Does Trend Following Work on Stocks?

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Abstract

Over the years many commodity trading advisors, proprietary traders, and global macro hedge funds have successfully applied various trend following methods to profitably trade in global futures markets. Very little research, however, has been published regarding trend following strategies applied to stocks. Is it reasonable to assume that trend following works on futures but not stocks? We decided to put a <u>long only</u> trend following strategy to the test by running it against a comprehensive database of U.S. stocks that have been adjusted for corporate actions[1]. Delisted[2] companies were included to account for survivorship bias[3]. Realistic transaction cost estimates (slippage & commission) were applied. Liquidity filters were used to limit hypothetical trading to only stocks that would have been liquid enough to trade, at the time of the trade. Coverage included 24,000+ securities spanning 22 years. The empirical results strongly suggest that trend following on stocks does offer a positive mathematical expectancy[4], an essential building block of an effective investing or trading system.

Introduction

Our firm Blackstar Funds, LLC manages a multi-advisor commodity pool that invests primarily in systematic[5], long-volatility[6] programs. We focus mainly on trend following programs from the commodities, financial futures and currency trading arenas, as they tend to be the most systematic in terms of trading and portfolio management. Years of searching for systematic trend following programs that focus on stocks, however, has left us empty handed.   Having spent literally thousands of man hours performing due diligence on trend following commodity and currency funds, along with years of personal experience trading proprietary capital in stocks, we feel uniquely qualified to tackle the question, "Does trend following work on stocks?"

In order to evaluate the effectiveness of trend following on stocks we must first determine:

- What stocks will be considered?
- When and how will a stock be purchased?
- When and how will a stock be sold?

1. **Corporate action** – Significant events that are typically agreed upon by a company's board of directors and authorized by the shareholders. Some examples are stock splits, dividends, mergers and acquisitions, rights issues and spin offs.
2. **Delisted** – When the stock of a company is removed from a stock exchange. Reasons for delisting include violating regulations and/or failure to meet financial specifications set out by the stock exchange.
3. **Survivorship bias** – A phenomenon where poorly performing stocks, having been delisted, are not reflected in a current sample or database. This results in overestimations of what past performance would have been.
4. **Mathematical expectancy** – The weighted average of a probability distribution. Also known as the mean value.
5. **Systematic** – Having clearly defined rules that can be defined mathematically and tested empirically.
6. **Long volatility** – An investing strategy that tends to benefit from increasing volatility and/or persistent directional trends. Often associated with strategies employed by commodity trading advisors from the managed futures industry.

Data Integrity - *A complete discussion of these data integrity issues can be found in appendix 4.*

Survivorship bias

The database used for this project included historical data for all stocks that were delisted at some point between 1983 and 2004. Slightly more than half of the database is comprised of delisted stocks.

Corporate actions

All stock prices were proportionately back adjusted for corporate actions, including cash dividends, splits, mergers, spin-offs, stock dividends, reverse splits, etc.

Realistic investable universe

A minimum stock price filter was used to avoid penny stocks[7]. A minimum daily liquidity filter was used to avoid stocks that would not have been liquid enough to generate realistic historical results from. Both filters were evaluated for every stock and for every day of history in the database, mimicking how results would have appeared in real time. The following chart shows how many stocks would have passed the above mentioned filters for each year of historical testing.

Investable Universe

Entry & Exit

Entry

For the purposes of this project the entry method chosen was the all-time highest close. More specifically, if today's close is greater than or equal to the highest close during the stock's entire history then buy *tomorrow on the open*. We chose this method to avoid ambiguity. A stock that is at an all time high must be in an uptrend by any reasonable person's definition. This is a trend following entry in its purest form.

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7. Penny stock – Loosely defined as stock with a low nominal share price that typically trades in the over the counter market, often an OTC Bulletin Board or Pink Sheets quoted stock.

The following *weekly* charts illustrate what would have been notable trades for a trend following system in the past. The green dots denote instances where the closing price for the week was at a new all time high. The horizontal pink line represents the previous all time high that would have triggered the initial entry:
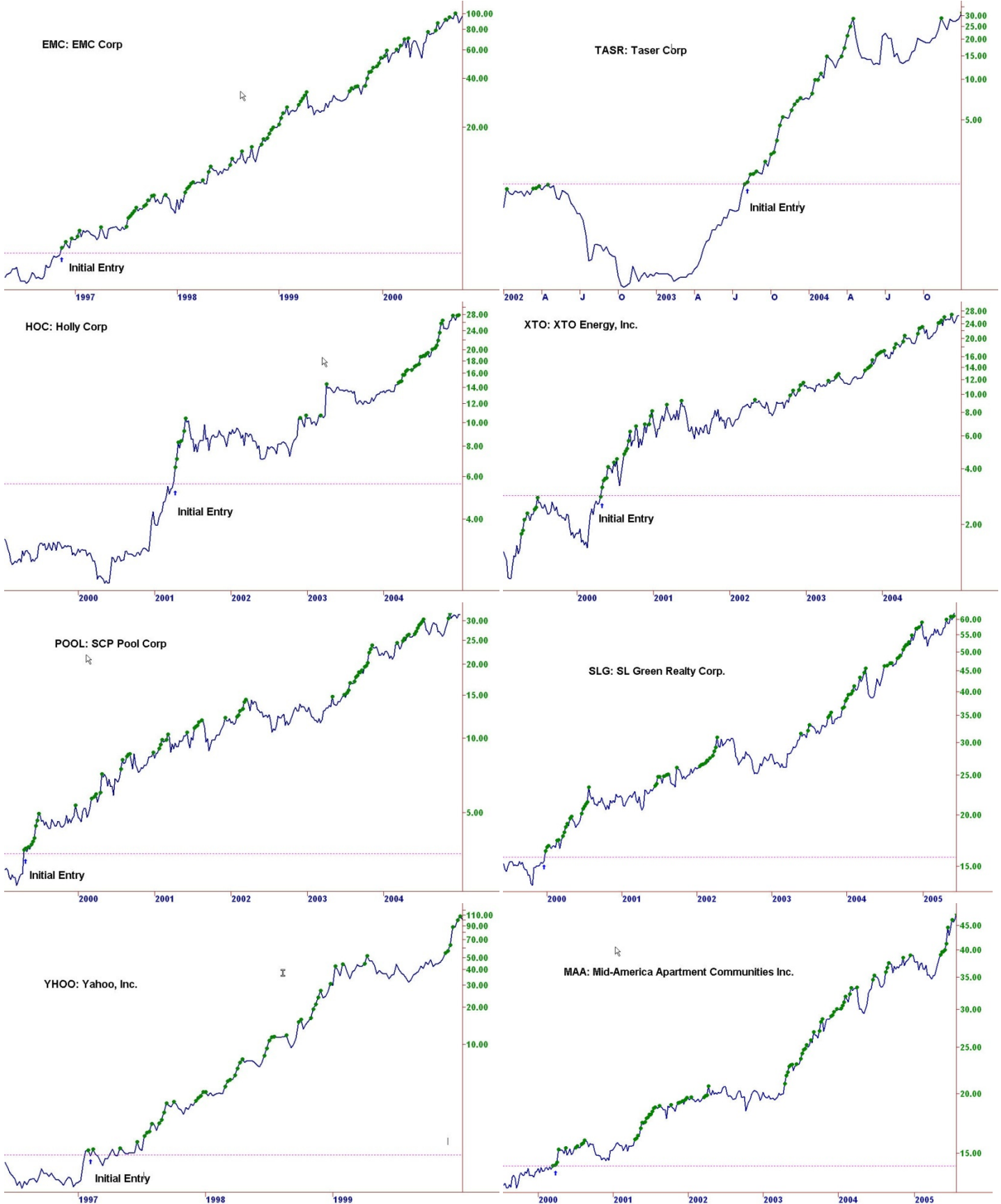
Exit (stops)

Exits are essential to any trend following strategy. We decided to use average true range trailing stops because they are universally applicable and commonly used by trend following programs. The average true is a derivative of the true range indicator, which measures the daily movement of a security by calculating the greater of:

- Today's high minus today's low
- Today's high minus yesterday's close
- Yesterday's close minus today's low

The true range illustrates the maximum distance the security's price traveled from the close of one business day to the close of the next business day, capturing overnight gaps and intraday price swings. A 40 period average of this number would yield the 40 day *average* true range. This can be used to integrate the underlying volatility of a security into a universally applicable trailing stop.

For example, a 10 ATR stop for a volatile internet stock might be 55% away from the stock price:
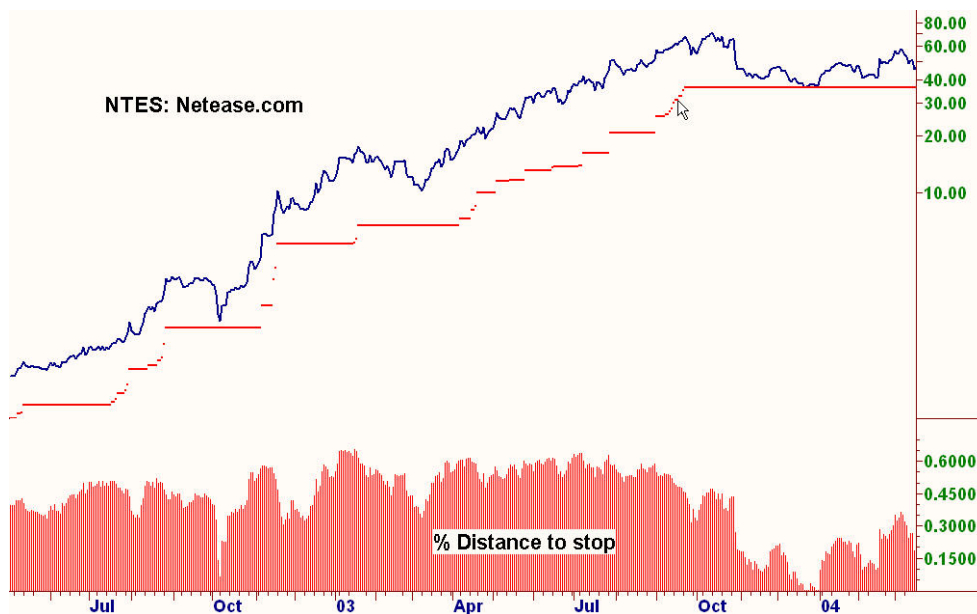
Alternatively, a 10 ATR stop for a quiet utility stock might only be 15% away from the stock price:
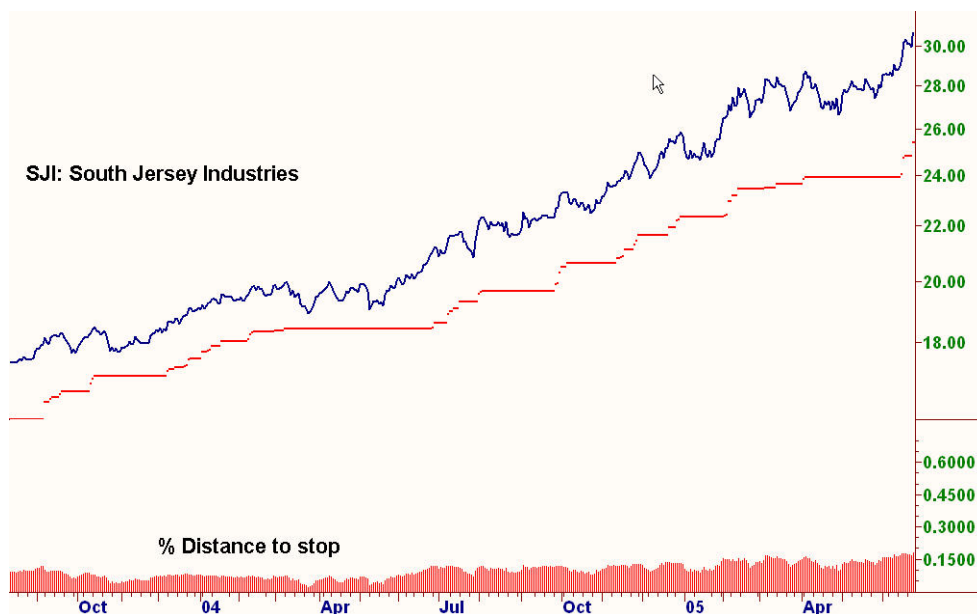
For all 18,000+ simulated trades the average distance from entry price to exit was 27% for a 10 unit ATR stop; though it often ranged from 5% to 50% depending upon the volatility of the security in question. For the purposes of historical testing we chose to exit a stock on the open *the day after our exit level was breached*. The following charts illustrate how a 10 ATR stop would have looked on some well known stocks from the past:
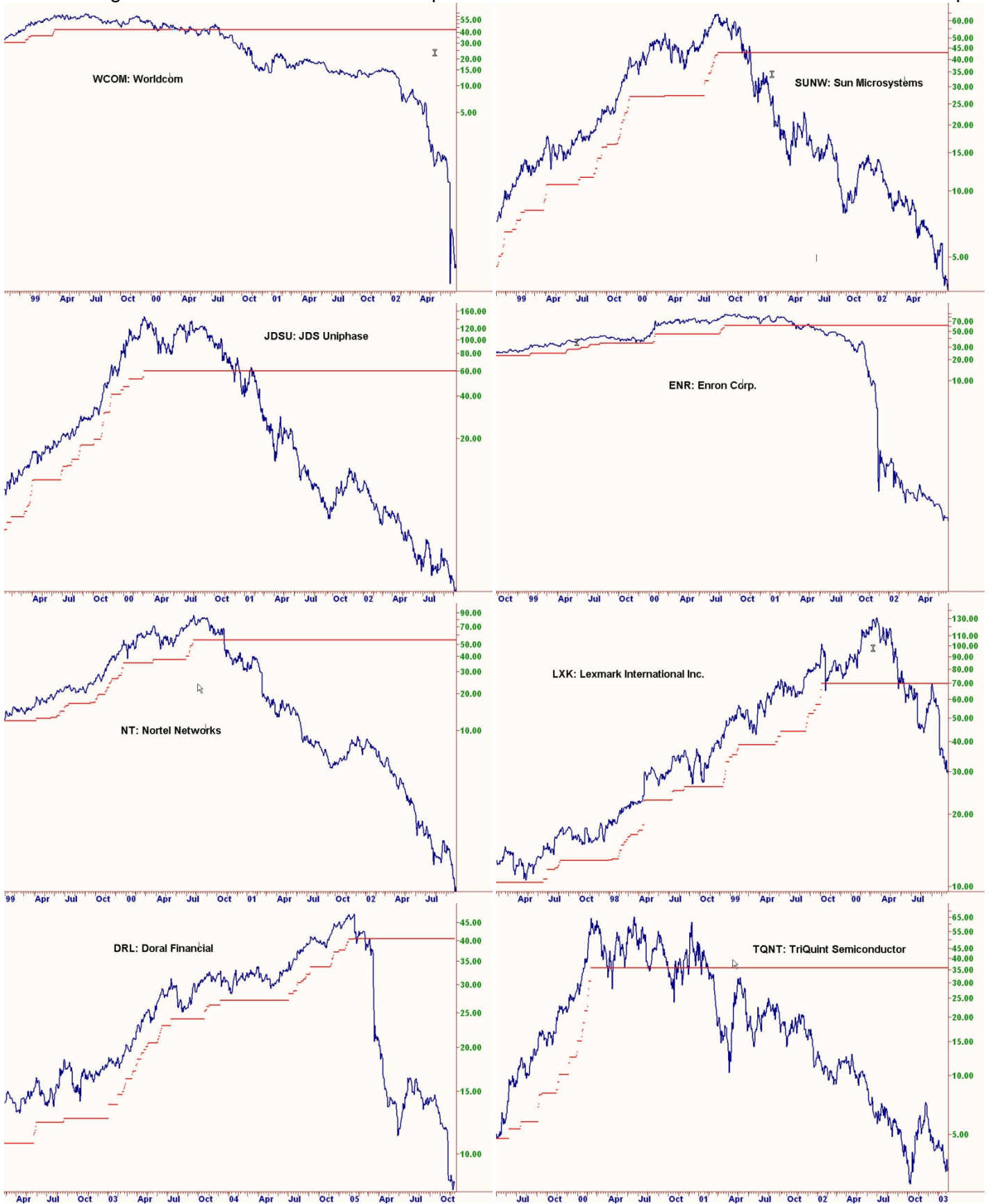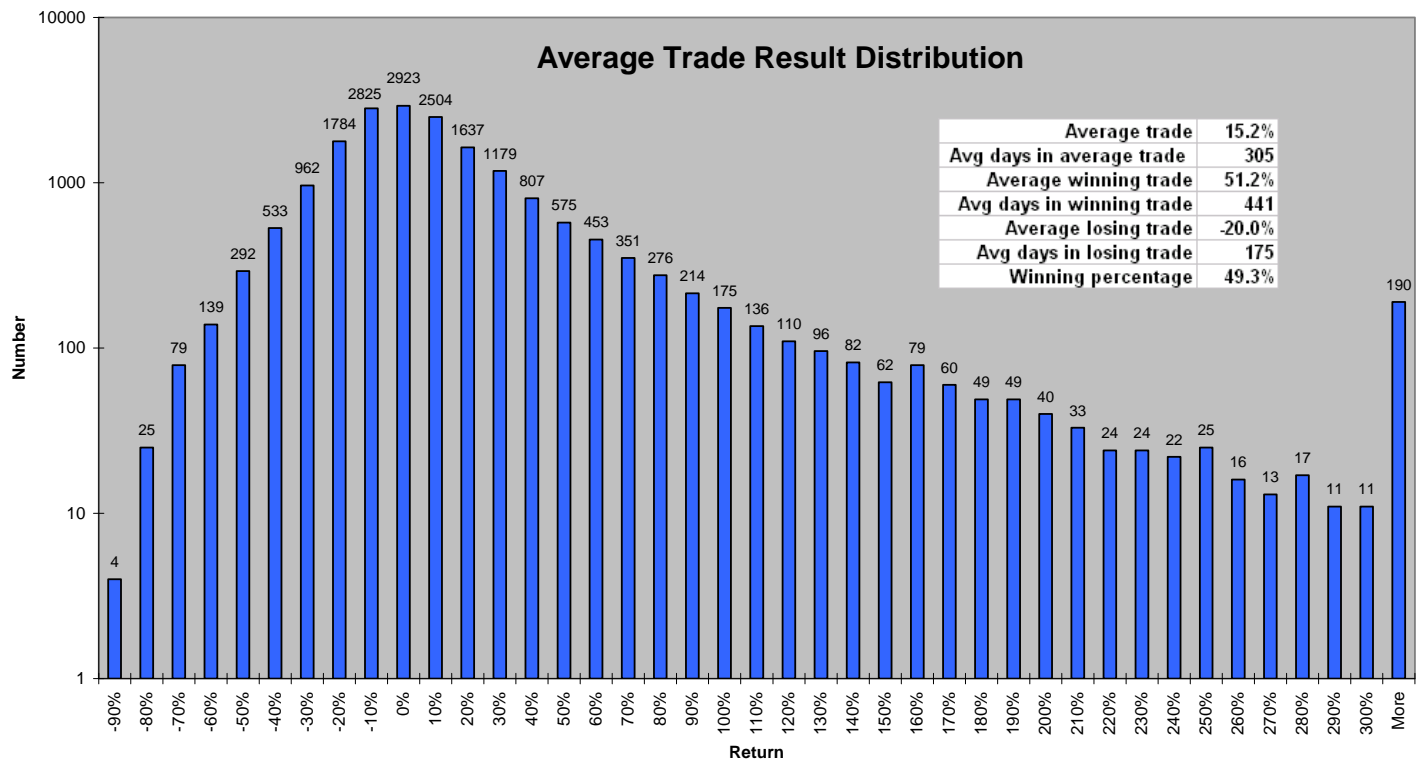

Many more graphical illustrations of the stops we used can be found in the appendices at the end of this paper.

Expectancy Studies

To determine how well these entries and exits would have worked in the past it was necessary to test the combination against our historical database, while honoring the previously mentioned data integrity issues.

The following distribution shows the results from using an all time high entry along with a 10-unit ATR stop. There were 18,000+ trades during the 22 year test period. Transaction costs of 0.5% round-turn were deducted from each trade to account for estimated commission and slippage.

Average Trade Result Distribution

Average trade	15.2%
Avg days in average trade	305
Average winning trade	51.2%
Avg days in winning trade	441
Average losing trade	-20.0%
Avg days in losing trade	175
Winning percentage	49.3%

The X-axis represents the net return from the trade. The Y-axis indicates how many trades would have achieved the indicated net return. The long volatility component resulting from the combination of a trend following entry & trailing volatility stop is immediately recognizable by the extreme right skew of the distribution. 17% of trades would have gained 50% or more while less than 3% of trades would have registered a loss equal to or worse than -50%.

At first glance a winning percentage of 49.3% might seem less than impressive, but it is relatively high for a trend following system. Trend following systems can be very effective with much lower winning percentages if the profitable trades are significantly larger than the more frequent unprofitable trades. In the case of this system the ratio between average winning trade and average losing trade is 2.56; a healthy number in our experience.

A positive mathematical expectancy is the bare minimum needed to justify the use of, or further research of an investing or trading system. In the case of this system, the weighted average of the trade results distribution yields an expectancy of approximately 15.2% with an average holding period of 305 calendar days. Considering the significance of the sample size, depth of the sample period, realistic assumptions used, and the right skewed return distribution, we felt this was a very solid foundation to build from.

Other settings for the ATR stop were tested, the range spanned from 8 to 12 with a step increment of 0.5. The middle setting of 10 was chosen for illustration purposes. There were no material differences in results among the various settings. Higher ATR levels (looser stops) resulted in slightly higher winning percentages and slightly lower win/loss ratios. The inverse was true of lower ATR levels (tighter stops).

The next distribution illustrates a collection of all trades, each normalized for its own risk. This will require some explanation. Every trade ultimately has a recorded percent return ((exit price / entry price) – 1). Every trade also has a recorded percent initial risk from the day of entry ((stop loss price / entry price) – 1). The result is that we know what the percent return of each trade would have been and we know how much risk each trade would have subjected us to. The *ratio* between these two numbers is the focus of this section.

The simplest way to interpret the following distribution is to focus on a couple of specific numbers on the X-axis. First the -100% column contains trade results where the absolute value of the *net loss* approximately equaled the initial risk (lost the full amount that was expected). Likewise, the 100% column contains trades where the *net gain* approximately equaled the initial risk. Results worse than -100% represent trades where we would have lost more than what was budgeted for on the trade (negative outlier trades). This is usually the result of a large, overnight price decline. Results greater than 100% represent trades where we would have gained more than what was initially risked (positive outlier trades). Consider the following two scenarios:

- We purchase XYZ stock at $15.50. Our 10 ATR stop is $11.32. Initial risk in this case is 27%. Two years later we sell XYZ at $30.75 for a gain of 98%. The ratio between gain and initial risk is 3.63 or 363%. This data point would therefore go in the 350% column in the following distribution. Our return would have been 363% the size of our initial risk.

- We purchase ABC stock at $32.35. Our 10 ATR stop is $26.53. Initial risk in this case is 18%. Three months later the company misses its earnings estimate and gaps down well below our stop. We sell ABC at $21.15 for a loss of -35%. The ratio between gain and initial risk is -1.94 or -194%. This data point would therefore go in the -200% column. Our loss would have been almost double what was budgeted for.
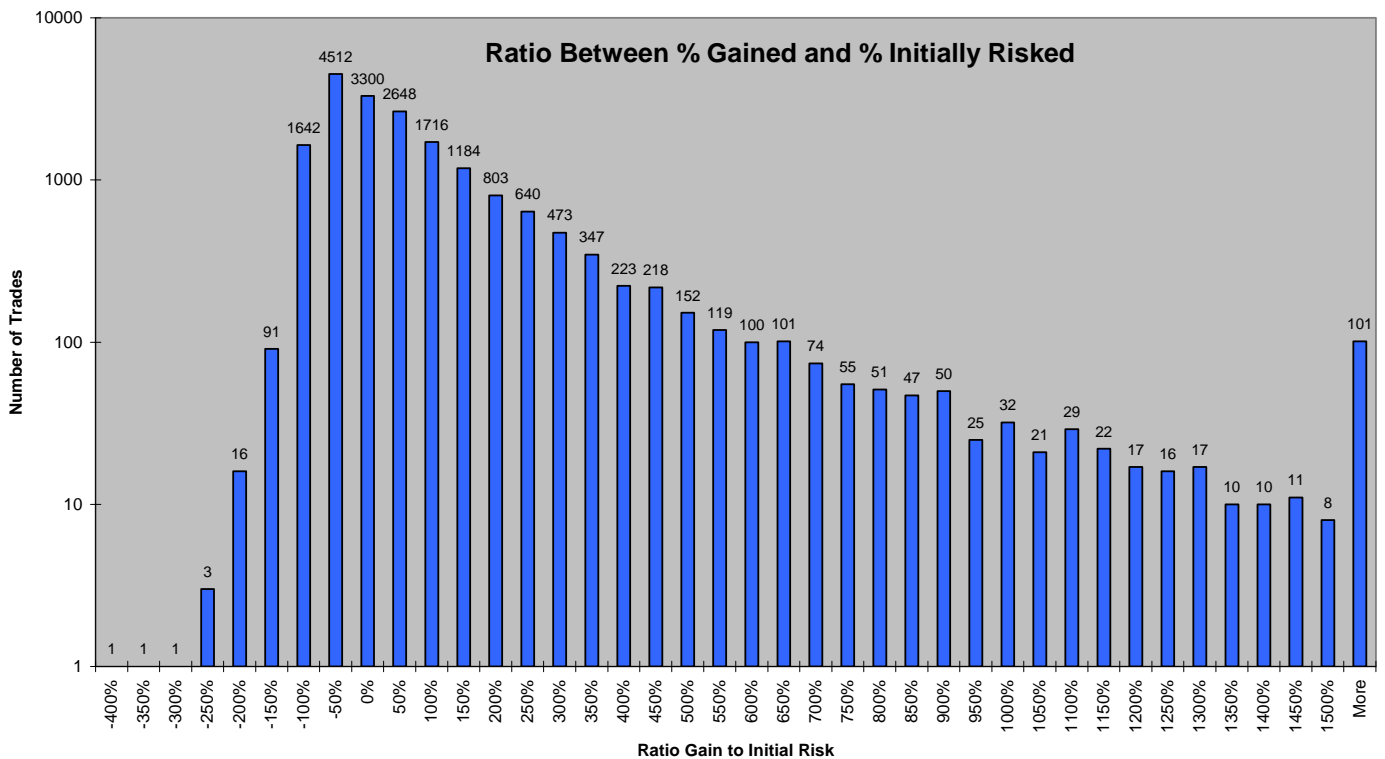

From the above distribution one can get a feel for how realistic his/her stops are for real world trading. Data points to the left of -100% reflect trades that couldn't be controlled. There were less than 400 trades that caused worse than expected losses. This amounts to approximately 2% of all historical trades.

In some ways this second distribution is more important than the first. Normalizing each trade by its own risk reduces the possibility that highly volatile stocks will unjustifiably dominate the results.

Having a low number of negative outlier trades can lead to a false sense of security. If all or most of the negative outlier trades come in one year the results can be far worse than what was expected. The following chart shows how negative outlier trades, as a percentage of total trades for the year, would have been distributed through time:

Negative Outlier Trades as a Percent of Total Trades for the Year
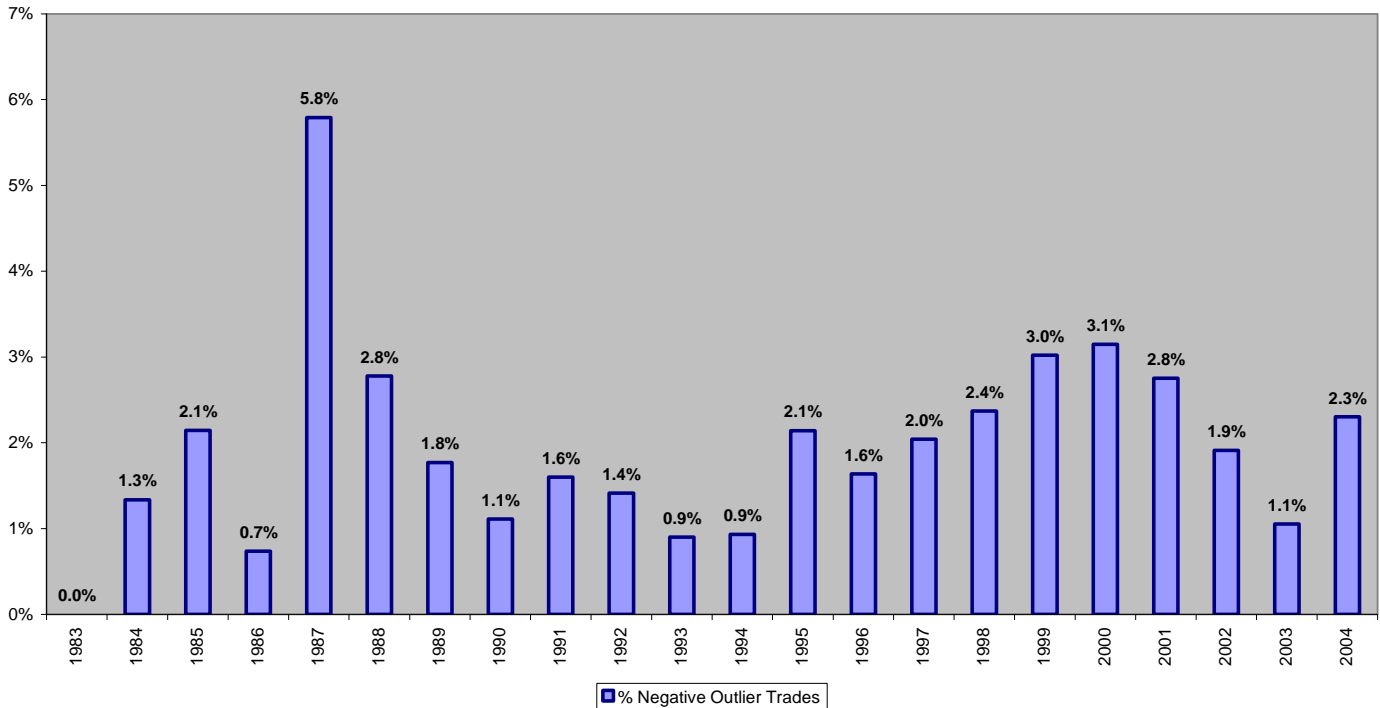
The next chart illustrates how positive outlier trades would have been distributed throughout time. These are trades that resulted in a net gain that exceeded estimated initial risk. Charts such as these can provide insight into how effective a system is in different market environments.

Positive Outlier Trades as a Percent of Total Trades for the Year
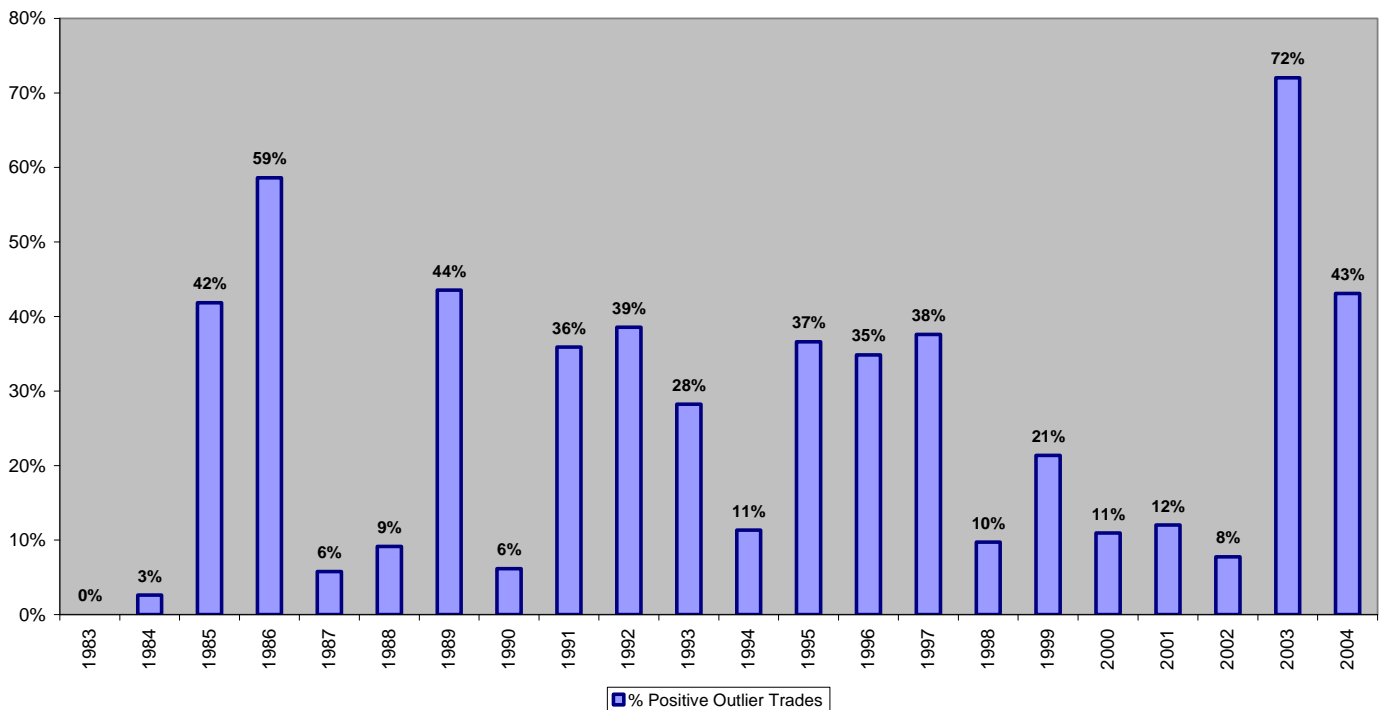
Short Selling

For the purposes of this project we decided against testing short selling[9] strategies. Our reasons for this have to do with the following issues:

Forced buy-ins

A short seller has to borrow shares before they can short sell them. Likewise, the short seller must return (deliver) the shares should the rightful owner wish to call them back. From the historical data available there is no way to know *when or if* a short seller would have been subject to a forced buy-in[10].

Borrowing shares

Short selling a security requires borrowing shares from an investor who holds them in a margin account. Not all stocks meet these criteria all the time; some never meet these criteria at all. There is no reliable method to determine what stocks would have been realistically shortable in the past.

Limited expectancy

With respect to long term trend following, short selling offers a severely limited mathematical expectancy. The price of a stock can only decline by a maximum of 100%. However, it can rise by an infinite amount. This is a significant disability to overcome.

Tax Efficiency

The average hold time for the average trade came in lower than the 12 months necessary to qualify for long term capital gains treatment. However, due to the nature of trend following systems in general, this statistic is misleading. There was a significant correlation between trade length and profitability, showing that the vast majority of historical profits would have qualified for long term capital gains treatment.

Average Trade Result Relative To Days in Trade
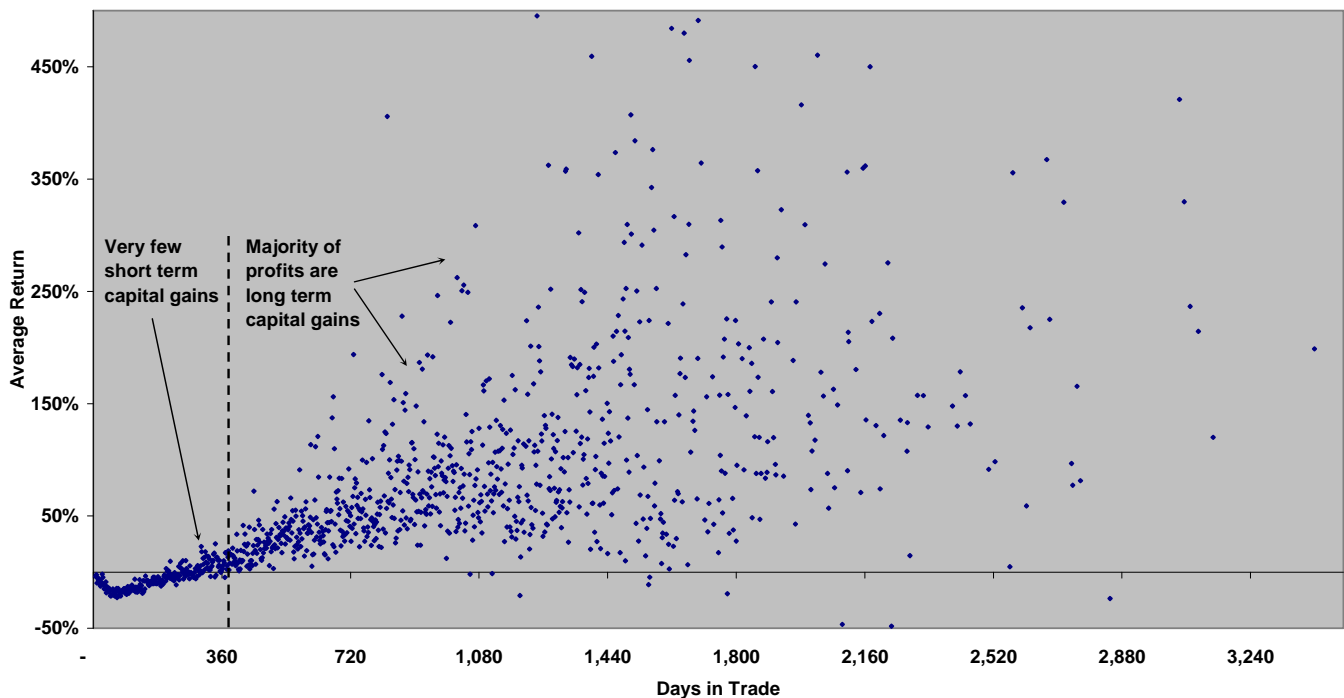
9. Short selling – The selling of a security that the seller does not own with the goal of buying the security back at a lower price, thus profiting from a decline.
10. Buy-in – When a short seller is forced to repurchase the shorted shares in order to deliver them to the rightful owner.

Diversification

The following table shows how many positions would have resulted from entering stocks at all time highs and exiting with a 10-unit ATR stop while honoring all data integrity and realistic universe issues. The resulting average number of positions per year exceeds that of most mutual funds.

Year	Average Number of Positions	Year	Average Number of Positions
1983	148	1994	808
1984	74	1995	1078
1985	215	1996	1455
1986	336	1997	1668
1987	319	1998	1305
1988	150	1999	983
1989	439	2000	970
1990	299	2001	722
1991	634	2002	607
1992	782	2003	708
1993	1046	2004	1197

Conclusions:

The evidence suggests that trend following can work well on stocks. Buying stocks at new all time highs and exiting them after they've fallen below a 10 ATR trailing stop would have yielded a significant return on average. The evidence also suggests that such trading would not have resulted in significant tax burdens relative to buy & hold investing. Test results show the potential for diversification exceeding that of the typical mutual fund. The trade results distribution shows significant right skew, indicating that large outlier trades would have been concentrated among winning trades rather than losing trades.

The research described so far in this paper was only a small initial step in a complex process. Portfolio level money management is absolutely essential to the success of a trend following system. Controlling risk at the portfolio level encompasses initial position sizing, scaling into and out of individual positions, total open risk constraints, etc. However, at this stage we are comfortable answering the question "Does trend following work on stocks?" The evidence strongly suggests that it does.

Having determined that a significant positive mathematical expectancy does exist for long term trend following on stocks, we took the next step and put our own portfolio management process to the test.

Hypothetical portfolio results follow this disclaimer:

Portfolio Simulation:

Although a complete discussion is beyond the scope of this paper the following hypothetical returns reflect the application of the portfolio management system we use to manage client & proprietary capital.

The mechanics behind our portfolio management system are not disclosed. However, the system strictly adheres to the following principals:

- Losing trades are never added to
- Winning trades are only reduced to alleviate risk concentrations
- New entries are never skipped
- Stop losses are always honored
- Total open risk at the portfolio level is always *limited* to a specific number

It is a complete portfolio management system that sizes positions according to a multifactor utility function that considers the number of open positions, the total open risk at the portfolio level, and the volatility of the open positions. Positions are resized dynamically with two goals. First, to limit total portfolio risk to less than 30%. Second, to manage individual position risk concentrations.

Hypothetical Equity Curve

The following hypothetical portfolio returns would have out performed the S&P 500 total return index:

Blackstar Equity Trend Following System VS. S&P 500 Total Return Index

These hypothetical portfolio returns are net of all trading costs including estimated commissions, slippage and margin expense.
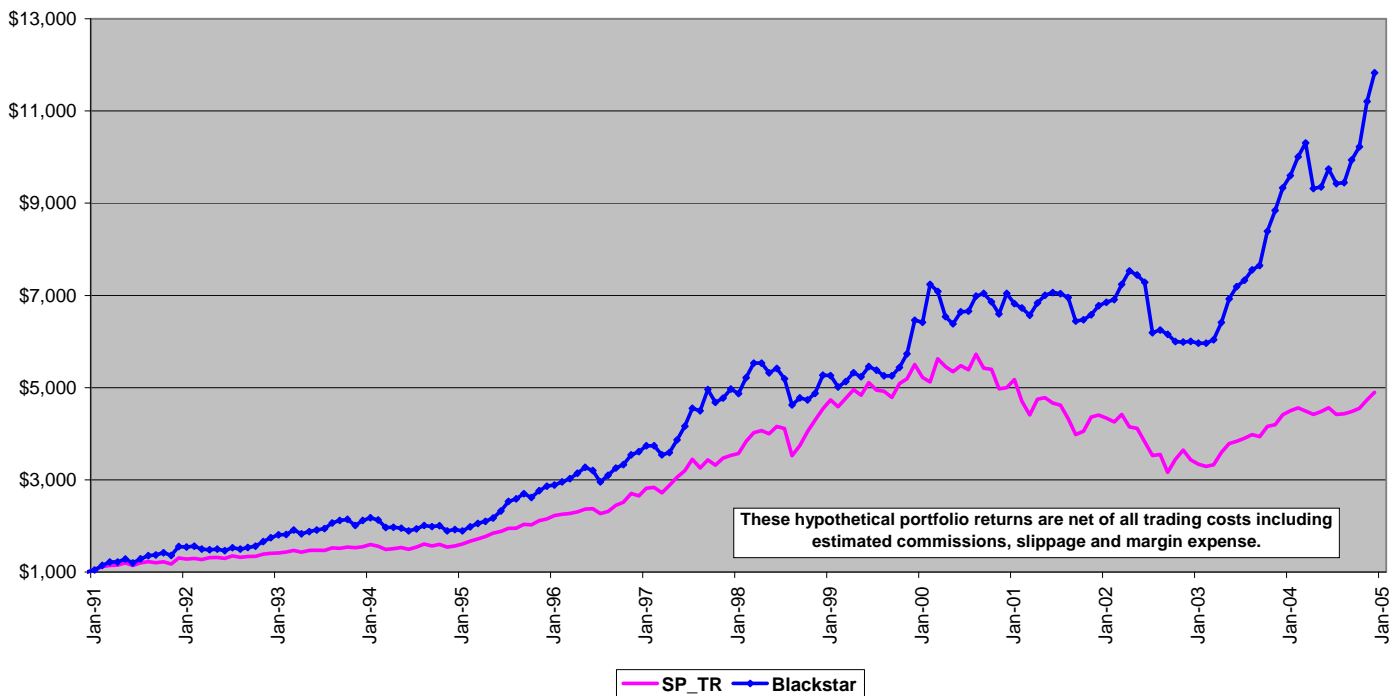
This historical testing was done with the PowerST strategy testing software.

Hypothetical Monthly Returns

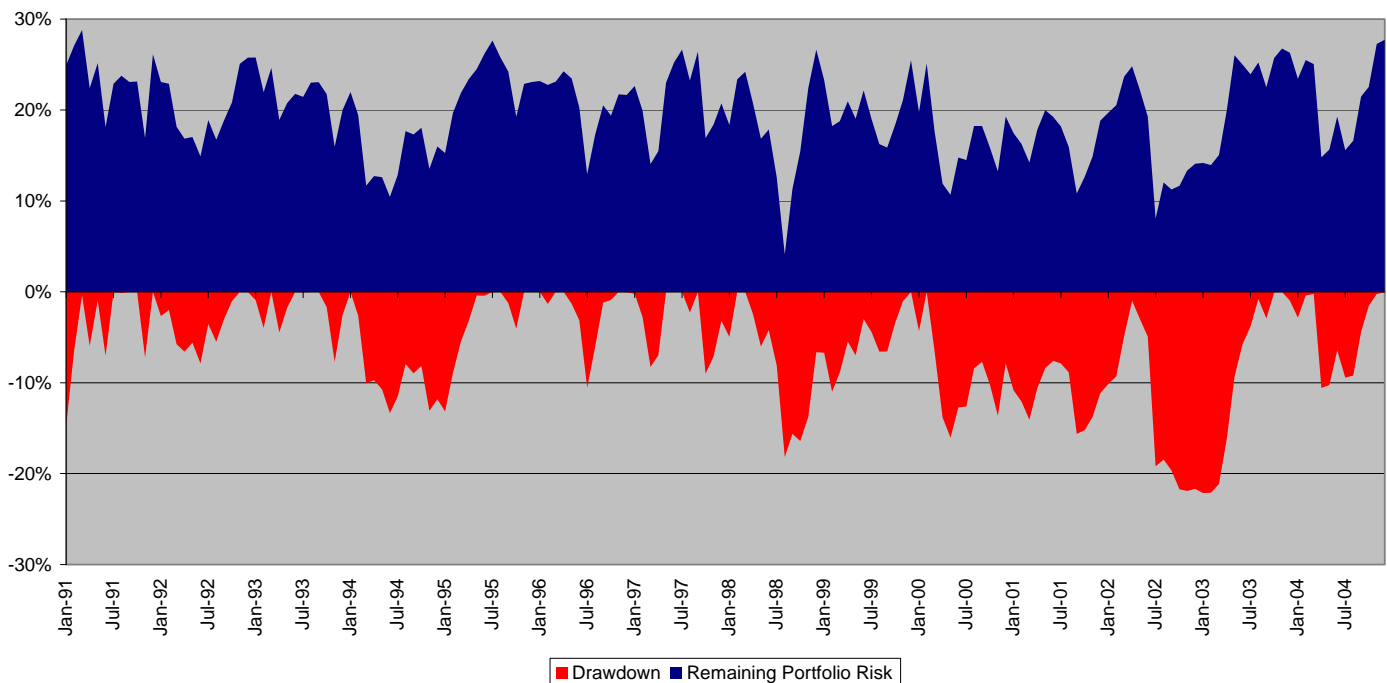|	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Blackstar	S&P 500
1991	4.7%	9.3%	6.4%	0.0%	5.1%	-6.3%	7.4%	5.3%	1.2%	3.5%	-4.3%	14.3%	**55.2%**	**30.5%**
1992	-0.7%	1.3%	-4.0%	-1.0%	1.0%	-2.5%	4.6%	-2.1%	2.5%	1.9%	6.3%	4.9%	**12.4%**	**7.6%**
1993	3.6%	0.5%	5.3%	-4.5%	2.7%	1.9%	1.6%	6.4%	2.7%	1.0%	-6.2%	5.5%	**21.5%**	**10.1%**
1994	2.8%	-2.3%	-7.7%	0.3%	-1.1%	-2.9%	2.1%	4.0%	-1.2%	0.8%	-5.5%	1.5%	**-9.3%**	**1.3%**
1995	-1.6%	4.8%	3.7%	2.2%	3.5%	7.1%	8.9%	2.1%	4.3%	-3.1%	5.6%	3.5%	**48.9%**	**37.6%**
1996	1.0%	2.4%	2.3%	3.9%	4.0%	-2.0%	-7.8%	5.0%	5.1%	2.2%	6.3%	2.0%	**26.2%**	**23.0%**
1997	3.5%	0.0%	-5.2%	1.3%	7.8%	7.6%	9.3%	-1.2%	10.4%	-5.6%	1.9%	4.1%	**37.7%**	**33.4%**
1998	-2.0%	7.0%	6.1%	0.0%	-3.8%	1.8%	-4.1%	-10.9%	3.3%	-0.9%	3.1%	8.1%	**6.1%**	**28.6%**
1999	-0.2%	-4.7%	2.3%	3.7%	-1.6%	4.3%	-1.5%	-2.3%	0.1%	3.4%	5.4%	12.8%	**22.6%**	**21.0%**
2000	-0.7%	12.8%	-2.1%	-7.7%	-2.4%	4.1%	0.2%	4.9%	0.9%	-2.6%	-3.8%	6.7%	**9.0%**	**-9.1%**
2001	-3.2%	-1.4%	-2.3%	4.0%	2.5%	0.8%	-0.4%	-1.1%	-7.4%	0.5%	1.7%	3.0%	**-3.8%**	**-11.9%**
2002	1.1%	0.9%	4.8%	4.0%	-1.2%	-2.1%	-15.0%	0.9%	-1.5%	-2.6%	-0.2%	0.3%	**-11.4%**	**-22.1%**
2003	-0.6%	0.0%	1.2%	6.2%	8.0%	3.8%	1.9%	3.0%	1.2%	9.7%	5.4%	5.6%	**55.5%**	**28.7%**
2004	2.8%	4.3%	3.0%	-9.6%	0.3%	4.2%	-3.2%	0.2%	5.2%	2.9%	9.6%	5.5%	**26.7%**	**10.9%**

These hypothetical portfolio returns are net of all trading costs including estimated commissions, slippage and margin expense.

Annual Compounded Return	**19.3%**	**12.0%**
Annual Standard Deviation	**15.6%**	**14.4%**
Maximum Drawdown	**-20.8%**	**-44.7%**

Portfolio Risk

Remaining portfolio risk represents the percent of the current portfolio value that would be lost if every position were to decline to its stop loss level simultaneously. The following chart shows the historical drawdowns and corresponding remaining portfolio risk as they would have looked in real time.

Remaining Portfolio Risk / Drawdown Relationship

Appendix 1: Examples of Recent Winning Trades

NIHD: NII Holdings Inc.

QSII: Quality Systems Inc.

FRO: Frontline Ltd.

FDG: Fording Canadian Coal Trust

UPL: Ultra Petroleum

URBN: Urban Outfitters Inc.

CME: Chicago Mercantile Exchange Holdings Inc.

SHLD: Sears Holdings Corporation

Appendix 2: Examples of stocks that were entered, exited, and then re-entered:

CECO: Career Education Corp

TWX: Time Warner

CTS: CTS Corp

FRK: Florida Rock Ind

QLGC: QLogic

NSOL: Network Solutions

POG: Patina Oil & Gas Corp

CMGI: CMGI Inc.

Appendix 3: Examples of boom/bust stocks from the past:

BOST: Boston Chicken

QCOM: Qualcom

PMCS: PMC Sierra

NTAP: Network Appliance Corp

CSCO: Cisco Systems

CPN: Calpine Cp

CMGI: CMGI Inc.

YHOO: Yahoo
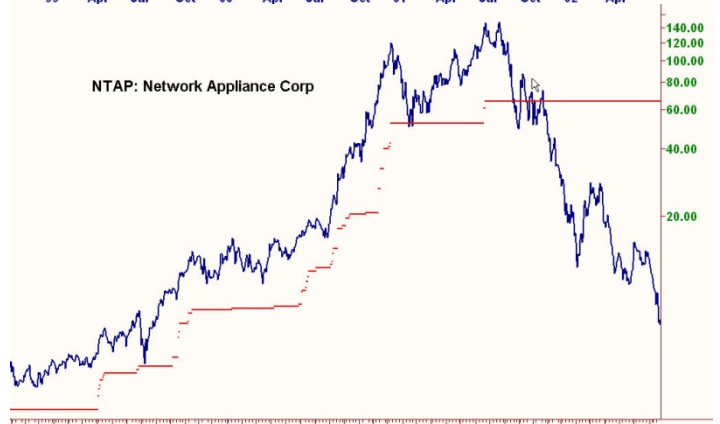
Appendix 4 – Data Integrity Issues

The scope of this project included all stocks that traded on U.S. exchanges (AMEX, NYSE & NASDAQ) from 1983 to year end 2004. This amounted to more than 24,000 securities spanning 22 years.

Delisted stocks, symbol overlap, unique identifiers

In our experience, a very common mistake made in testing stock trading strategies is failure to understand and deal with the reality that actively traded securities existed for companies that have since gone out of business or have been acquired by other companies. These securities will *not* show up in most databases. Only the securities of "surviving" companies will show up in the typical database or charting service. To account for this survivorship bias, delisted companies were included in our universe. Since current companies sometimes use ticker symbols that were previously used by former (since delisted) companies, a unique serial number was necessary to identify each stock.

At the time of this writing the entire database showed 24,057 individual securities. However, only 11,384 securities were active on U.S. exchanges. This left 12,673 securities that did exist historically but do not exist now. Most databases will omit these 12,673 securities, leading to erroneous results from any kind of historical testing. In the interest of accuracy we chose to include these data in our testing.

The following illustrations are examples of companies whose shares became worthless and are thus not reflected in most of today's databases:

Adjustments for corporate actions (stock-splits, dividends, mergers, etc.)

Another common mistake made in testing stock trading strategies is the failure to understand and deal with corporate actions. Most notably, databases and charting services often ignore cash dividends. This is unfortunate since a cash dividend is part of a shareholder's return on investment. Stocks almost always "gap down" by the amount of the dividend on the ex-dividend date[11]. The following illustrations show two different charts for the same security over the same time frame. The first is *not* adjusted for dividends and shows that Cousins Properties gapped down $6.65 on Nov-19-2004, resulting in a one day loss of 19.5%.

The second chart is adjusted for dividends and shows that Cousins Properties finished the day with a mild loss of only -1.3%. It turns out that Nov-19-2004 was the ex-dividend date, the day after the owner of record has been determined regarding the $7.15 dividend.

11. **Ex-dividend date – The first day of the ex-dividend period. The day upon which the stock will typically fall by an amount equal to the anticipated dividend. Owners of record prior to the ex-dividend date are entitled to the dividend proceeds**

In reality the security did gap down $6.65 and did trade even lower to close down -$7.66 for the day. But the owner of the security did *not* incur a 19.5% loss. Rather, the owner of the security became the beneficiary of a $7.15 dividend, and thus his/her return on investment should be calculated as a loss of 1.3% for the day. For the purposes of historical testing this can be done by proportionally back adjusting previous price data down by a value equal to the amount of the dividend divided by the close on the day preceding the ex-dividend date.

Failure to adjust for dividends causes more than just erroneous profit and loss results. If you are using mathematically derived entries and exits for trading purposes, non-adjusted data will corrupt the logic of your system. For example, consider two investors starting their programs in December-2004. Both investors utilize the same strategy where a stock is purchased if it breaks out to a new 5 year high. Investor A is not using dividend adjusted data and must wait for Cousins Properties to breakout above $39.81. Investor B is using dividend adjusted data and thus would be buying on a breakout above $31.62.

We will argue that Investor A is unnecessarily waiting for a price of $39.81. Investor B is correct to use a price of $31.62 as a key breakout point since it is not possible for any investor to have a loss in the investment above this price level. Any investor who purchased at higher prices, and still owns the stock, would have also been the shareholder of record prior to the ex-dividend date and would have received the $7.15 dividend.

The following illustrations highlight the significance of failure to adjust for dividends in high yielding stocks:

The same error impacts exits (stops) in a similar manner. A casual glance at the first chart of Cousins Properties clearly shows significant volatility that is a function only of a corporate action, not of monetary losses. This "phantom" volatility can result in your exit price being breached when it otherwise would not have been, as well as negatively impacting risk adjusted return metrics.

A price chart supplied by the typical database or charting service often does not tell the whole story. Failure to adjust for cash dividends will result in an understatement of the profitability of owning dividend paying stocks. This error is a direct function of the dividend yield of the security in question; the higher the yield the greater the error. Failure to adjust for cash dividends will also overstate the profitability of any short selling strategies

since the short seller (who must borrow shares to short) is required to pay the received dividend to the rightful owner of the stock. Entries, exits, and subsequent profitability estimates are all impacted by any failure to properly adjust for cash dividends.

For the above mentioned reasons we have proportionately back adjusted our entire database for cash dividends, stock dividends, stock splits, reverse splits, and various other types of corporate actions.

Realistic universe of tradable securities

A database consisting of all stocks that traded on U.S. exchanges since 1983 will include thousands of penny stocks and securities that were simply too illiquid to generate trustworthy historical test results from. For this reason we created "minimum stock price" and "minimum average daily dollar volume" filters to limit our trading universe. Non-adjusted historical closing price and volume data are required to calculate both. If you'll recall from the last section on dividend adjusted data, the adjustment process artificially deflates historical prices in order to keep daily percent changes in line with what an investor would have realized. The higher the dividend yield the more deflated the price series becomes during proportional back adjustment.

Having non-adjusted price information available makes it possible, through the use of formulas, to utilize "minimum stock price" and "minimum average daily dollar volume" filters historically *as the trades actually would have been executed or rejected*.

We chose $15 as the "minimum stock price". It was not a scientific decision. Rather, it was based on our current policy to avoid very low priced stocks. Low priced stocks tend to have relatively high statistical volatility and little institutional following. That being said, the "minimum stock price" filter was made to be dynamic, accepting stocks that climbed higher than $15 and rejecting stocks that fell to below $15. The "minimum average daily dollar volume" was chosen, in current terms, to be $500,000 for NYSE and AMEX listed securities; $1,000,000 for NASDAQ securities. This minimum value was back adjusted, in terms of time, with a decay rate equal to that of inflation, as defined by the consumer price index. For example, the "minimum average daily dollar volume" for an NYSE or AMEX security would have been $270,000 back in 1983.

At this point we had the pieces in place the answer question a) What stocks will be considered? Our tradable universe consisted of any stock above $15 that had an average daily dollar volume that exceeded a minimum value depending upon the year being evaluated.

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