

Algorithmic Trading Systems

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Overview

Background

- Motivation
- Market moving events
- Market psychology
- Evolution of trading
- What assets can be traded?
- High frequency trading
- Dark pools

Overview (cont.)

Technical Analysis

- Fundamental vs technical analysis
- Supply/demand
- Chart reading
- Trend analysis
- Technical indicators
- Moving averages
- Market sectors

Overview (cont.)

Trading Systems

- Trade criteria
- Money management
- Trade management
- Trading strategies
- Trading systems design

Overview (cont.)

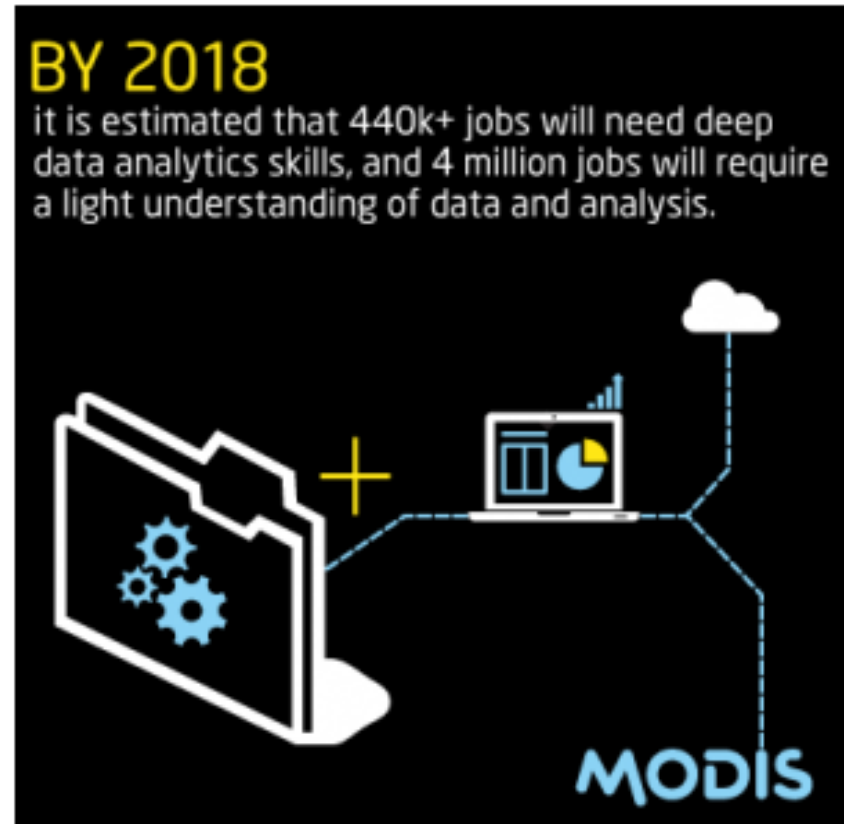
Next Steps

- Research opportunities
- Personal growth as a trader
- Trading books
- Trading education
- General references
- Conclusions and comments

Background

Motivation #1: Job Opportunities

- Professional opportunities span multiple fields — e.g., finance, healthcare and high tech.
- Data scientists are in high demand but short supply.
- Average salaries are much higher for data scientists who are skilled in data analysis and financial systems



Motivation #2: Personal Investing

- 1929
-
-
-
- 1987
- 1994
- 2001
- 2008
- 2015 !!

7 year cycles!



\$INDU - Monthly US L=15628.53 188.30 1.22% B=15623.32 A=15627.43 O=15443.83 Hi=15 ...



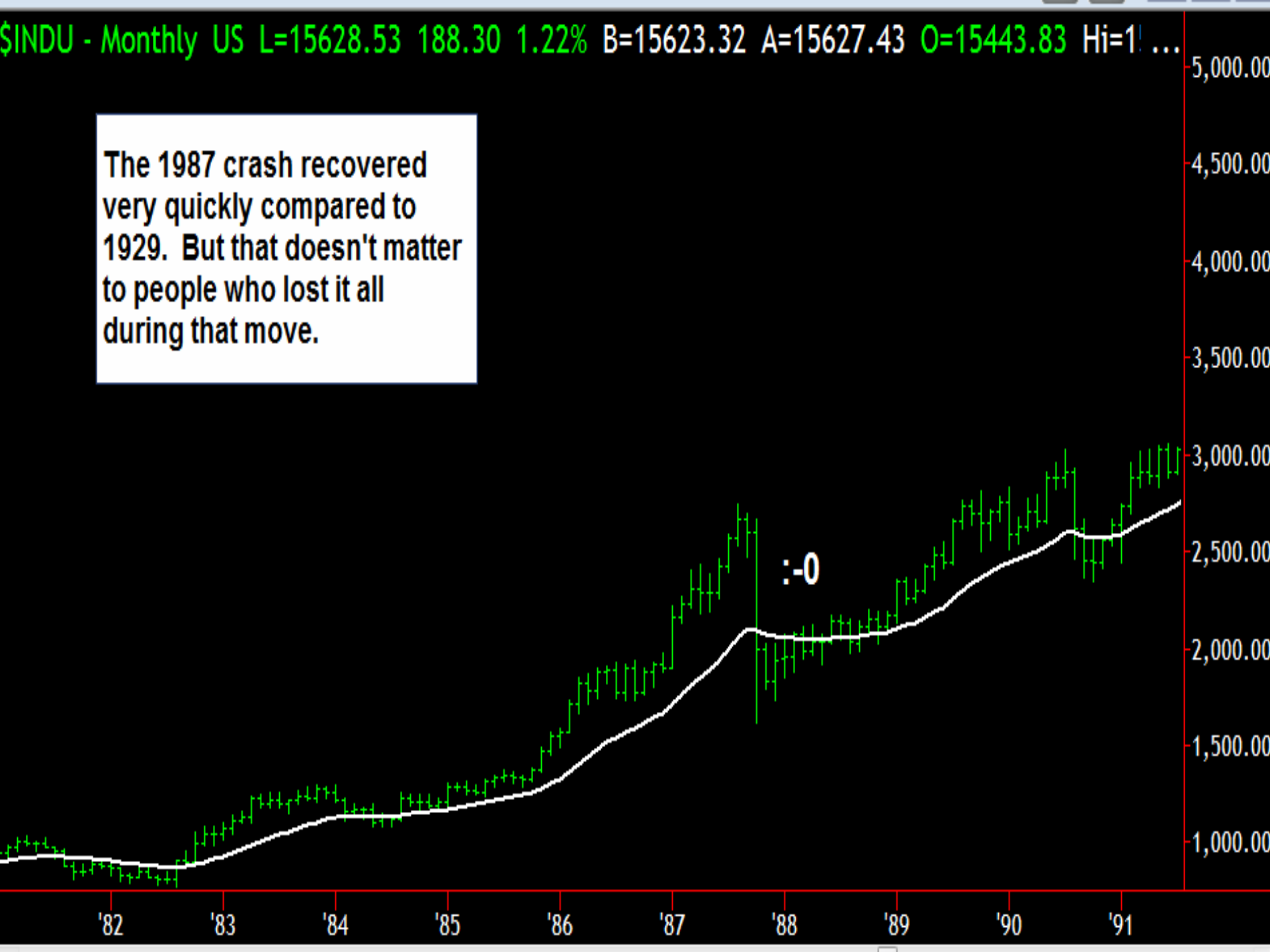
5 years up

5 years down

The Crash of 1929. Buying the dip worked awesome . . . right up until it didn't.

\$INDU - Monthly US L=15628.53 188.30 1.22% B=15623.32 A=15627.43 O=15443.83 Hi=1...

The 1987 crash recovered very quickly compared to 1929. But that doesn't matter to people who lost it all during that move.

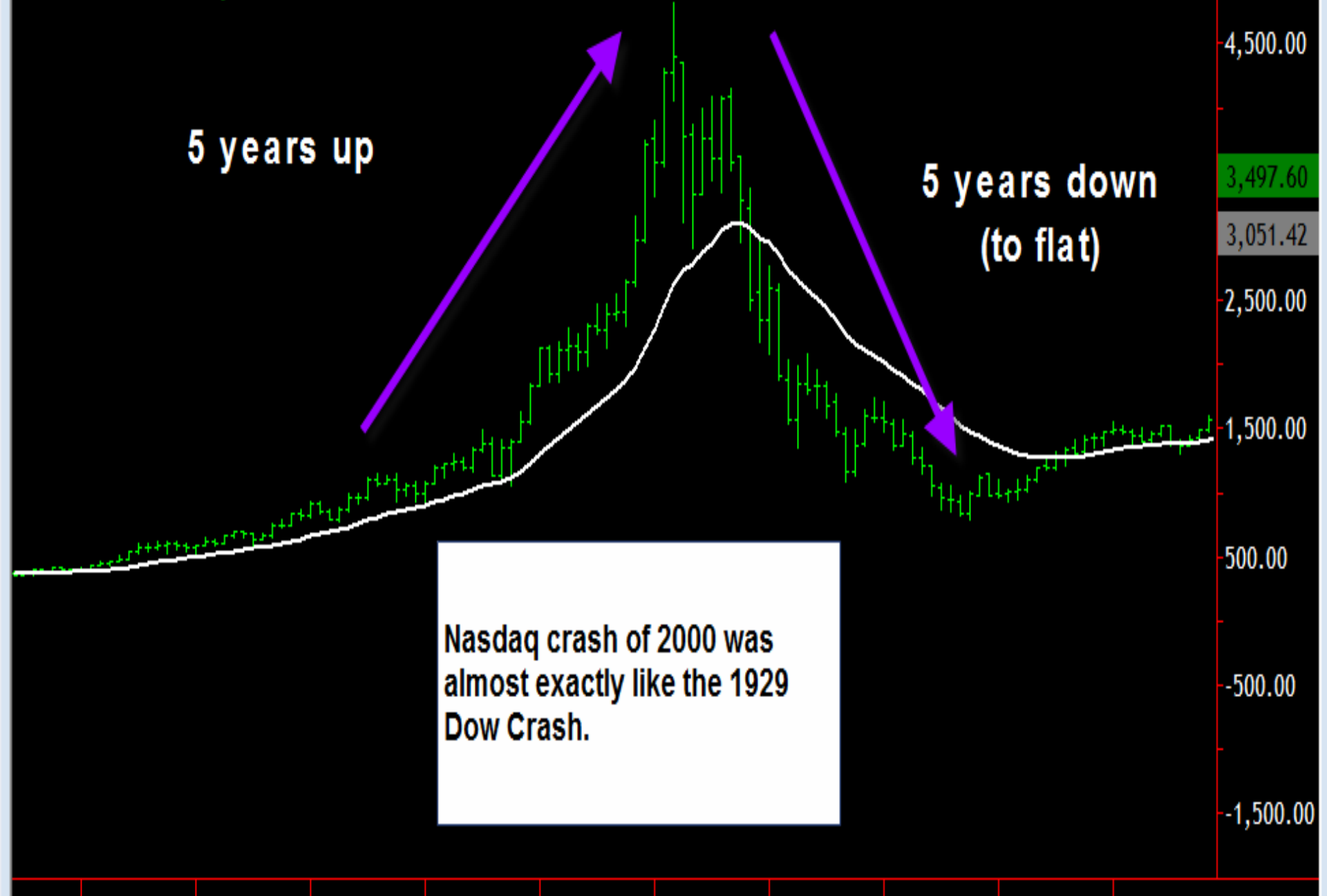


\$NDX.X - Monthly NASDAQ L=3497.60 42.70 1.24% B=0.00 A=0.00 O=3465.83 Hi=3502.52 ...

5 years up

5 years down
(to flat)

Nasdaq crash of 2000 was almost exactly like the 1929 Dow Crash.

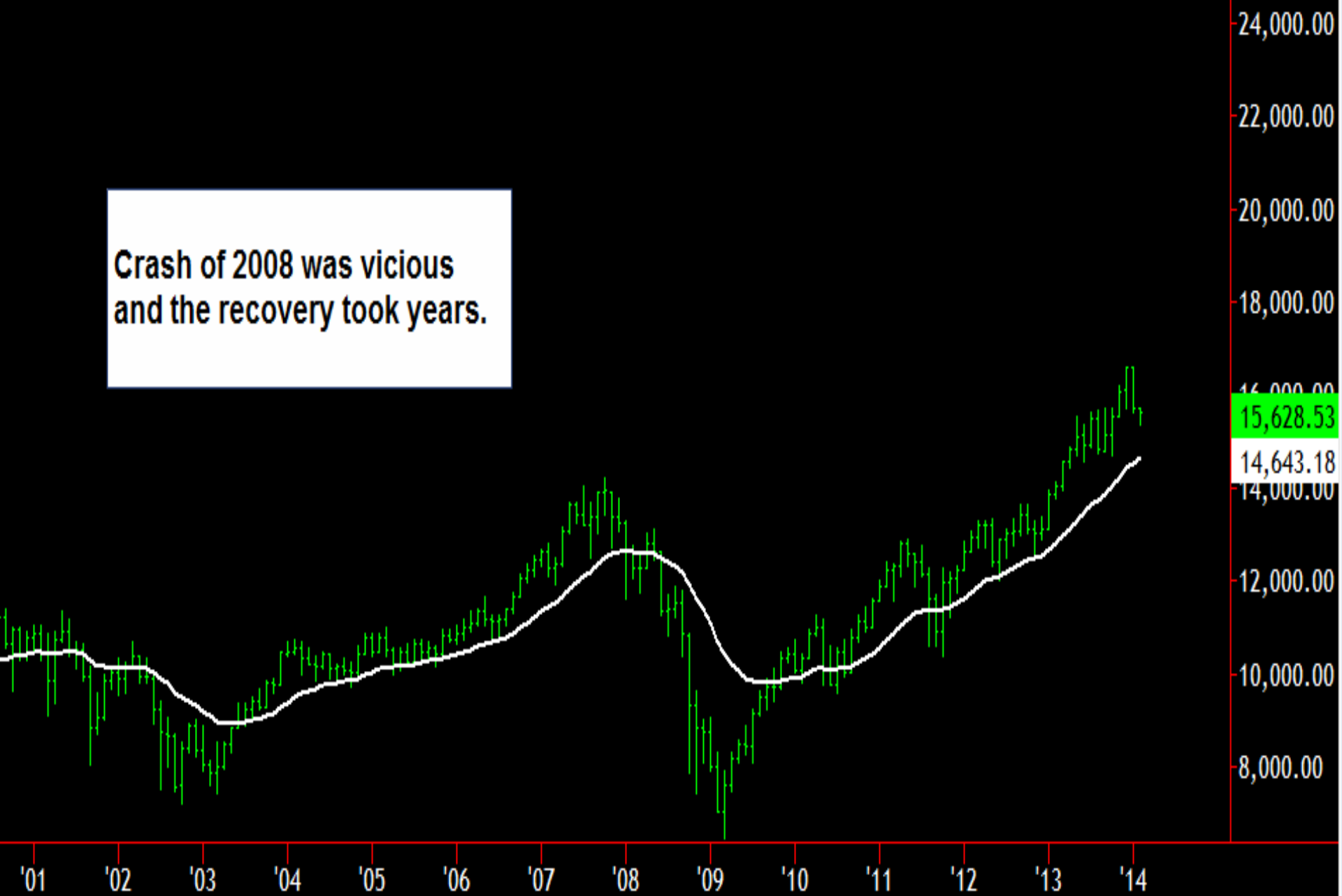


4,500.00
3,497.60
3,051.42
2,500.00
1,500.00
500.00
-500.00
-1,500.00

'95 '96 '97 '98 '99 '00 '01 '02 '03 '04

SINDU - Monthly US L=15628.53 188.30 1.22% B=15623.32 A=15627.43 O=15443.83 Hi=' ...

Crash of 2008 was vicious
and the recovery took years.



24,000.00
22,000.00
20,000.00
18,000.00
16,000.00
15,628.53
14,643.18
14,000.00
12,000.00
10,000.00
8,000.00

'01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14

Buy and Hold?

Closing Price
20-ATR Trailing Stop

AIG

10-Nov-2010
© alltimehighstocks.com



Motivation #3: Research

- Pattern recognition of time series
- Intelligent system technologies
 - Fuzzy/neural systems
 - Machine learning
 - Evolutionary algorithms
 - Collaborative agent systems
 - Evolving structure systems
- High speed computing architectures
- Decision support for human traders
- Algorithm development
- Automated trading systems



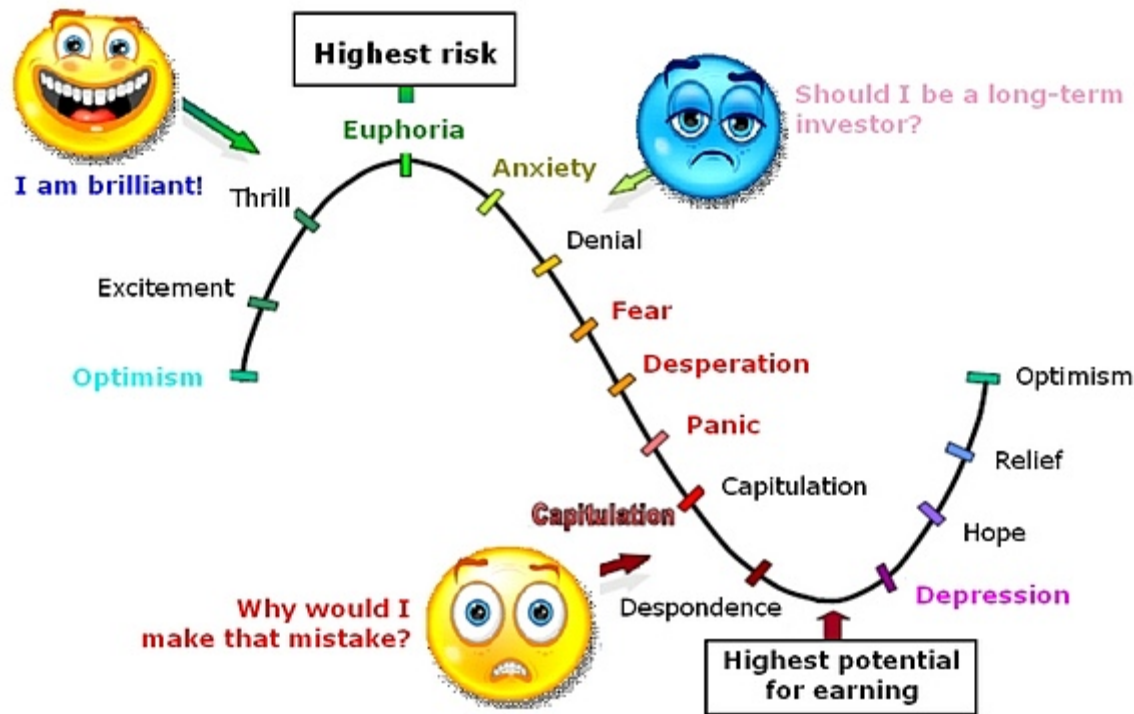
What Moves the Markets?

- Publicly available news
- International conflicts
- Fundamental analysis of a company's value
- Market manipulation by central banks
- Macro-economic reports
- Upgrades and downgrades of companies
- Human perception and emotion

“Macroeconomic news bearing on fundamental values ... explains only about one-fifth of the movement in stock prices”

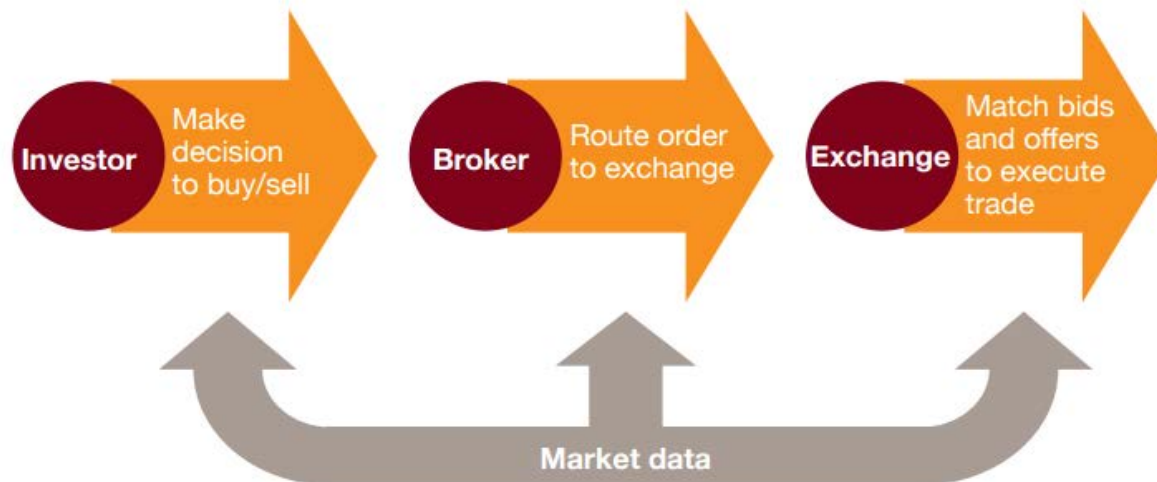
David M. Cutler, James M. Poterba, and Lawrence H. Summers, “What moves stock prices?” *Journal of Portfolio Management*, Spring 1989.

Novice Traders Are Emotional Slaves Trying to Make Predictions



Evolution of Trading

- Computerization of order flow began in early 1970s
- Full electronic execution of the NASDAQ started in 1990
- Pit trading vanished from most exchanges
- Conversion from fractional reporting of stock prices on the NYSE to decimals greatly improved liquidity.
- 2001 study by IBM showing that algorithms outperformed human traders



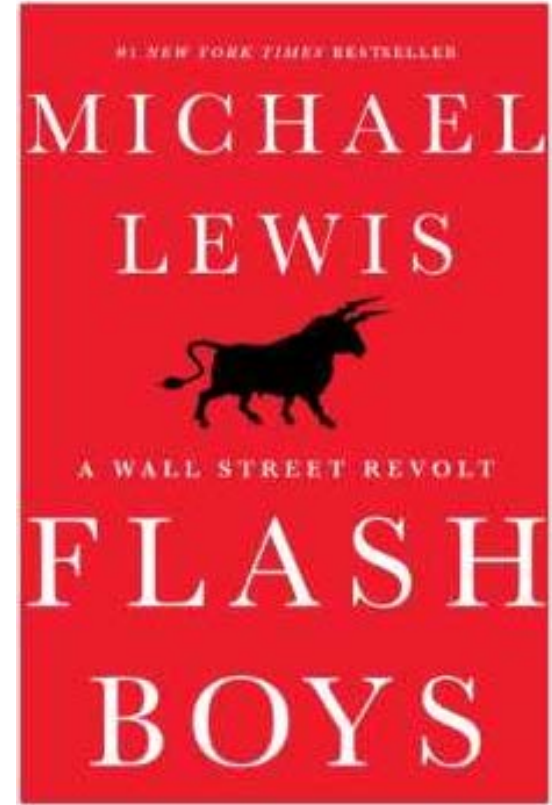
Algorithmic Trading

- Use of electronic platforms for entering orders with an algorithm that executes pre-programmed instructions for timing, price, and quantity of the order.
- Basic algorithms use linear regression, game-theoretic, and predictive models. Machine learning, neural networks, and genetic algorithms are also useful.
- Some algorithms use historical prices and volumes of equities. Some scan news to identify trends.



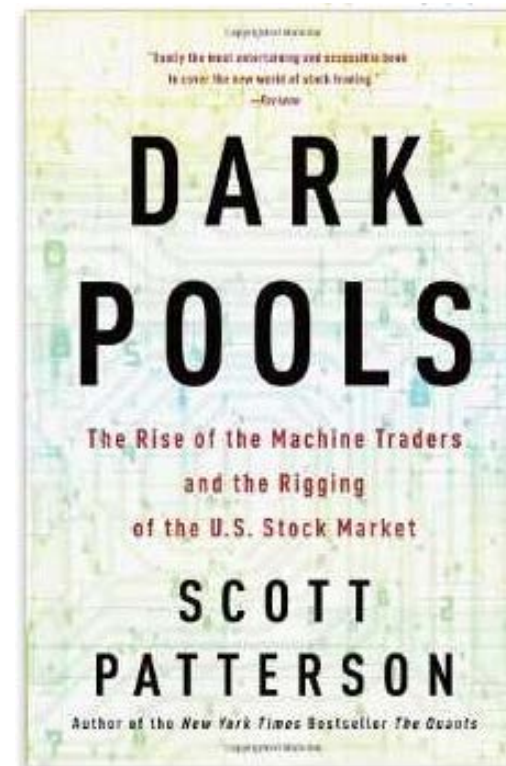
High Frequency Trading

- Use of extraordinarily high-speed networks, computers, and programs for generating, routing, and executing orders
- Use “co-location” services and individual data feeds offered by exchanges and others to minimize network and other types of latencies
- Submit numerous orders that are canceled shortly thereafter
- End the trading day as close to a flat position as possible



Dark Pools

- Dark pools are a form of alternate trading system. They are used by institutional traders to execute large trades with as little market movement as possible.
- Dark pools are regulated as broker-dealers rather than as exchanges.
- Trades are not displayed to other market participants and are matched anonymously.
- Once trades are executed, however, they are immediately reported to the consolidated tape, which provides public post-trade transparency.



Trading Pits at the CME prior to 2015



... Nasdaq Electronic Exchange



What Assets can be Traded?

- Stocks
- Commodities
- Bonds
- Exchange Traded Funds (ETFs)
- Options
- Futures
- Forex pairs



Technical Analysis

Market Analysis

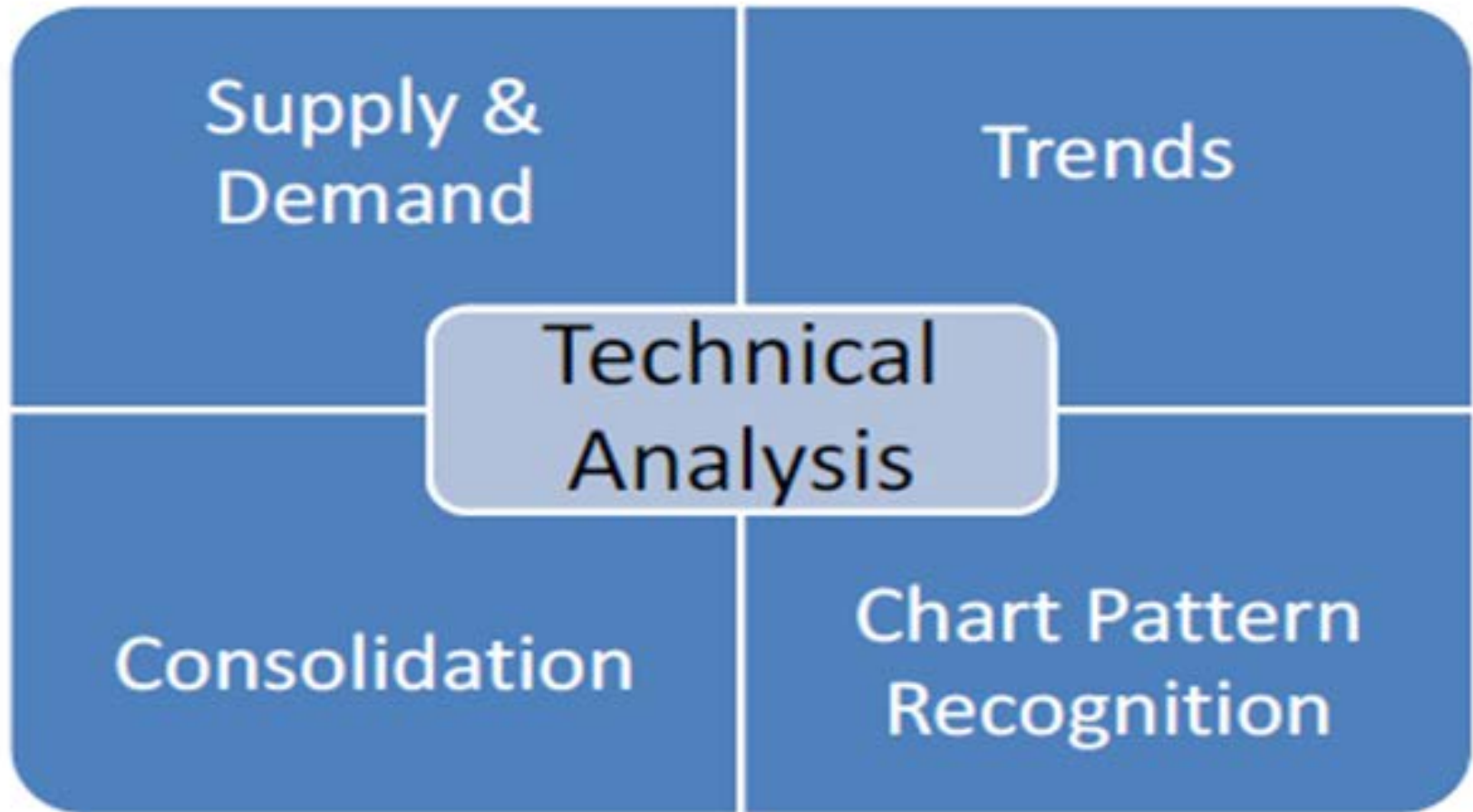
Fundamental Analysis

- What the stock should be worth

Technical Analysis

- What the stock is worth

Four Aspects of Analysis



Supply/Demand



The diagram consists of two large blue arrows pointing in opposite directions, one to the left and one to the right, meeting at a central point. A white callout box with a blue border is attached to the left arrow, and another white callout box with a blue border is attached to the right arrow. The callout boxes contain text and bullet points.

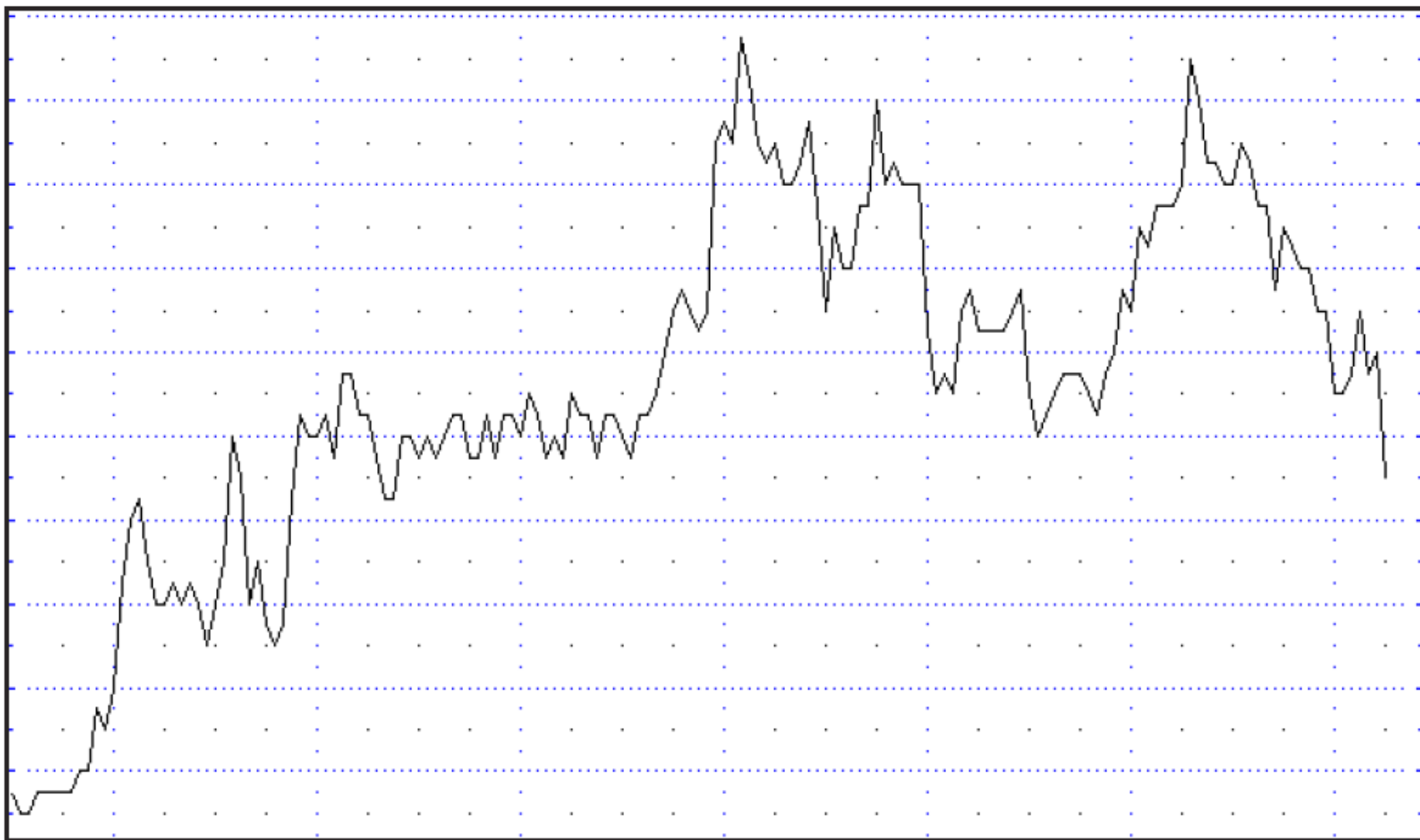
Support = Demand

- Demand is greater than supply
- Price goes up.

Resistance = Supply

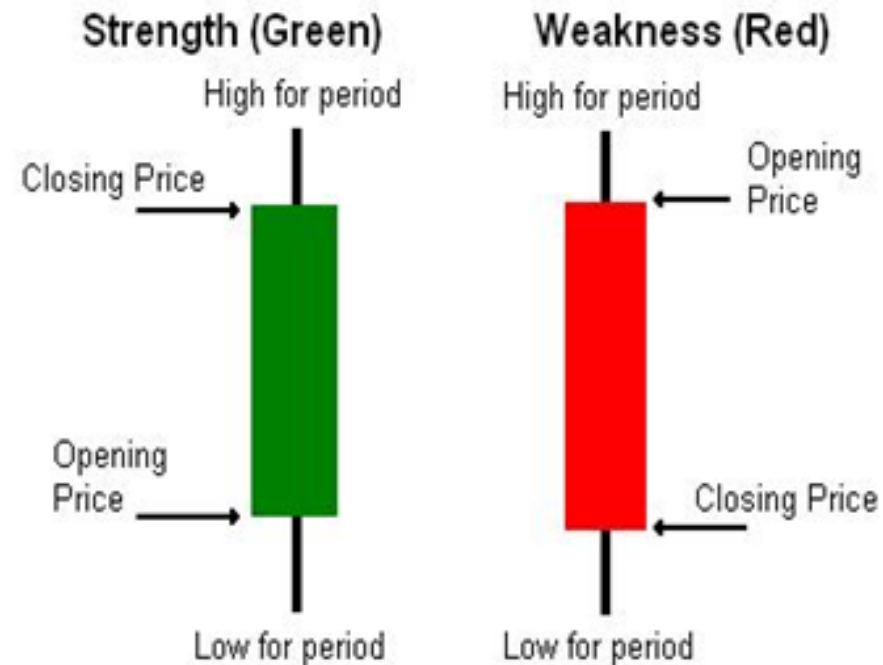
- Supply is greater than demand
- Price goes down.

Line Chart



Japanese Candlestick Charts

- Ancient method of technical analysis developed by Japanese traders in 1600's to trade rice contracts
- Homma Munehisa is often referred as "*The Father of The Japanese Candlestick Charting*".
- He reasoned that studying the emotions of the market could help in predicting prices.
- He understood that there was a difference between the value of rice and its price.



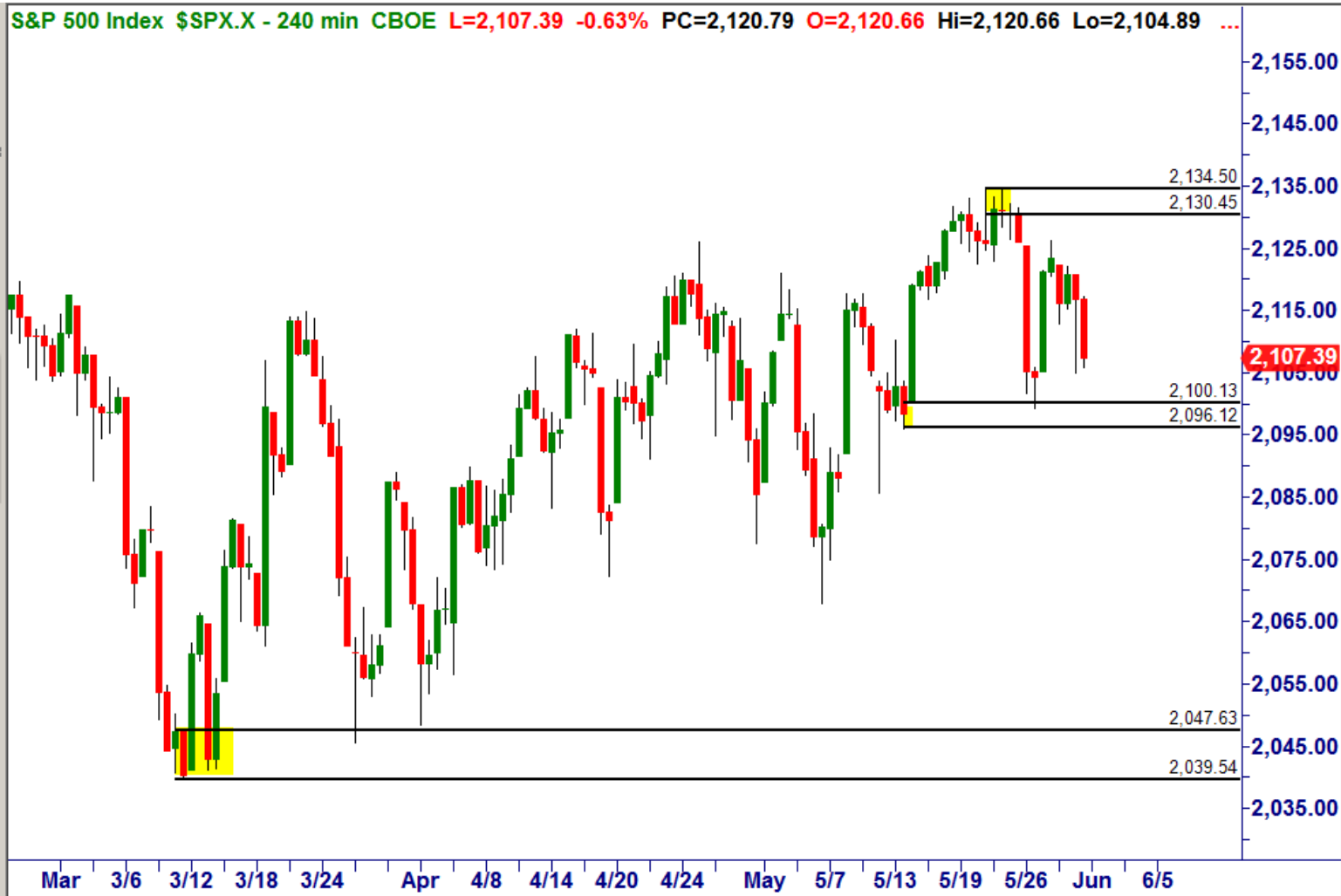
Trend Analysis



Consolidation



Supply and Demand



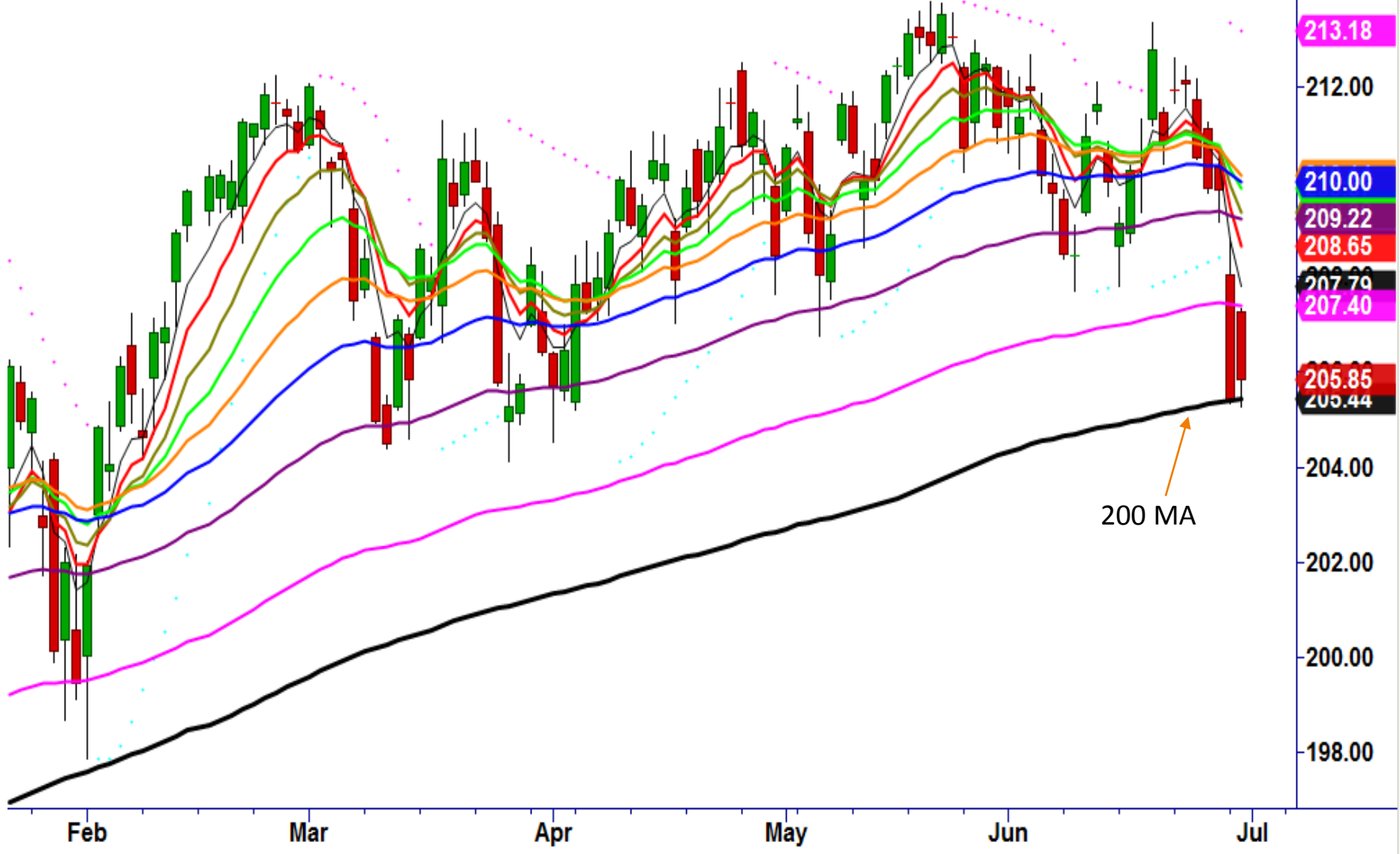
Technical Indicators

- Average volume
- **Average true range**
- Put/call volume
- **Implied volatility**
- **Moving averages**
- **RSI, MACD, CCI, ADX**
- Oscillators
- Parabolic SAR
- **Fibonacci price retracements and projections**
- Fibonacci time extensions
- Elliott waves and Gann levels
- Bollinger bands
- Linear regression channel
- Keltner channels
- **TTM Squeeze** and waves

Moving Averages

- Line representing the average price over a fixed period
- Strength of trend is determined by price above, below, or near a key moving average
- Can act as
 - Entry points
 - Trend indicators
 - Exit points
 - Dynamic support and resistance
- Slope of moving average determines trend direction

SPY - Daily L=207.54 1.69 0.82% V=118,698 Mov Avg Exponential (Close,89,0) 209.22 Mov Avg Expor ...

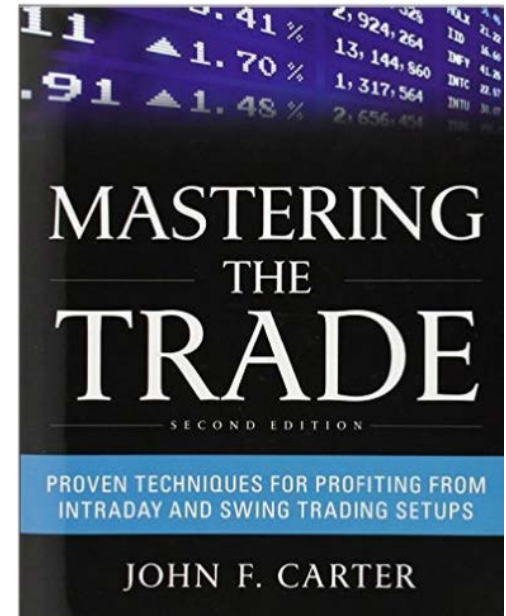




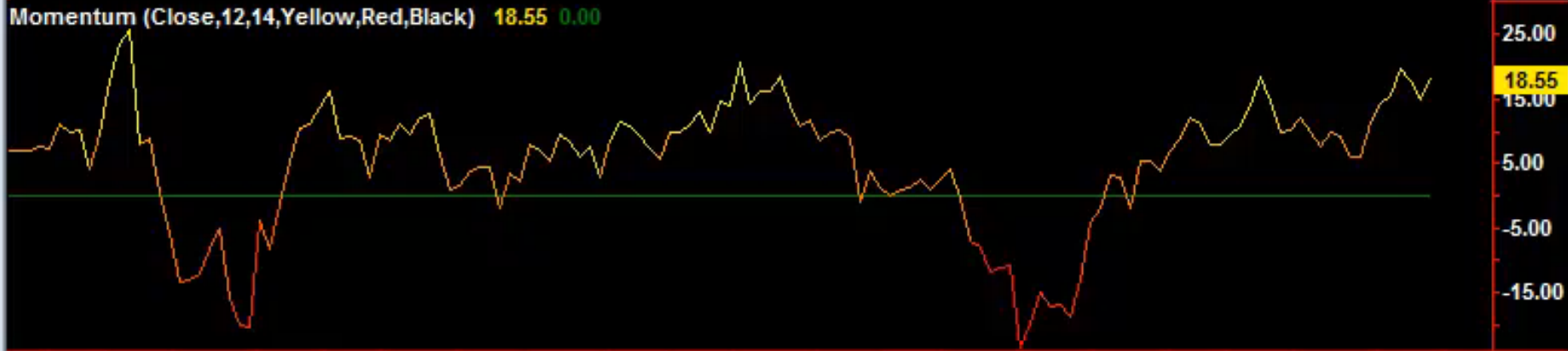
Daily Chart of SPY. Is there any clue here that SPY was about to release built up energy to the upside?

Squeeze Indicator

- Proprietary technical analysis indicator developed by John Carter
- Provides advance warning that a large change in price may occur
- Uses three indicators
 - *Bollinger Bands*, based on a standard deviation move in price from the mean
 - *Keltner Channel*, based on a volatility move in price from the mean
 - *Momentum Indicator*, based on the velocity of price changes for a fixed time interval



AAPL - 60 min NASDAQ L=567.60 15.60 2.83% B=567.62 A=567.85 O=557.54 Hi=568.18 Lo=555.75 V=24,568,258 Bollinger Bands (Close, ...

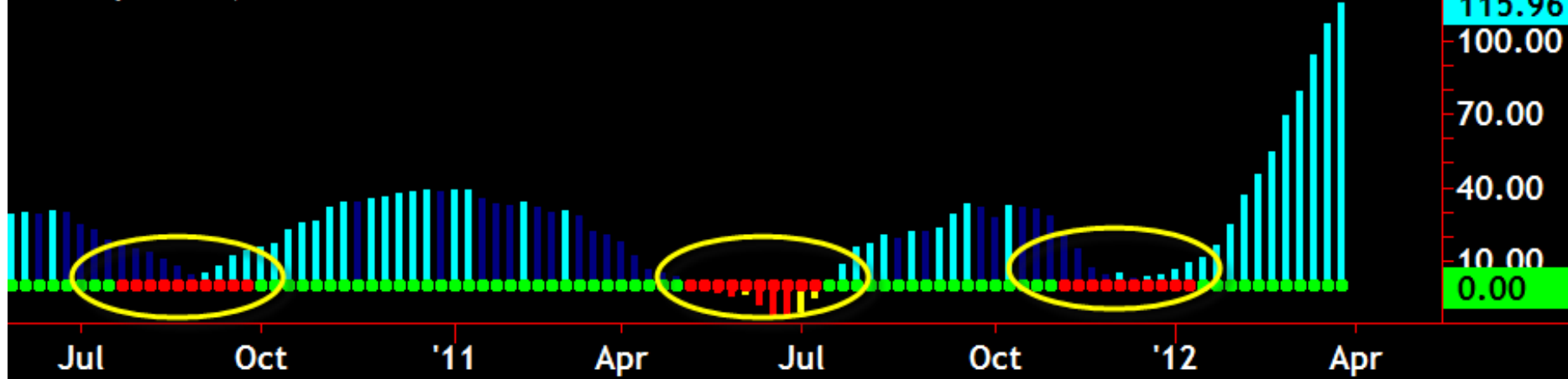


2/14 2/15 2/16 2/17 2/21 2/22 2/23 2/24 2/27 2/28 2/29 Mar 3/2 3/5 3/6 3/7 3/8 3/9 3/12 3/13 3/14

AAPL - Weekly NASDAQ L=631.55 7.24 1.16% B=631.49 A=631.55 O=626.98 Hi=634.6 ...

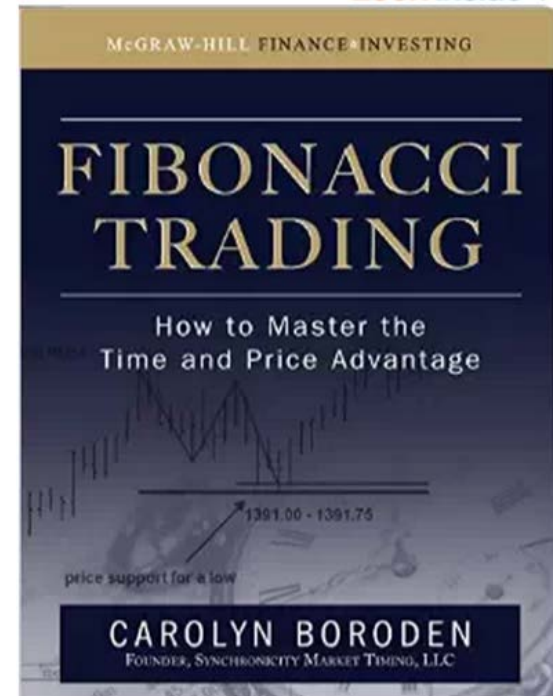


TTM Squeeze (Close, 1, "Futures=1 Stocks=2 FX=3", 20, 1.5, 2, ... 0.00 115.96

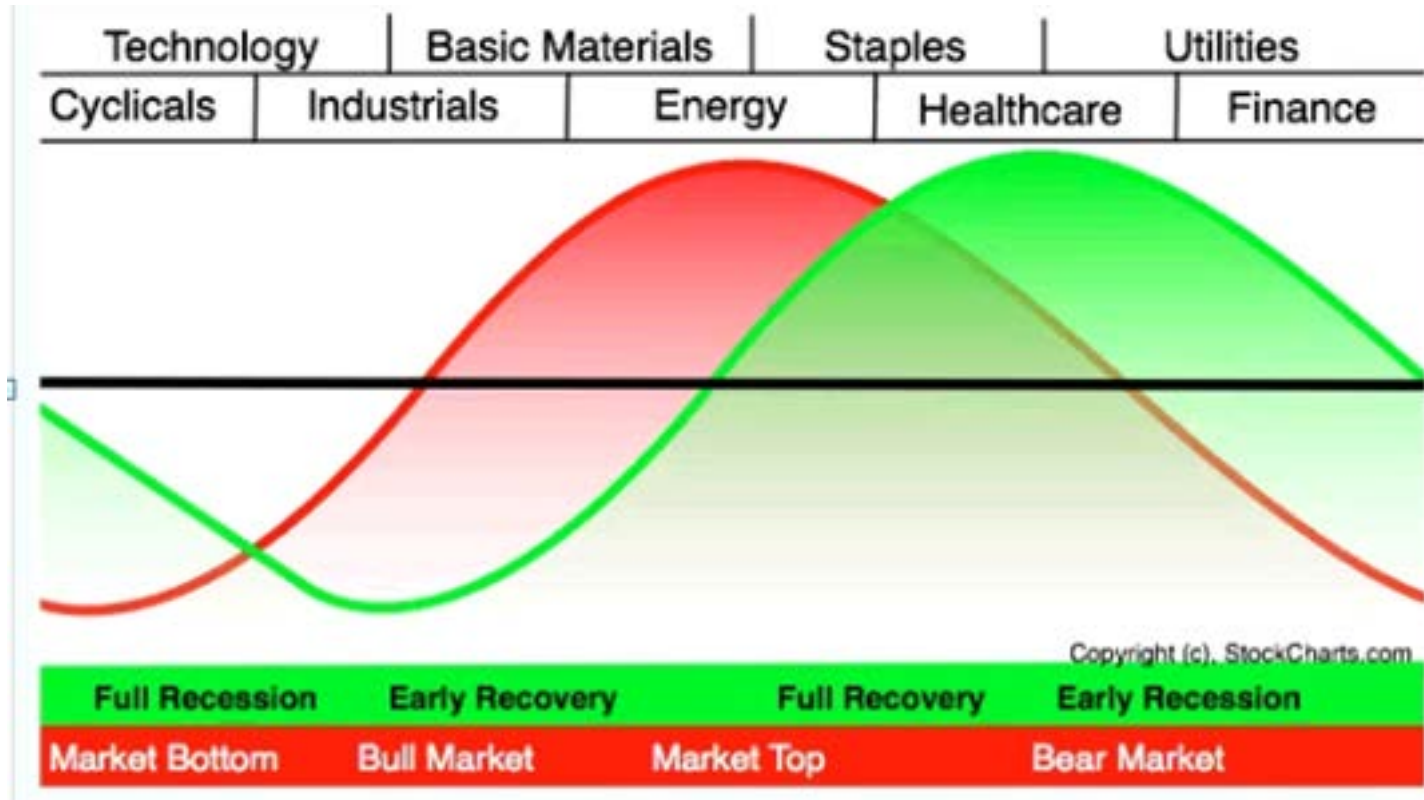


Fibonacci Levels

- Presented in the book *Liber Abaci* by Leonardo Fibonacci in 1202
- Known to Indian mathematicians during 6th century
- Fibonacci sequence is 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610 , ...
- Retracement can be measured by taking the high and low points on a chart and marking the key Fib ratios of 38.2%, 61.8%, and 78.6%.
- 50% is a key reversal level, but not a Fib level
- Targets can be measured using the Fibonacci extensions 127.2% and 161.8%



Sector Rotation Model



Select Timeframe **1D** 5D 1M 3M 6M **YTD** 1Y 5Y

Sector SPDR Fund	% Change
S&P 500 Index	-3.40%
Consumer Discretionary (XLY)	+4.73%
Consumer Staples (XLP)	-1.75%
Energy (XLE)	-16.95%
Financials (XLF)	-4.45%
Health Care (XLV)	+5.00%
Industrials (XLI)	-8.54%
Materials (XLB)	-10.25%
Technology (XLK)	-1.81%
Utilities (XLU)	-8.62%

<http://www.sectorspdr.com/sectorspdr/tools/sector-tracker>

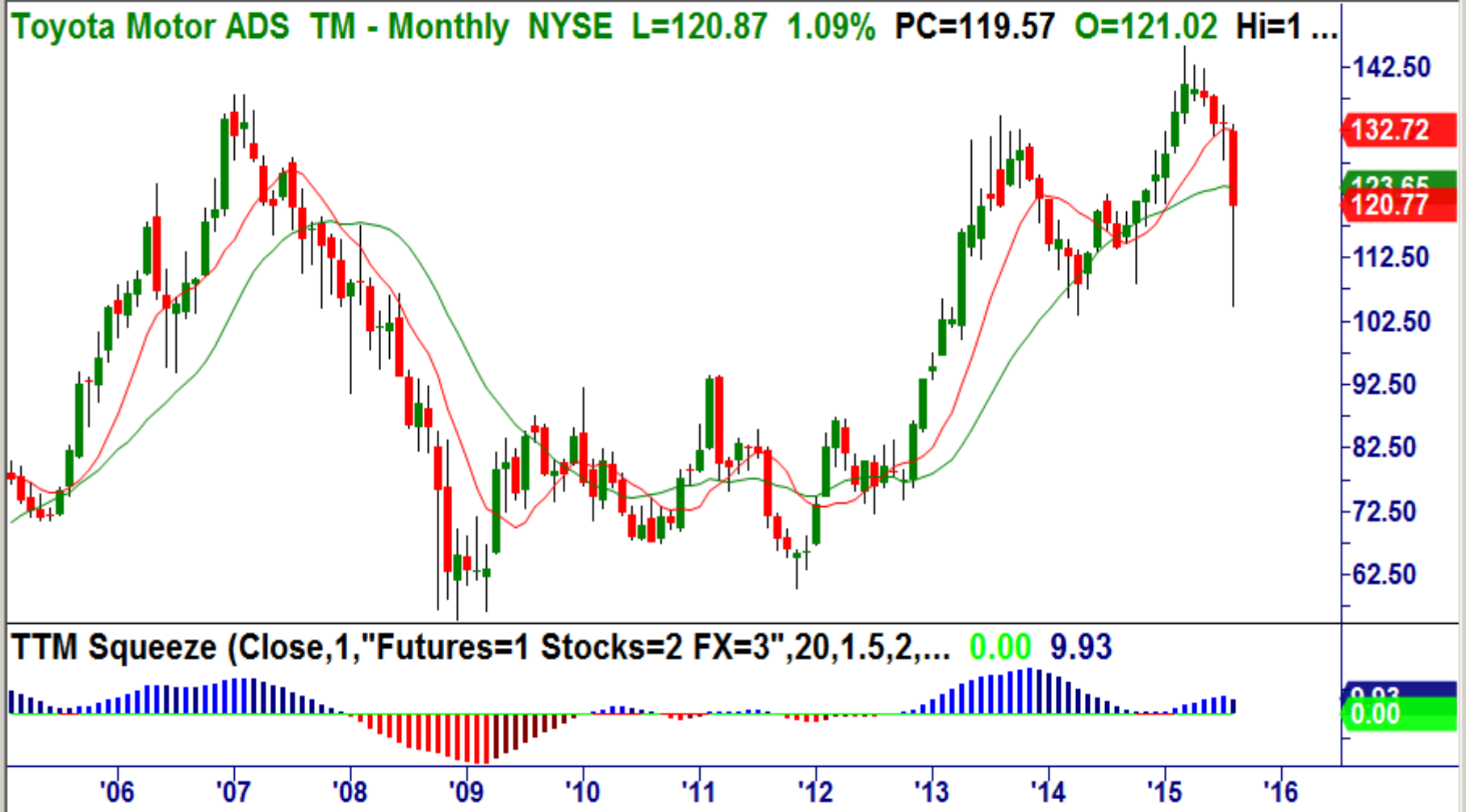
Apple



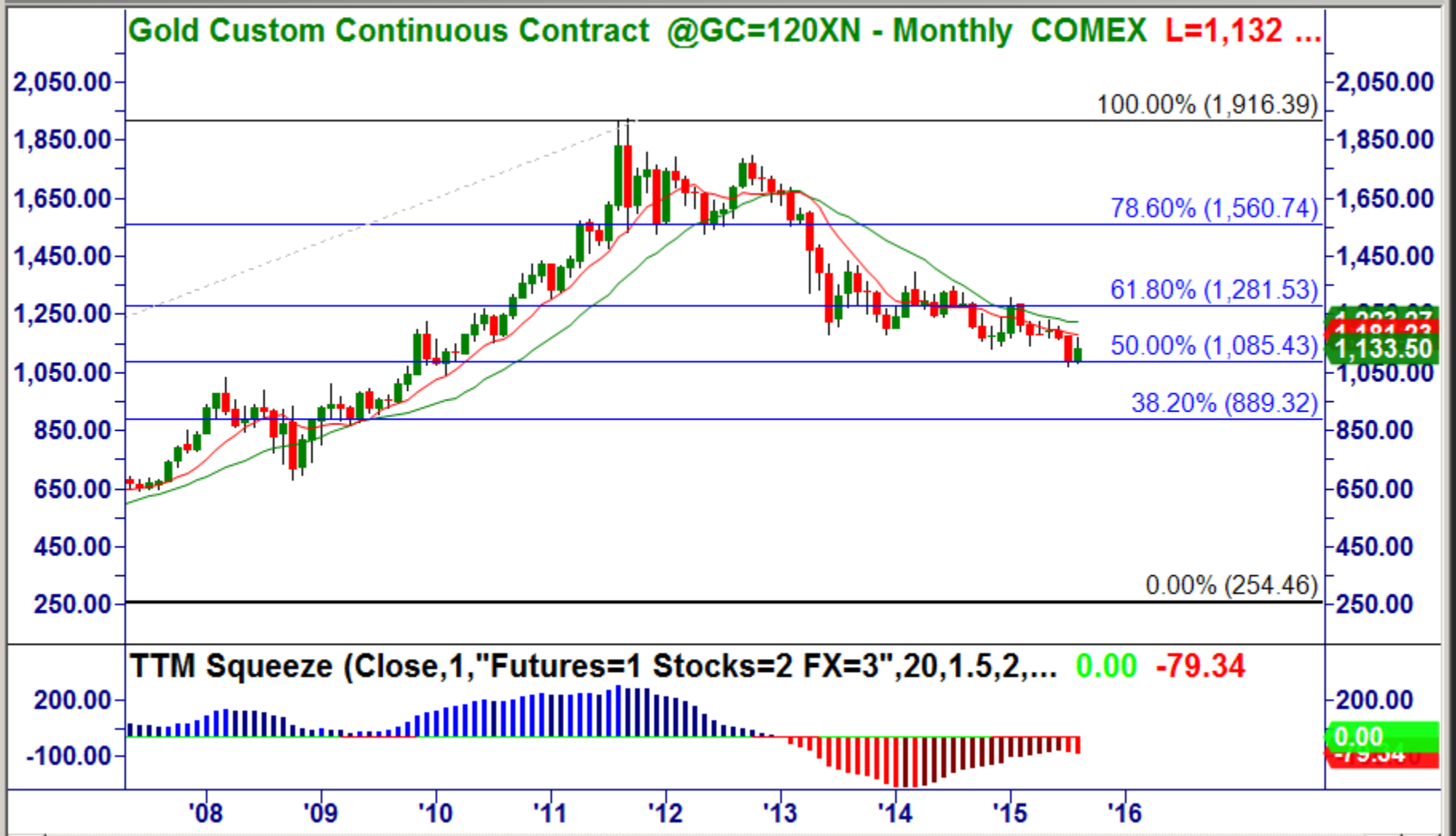
Google



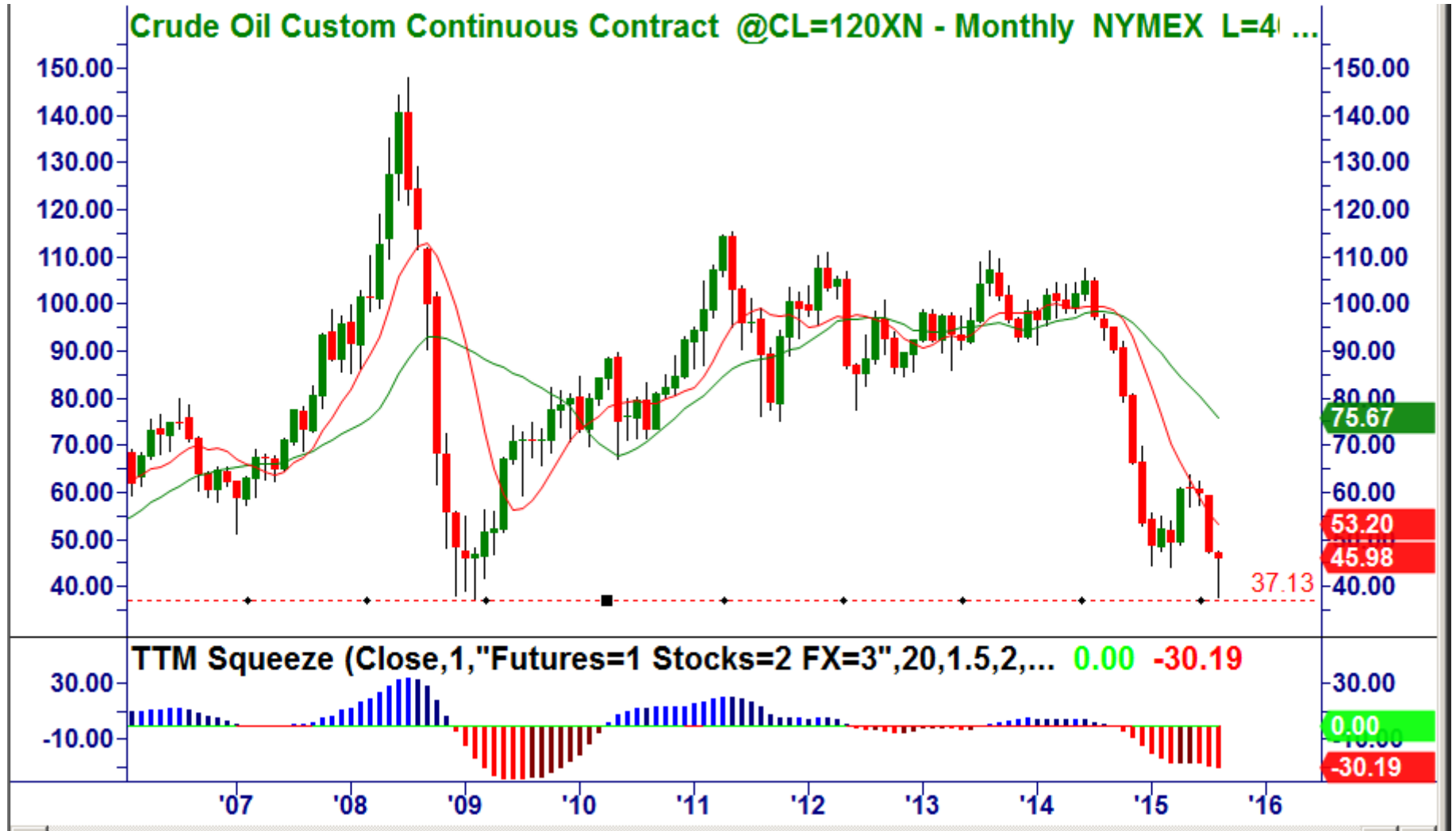
Toyota



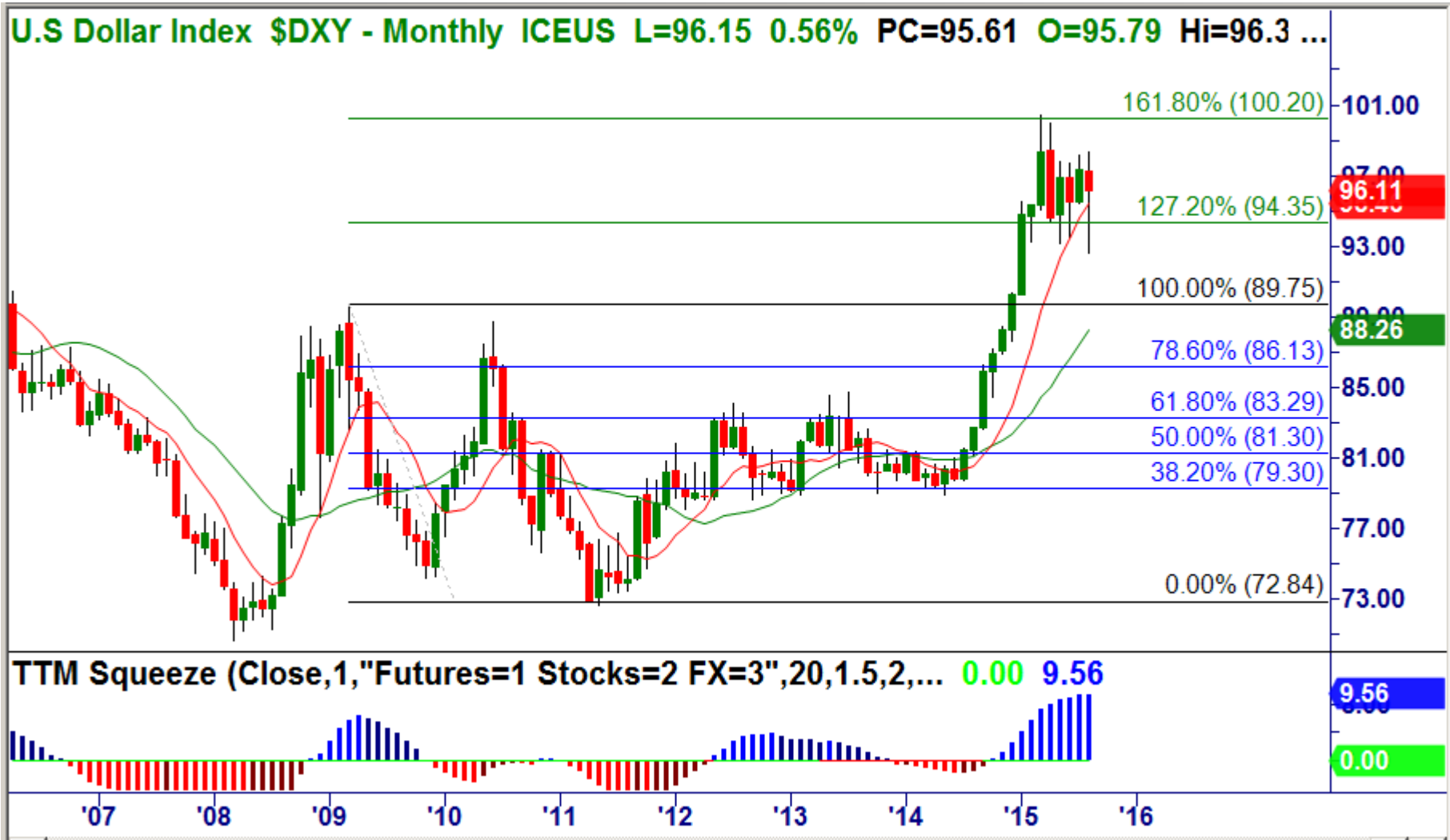
Gold



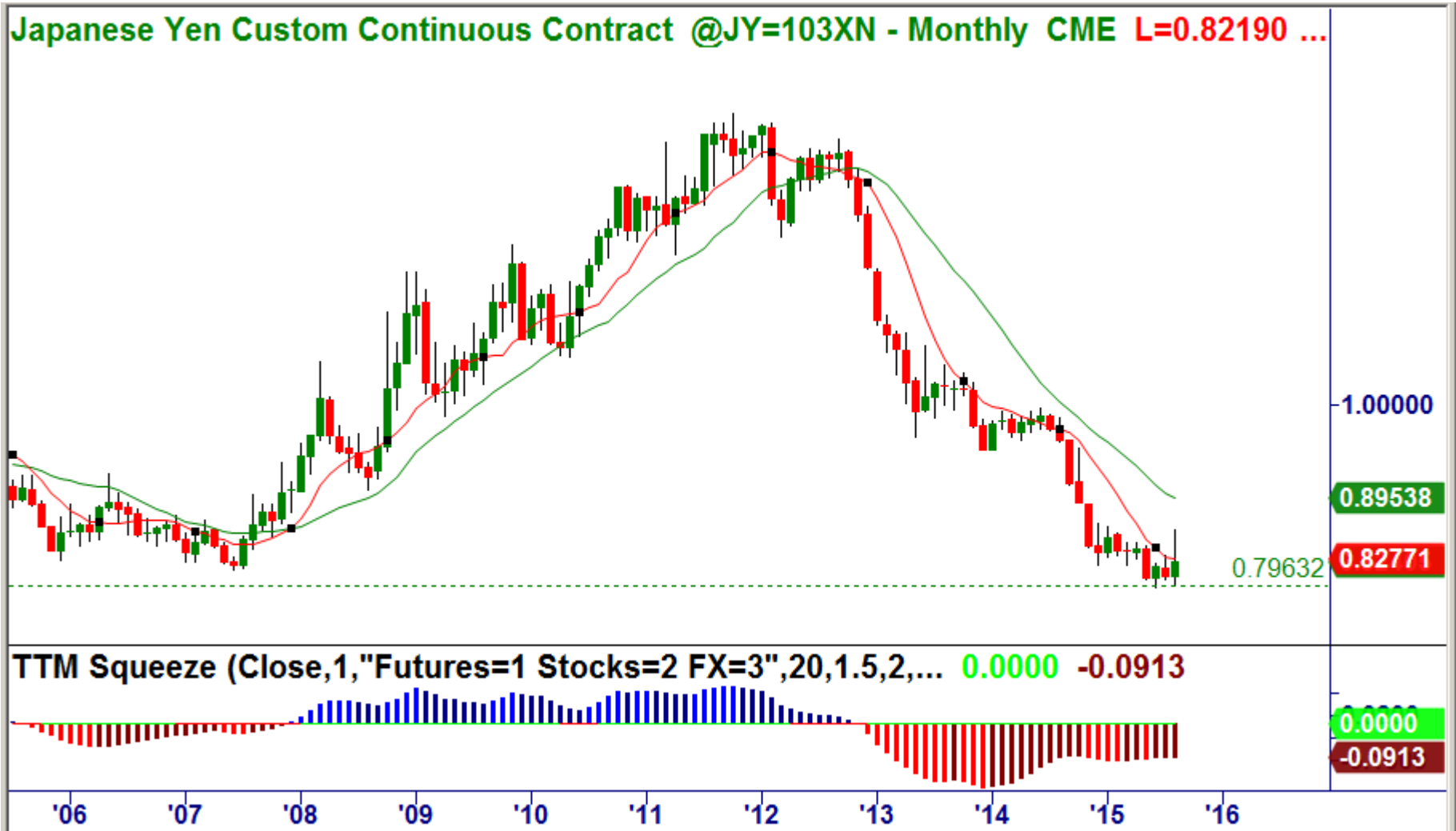
Crude Oil



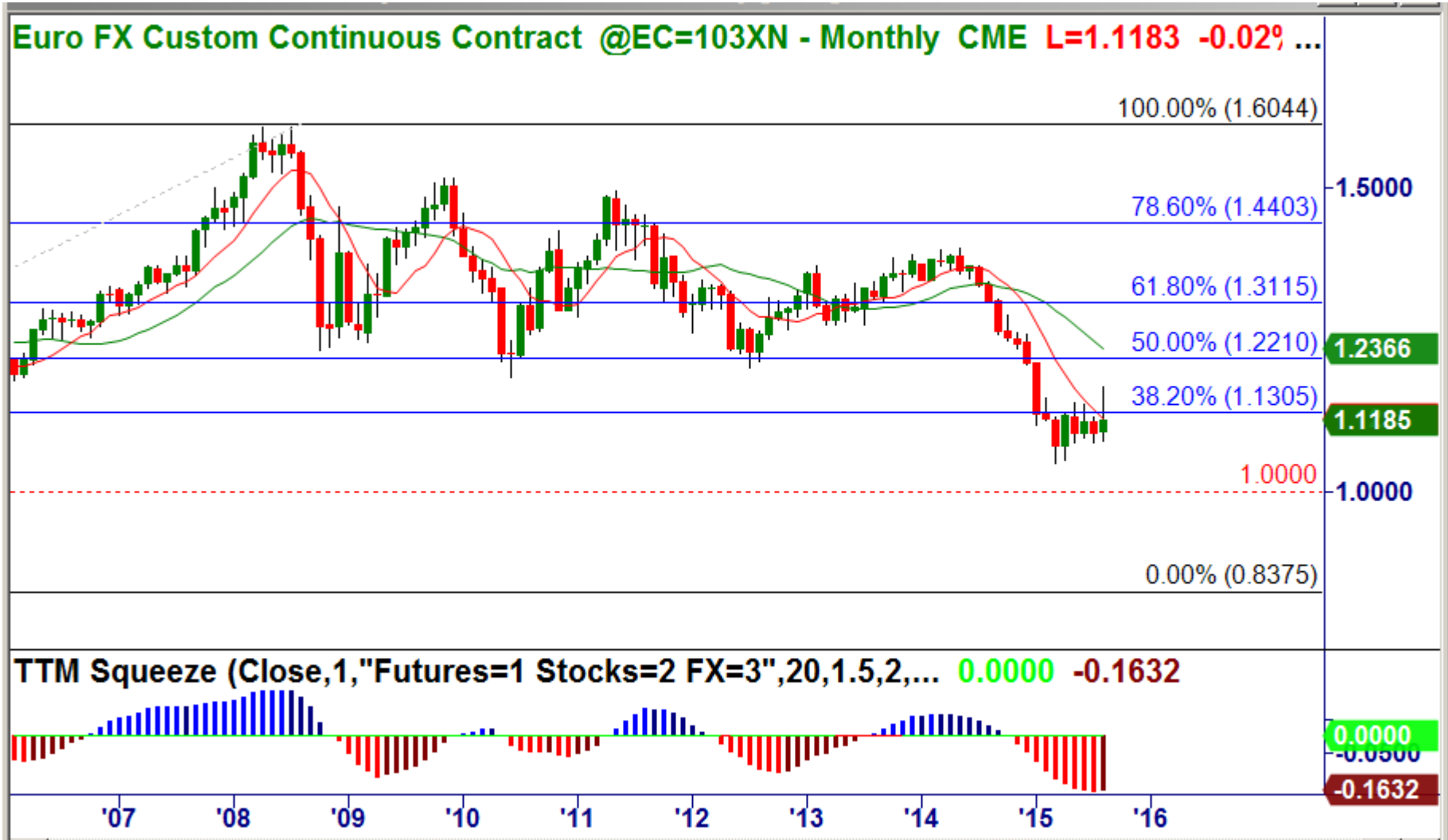
US Dollar



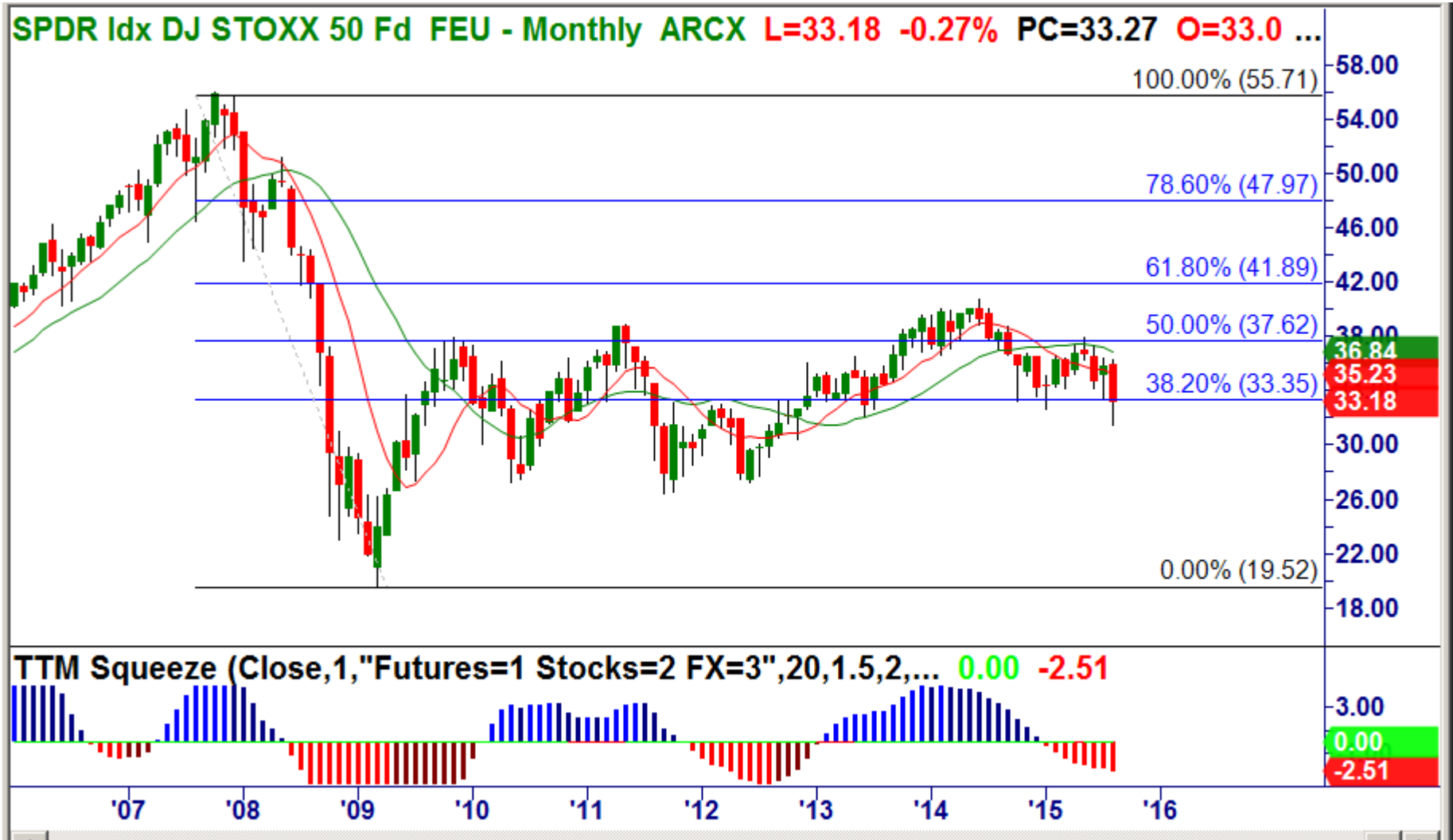
Japanese Yen



Euro

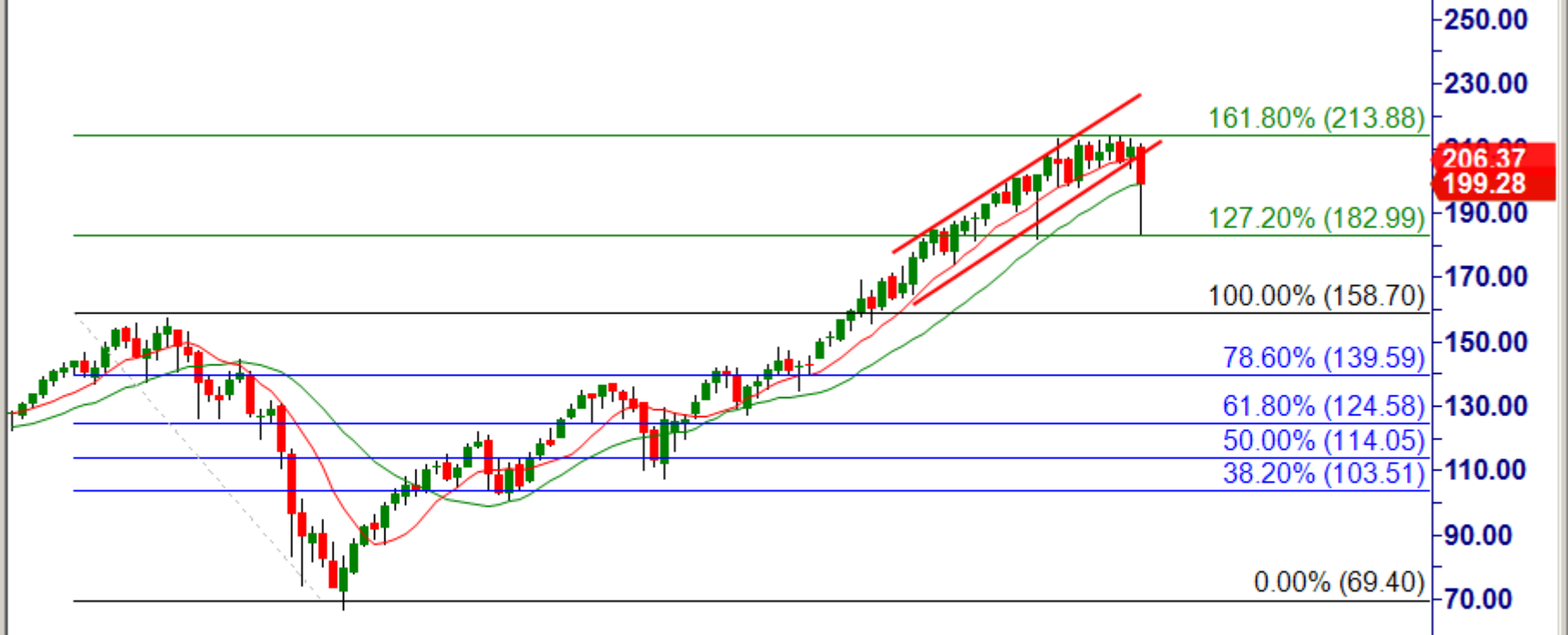


STOXX 50

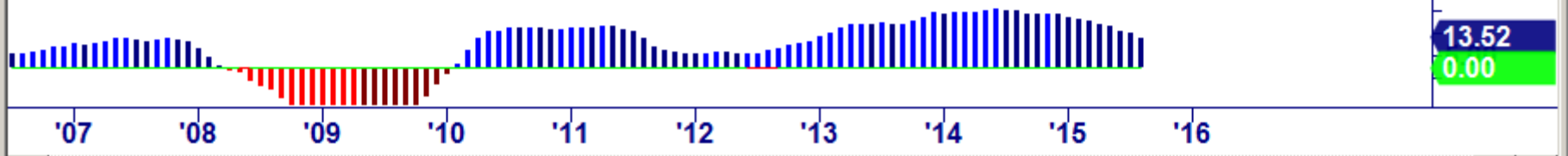


S&P 500

SPDR S&P 500 ETF SPY - Monthly ARCX L=199.45 0.09% PC=199.27 O=198.50 Hi ...



TTM Squeeze (Close,1,"Futures=1 Stocks=2 FX=3",20,1.5,2,... 0.00 13.52



S&P 500 (daily chart)



Trading Systems

What can be Controlled in Trading?

- You cannot control the direction of the market
- You cannot control the outcome of your trades
- You can only control how much money you will lose



Plan Your Trade

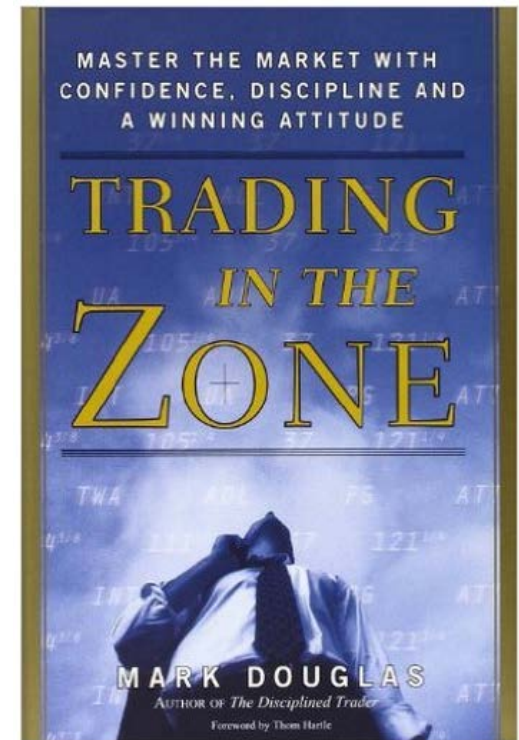
Before entering any trade, the following trade criteria must be known:

- Entry price
- Target for exiting the trade (profit)
- How much money will be risked (stop loss)



Probabilistic Mindset

- Anything can happen
- You don't need to know what is going to happen next in order to make money
- There is a random distribution between wins and losses for any given set of variables that define an edge
- An edge is an indication of a higher probability of one event happening over another
- Every moment in the market is unique





Baseball is ninety percent mental and the other half is physical.

(Yogi Berra)

izquotes.com

Money Management

Risk no more than 1-2% of portfolio in any one position

- \$25,000 trading account
 - \$500 risk per position
 - If trade has \$0.50 stop loss => 1000 shares
 - If trade has a \$1.00 stop loss => 500 shares
- Adjust share size according to risk tolerance



Trade Management

Dollar Risk

- 1/3rd of Potential Profit
- Potential Profit is \$1.00 - Stop = \$0.33

Percentage Risk

- IBD recommends 7-8% pullback in price

Technical Stop

- May be the best
- Based on a technical price level
- Or based on analysis technique

Trading Strategies

- *Trend following*
- *Mean reversion*
- *Weekly/daily squeeze*
- *Growth*
- *Floor trader pivots*
- Pairs trading
- Options
- Arbitrage
- Fund rebalancing



Trend Following Strategy



Mean Reversion Strategy



Growth Strategy

- Unusual daily volume
- Unusual weekly volume
- Daily squeeze setting up
- Weekly squeeze setting up
- 8 day moving average > 50 day moving average
- New 52 week high

Growth Strategy Scan

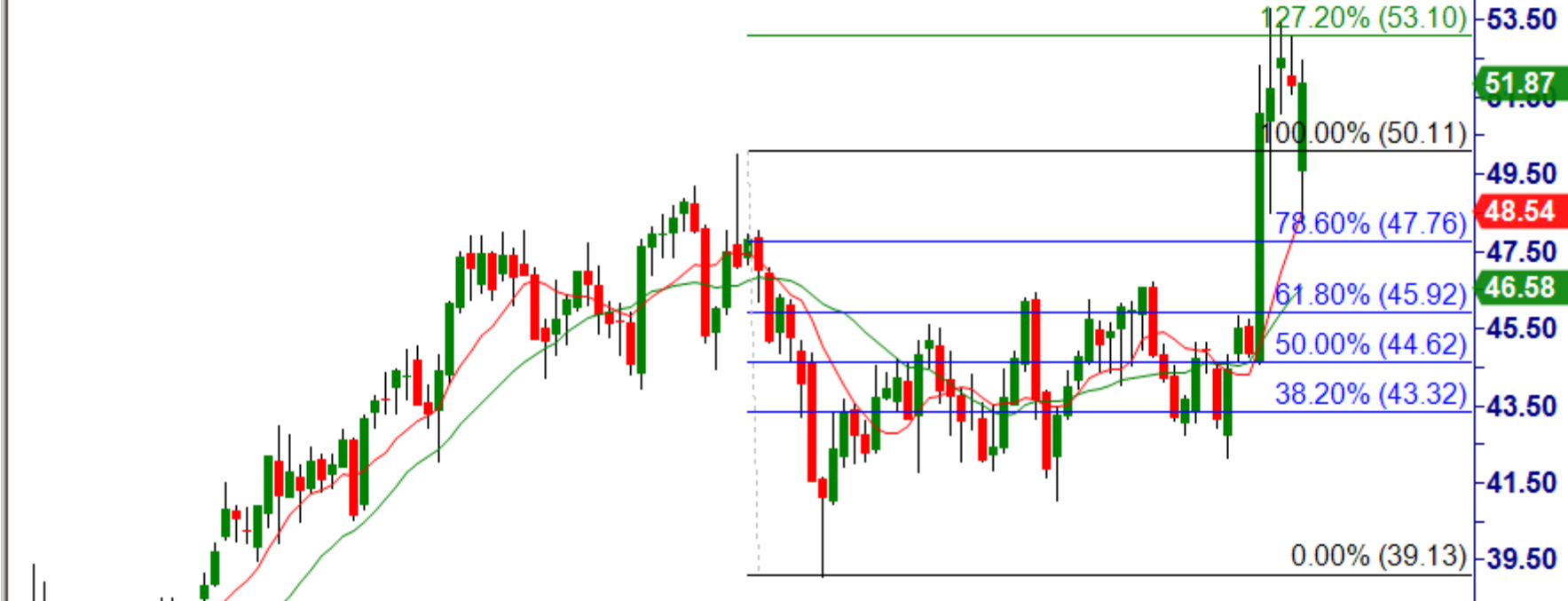
- Weekly squeeze fired long with last 15 bars and no loss of momentum
- Daily squeeze setting up but has not yet fired
- Average daily trading volume > 1000 shares

Symbol	Last	Vol (avg)	Vol %change	Market Cap(mil)	RS	Rank	Float	Shares Short	Short % of Float	Has Options?	Has Weekly?
ACRE	12.92	337360	-25	370	86	130	27.22M	508.82K	1.81%	✓✓✓	X X X
ALK	75.81	1496180	-10	9652	96	11	126.84M	9.45M	7.25%	✓✓✓	X X X
CCE	51.87	4853480	-39	11883	91	8	209.80M	3.90M	1.69%	✓✓✓	X X X

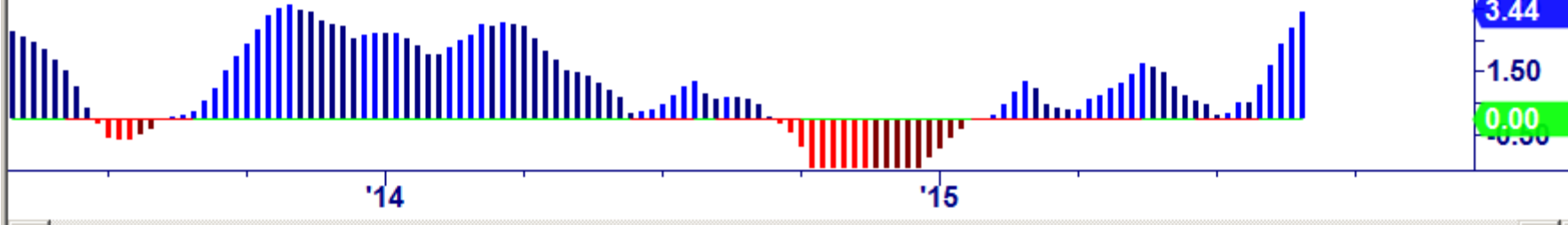
Scan results as of 8/29/2015 4:55:18 PM

CCE

Coca-Cola Enterprises Inc CCE - Weekly NYSE L=51.87 0.04% PC=51.85 O=51.60 ...



TTM Squeeze (Close,1,"Futures=1 Stocks=2 FX=3",20,1.5,2,... 0.00 3.44

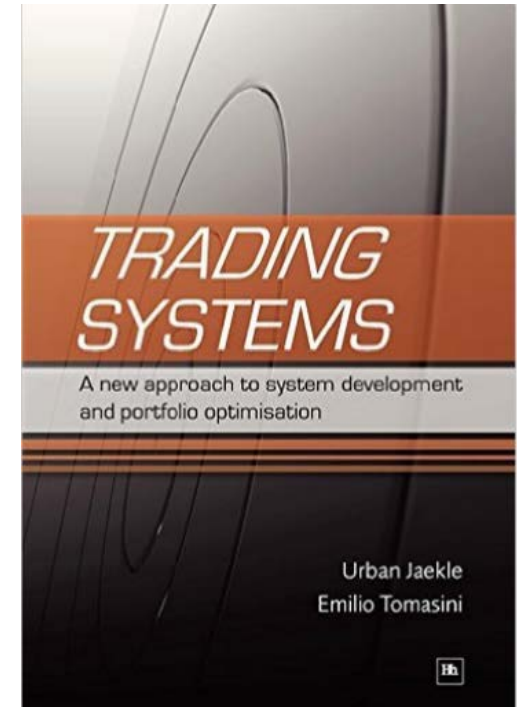


Floor Trader Pivot Strategy



Trading System Design

- **Asset class:** stocks, ETFs, futures, options, forex pairs
- **Type of trading system:** trend following, mean reversion, trading ahead of fund rebalancing, pairs trading, delta-neutral strategies, transaction cost reduction
- **Trading strategy:** buy in demand, sell in supply, buy premium, sell premium, hedging, pairs trading, spread trading
- **Trade duration:** interday, swing (multiple-days), position
- **Trading time frame:** monthly, weekly, daily, 240 min, 60 min, 30 min, 15min, 5min



Trading Systems Design (cont.)

- **Entry rule:** supply/demand levels, support/resistance lines, trend lines, Fibonacci retracement, Elliott waves, moving averages, stochastic indicators, MACD, RSI, CCI, Bollinger bands
- **Exit rule for risk management:** stop loss, target exit, Fibonacci extension, Bollinger bands, max dollar risk on each position
- **Rule for money management:** dollars to invest in each position
- **Goals/objectives:** comfortable retirement, portfolio stability, capital preservation, speculation hedge
- **Performance evaluation metrics:** R-multiple distribution, Sharpe ratio, MAR ratio, Ulcer index/UPI, average 1 yr trailing return, max monthly drawdown, longest drawdown, R-squared, scalability, risk of ruin trading stops, risk of low returns, risk of system death, risk of price shock wrt % max equity

Next Steps ...

Research Directions

- **Decision support for human traders**
 - Using historical data of price and volume, technical indicators, candlestick pattern recognition, volatility
- **Automated trading systems**
 - Automated selection of trading strategies
 - Automated execution of trades
- **High speed computing architectures**
 - Reconfigurable FPGAs
 - HFT algorithm development
- **Intelligent system technologies**
 - Multi-agent systems
 - Evolutionary systems
 - Evolving structure systems

Personal Growth as a Trader/Investor

- Determine long term trends on the major indices in the major markets: S&P 500, Euro Stoxx50, Nikkei 225, Hang Seng, ...
- Learn technical analysis to identify supply and demand.
- Trade a few important ETFs to gain experience and have “skin in the game.”
- When you are proficient with trading stocks and ETFs using technical analysis, learn options and futures.
- Use this experience to protect your personal wealth.
- When you can better understand market dynamics, you will be prepared for the next major downturn.

Remember ...“Stocks take the stairs up and the elevator down”

Trading Books

- John F. Carter, *Mastering the Trade*, McGraw-Hill, 2012
- Carolyn Boroden, *Fibonacci Trading*, McGraw Hill, 2008.
- U. Jaekle and E. Tomasini, *Trading Systems*, Harriman House, 2009.
- Perry J. Kaufman, *Trading Systems and Methods*, John Wiley & Sons, 2013.
- William J. O'Neil, *How to Make Money in Stocks*, McGraw-Hill, 1995
- Kevin J. Davey, *Building Winning Algorithmic Trading Systems*, Wiley, 2014.
- Mark Douglas, *Trading in the Zone*, Prentice Hall, 2001

Trading Education

- Online Trading Academy, CA USA , intensive courses on trading stocks, options, futures, and forex; free resources on website; daily trade rooms (www.tradingacademy.com)
- SimplerOptions Inc., TX USA, webinar classes on options trading; free resources on website, daily trade room (www.simpleroptions.com)
- Equity Management Academy, Los Angeles, CA, trading education for precious metals, mining stocks, and crude oil; daily trade room www.ema2trade.com
- Investopedia, free resources on website; (www.investopedia.com);

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- Jacob Loveless, Sasha Stoikov, and Rolf Waeber, “Online Algorithms in High-Frequency Trading,” *ACM Queue* vol. 11, no. 8, Oct. 7, 2013
- Martin Sewell, “Characterization of Financial Time Series,” *Research Note RN/11/01*, Department of Computer Science, UCL, 20 January 2011.
- A. Damodaran, *Investment Philosophies: Successful Strategies and the Investors Who Made Them Work*, Wiley, Hoboken, NJ, 2003.

Remember ...

- Have an effective sell strategy to limit losses or harvest gains.
- Create rules around a trading timeframe that fits your tolerance for risk.
- Don't violate your rules.
- Start your analysis with higher trading time frames.
- Don't lose sight of the critical importance of money management.
- Use experience to improve your trading skills.





- Analysis and trading of the financial markets can provide significant opportunities for employment, protection of personal wealth, and research.
- A prerequisite to developing and applying algorithmic trading systems is a practical understanding of how to determine supply and demand, and apply the tools of technical analysis.

For further information ...

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References (cont.)

- Luther Zhao, “China Futures set for World Dominance,” <http://tabbforum.com/channels/derivatives/opinions/china-futures-set-for-world-dominance>

CSI300

3,342.29 **+136.65(+4.26%)** Shanghai - As of 3:01AM EDT

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+ Indicator + Comparison 1d 5d 1m 3m 6m YTD 1y 2y **5y** 10y Max Linear Go To Symbol

