolution Capital Management (RCM) is a Colorado-based Limited Liability Company (LLC) formed in 2004. RCM's main office is located in Denver, Colorado.
  - RCM is registered with the National Futures Association as a CTA and CPO and has been trading proprietary capital since January 2005 (11 years).
  - RCM's two principals are Michael Mundt and Rob Olson (both have engineering backgrounds).
- Company philosophy
  - All programs are systematic and quantitative.
  - Products are targeted to well-defined specifications.
  - Rigorous statistical analysis is applied to all aspects of research, development, and operations.
  - Automation and technology are critical enablers for achieving superior risk-adjusted returns.
- Program details
  - RCM offers two programs: Alpha and Mosaic Institutional.
  - RCM directs trading for about \$420 million across its full product suite (including custom programs).

*See Appendix A for more Company information.*

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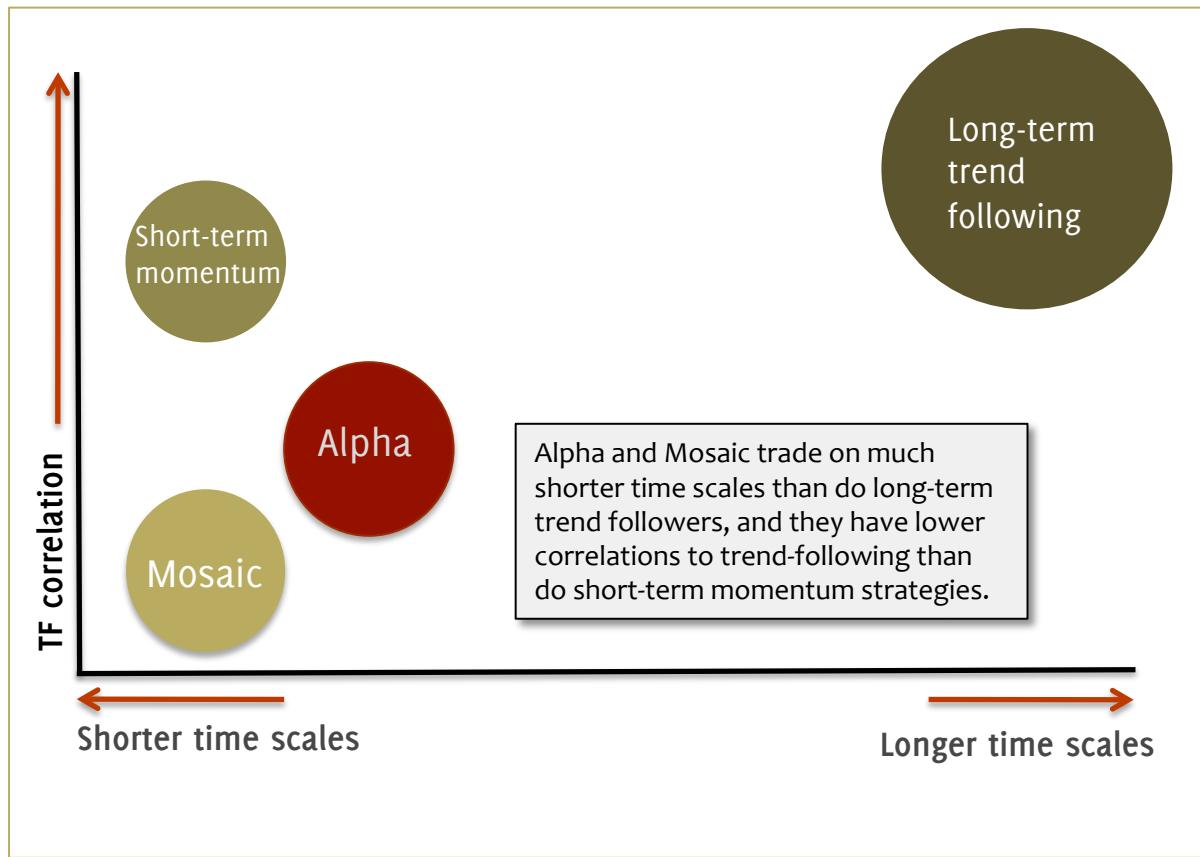
# ORGANIZATIONAL CHART



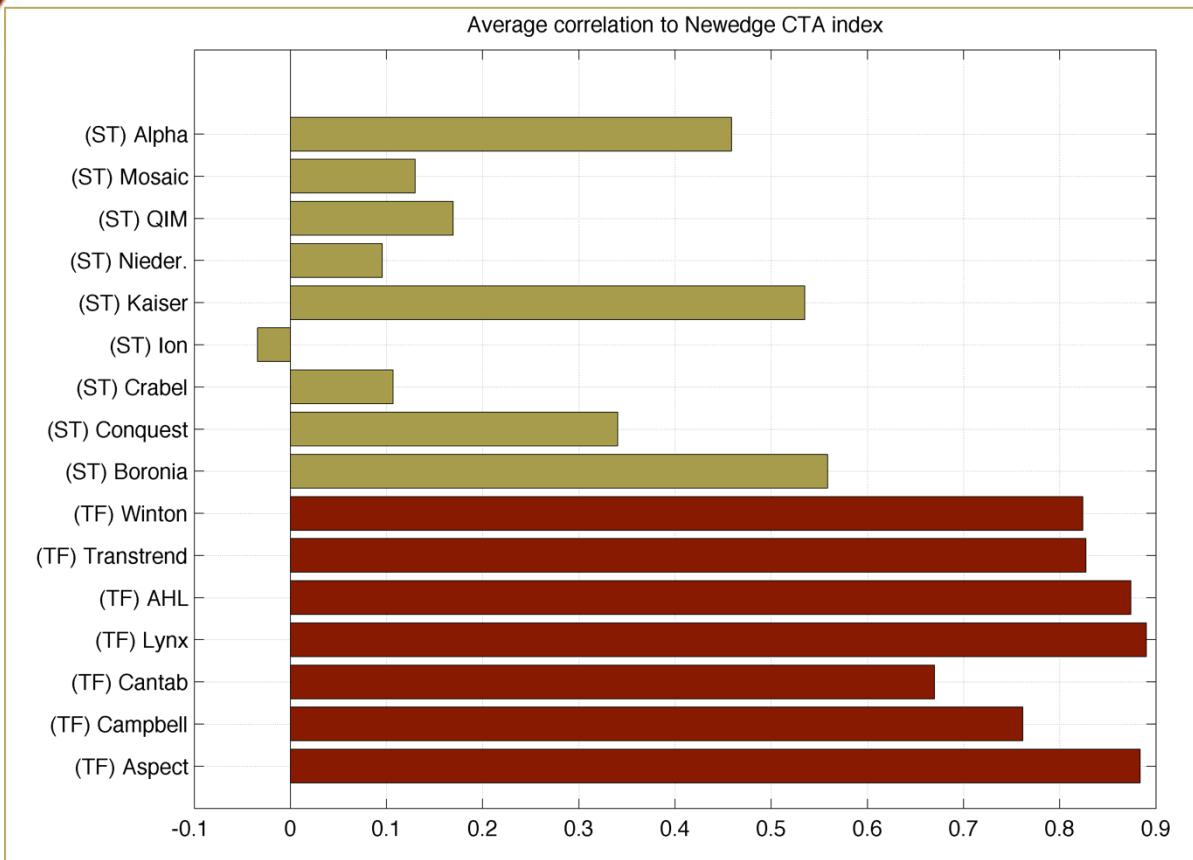
# PRODUCT HIGHLIGHTS

	<b>ALPHA</b>	<b>MOSAIC AND MOSAIC INSTITUTIONAL (MI)</b>
<i>SECTOR DIVERSIFICATION</i>	<i>DIVERSIFIED</i>	<i>DIVERSIFIED</i>
<i>TRADING STYLE</i>	<i>SHORT- AND MEDIUM-TERM PATTERN RECOGNITION</i>	<i>SHORT-TERM PATTERN RECOGNITION</i>
<i>CAPACITY</i>	<i>&gt;\$2 BILLION</i>	<i>&gt;\$1 BILLION</i>
<i>TARGET NICHE</i>	<i>ACTIVELY MANAGED TO A LOW CORRELATION TO TREND FOLLOWING</i>	<i>ACTIVELY MANAGED TO A NEAR-ZERO CORRELATION TO TREND FOLLOWING</i>
<i>NEWEDGE CTA INDEX CORRELATION</i>	<i>~0.3 TO 0.5</i>	<i>~0.0 TO 0.25</i>
<i>S+P 500 CORRELATION</i>	<i>~ZERO</i>	<i>~ZERO</i>
<i>ANNUALIZED VOLATILITY</i>	<i>12% TARGETED ANNUAL VOLATILITY BASED ON DAILY RETURNS</i>	<i>12% TARGETED ANNUAL VOLATILITY FOR MI, 30% FOR MOSAIC</i>
<i>TRADING FREQUENCY</i>	<i>3,000 RT/M/YEAR</i>	<i>6,000 RT/M/YEAR (MI)</i>
<i>AVERAGE HOLDING PERIOD</i>	<i>6 DAYS</i>	<i>3 DAYS</i>

# PRODUCT RELATIONSHIPS

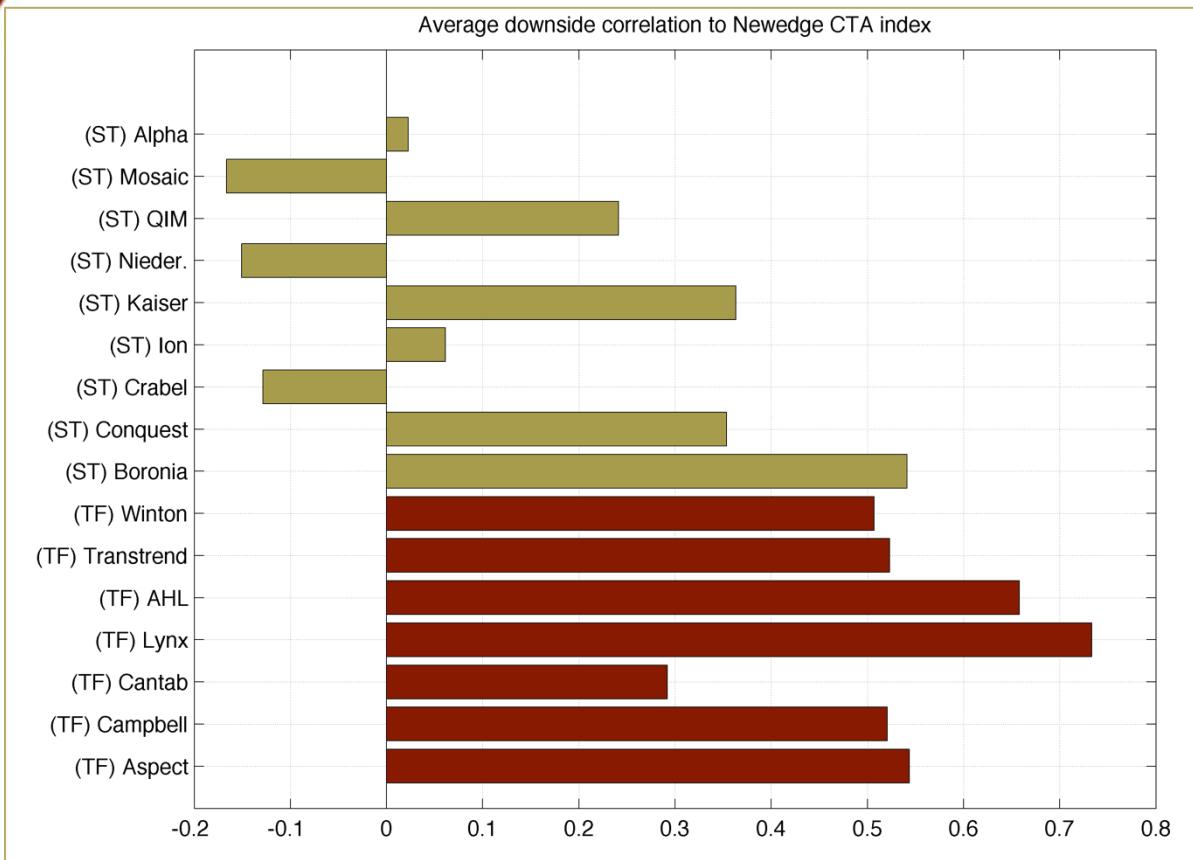


# CORRELATION ANALYSIS

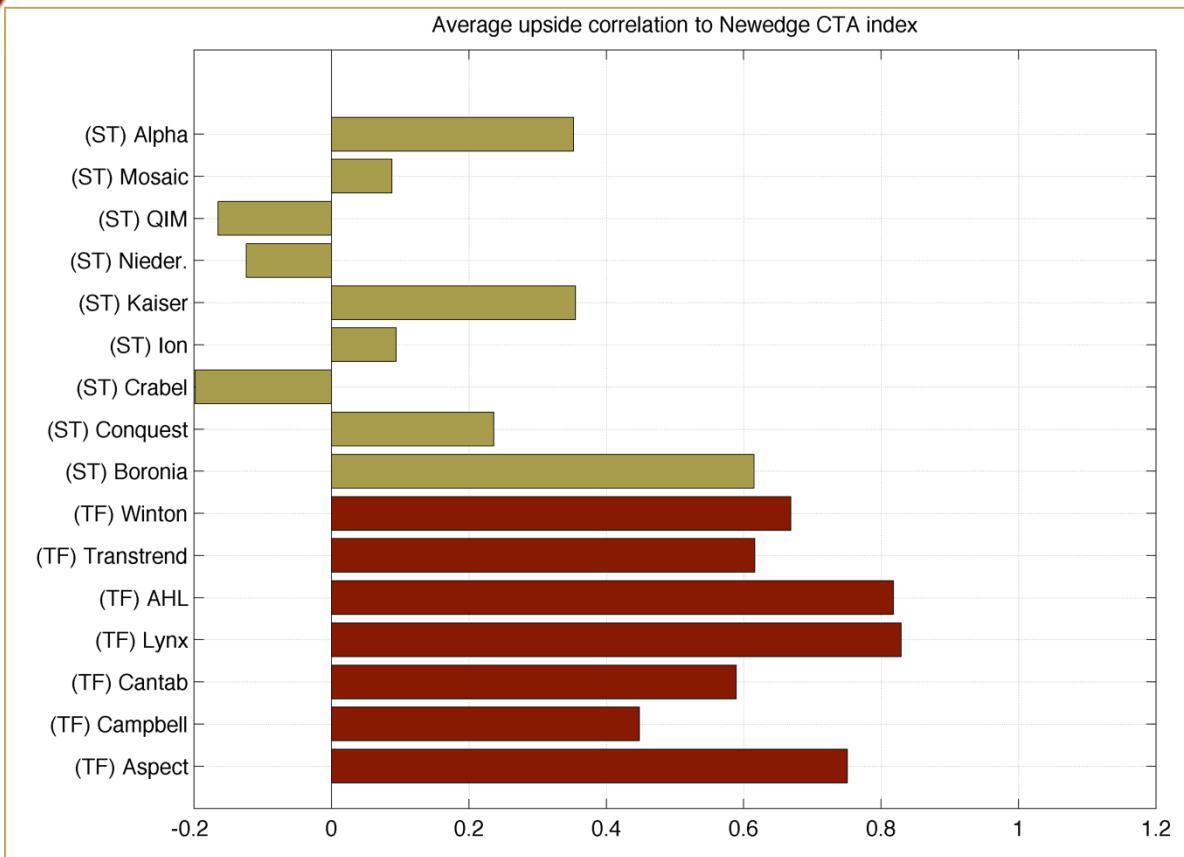


- Alpha is similar to some other short-term traders and less than trend followers.
- Mosaic has a low average correlation to TF.

# CORRELATION (DOWNSIDE)

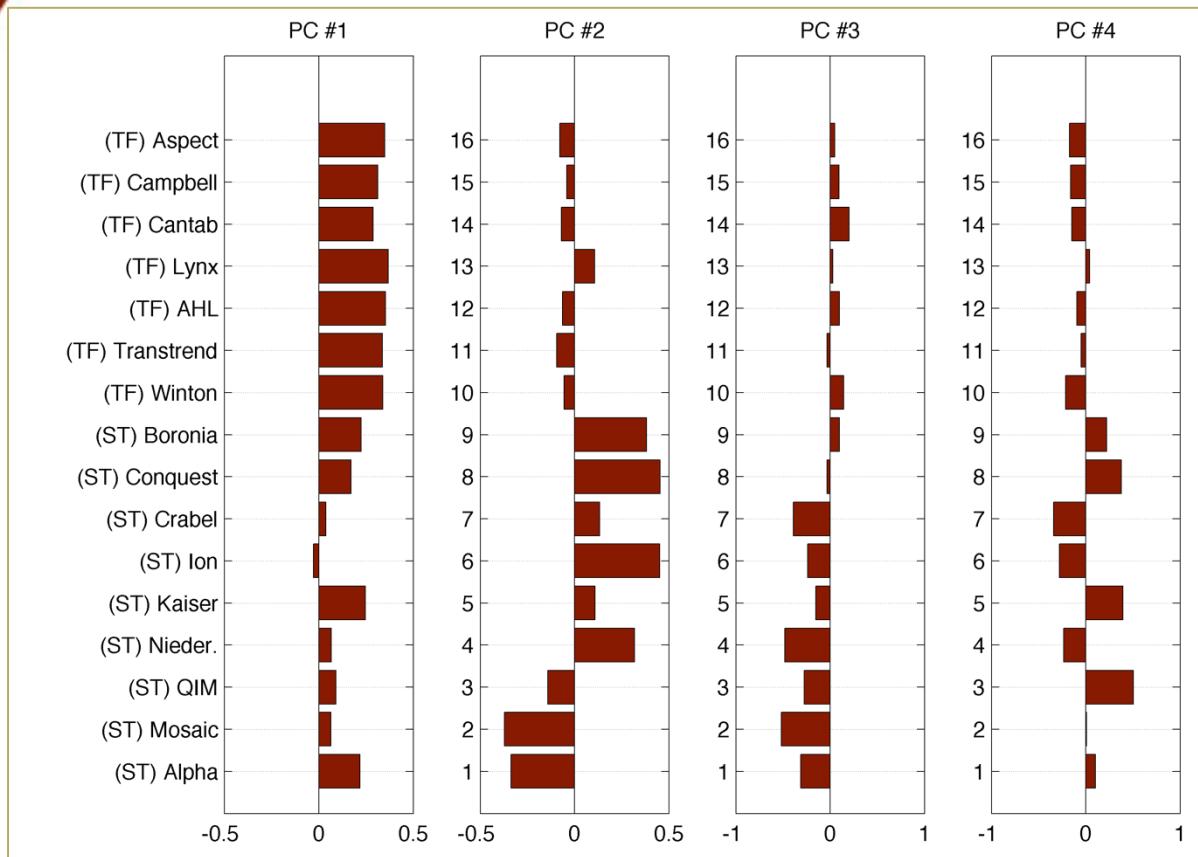


# CORRELATION (UPSIDE)



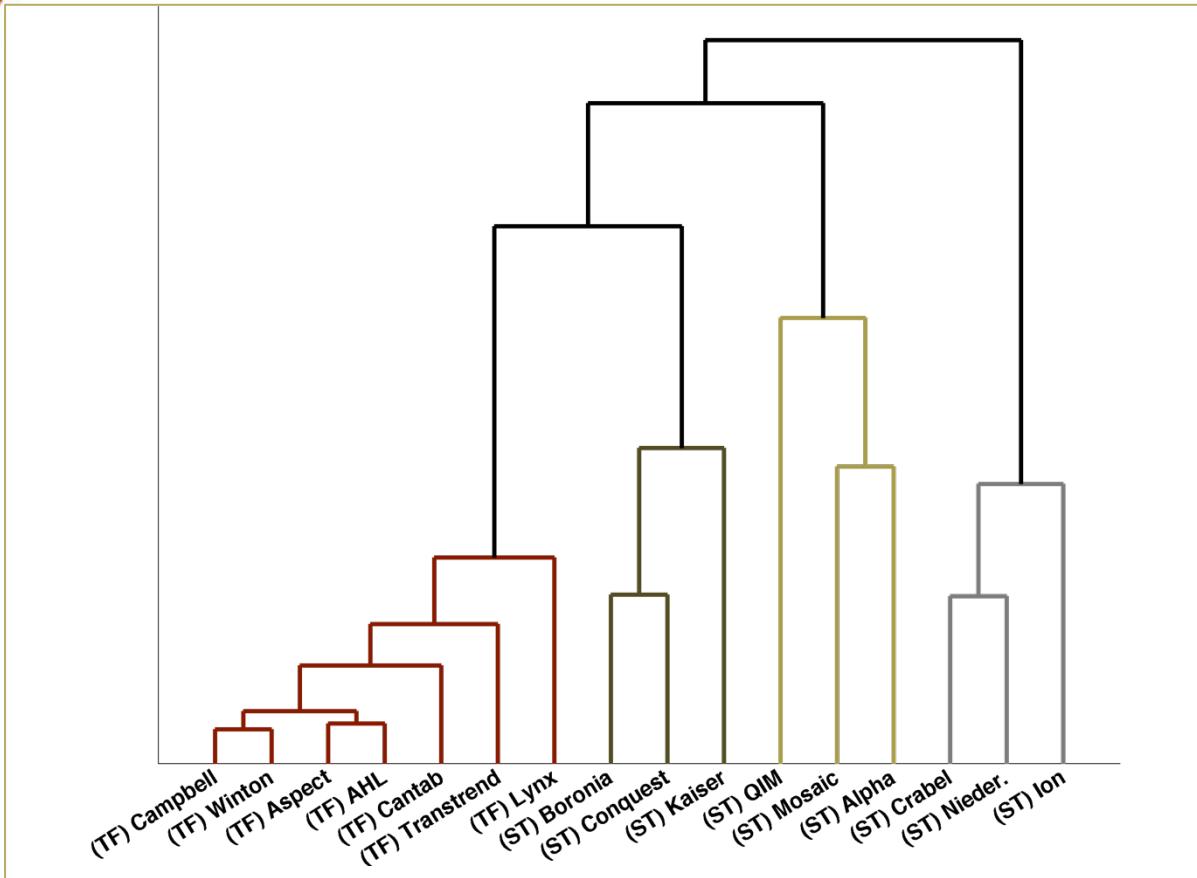
- Alpha has a moderate upside correlation to TF, but less than trend-followers.
- Mosaic has very little upside correlation to TF.

# PRINCIPAL COMPONENT ANALYSIS



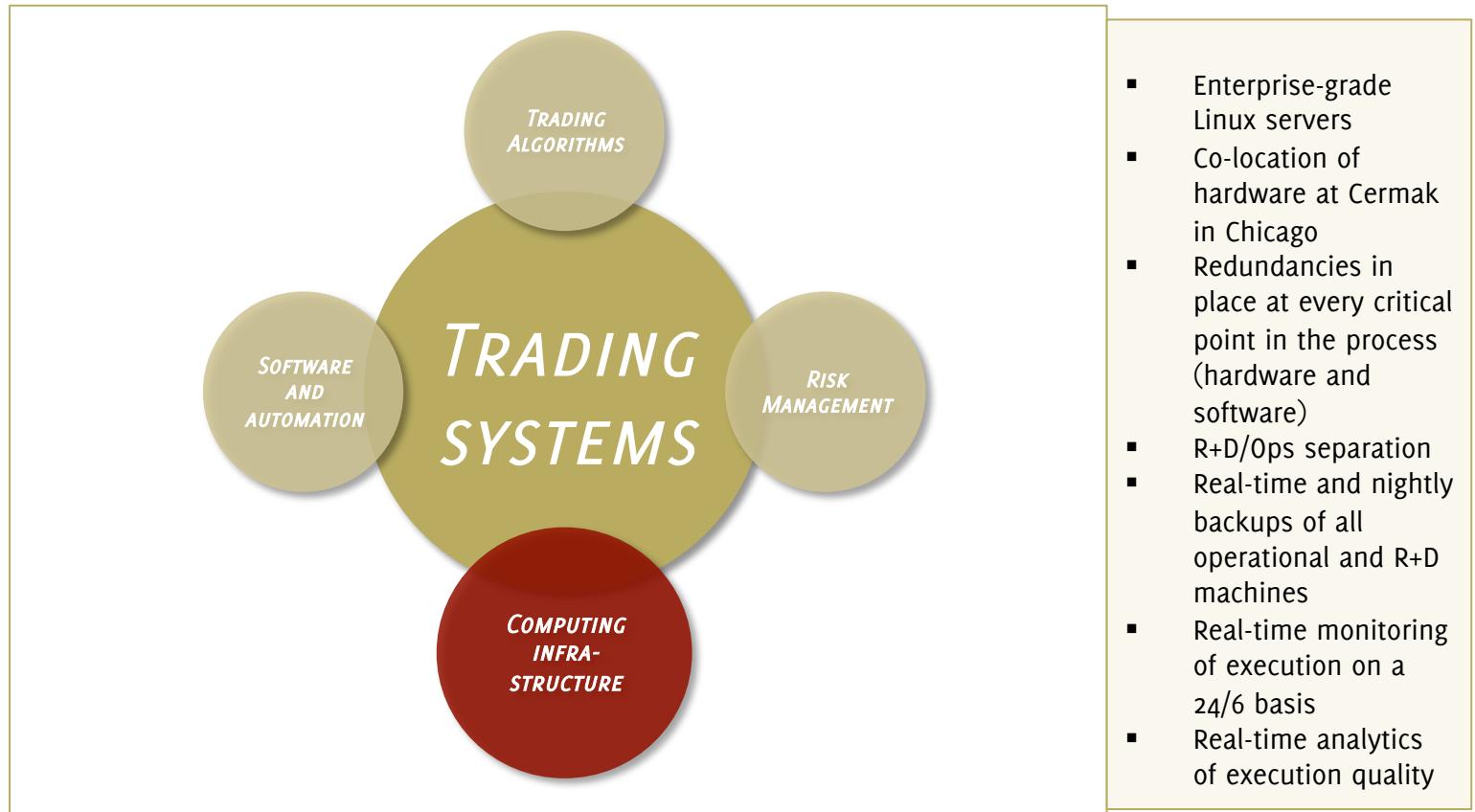
- Principal component analysis was used to decompose both trend followers and short-term traders.
- PC #1 represents long-term TF.
- PC #2 represents short-term TF.
- PC #3 and PC #4 represent non-trend behavior.

# MANAGED FUTURES FAMILY TREE



- Principal component analysis was used to decompose both trend followers and short-term traders.
- The output of this analysis was used to group traders by similarity to each other.
- All 7 trend followers cluster on the left-hand side.
- All 9 short-term traders cluster on the right-hand side.
- Alpha is grouped with Mosaic even though there are key differences.

# COMPUTING INFRASTRUCTURE

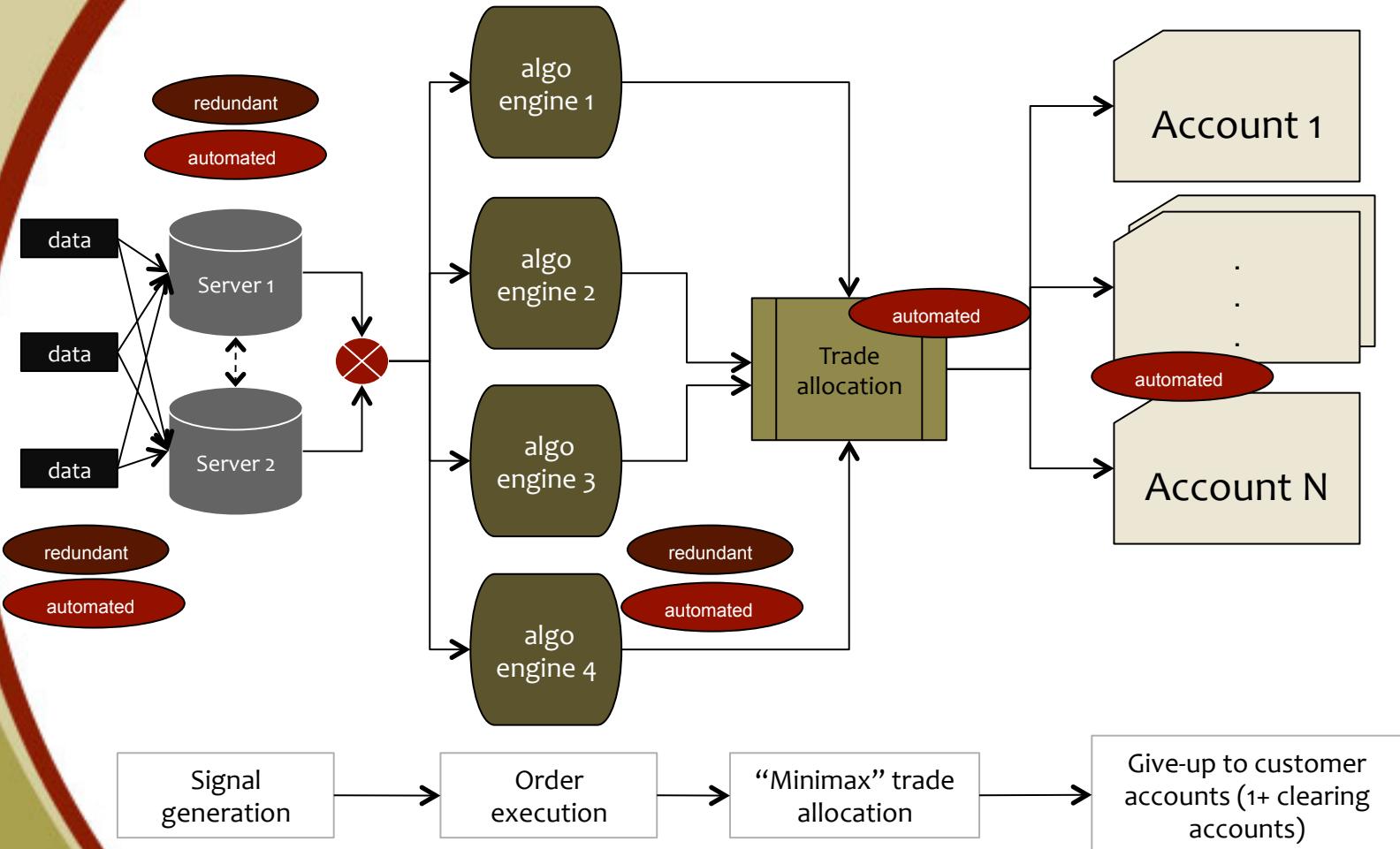


# SOFTWARE AND AUTOMATION



- Matlab, C, Java code bases
- MySQL database infrastructure
- Automated data ingest
- Automated signal and order generation
- Automated order execution via FIX
- Multi-level consistency checks on data and trade directives
- Automated info, warning, and error notifications

# TRADING PROCESS FLOW



# TRADING ALGORITHMS



# INVESTMENT THESIS

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- News can cause nearly-instantaneous adjustments in market prices (per the efficient market hypothesis, or EMH).
- However, real news/information is rare. The remainder of the time, markets generate their own dynamics.
- In this regime, patterns in prices can and do arise (in contrast to the EMH).
- With a rigorous systematic, statistical approach, these price patterns can be targeted by trading algorithms.

*See Appendix B for more details.*

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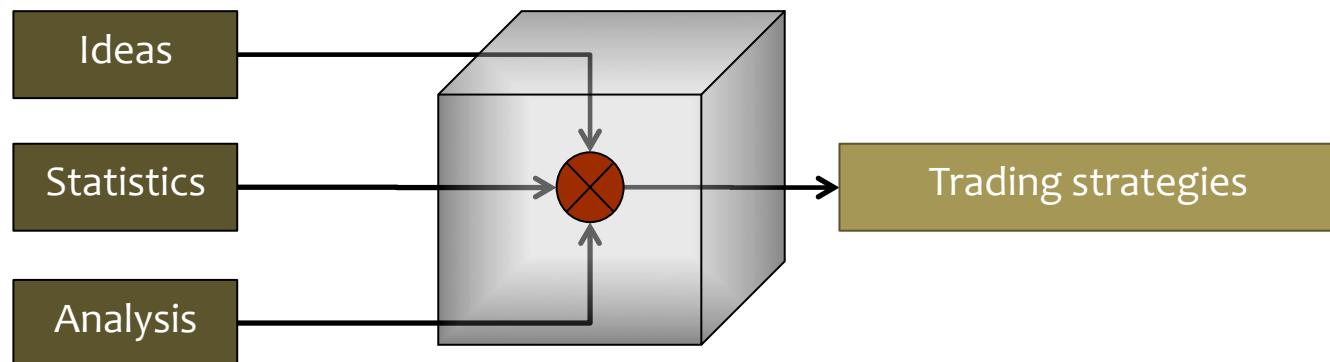


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# SYSTEM DEVELOPMENT APPROACH

- Our engineering backgrounds underpin our philosophy and approach to research and development.
- Pricing inefficiencies can be identified using a combination of sensible hypothesis formulation and sophisticated statistical analyses, and they can be exploited with systematic trading methodologies.
  - Not a black box.
  - Technical indicators are useful as inputs but not necessarily as rules for trading.
- Our general system-development methodology can be summarized as *statistical pattern recognition*.



# SYSTEM DEVELOPMENT APPROACH

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- “Pattern recognition”
  - Trends and counter-trends are the simplest patterns.
  - Pattern recognition generally refers to higher-order price movements.
- Pattern characteristics
  - Only patterns that are stable over time and across the full spectrum of liquid markets are used; this reduces the chances of data mining/over-fitting.
  - Multiple patterns and multiple variants per pattern are employed to maximize generalization and further minimize over-fitting.
- Finding patterns
  - Technical indicators are used as the starting point for pattern identification.
  - Sophisticated computational tools (e.g. computer clusters, parallel programming, et al.) are utilized to facilitate research and development efficiency.
  - Special attention is given to understanding and comparing in-sample versus out-of-sample results.
- Patterns versus trends
  - Ultimately, positions can only be taken with or against the prevailing trend.
  - Diverse patterns must be carefully balanced in the overall portfolio to produce desirable program properties.

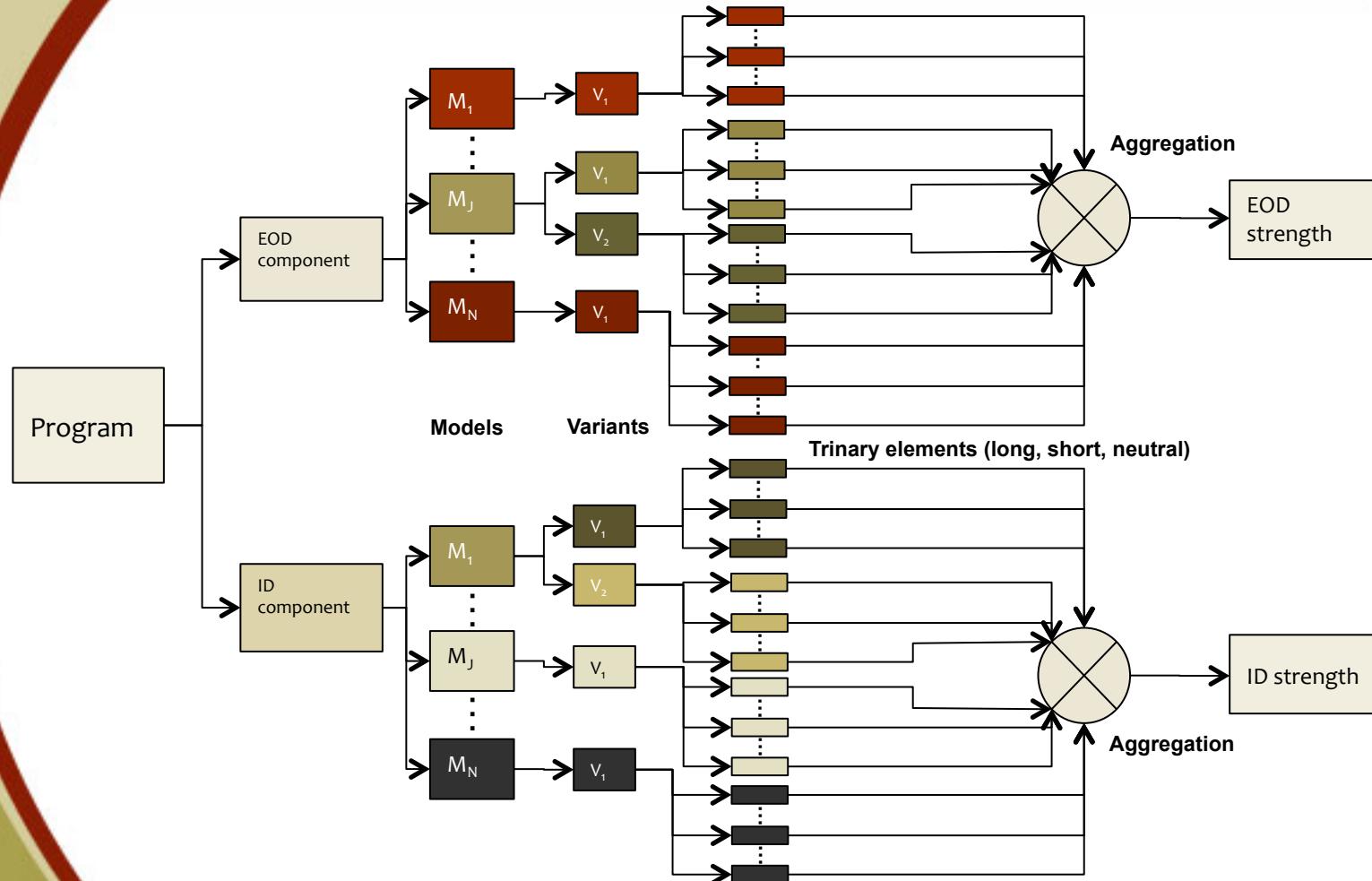
# TRADING ALGORITHMS

	<b>ALPHA</b>	<b>MOSAIC AND MOSAIC INSTITUTIONAL (MI)</b>
<i>TRADING STRATEGIES</i>	<i>TREND REVERSION</i>	<i>TREND REVERSION, MEAN REVERSION</i>
<i>EOD/INTRADAY ALLOCATION</i>	<i>75% / 25%</i>	<i>35% / 65%</i>
<i># OF MODELS (EOD / ID)</i>	<i>7 / 28</i>	<i>9 / 44</i>

- Model research and development
  - New models are developed on an ongoing basis.
  - Models are evaluated and incorporated into the ensemble when they are conclusively shown to benefit the portfolio.
  - Automated search processes are used to help improve efficiency in the R+D cycle.
- Model deployment
  - Depends on target trend-following correlation and trading frequency of program.
  - Cross-program overlaps are taken into consideration.

*See Appendix D for example trades.*

# MODEL STRUCTURE

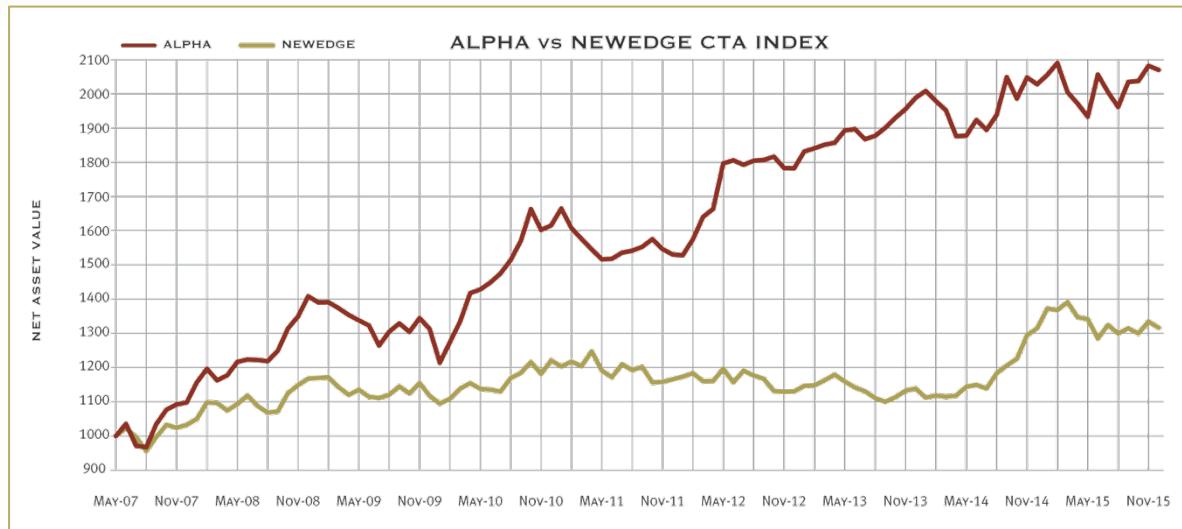


# ALPHA PROGRAM

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- Characteristics
  - Diversified (trades 33 markets, domestic and foreign, in all major sectors).
  - Actively managed to a low correlation to trend following benchmarks.
  - Average holding period of 8 days for EOD, 1 day for ID, 6 days overall.
  - Maximum expected margin-to-equity is approximately 25%.
  - Targeted annualized volatility (based on daily returns) is approximately 12%.
- History
  - The fund started in January 2005 as a domestic-market trend-following program.
  - A multi-strategy system trading global markets was introduced in August 2006.
  - The managed account program (with the multi-strategy system) started in May 2007.
  - The realized post-fee Sharpe ratio is approximately 1 for both the fund and the program.
- Target niche
  - Alpha provides a return stream that exhibits mild correlation to trend followers, but...
    - We believe we can provide better risk-adjusted performance.
    - Alpha tends to do well when trends are weak to moderate, unlike pure trend following.
    - Alpha provides diversification by actively managing to a low correlation to TF.

# ALPHA PROGRAM OVERVIEW



- AUM: \$230 million
- Annualized return: 8.8%
- Annualized volatility: 9.7%
- Sharpe ratio: 0.92
- Correlation to Newedge CTA Index: 0.41

PERFORMANCE TABLE													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YTD
2015	1.32	1.71	-4.09	-1.67	-1.95	6.37	-2.50	-2.17	3.73	0.14	2.19	-0.58	2.07
2014	1.01	-1.47	-1.38	-3.86	0.08	2.44	-1.52	2.30	5.71	-3.06	3.11	-0.97	1.99
2013	2.76	0.51	0.56	0.31	1.94	0.20	-1.56	0.53	1.25	1.53	1.32	1.70	11.55
2012	-0.13	3.04	4.14	1.44	7.99	0.50	-0.73	0.67	0.12	0.54	-1.84	-0.04	16.46
2011	3.06	-3.43	-1.99	-1.92	-1.88	0.09	1.19	0.36	0.75	1.44	-1.86	-1.01	-5.26
2010	-7.49	4.94	4.71	6.23	0.76	1.43	1.83	2.65	3.68	5.92	-3.66	0.83	23.06
2009	-1.27	0.04	-1.26	-1.42	-1.18	-1.11	-4.45	3.20	1.87	-1.85	3.07	-2.37	-6.79
2008	5.33	3.42	-2.81	1.25	3.34	0.58	-0.11	-0.30	2.51	5.20	2.68	4.35	28.23
2007	-	-	-	-	-	3.54	-6.17	-0.42	6.99	4.06	1.39	0.56	9.82

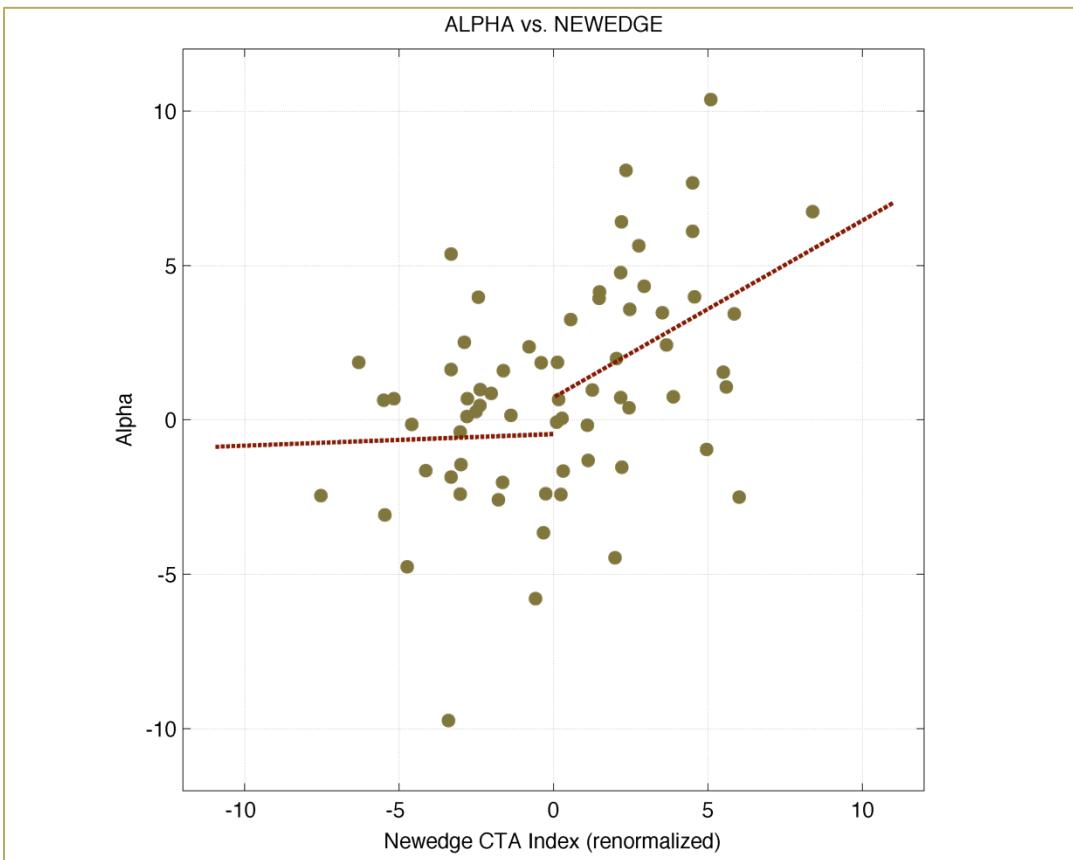
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# ALPHA CORRELATIONS



- Correlation is distinctly non-linear.
- Downside correlation is only slightly positive, thus providing diversification when TF is negative.

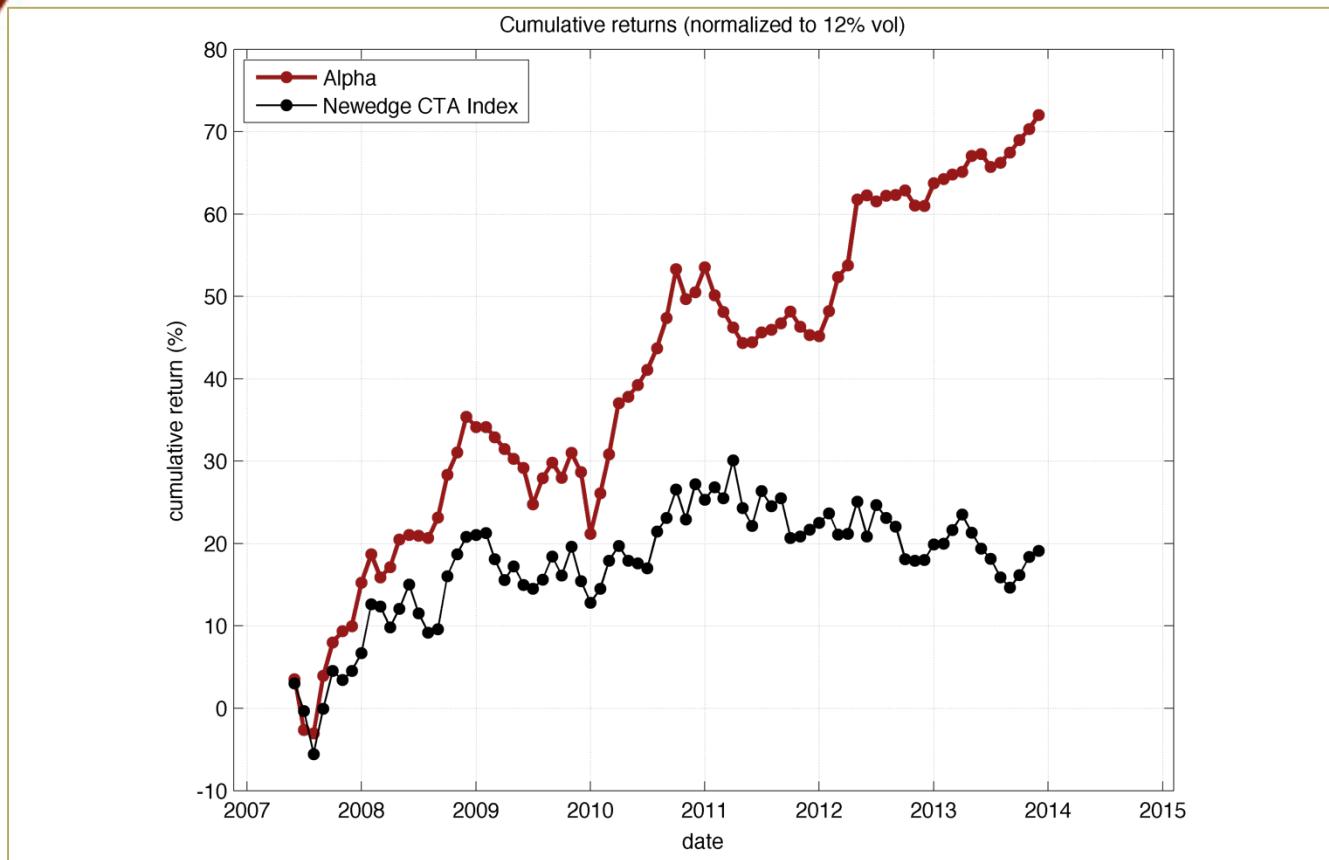
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# ALPHA VS. THE NEWEDGE CTA INDEX



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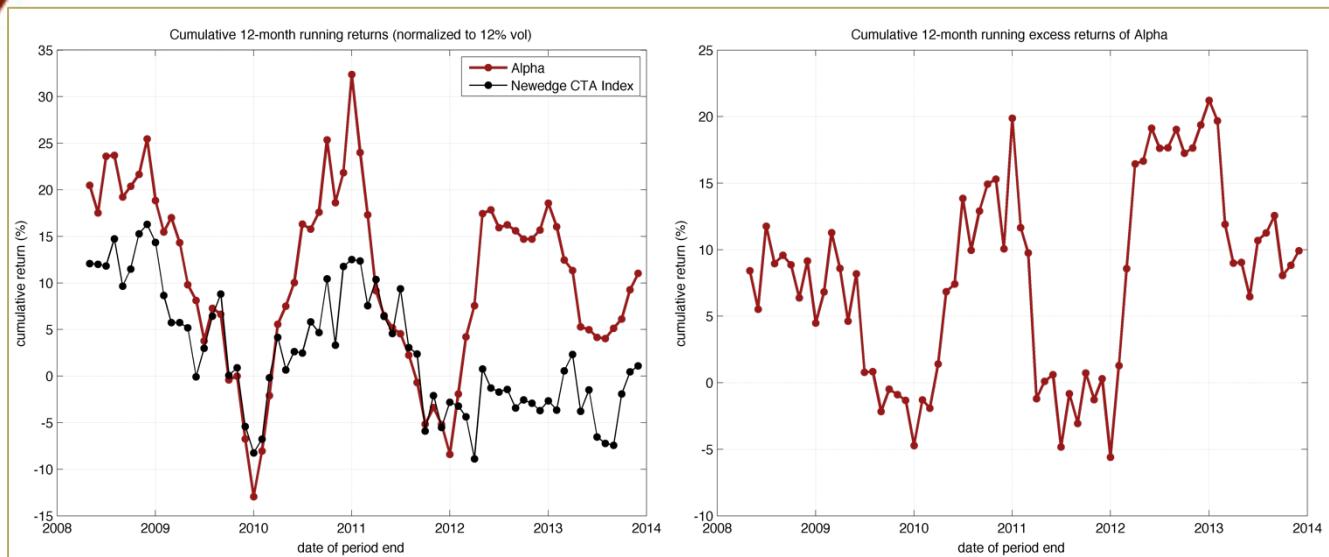


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# ALPHA VS. THE NEWEDGE CTA INDEX

## (12-MONTH RUNNING RETURNS)



- Alpha returns move somewhat coincidentally with trend followers on a running 12-month basis.
- However, during times of trend-based opportunities, historically we have seen relative outperformance by Alpha when compared to the Newedge CTA index.

PAST PERFORMANCE IS NO GUARANTEE OF FUTURE PERFORMANCE.

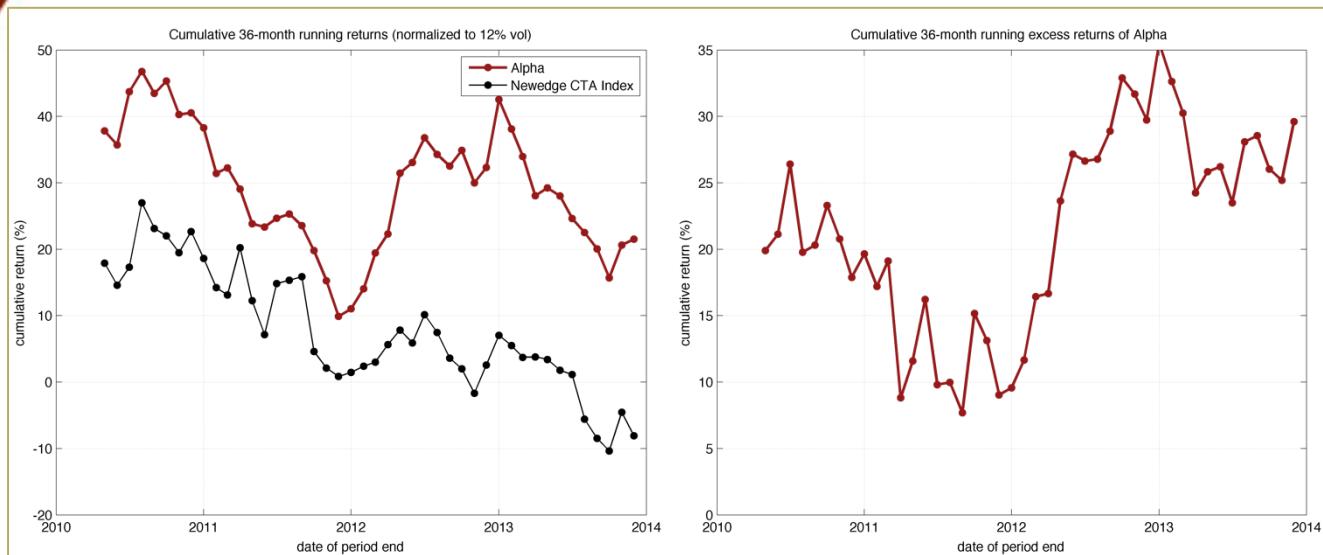


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# ALPHA VS. THE NEWEDGE CTA INDEX

(36-MONTH RUNNING RETURNS)



- On a running 36-month basis, there has been a consistent outperformance by Alpha relative to the Newedge CTA index.

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# RISK MANAGEMENT



# CHALLENGES WITH SHORT-TERM TRADING

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- Trading system development
  - Trends dominate, so counter-trend trading is difficult.
  - Simple “building block” study yields the following results:
    - As correlation to trend following decreases, so does model performance.
    - As correlation to trend following decreases, skew of returns becomes more negative (thus, achieving negative correlation to trend following generates high negative-skew returns).\*
    - Minimum correlation is limited to -0.3 or so, but with very poor performance (zero correlation is the practical limit if reasonable performance is required).
  - Thus, fine balancing is required to achieve de-correlation while still maintaining solid risk-adjusted returns.
- Risk management\*
  - Counter-trend strategies accumulate risk before profits accrue (trend followers only “give back” profits).
  - As a result, short-term returns have tendencies towards negative skew.
  - Existing risk approaches are necessary but not quite sufficient.
  - Intra-day strategies are a key ingredient for effective risk management.

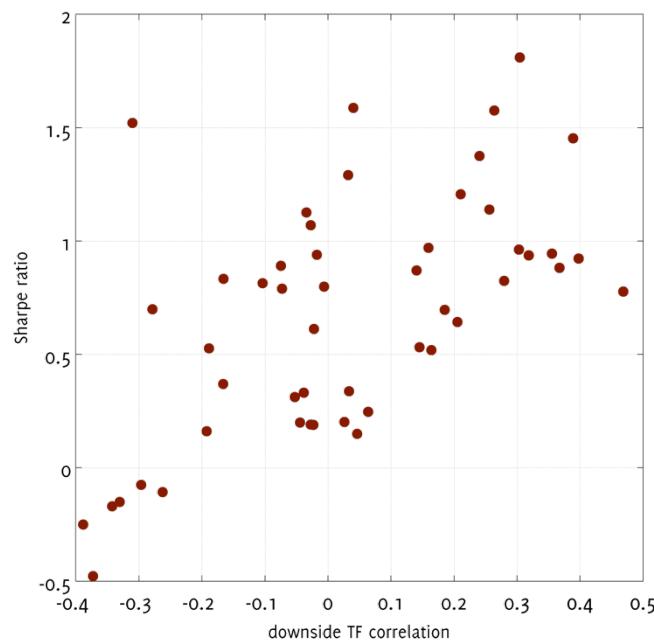
*\*These topics are explored in detail in a separate presentation on risk.*

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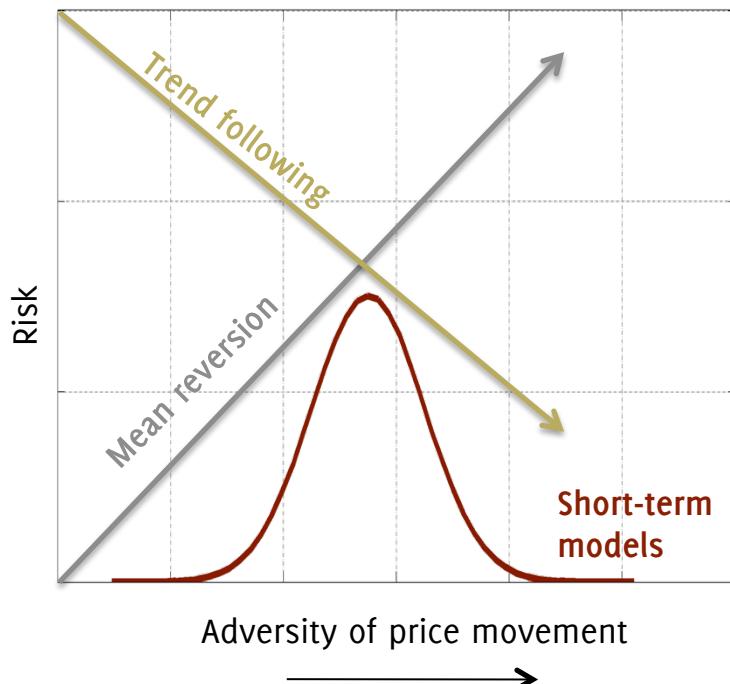
# CHALLENGES WITH SHORT-TERM TRADING

Sharpe vs. TF correlation (EOD)

Sharpe vs. downside TF correlation



Nonlinear risk profile



# RISK MANAGEMENT

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- The base risk management model accounts for:
  - Per-market volatility, both long-term and short-term
  - Inter-market correlations
  - Risk profile target and type
  - Historical system performance
  - Trading program characteristics
  - Time to approach “normality” (see next page)
- Program volatility/risk targets:
  - Alpha and Mosaic Institutional: 12% annualized
- Per-market exposure bounds are enforced, as well as total-portfolio exposure bounds.
- All information is re-evaluated on a daily basis, and positions are re-sized accordingly.

*A detailed exploration of risk management can be found in a separate, stand-alone presentation.*

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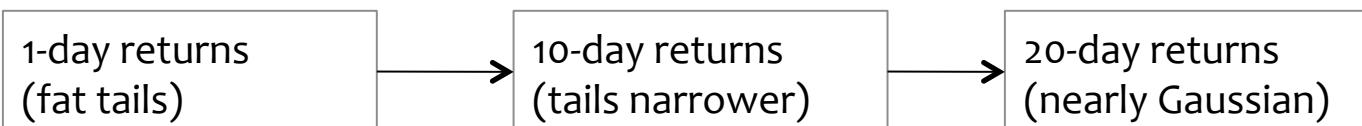
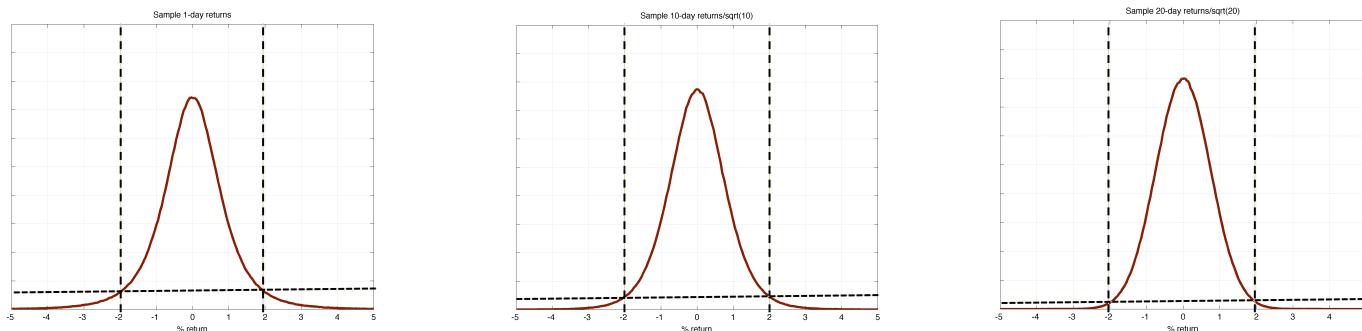


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# RISK MANAGEMENT

- “Normality” constraints
  - Opportunistic trading involves variable position sizing, which causes additional “fat tails” on the daily return distribution.
  - We aim to mitigate this as quickly as possible via multiple model classes, multiple models per class, and multiple variants per model.
  - Thus, part of the portfolio construction process involves looking at the rate at which the downside returns approach normality.



See Appendix C for detailed drawdown expectations.

# ONGOING R+D

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- Continue to innovate and develop independent return streams.
  - Competitive analysis.
  - New applications of existing knowledge.
  - Establish apparent limits of diversification and possible work-arounds.
- Enhance short-term (intra-day) algorithms to complement current inter-day systems.
  - Real-time testing was performed throughout 2010 and 2011.
  - Deployment into existing products occurred throughout 2012.
  - Continued efforts are focused on transaction cost minimization.
- Further develop our understanding of risk and ways to manage/mitigate it.
  - Examine strategy-level solutions.
  - Enhance volatility estimation.
  - Explore exogenous indicators.
- Enhance our execution strategies to facilitate larger trading capacities.
  - Automation has been a useful by-product of intra-day development.
  - Automated execution is more efficient than interactive trading, especially if order book information is used effectively.

# Appendix A

## Company Information

# RCM PERSONNEL

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- Michael Mundt (*Research and Development, Business/Marketing*)
  - Education: Ph.D., Aerospace Engineering, University of Colorado, 1993.
  - Primarily involved in model development and business/marketing/compliance.
  - Previously a principal at Analytic Investments, an NFA-registered CPO.
  - Previously employed as a mechanical engineer at Seagate Technology, a major hard-disk-drive manufacturer.
  - Holds 19 patents in the area of disk-drive head/disk mechanics.
- T. Robert Olson (*Operations, Business/Marketing*)
  - Education: Ph.D., Aerospace Engineering, University of Colorado, 1996.
  - Primarily involved in the architecture and development of the computing infrastructure, daily operations management, and business/marketing.
  - Previously employed as a software engineer at Raytheon Systems.
- Geoffrey Dix (*Software development*)
- Chad Dougherty (*Operations*)
- Mike Helmstetter (*Business/Marketing*)
- Jeff Perini (*Research and Development, Operations*)

# PRINCIPAL BIOGRAPHIES

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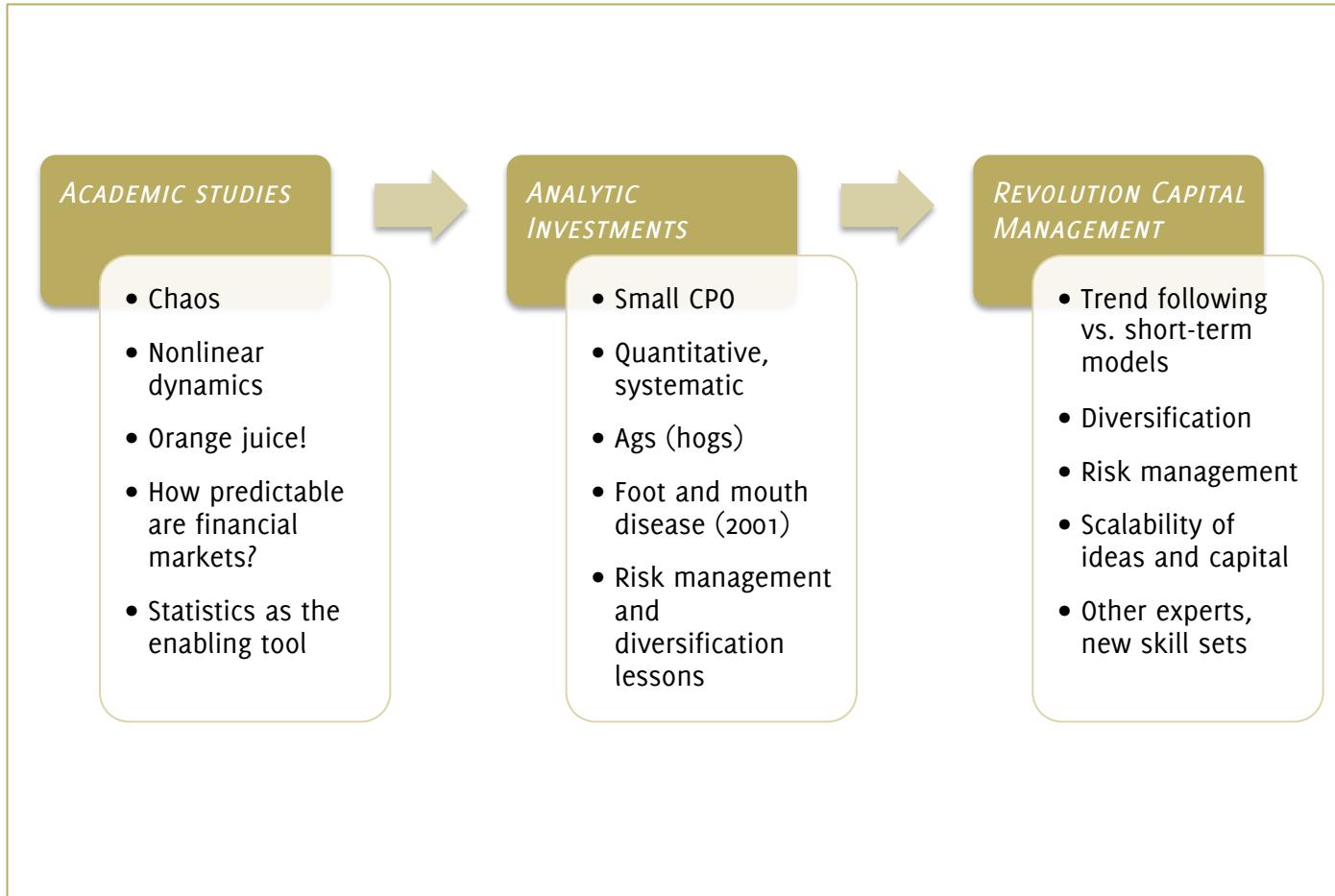
## **MICHAEL DAVID MUNDT**

Michael's tasks primarily consist of model development, business/marketing, and coordinating RCM's overall business and trading strategy. Michael's background is in engineering and applied science. He received his Bachelor of Science degree in Aerospace Engineering from the University of Colorado in 1989. He was awarded a Ph.D. in Aerospace Engineering in 1993, also from the University of Colorado; his thesis involved the exploration of chaos and turbulence in simple weather/climate models. After the completion of his academic studies, Michael transitioned into the technology industry. He was employed by Seagate Technology (a hard-disk drive company) as an engineer specializing in computational fluid mechanics between March 1998 and July 2007. He currently holds nineteen U.S. patents in the area of disk-drive head/disk mechanics. Michael has been registered with the NFA as an Associated Person since 12/27/2004 and has been a listed Principal of RCM since 12/27/2004.

## **THEODORE ROBERT OLSON**

Rob oversees the architecture and development of the hardware and software computing infrastructure at RCM. Rob received his Bachelor of Science degree in Aerospace Engineering at the University of Arizona in 1989. He received his Master's and Doctorate degrees in Aerospace Engineering at the University of Colorado in 1992 and 1996, respectively. Rob was employed at Raytheon Technology, an aerospace defense contractor, from June 1996 through June 2006. His primary job duties included code/software development, data analysis, and the development of statistical algorithms to process high-frequency, real-time data. Rob is familiar with a wide range of computing languages (e.g. Fortran, C, C++, Java), operating systems (e.g. Windows, Linux, Unix, Mac OS X), and application software (e.g. Perl, Matlab, Tcl/Tk). Rob has been registered with the NFA as an Associated Person since 06/19/2008 and has been a listed Principal of RCM since 09/02/2005.

# THE ORIGINS OF REVOLUTION CAPITAL



# Appendix B

## Trading Ideology

# OUR APPROACH

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- People place trades for reasons, and much of the time those reasons are based on analyses of prices and price movements. This has generated an entire field of study known as “technical analysis”.
- Technical analysts have devised a multitude of different indicators to characterize price movements (as well as volume, volatility, etc).
- Further, many technical rules have been formulated that attempt to predict future price movements based on current technical measures.
- These rules have a general form:

IF {indicator} SATISFIES {condition} THEN {action}

# OUR APPROACH

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- As a simple example, consider a “breakout” rule:
  - The **{indicator}** can be defined as the 10-day moving average of close prices minus the 20-day moving average of close prices.
  - The **{condition}** is that the difference must change from negative to positive (i.e. the 10-day crosses the 20-day from below).
  - The **{action}** is to buy (go “long”) if the above condition is met.
- With such technical rule sets, the **{action}** decision is pre-ordained.
- But how do we know this is the correct action?

# OUR APPROACH

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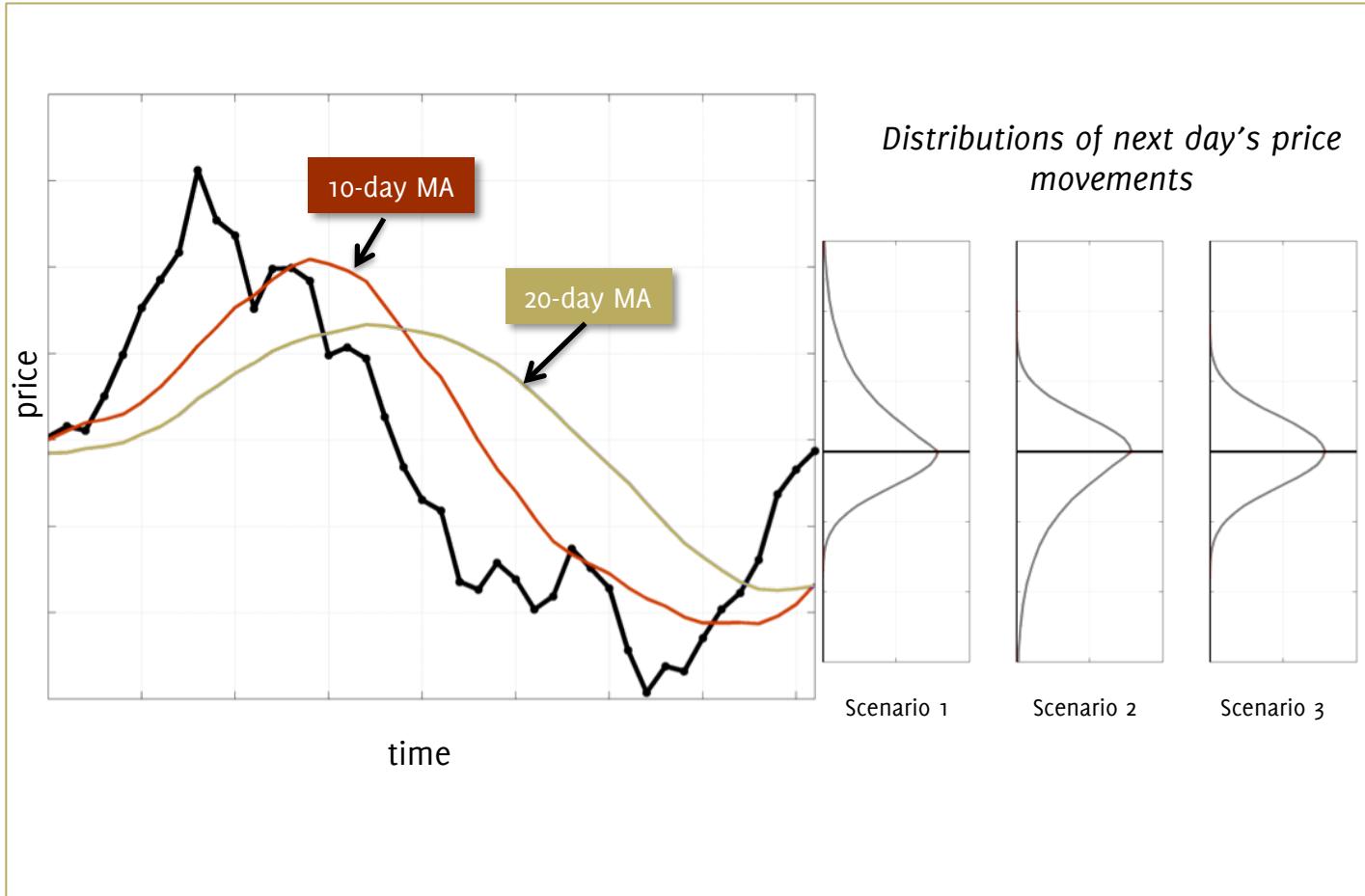
- Generally speaking, there are only 3 possible outcomes:
  - The technical rule has merit, and the 10-20 day crossover does indicate a continuing upward trend.
  - Some people believe in the rule, and others prey off of these believers. In other words, they wait for the buyers relying on the rule to pile in on the long side and then overwhelm the market with sell orders once the buying has been exhausted.
  - Everyone knows the rule, so therefore no one can profit off of it. Thus, the 10-20 day crossover has no significance whatsoever.

# OUR APPROACH

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- RCM's approach is completely agnostic.
  - We start with an array of technical indicators as inputs.
  - However, we let historical data, *not* technical rules, dictate the action that we take.
  - If the markets are random (scenario 3), then no significant signals can be found.
  - However, if either of the other two scenarios (scenarios 1 and 2) shows a significant non-random response, our system will be trained to respond to both.
  - We do this by looking through historical data for statistical biases in price movements, conditioned on technical indicator values.

# OUR APPROACH



# SUMMARY OF OUR APPROACH

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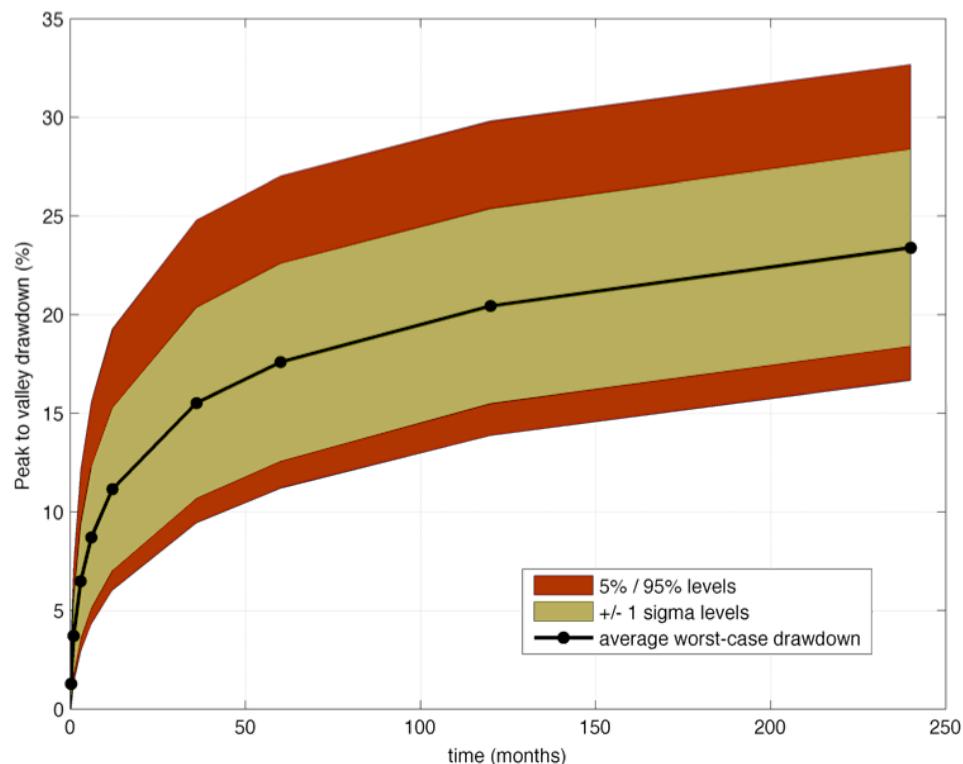
- Markets are not entirely efficient. Rule-based trading by the trading community at large generates patterns.
- RCM uses technical indicators as the starting point to identify instances when patterns are likely to exist.
- These patterns can be uncovered with a rigorous systematic, statistical approach.
- Trading algorithms are then created to react to these patterns.
- Alternate (and equivalent) interpretation is that of an asymmetric risk/reward situation.

# Appendix C

## Risk Management

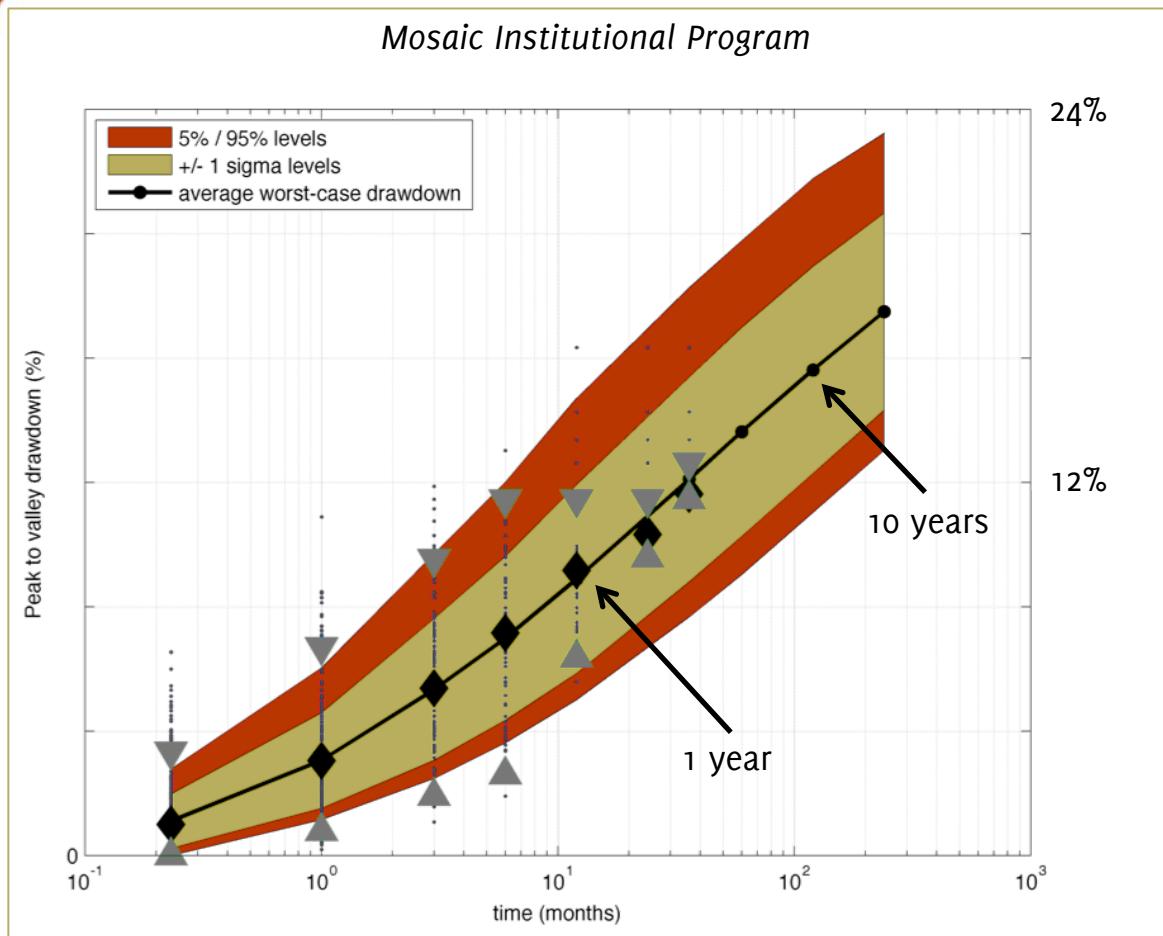
# DRAWDOWN EXPECTATIONS

*Distributions of worst observed peak-to-valley drawdown in any N-month period  
(for Sharpe=1.5, 15% annualized volatility)*



- RCM uses Gaussian-based Monte Carlo simulations as the starting point for risk estimation.
- We have no expectation for under-drawing since we don't exploit trend following.
- Gaussian simulations are reasonably accurate for 20+ days.
- These simulations help tie together volatility and risk.

# DRAWDOWN REALIZATIONS



- 3.5 years of empirical data shows excellent agreement with Monte Carlo expectations
- Black dots: empirical samples
- Black diamonds: empirical means
- Gray triangles: empirical 5% and 95% levels

# Appendix D

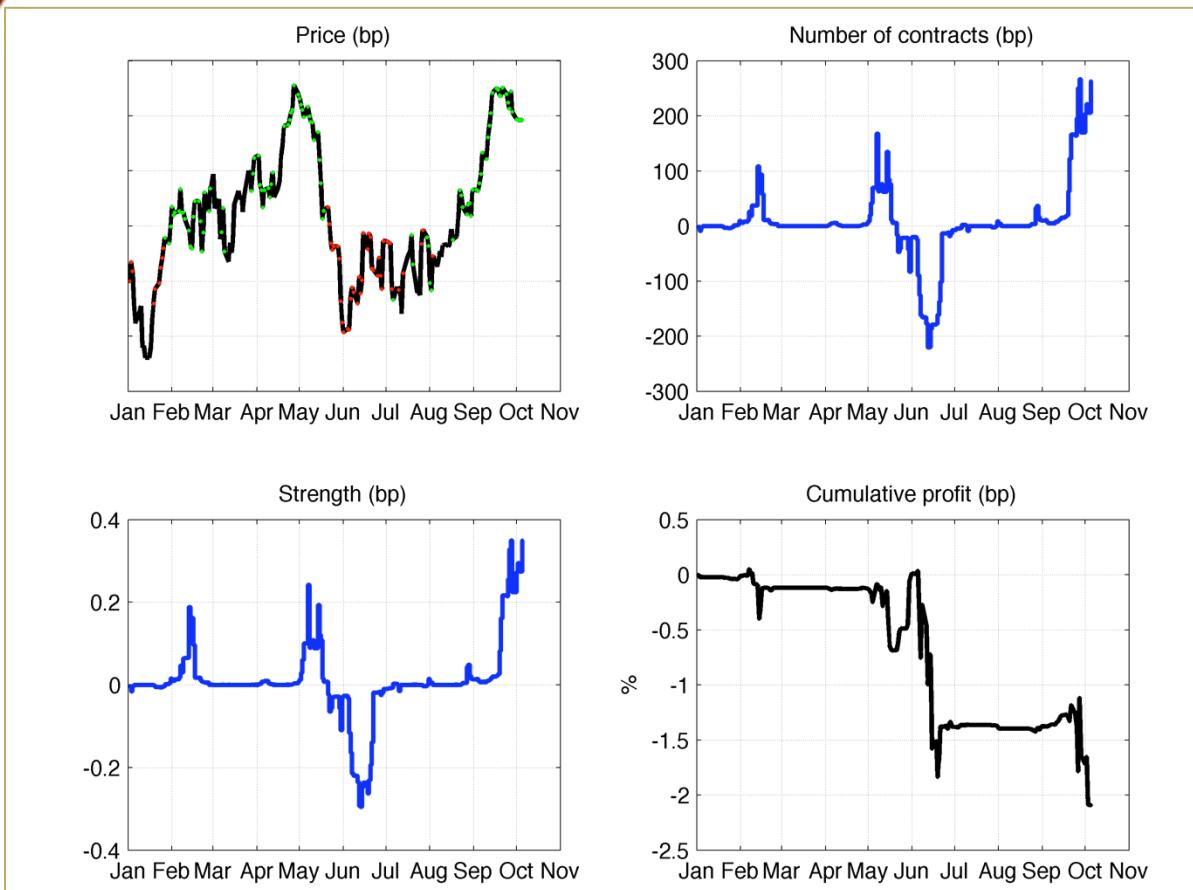
Example trades (Alpha Program, 2012)

# SUMMARY

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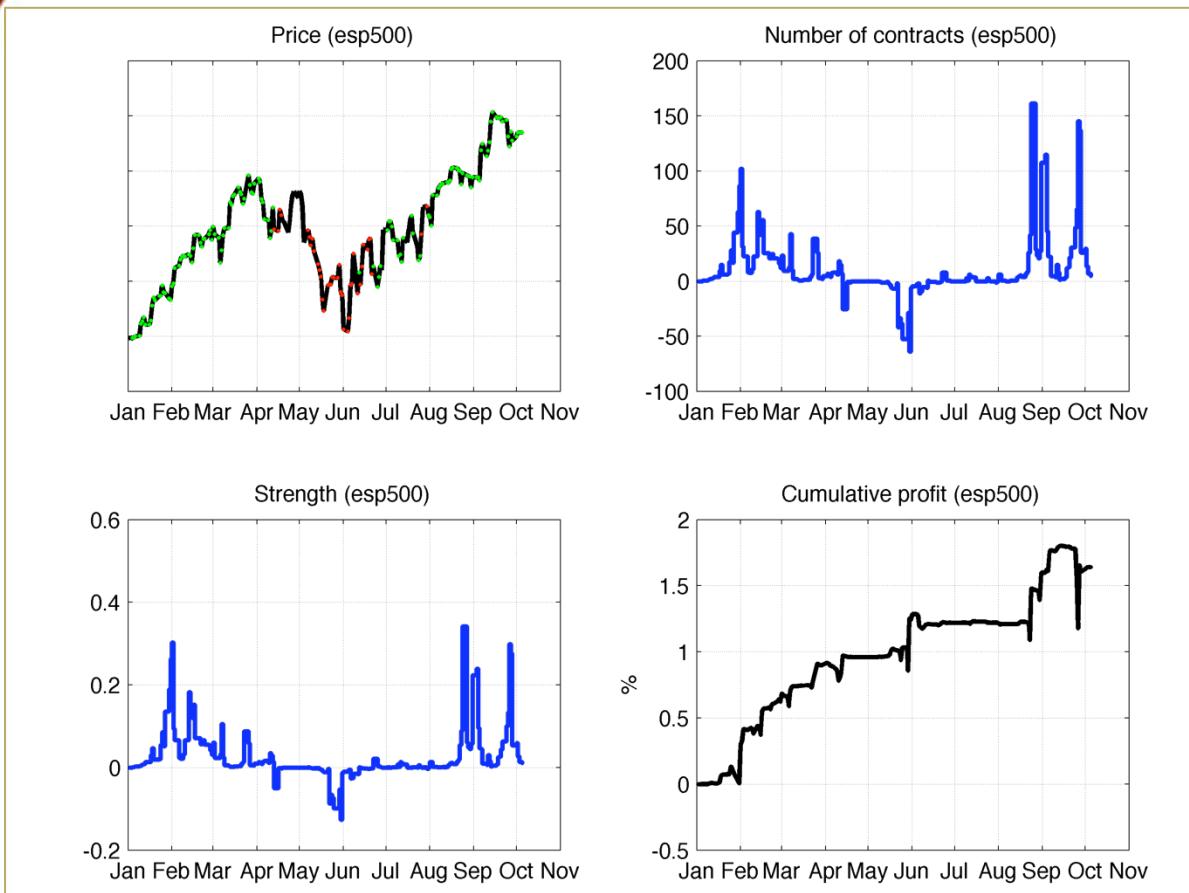
- Examples are shown for five markets during 2012: British pound, S&P 500, Euro Bund, Soybeans, and Wheat.
- Each figure shows price history with longs and shorts superimposed using green and red dots, respectively.
- The degree of long or short is shown both by the strength history and the position size in contracts (for a \$20 million reference account).
- The large number of input signals generate fairly complex position strengths versus time.
- The cumulative profit history is also shown in the bottom right-hand corner.
- Each figure has annotations on the right-hand side to highlight the specific dynamics that generated significant positions.

# BRITISH POUND



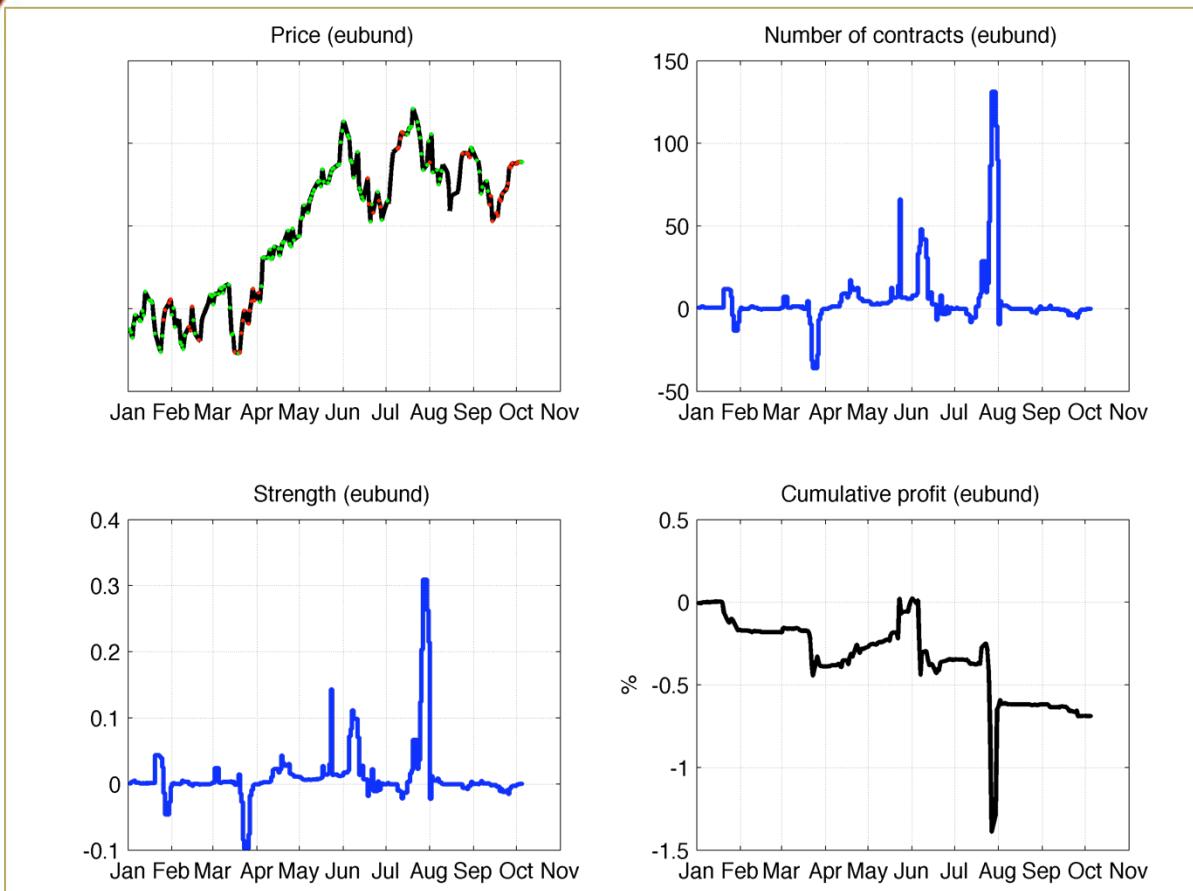
- The price choppiness led to mixed long/short positions during May.
- The model was biased to the short side and was unprofitable in mid-June.
- In late September, a long bias was also unprofitable as prices again reversed.

# E-MINI S+P 500



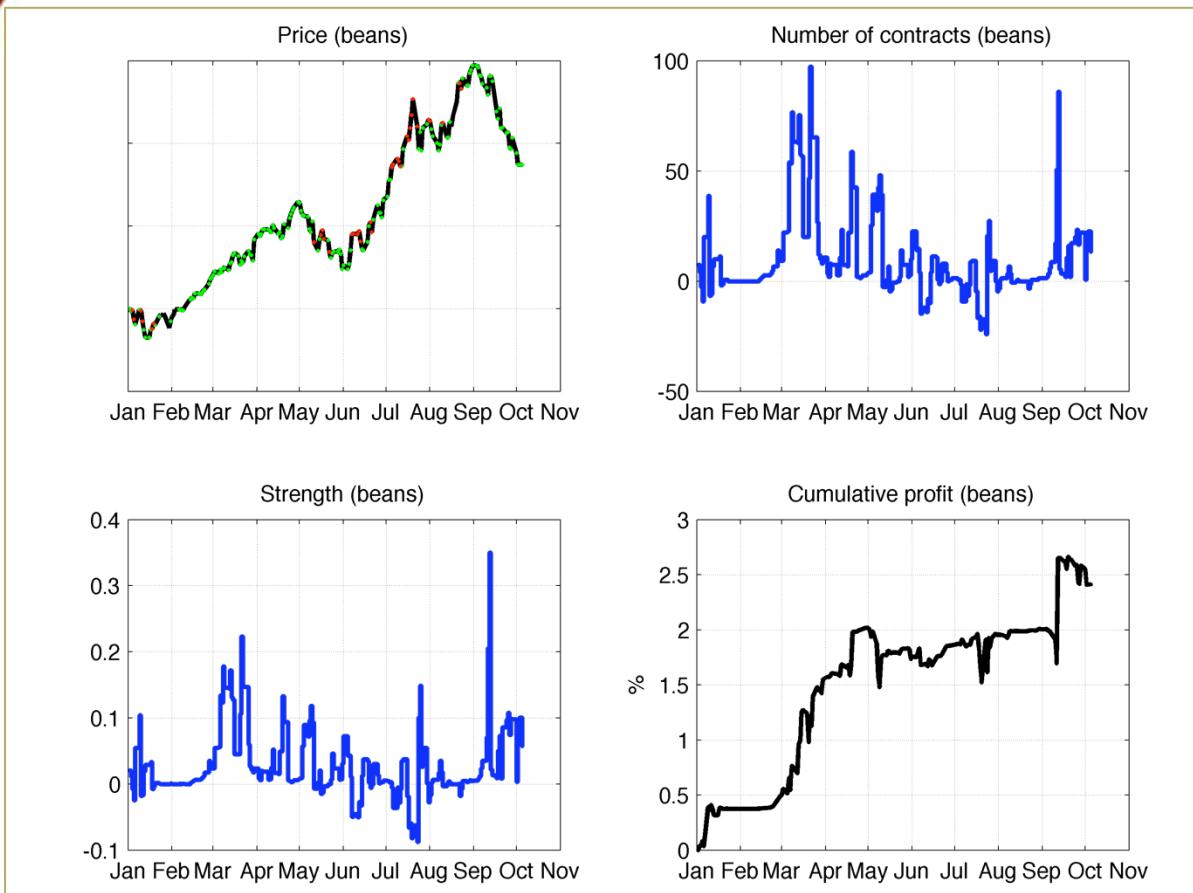
- The choppy upward trend during January to March resulted in intermittent and profitable long positions.
- The model re-biased to the short side in May and entered a profitable short position in late May.
- The system did not give back any profits during the larger reversals.

# EURO BUND



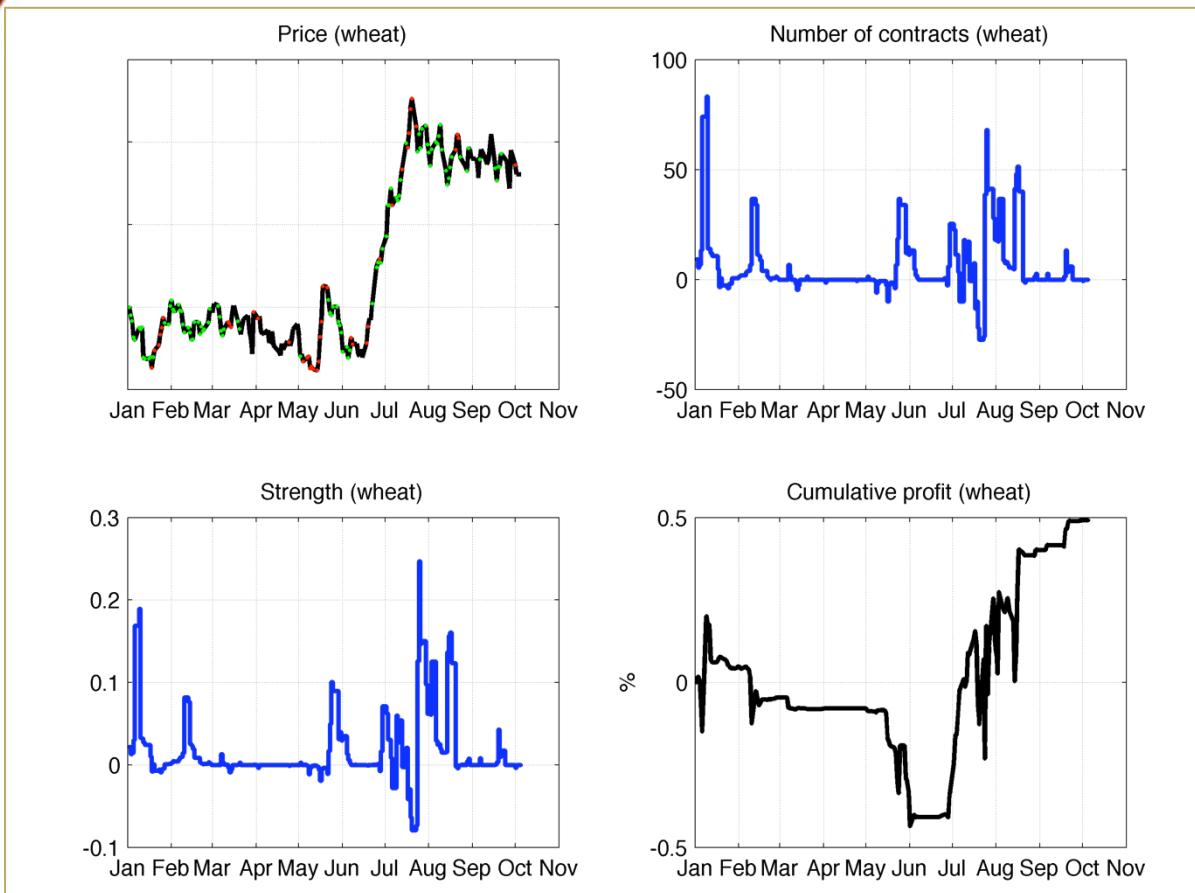
- The Alpha program was long throughout April and May but the strength was very low due to a consistent upward trend.
- Long positions were taken in June and late July after corrections to the upward trend.
- These positions were eventually exited for a loss.

# SOYBEANS



- The Alpha program was largely long as a result of a continuing upward trend, but strength was highly intermittent.
- Short positions (against the long-term trend) were taken in July as a result of trend steepening.

# WHEAT



- The Alpha program took short counter-trend positions in mid-May and intermittently in July.
- After the mid-year price run-up, the program took long positions during Aug-Oct due to newly-established upward price trend.