

Relative Value Strategy

September 30, 2014



Overview

In this report, we describe a **Relative-Value** strategy between Google and Apple. The intuition behind Relative-Value is to derive a fair value of an asset “relative” to another. But what gets interesting is when the pair is cointegrated, it forms a linear combination that is stationary.

Why is that important? Because a model built on such combination will generalize beyond the training span. The most devastating situation for a trader is being certain of an idea and then watching it fall woefully short when traded live.

Days correct: 76.9%, Return: 38.8%, P/L: 6.39



The graph above shows the out-of-sample results of trading GOOGL (long positions only). We have included the buy & hold benchmark for comparison.

In what follows, we give a description of the strategy and a summary highlighting how it is performing.

Key takeaways

- If two stocks are cointegrated, it is then possible to form a stationary pair from a linear combination of both stocks.
- Relative-Value strategies make it possible to limit market exposure, exposing ourselves more to the portion of the returns based on stock specific profile. We can then safely make a bet on a security regardless of where the market goes.

38.8%
Annual Return on Account

Chart Summary

Chart Name AME #980 Relative Value Sept. 30, 2014

Platform NeuroShell Daytrader®

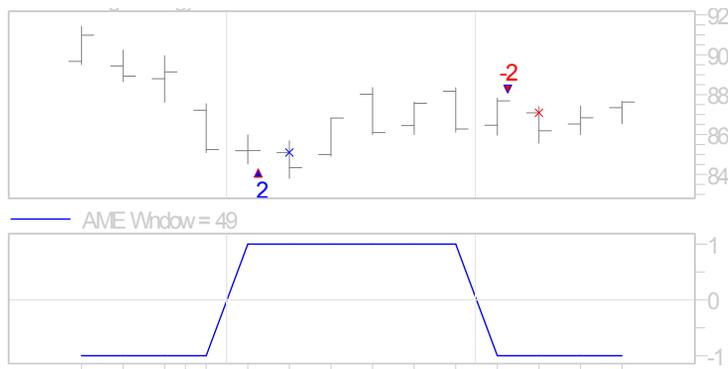
Instruments Google Inc. (GOOGL).
AAPL Inc. (AAPL) is used as the explanatory variable.
EOD data is downloaded from the Yahoo Finance website.
Price is adjusted for splits and dividends.

Type Relative Value trading
Linear combination by Ordinary Least Squares.
The entry/exit signals are generated by the “Adaptive Mixture of Experts” applied to the slope coefficient $Beta$. See [Noxa AME](#) for a description of the indicator.

Position Sizing Fixed Size: Shares/Contracts = 1

Click to [download chart](#).

Figure 1 | Strategy rules



Go Long at the next available Open when the AME of the Slope coefficient has crossed over above the zero line.

Exit at the next available Open when the AME of the Slope coefficient has crossed over below the zero line.

The NeuroShell Trader® implementation is described in the Appendix.

Linear combination

The first step is to generate an estimated value for the symbol to trade, GOOGL for example, given a value for AAPL. For this, we use a rolling linear regression model yielding the following equation:

$$GOOGL = \beta \times AAPL + u$$

With Beta (β) the slope and u the residual:

Beta is the rate at which GOOGL closing price is changing for every unit change in AAPL. It measures the volatility for GOOGL in relation to AAPL. In other words, it gives a sense of the stock's risk compared to AAPL or the level of risk GOOGL possesses that depends on how correlated it is with AAPL.

In contrast, the Residual is the part that cannot be explained by Beta or the amount of risk GOOGL possesses that is not correlated with AAPL.

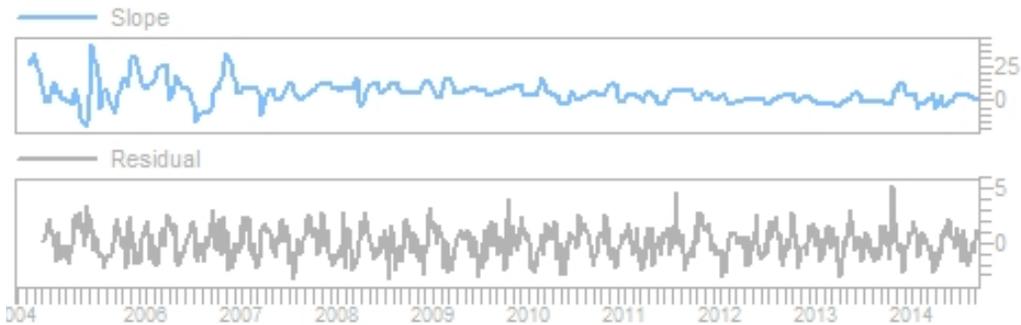
Simply put, the linear regression has decomposed price into a market related (systematic) portion $\beta \times AAPL$ and a stock specific (uncorrelated) portion u .

In the graph below we've shown the estimated close for GOOGL (red) versus the actual price (green). The lower panels show the Slope β (blue) and the residual u (grey).



Market Neutrality

Note that cointegration tests and related analysis are deliberately being glossed over for the sake of brevity. But the previous graph illustrates beautifully the cointegrating relationship that GOOGL and AAPL happen to share. Zooming out, we can clearly see that the Slope and the Residual nicely revert to zero, keeping the mispricing about stationary.



Also note that the Slope conveniently lies near the zero line since mid 2007; the systematic portion of the returns $\beta \times AAPL$ is under control, effectively limiting the market exposure and exposing ourselves more to the portion of the returns based on stock specific profile. We can safely make a bet on a security without betting on the direction of the market.

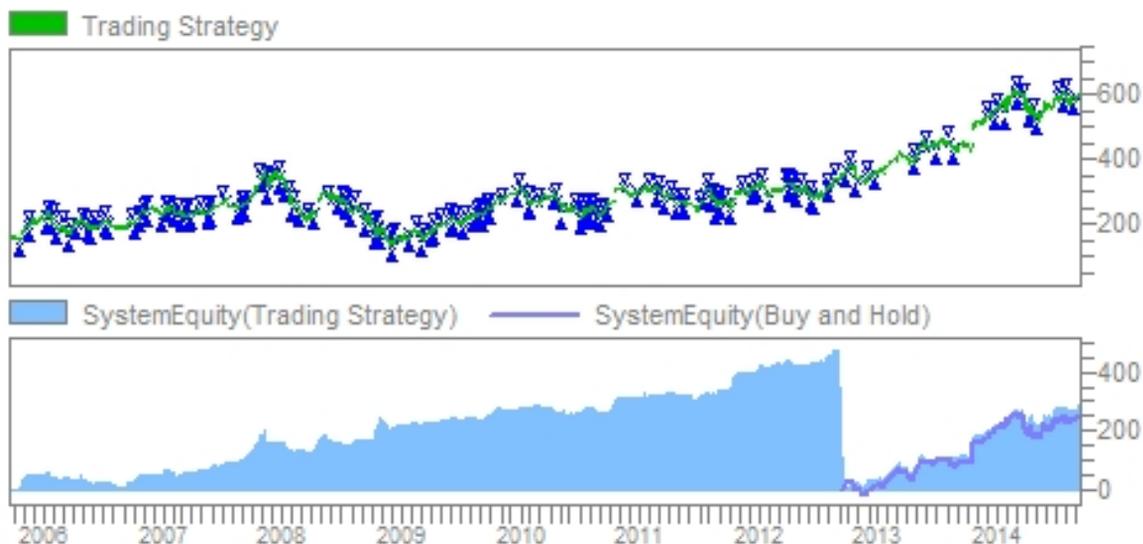
Entry/Exit signals

Buy Google (GOOGL) at the open after the AME of Slope β has closed above 0. Sell when the AME of Slope β has closed below 0.



Performance Chart

The chart below shows the equity curve. We have added the Buy & Hold strategy for comparison. Note that the last two years of the equity curve correspond to real trading.



For the number lovers *

	Optimization	Trading
Start Date =	8/19/2004	9/10/2012
End Date =	9/7/2012	9/8/2014
Annual % Change in Price	74.1%	35.9%
Annual Return on Account	30.4%	38.8%
% Profitable Trades	57.5%	76.9%
Ratio Gross Profit/Loss	2.78	6.39
Ratio Avg Win/Avg Loss	2.06	1.92
Number of Trades	87	13
Average Trade Span	11 bars	28 bars

* The results do not account for transaction costs but because of how infrequently the model trades, transaction costs are minimal assuming a decent sized account.

Appendix | NeuroShell Trader® implementation

LONG ENTRY:

Generate a buy long market order if all of the following are true
CrossAbove(Noxa AME-Expert(LinXYReg Slope(AAPL adjusted Close,Close,40),7,1,0),0)

LONG EXIT:

Generate a sell long market order if all of the following are true
CrossBelow(Noxa AME-Expert(LinXYReg Slope(AAPL adjusted.csv Close,Close,40),4,1,0),0)

TRADING STRATEGY PARAMETERS:

The Regression Periods in the LinXYReg Slope indicator (the Slope) has been set to its value by default or Regression Periods = 40

The Window parameters in the AME-Expert indicators have been set set by the optimizer or Window = 7 for the Long Entry and Window = 4 for the Long Exit.

Optimization of trading strategy

- Begin at first date displayed on chart

Trading of trading strategy

- Begin 2 years before last date on chart

Objective used during optimization

- Maximize Return on Account

Optimization Algorithm

- Brute Force Optimization

Position Sizing

- Initial Account Balance = 250000

- Position Sizing Method = Fixed Size

 - Buy a fixed number of shares/contracts

 - 1 Shares/Contracts