

Analysis of Trend Following Systems

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Abstract

This essay introduces the reader into system development and presents various successful Trend following systems and simulate them in most popular markets. Since good and reliable data is the basis of correct backtesting results at the beginning we discuss important data issues. Then, we present different trend following concepts and try to point out the inherent risks of over optimizing. To avoid this pitfall we test the presented systems over a broad range of parameters. As another stability test, we run some of our systems on a different set of data, i.e. a completely different portfolio. Finally, we do also look at the impact of money management settings in system results.

Preface

The aim of this document is twofold: On one hand it shall introduce you into the world of trend following systems which are often used by large hedge funds to be profitable in nowadays markets. On the other hand it shall help you in understanding the risks associated when developing trading systems, especially trend following systems.

Many systems look very nice because they are over-optimized, i.e. they work perfect in a certain market condition. But they are so much tied to this market condition that they fail when this condition changes. So it's no wonder many systems' performance drops soon after they have been released.

I hope that this document is able to help you developing a successful system and to foster a broad discussion about trading systems. Feel free to send me any comments to info@systemtrader24.com

Happy and successful trading!

José Cruset

Trend Following systems

Among large hedge funds, Trend Following systems are very popular, maybe even the most used ones. The main reason for that is simple: They are able to support large amounts of equity. The larger a fund is the more difficult it becomes for this fund to enter and exit the market. Trend Following systems try to ride long-term trends and do not trade very often. They are therefore predestined for large positions. Moreover, trends did exist in the past, they exist in the present and they will exist in the future. As we will see here, it is possible to be profitable in the financial markets using this approach.

In the following, we are presenting several trend following concepts together with systems that use these concepts. Like most other trend following systems, they have these basic principles in common:

- Their rules are simple
- They detect major trends by measuring the price variation from a certain reference value
- As soon as a trend is detected a position (long/short) in favor of the trend is established
- Profitable trades are not exited until the trend changes (“let the profits run”)
- Unprofitable trades are exited at a predefined stop loss point (“cut the losers short”)
- Money Management (Position sizing) is based on the maximum risk we are willing to take, i.e. the maximum amount we are accepting to lose in a single position if the market expectation was wrong.

The differences between different trend following systems lie in the way they determine the entry and exit-threshold and in the timeframe they apply to detect trends. Several basic concepts exist to define a trend. Here, we present systems based on the most common ones:

- Moving averages
- Donchian channels (High/Low Breakouts)
- Bollinger Bands (Standard Deviation Breakouts)

Other techniques exist. They are sometimes based on more complex indicators and use additional information like e.g. volume. Here we want to show that even the simplest techniques can be used to detect trends successfully and to get an edge in the market.

Data

All systems use only the daily price information of a security. Each day provides these four price data values: Open, High, Low, and Close. Neither Volume nor any intraday information is used. The systems have all been tested on this futures-portfolio:

Sector	Market	Sector	Market
Currencies	BRITISH POUND	Softs	COFFEE
	JAPANESE YEN		COTTON #2
	SWISS FRANC		SUGAR #11
	EURO	Grains	CORN
Financials	S & P 500		SOYBEAN OIL
	NASDAQ 100		WHEAT, KC
	T-NOTE, 5yr	Meats	LIVE CATTLE
	T-BONDS		LIVE HOGS
Metals	GOLD (COMMEX)	Energies	CRUDE OIL
	SILVER (COMMEX)		NATURAL GAS

Total: 20 Markets

This portfolio has been chosen because its members are only very little correlated to each other and because the markets are very liquid. We used 15 years (1/1/1990 – 12/31/2004) of continuous ratio-back-adjusted data from Pinnacle Corp. Ratio-back-adjusted data simplifies the backtesting process by merging contract data from different delivery months into one continuous data stream. Price differences in adjacent contracts resulting from carrying charges and interests are taken into account by adjusting backward data (usually past data is lifted up, except for bonds where it is lowered). This data can be used for backtesting trading systems as it provides one single price stream for each contract. Although this approach makes back-testing comfortable we should bear in mind that this is a simplification of the reality. These facts have to be considered:

- Back-adjusted data merges adjacent contracts but does not take rollover-trades into account. Rollover-trades account for slippage and commission like all other trades. Depending on the contract, between 4 and 12 rollover trades occur within a year.
- By doing the back-adjusting process past data of a contract is raised either by adding (or subtracting) a fixed value or by applying a multiplier to all values that are older than the rollover date. This eliminates the gaps from one contract to another. But it also inflates past data resulting sometimes in incorrect simulation results. The more back the data goes the higher the differences between real prices and back-adjusted prices. Example: Corn traded in the last 30 years in a range between 110 and 513, today it trades around 200. Back-adjusted data shows Corn today at a price of 200 as well but it shows Corn 30 years ago trading at prices of above 4000! When calculating position size, this fact has to be taken into account.
- When rolling from one contract to the next during the back-adjusting process, different data-providers use different rules for the exact timing when to switch. When analyzing back-adjusted data you should inform yourself what kind of process the data-provider follows when switching from one contract to the next in order to see if this rollover rule matches your own rollover process in real life trading.

Thus, results based on back-adjusted data can not reflect reality 100%. However, they still can provide a good indication about whether a certain trading strategy is profitable or not. Results presented here should therefore be seen as a good start and working ground for further investigation. To get the most realistic results you should use systems that work on non-adjusted data and that take care of all the rollover procedures to simulate reality as close as possible.

Position sizing

The starting equity for all simulations is 1 Mio USD. The initial position size is based on the maximum amount of risk we are willing to take for each position. All simulations have an initial risk of 2%, i.e. if the market works against us, we will lose a maximum of 2% of our equity in this position. To determine the position size we have to take the stop-price of our system into account. Thus, we assume the worst case, i.e. that the stop will be hit and we are losing slippage on each trade. For this case, we have to calculate the maximum number of contracts resulting in a loss which is smaller than 2% of our current equity. The result is the position size for this trade. So, we can be sure that on each trade only 2% of our equity is at risk (except of situations in which there are large overnight-gaps and we have to exit on the next open). In cases in which the stop is very close to the entry price this position size would result in very high positions. In these cases large overnight gaps would produce higher losses than 2%. To avoid this risk, we additionally restrict the exposure of each position to 10% of our current equity.

Other money management techniques like the Kelly formula or Optimal f rely on the system's performance numbers like Win/Loss ratio, Profit Factor or max. Drawdown. Because these numbers change depending on the length of the simulated period and because we want to be able to compare all systems with each other we decided to use the above mentioned 2% risk-stop instead for all systems alike.

Commission and Slippage

In our simulations we deducted also 20\$ roundturn commission for each contract and 4 ticks of slippage in case of market and stop orders. By applying slippage to the simulation each trade is executed 4 ticks worse than it should have happened according to the data. This makes the simulation more realistic as in real life the execution price is also usually some ticks worse than in backtesting simulations.

Stability-tests

When developing trading systems one should make sure a system is robust enough to withstand certain changes in the market behavior. Whenever we try to get an edge in the market by detecting certain market rules or behaviors we assume that these rules will persist but we also know that the market will never behave exactly in the future as it did in the past. Systems that rely too much on past data and past occurrences are very likely going to fail in the future. So, our trading rules should try to find market opportunities but should not be too strict. Otherwise, it might occur that a system is too much sticking to the past (i.e. it is over-optimized) and it thus might fail in the future.

Out of sample data

A good test whether the system is able to work in different market conditions than the ones it was developed for is to do a simulation on complete different (i.e. out of sample) data than it was designed for. Before risking money you should test any system in various different markets and other time periods to verify its robustness. So, in some of our simulations, we will use the following out of sample portfolio to validate the system's stability:

Sector	Market	Sector	Market
Currencies	Australian Dollar	Softs	Cocoa
	Canadian Dollar		Orange Juice
	Mexican Peso	Financials	Dow Jones
Energies	Heating Oil		Nikkei Index
	Unleaded Gas		T-Note, 2yr
Metals	Copper		T-Note, 10yr
	Platinum	Eurodollars	
Meats	Feeder Cattle	Grains	Soybeans
	Pork Bellies		Rough Rice
Total: 20 Markets			

Testing various parameter values

Whenever a system uses certain input-parameters (like e.g. number of days) one should test whether the performance differs much if these parameters are changed. Certain parameter combinations might work well in the past but not in the future. So, in some of our simulations we will present the simulation results of various different input parameters to prove the robustness of the presented system.

Monte Carlo simulation

We furthermore recommend doing a Monte Carlo Simulation of all generated trades. During this process, all generated trades will be scrambled as if they occurred at different times and in a different order. So, you will get a new and different equity curve which might have different drawdown- and performance values. The Add-On product *Monte Carlo Lab for Wealth Lab Developer* helps in doing this test in running a simulation several hundred times in order to analyze the robustness of a system. This simulation assures that the result you get in a normal simulation is not the result of luck but of a certain edge the system has in the market. If even after a Monte Carlo simulation your system provides still good performance numbers, the chance of having found a robust strategy is much higher.

The systems

Concept: Moving averages

Moving averages are the most used indicators in technical analysis. Their main usage is to detect trends. They exist in various forms: the Simple Moving Averages (SMA) is simply the average price over the specified period. The average is called "Moving" because it is plotted on the chart bar by bar, forming a line that moves along the chart as the average value changes. Whereas a Simple Moving Average (SMA) calculates a straight average of the data, the Weighted Moving Average (WMA) and the Exponential Moving Average (EMA) apply more weight to the more recent data. The most weight is placed on the most recent data point. Because of the way it's calculated, a WMA and an EMA will follow prices more closely than a corresponding SMA. However, results differ not very much. We therefore will use only the SMA in our systems.

Although moving averages are widely used they are mainly criticized because they usually lag in their trend-detection. I.e. they only are able to detect a trend after the trend has been established. Entering a trend at this point means giving away a big part of the possible profit. However, trend-followers accept this as they expect that the market will continue on its move into the same direction and the big move is still to come.

Fast SMA crossover slow SMA 100-50

The first presented system is one of the most classic one's. It uses two different Simple Moving Averages (SMAs), a fast one which follows the short-term trend and a slow one which reflects the long-term trend. Our system uses a fast moving average out of the last 50 days and a slow one using 100 days. A typical chart would look like the one in Figure 1:



Figure 1

Notice how the fast SMA (dotted line) reacts faster to price changes than the slow SMA (solid line). As soon as the fast SMA-line crosses over the slow SMA-line the market is about to change its long-term trend direction and thus this crossover will be used as a market-entry signal. The system we present here will identify a trend (and take action) as soon as the fast SMA crosses over the slow SMA.

Rules:

- Go Long the next day at Market (=on the Open) as soon as the fast SMA (of 50 periods) crosses over the slow SMA (of 100 periods)
- Exit Long and Go Short the next day at Market as soon as the fast SMA (of 50 periods) crosses under the slow SMA (of 100 periods)

- Set a StopLoss of 4 times the ATR (Average True Range*) of 10 days

We set a stop loss to control our risk and thus to avoid a loss of more than 2% of our current equity.

*) The Average True Range is calculated by applying the Moving Average of a specified period to the True Range. The True Range takes gaps into account which can occur between the previous close and the open. The True Range is always a positive number and is defined to be the greatest of the following for each period:

- The distance from today's high to today's low.
- The distance from yesterday's close to today's high.
- The distance from yesterday's close to today's low.

Position sizing:

2% based on initial stop loss (based on 4 times the 10-day-ATR)

Example trade:

Figure 2 shows some example trades in the S&P. The up arrows show long entries (and short exits) and the down arrows short entries (and long exits). We can see that this system experiences whipsaws in sideways markets (like from November 01 until March 02) and excels at long trends like the bear-trend from April 02 until December 02. It usually never buys at the lowest price and never sells at the highest price, though.



Figure 2

Results:

The portfolio equity curve (Figure 3) shows a nice and steady increase until beginning of 2001 with only very little drawdowns. Afterwards, a deep drawdown period starts where it reaches its maximum drawdown of 47%. It needs two years to recover from this loss and to continue to new equity highs. Still, the annualized profit of almost 19.6% makes this system very attractive.

Trend-following systems usually have a low number of profitable trades. They make most of their profits out of very few trades. This system works similar. Less than 40% of its trades are profitable. On average, each of these trades makes 14.0% profit, enough to withstand the 60% unprofitable trades whose average loss is 5.9%. Please also note that long trades are more profitable than short trades.

Although more investigation and robustness tests are necessary, we can conclude that the general rules presented in this system can help in taking advantage of long term trends.

Portfolio Equity Curve:

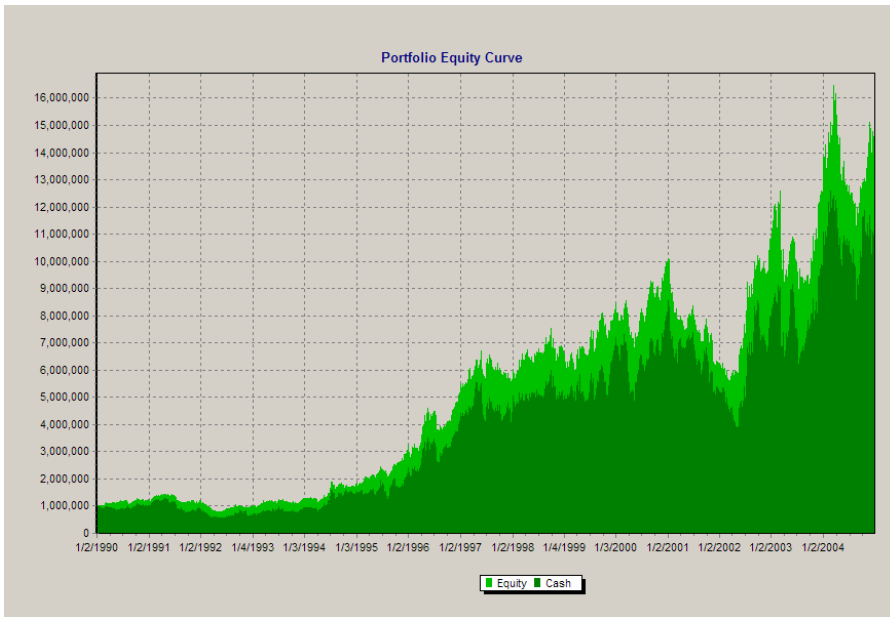


Figure 3

Drawdown Curve:

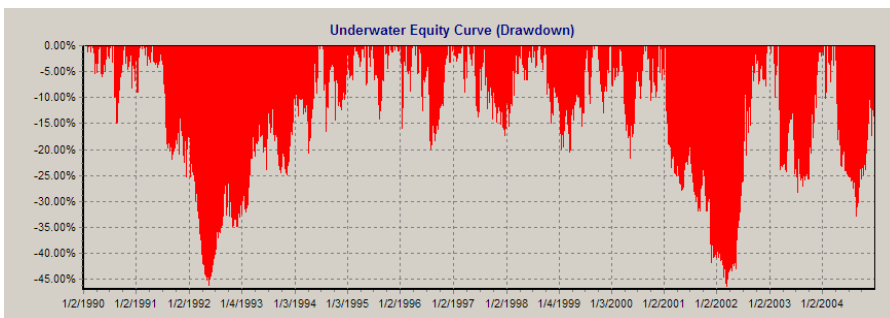


Figure 4

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$14,651,969.00	\$13,372,551.00	\$2,279,417.75
Net Profit	\$13,651,969.00	\$12,372,551.00	\$1,279,417.75
Net Profit %	1,365.20%	1,237.26%	127.94%
Annualized Gain %	19.59%	18.86%	5.64%
Exposure	21.61%	22.14%	11.97%
Number of Trades	515	368	147
Avg Profit/Loss	\$26,508.68	\$33,621.06	\$8,703.52
Avg Profit/Loss %	1.78%	2.46%	0.10%
Avg Bars Held	84.18	83.64	85.52
Winning Trades	199	145	54
Winning %	38.64%	39.40%	36.73%
Gross Profit	\$39,654,793.64	\$30,758,031.33	\$8,896,762.30
Avg Profit	\$199,270.32	\$212,124.35	\$164,754.86
Avg Profit %	13.95%	15.16%	10.71%
Avg Bars Held	148.22	148.58	147.24
Max Consecutive	8	9	7

Analysis of Trend Following systems

Losing Trades	316	223	93
Losing %	61.36%	60.60%	63.27%
Gross Loss	\$-26,002,824.58	\$-18,385,480.10	\$-7,617,344.48
Avg Loss	\$-82,287.42	\$-82,446.10	\$-81,906.93
Avg Loss %	-5.88%	-5.80%	-6.06%
Avg Bars Held	43.85	41.42	49.69
Max Consecutive	12	12	10
Max Drawdown	\$-5,631,295.00	\$-5,325,782.00	\$-3,470,406.25
Max Drawdown %	-46.96%	-75.77%	-60.36%
Max Drawdown Date	8/25/2004	8/27/2004	11/3/2004
Wealth-Lab Score	48.08	20.65	18.70
Profit Factor	1.53	1.67	1.17
Recovery Factor	2.42	2.32	0.37
Payoff Ratio	2.37	2.61	1.77
Sharpe Ratio	0.83	0.68	0.34
Ulcer Index	18.00	23.87	25.97
Wealth-Lab Error Term	16.87	17.45	25.67
Wealth-Lab Reward Ratio	1.16	1.08	0.22
Luck Coefficient	12.43	11.44	6.38
Pessimistic Rate of Return	1.32	1.46	0.80
Equity Drop Ratio	0.25	0.32	0.98

Stability test: Different lookback-periods for moving averages

Initially, we used 50 and 100 as parameters for the SMA-periods. We now want to see what impact different lookback periods have on our performance. Therefore, we run several simulations where we use different parameters in order to prove the system's robustness. When doing this, we will use the same parameter across all markets alike. Thus, we do not try to find the best parameter for every market separately. Although it is possible to design a system in Wealth Lab Developer using the best parameter for each market we believe that this would mean to over optimize the system and it would lead us into a curve-fitting-trap. If you search for (and later apply) the best parameter for each market, the system might not be robust enough in the future and is likely to generate worse profits than during your simulation.

The simulation has been run for each parameter combination and the annualized profit has been painted in Figure 5. The different shading represents different annualized profit ratios (percent profit per year). The vertical axis shows values for the fast SMA. The horizontal axis shows the difference between the fast and the slow SMA. So, for example, the point at (50, 50) represents a simulation result using 50 as parameter for the fast SMA and 100 for the slow SMA.

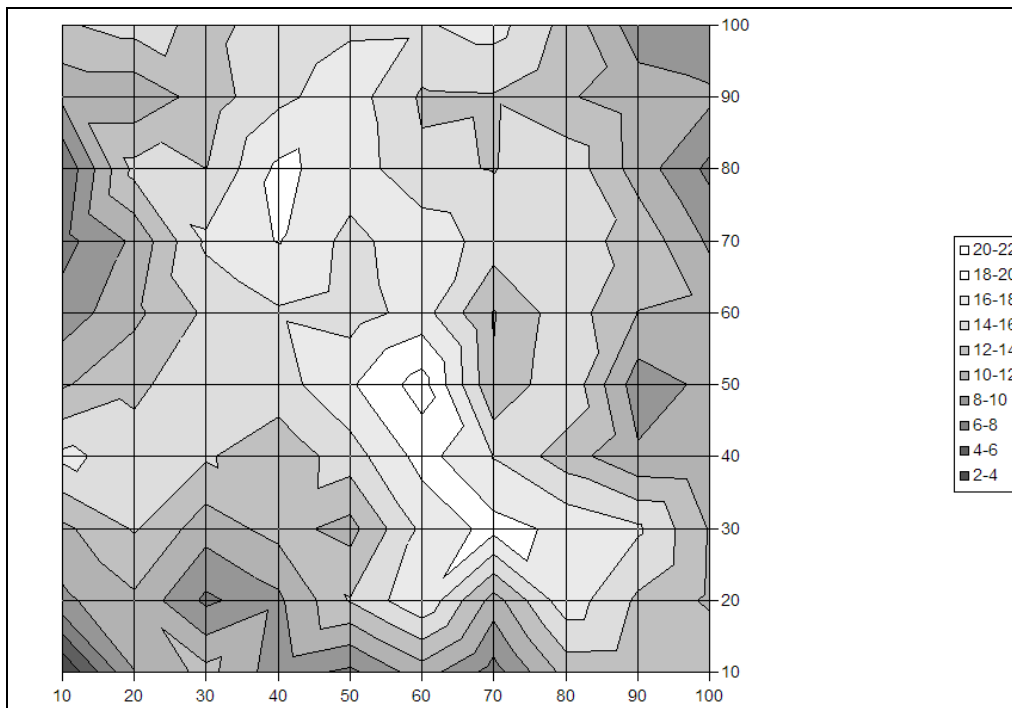


Figure 5

The graphic shows optimum values in the center of the chart. So, combinations of 40-60 for the fast SMA and 100-120 for the slow SMA provide the best results in backtesting.

In our case, the optimum combination of (50, 60; i.e. SMAs of 50 and 110) is surrounded by parameter combinations with results of more than 12% p.a. So, this parameter combination is a good choice because slight changes in the market behavior provide still good results. We should expect results in this magnitude if we use these parameters for our real trading.

SMA Crossover weekly

As our system tries to find long-term trends, we will now test if the usage of a weekly timescale is suitable, too. So, instead of computing our moving average points every day, we will use weekly SMAs which are calculated using the closing price of each week instead of the closing price of each day. So, there will be only once a week (Friday evening) a possible crossover and therefore only once a week (Monday morning) new orders have to be submitted to the broker. This makes trading such a system much more comfortable. According to the initial system with SMA parameters of 50 and 100 days, we will now use the weekly counterpart, i.e. 10 and 20 weeks of lookback periods.

However, with our initial risk setting of 2% we are getting a low margin to equity ratio (exposure) of only 8.2%. Therefore, we allow an exception here and execute this test with 3% risk stop. All other parameters remain the same.

Rules:

- Go Long the next day at Market (=on the Open) as soon as the fast SMA (of 10 weeks) crosses over the slow SMA (of 20 weeks)
- Exit Long and Go Short the next day at Market as soon as the fast SMA (of 10 weeks) crosses under the slow SMA (of 20 weeks)
- Set a StopLoss of 4 times the ATR (Average True Range*) of 10 weeks

Position sizing:

3% based on initial stop loss (based on 4 times the 10-week-ATR)

Example trade:

Figure 6 shows some example trades in Crude Oil. During 2003 the system experiences various whipsaws as the market changes its direction various times and no trend is established. But at the end of 2003, the system enters a long trade in which it stays until the end of 2004. Though it enters when the trend is already established it still catches 16 full points in this trade.



Figure 6

Results:

Our portfolio equity curve (Figure 7) has a similar shape as the one of the daily system. However, it does not show the same (high) performance nor the same (high) drawdown. Still, the annualized gain of over 11% is acceptable, especially taking the low number of trades into account (400 in 15 years) which make this system easy to trade. Maximum drawdown is 38.6%, which is also lower than in the daily system. Please also note in the drawdown graph (Figure 8) that most drawdowns are below 10% whereas in the daily system (Figure 4) most are between 10% and 20%. Again, this system shows a low number of profitable trades (40%) with a high profit per trade of almost 15%. Exposure (12.4%) is still much lower than in case of the daily system (21.6%) and therefore, increasing the position size even further could be considered in order to improve profits. However, this will also result in higher drawdowns.

Portfolio Equity Curve:

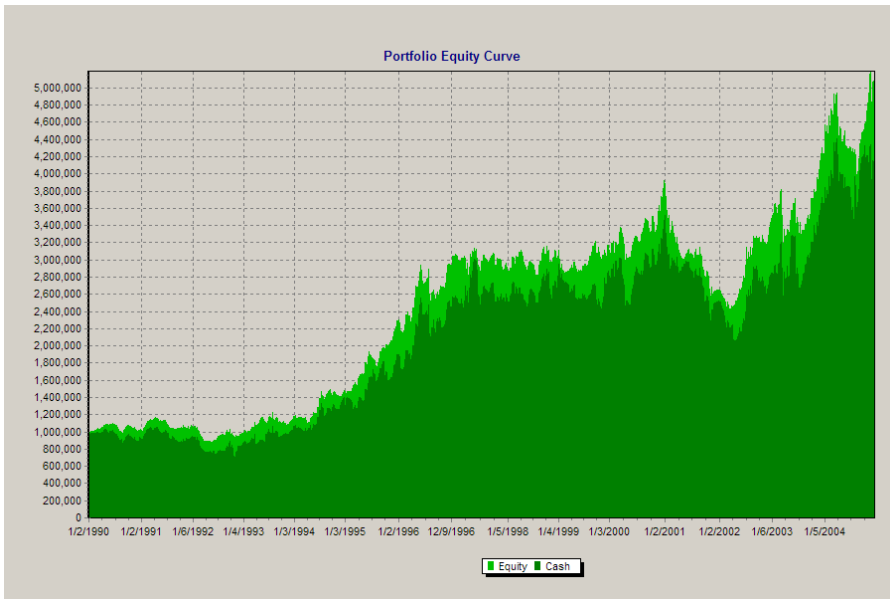


Figure 7

Drawdown Curve:

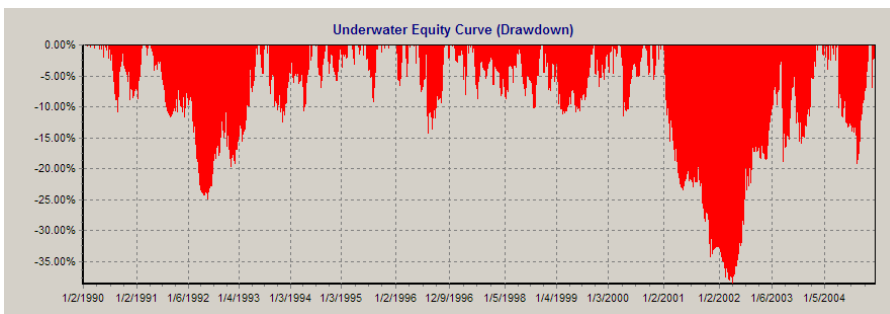


Figure 8

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$5,080,527.63	\$4,701,566.13	\$1,378,961.63
Net Profit	\$4,080,527.63	\$3,701,566.13	\$378,961.63
Net Profit %	408.05%	370.16%	37.90%
Annualized Gain %	11.45%	10.87%	2.17%
Exposure	12.43%	12.50%	1.41%
Number of Trades	400	380	20
Avg Profit/Loss	\$10,201.32	\$9,740.96	\$18,948.08
Avg Profit/Loss %	2.26%	2.21%	3.29%
Avg Bars Held	19.41	19.21	23.15
Winning Trades	161	153	8
Winning %	40.25%	40.26%	40.00%
Gross Profit	\$10,118,227.49	\$9,555,140.84	\$563,086.65
Avg Profit	\$62,846.13	\$62,451.90	\$70,385.83
Avg Profit %	14.91%	14.86%	15.85%
Avg Bars Held	31.42	31.37	32.50
Max Consecutive	7	8	3

Analysis of Trend Following systems

Losing Trades	239	227	12
Losing %	59.75%	59.74%	60.00%
Gross Loss	\$-6,042,733.17	\$-5,858,608.18	\$-184,124.99
Avg Loss	\$-25,283.40	\$-25,808.85	\$-15,343.75
Avg Loss %	-6.26%	-6.32%	-5.08%
Avg Bars Held	11.32	11.02	16.92
Max Consecutive	14	14	4
Max Drawdown	\$-1,517,648.25	\$-1,507,480.38	\$-174,799.88
Max Drawdown %	-38.60%	-42.18%	-12.03%
Max Drawdown Date	4/8/2002	4/8/2002	3/29/2004
Wealth-Lab Score	56.56	50.32	135.19
Profit Factor	1.67	1.63	3.06
Recovery Factor	2.69	2.46	2.17
Payoff Ratio	2.38	2.35	3.12
Sharpe Ratio	0.73	0.67	0.36
Ulcer Index	12.13	13.96	6.24
Wealth-Lab Error Term	11.59	11.64	5.26
Wealth-Lab Reward Ratio	0.99	0.93	0.41
Luck Coefficient	12.03	12.07	2.46
Pessimistic Rate of Return	1.39	1.37	1.04
Equity Drop Ratio	0.45	0.52	0.56

Trend with Pattern Entry

The following system combines trend following and countertrend concepts. It is called Trend with Pattern Entry (TPE) and was first introduced by Dion Kurczek and Volker Knapp in the Active Trader Magazine in April 2003. The system's main idea is that prices above the SMA indicate a bull trend and prices below the SMA indicate a bear trend. Additionally, the system waits for a short-term countertrend reaction to enter the market. If prices are above the SMA, the system waits for three consecutive down-days to enter long the next day. Consequently, if the price is below the SMA the system waits for three consecutive up-days to enter short the next day. The exit rule is a trailing stop which is 4 times the ATR of 10 days apart from the current close. The trailing stop will be adjusted if the price moves into our favor but remains if the price moves against us. Thus, achieved profits will be secured.

Rules:

- Go long the next day at Market if the price is below the 100-day SMA and the Closing price increased during the last three days
- Exit long at stop if the price reaches the trailing stop which will be computed by subtracting 4 times the ATR of 10 days from the current closing price.
- Go short the next day at Market if the price is above the 100-day SMA and the Closing price decreased during the last three days
- Exit short at stop if the price reaches the trailing stop which will be computed by adding 4 times the ATR of 10 days to the current closing price.

Position sizing:

2% based on initial stop loss (based on 4 times the 10-day-ATR)

Example Trade:

Figure 9 shows an example in the S&P. The thick line shows the 100 day SMA. The system enters at the end of October 2000 when the market experiences a strong up-move three times in a row while still below the SMA. The system goes short and exits as soon as the price crosses the trailing

stop which is represented by the small dots in the chart. The trailing stop will be calculated every day and as this is an example of a short trade it is adjusted downwards but never upwards.

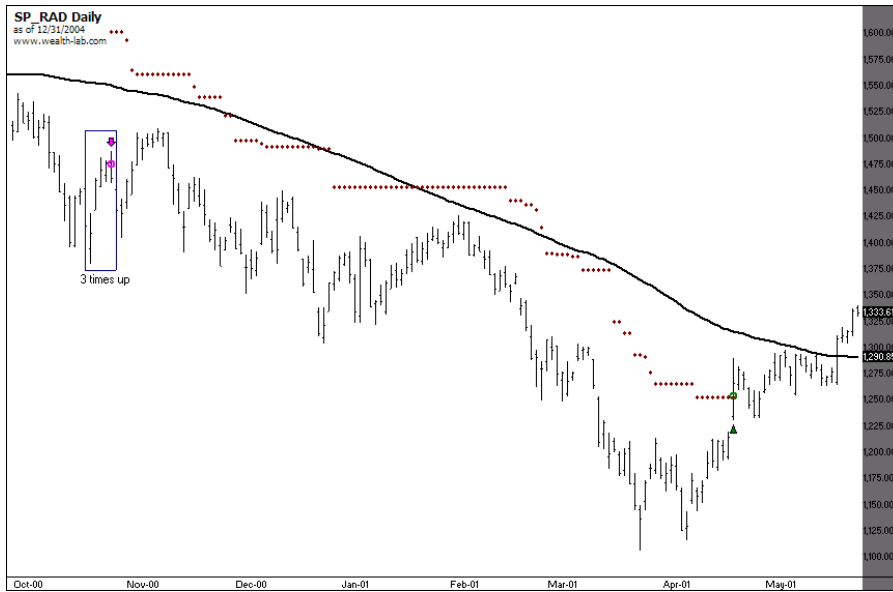


Figure 9

Results:

We see a nice and steady increase in our portfolio equity curve (Figure 10) until beginning of 2002. Then, higher volatility in our equity appears with drawdowns of maximum 49%. And if we have a look at our drawdown curve (Figure 11) we see many drawdown peaks above 20%. However, the system is able to recover quickly from these drawdowns. Although it is experiencing high drawdowns the system’s annualized profit is still 21.8%. Please note again the small number of profitable trades (40%) as in previous systems. As we can see from the performance result table, we have almost the same number of short and long trades but the short trades are on average losing trades whereas the long trades are profitable. Although more stability tests have to be run, one might consider trading this system with long trades only.

Portfolio Equity Curve:

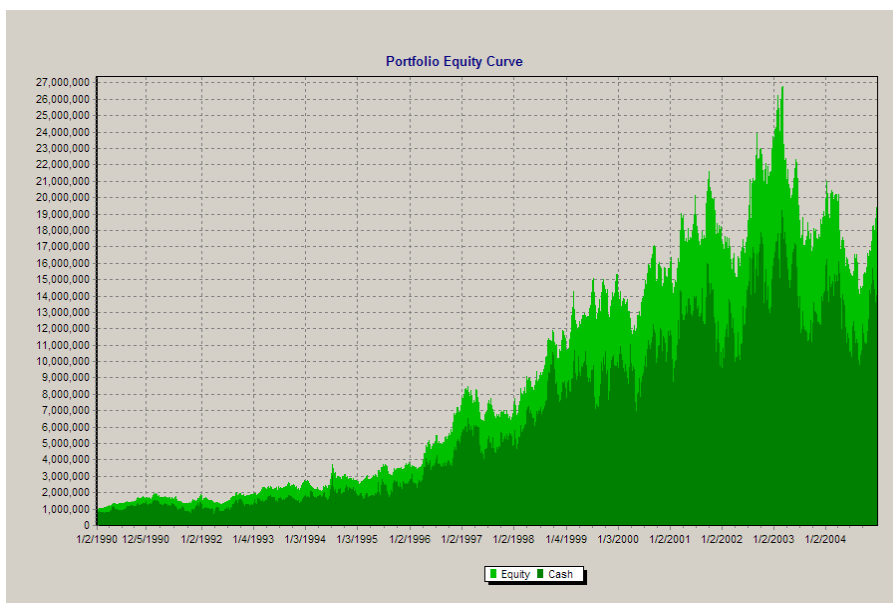


Figure 10

Drawdown Curve:

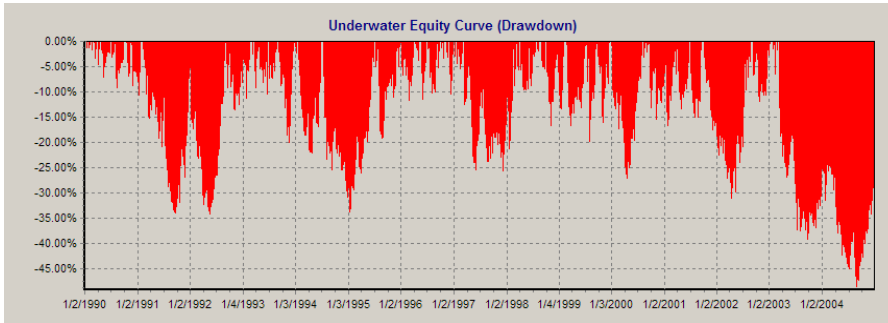


Figure 11

Performance Results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$19,207,066.00	\$21,856,120.00	\$-1,649,053.63
Net Profit	\$18,207,066.00	\$20,856,120.00	\$-2,649,053.63
Net Profit %	1,820.71%	2,085.61%	-264.91%
Annualized Gain %	21.77%	22.82%	0.00%
Exposure	28.09%	20.93%	32.33%
Number of Trades	1,243	626	617
Avg Profit/Loss	\$14,647.68	\$33,316.49	\$-4,293.44
Avg Profit/Loss %	0.69%	1.16%	0.21%
Avg Bars Held	40.30	40.39	40.20
Winning Trades	497	258	239
Winning %	39.98%	41.21%	38.74%
Gross Profit	\$116,910,604.93	\$66,666,494.66	\$50,244,110.27
Avg Profit	\$235,232.61	\$258,397.27	\$210,226.40
Avg Profit %	8.18%	8.73%	7.60%
Avg Bars Held	65.58	63.44	67.90
Max Consecutive	8	7	8
Losing Trades	746	368	378
Losing %	60.02%	58.79%	61.26%
Gross Loss	\$-98,703,539.32	\$-45,810,375.61	\$-52,893,163.72
Avg Loss	\$-132,310.37	\$-124,484.72	\$-139,929.00
Avg Loss %	-4.31%	-4.15%	-4.45%
Avg Bars Held	23.45	24.24	22.69
Max Consecutive	16	11	13
Max Drawdown	\$-13,438,228.00	\$-7,595,336.00	\$-18,730,228.00
Max Drawdown %	-49.06%	-76.64%	-113.27%
Max Drawdown Date	9/1/2004	4/16/2002	5/27/2004
Wealth-Lab Score	39.47	25.48	0.00
Profit Factor	1.18	1.46	0.95
Recovery Factor	1.35	2.75	0.14
Payoff Ratio	1.90	2.10	1.71
Sharpe Ratio	0.75	0.68	0.36
Ulcer Index	17.93	20.86	50.01
Wealth-Lab Error Term	12.37	14.16	184.14
Wealth-Lab Reward Ratio	1.76	1.61	0.00

Luck Coefficient	14.45	13.55	7.09
Pessimistic Rate of Return	1.17	1.31	0.96
Equity Drop Ratio	0.22	0.30	0.00

Impact of Money Management

Now, we want to concentrate on different risk- and money management-settings. In the following two examples, we show how important that part in any system is. In short, it decides how long a system is able to survive. As a general rule, when trying to define the optimum position size one should focus more on the losing part of a trade than on the winning part. “Control your risk; the returns will take care of themselves” is a well known advice among traders. The position size should be small enough to withstand long drawdown periods (but also high enough to provide us with enough profit).

In the following, we will show the results of the first presented system (SMA Crossover using 50 and 100 days as parameters) with different risk-parameters and concentrate only on the drawdown which is best illustrated by the underwater equity curve (Figures 12 to 16):

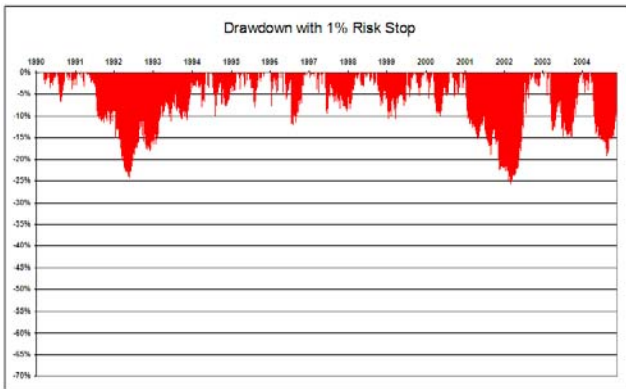


Figure 12

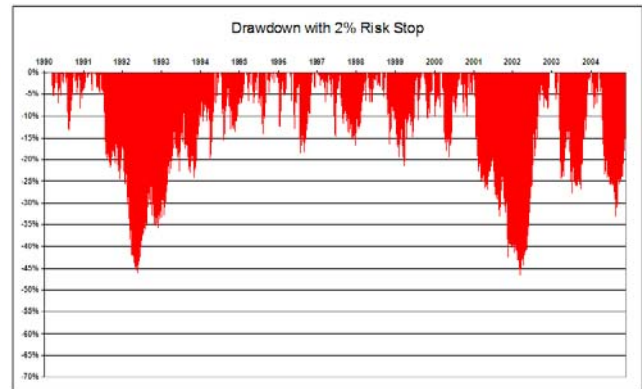


Figure 13

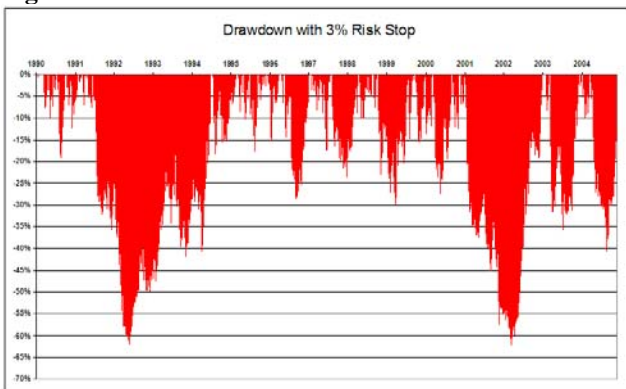


Figure 14

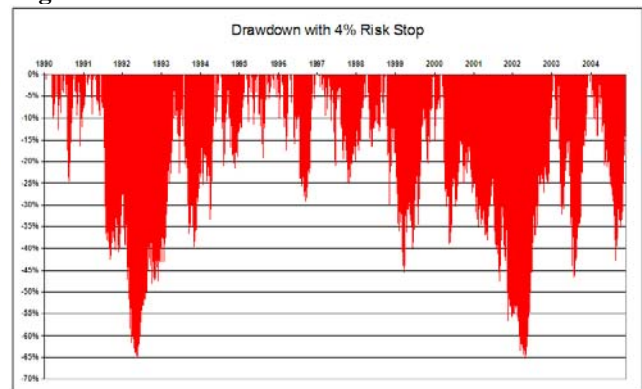


Figure 15

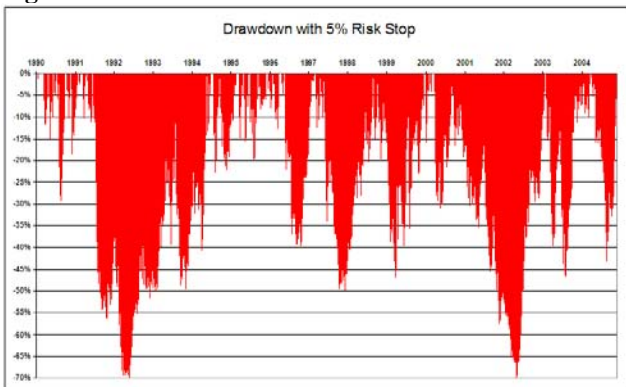


Figure 16

As you can see, the higher our risk stop parameter is the higher the maximum drawdown and the larger the time until a new equity high is reached. Remember, when using only 1% risk stop, most drawdown-peaks are below 10% whereas at a risk stop parameter of 5%, most are between 20% and 30% with two occurrences where they reach 70%. Here, psychology becomes an important factor, too. Trading a system day by day which loses up to 70% of its capital is a hard task. It is a completely different issue to experience and to accept the losses by real trading compared to analyzing drawdowns when backtesting a system. As all our decisions are also based on emotions we should minimize the negative impact of large drawdown periods.

As we could see here, regardless of how profitable a system is, without the proper risk management, you are likely to ruin your account sooner or later. The reason is that all systems have losing periods and to withstand them, it is wise to use a moderate position size.

SMA Crossover Pyramiding

When applying pyramiding techniques the system enters the market a second time at a later stage following the same direction of the first position. In trend following systems, this is usually done after the trend has been established. The idea behind is that at this stage, there is a higher probability that a trend exists and that it persists. The system used here creates the first position with the same rules as above and creates a second position after the trade has become profitable a certain percentage. All other parameters as well as position sizing rules remain the same. In case of an exit, the system will exit both positions together.

Rules:

- Go Long the next day at Market (=on the Open) as soon as the fast SMA (of 50 periods) crosses over the slow SMA (of 100 periods)
- Enter one additional long position next day at Market as soon as the price increased 1% from the entry price
- Exit Long and Go Short the next day at Market as soon as the fast SMA (of 50 periods) crosses under the slow SMA (of 100 periods)
- Enter one additional short position next day at Market as soon as the price decreased 1% from the entry price
- Set a StopLoss of 4 times the ATR (Average True Range*) of 10 days

Position sizing:

2% based on initial stop loss (based on 4 times the 10-day-ATR)

Example trade:

Figure 17 shows some example trades in British Pound. At the end of October 2003, the system detects a crossover from the fast SMA over the slow SMA. It enters long at a price of 162. It waits for a 1% gain which occurs in November 2003. Then, the system opens a second long position at a price of 164. Both positions are closed in May 2004 when an opposite crossover occurs.



Figure 17

Results:

Applying this additional rule improves the system performance considerably. The system’s performance is boosted to 25% p.a.! However, the portfolio equity curve (Figure 18) shows much higher volatility. The maximum drawdown (see Figure 19) increases to (an unsustainable) 64% which is reached twice during the simulation period. Furthermore, when comparing the results with the figures from the original system (without pyramiding) we should take into account that this higher profit has been achieved due to higher exposure.

As a result we can conclude that applying pyramiding rules to an already profitable system can help to increase performance (and also volatility) considerably.

Portfolio Equity Curve:

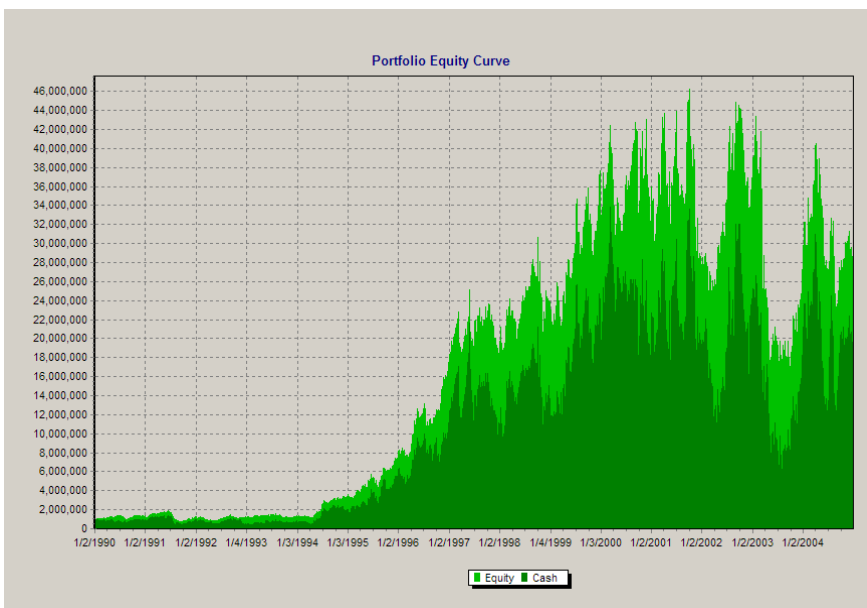


Figure 18

Drawdown Curve:

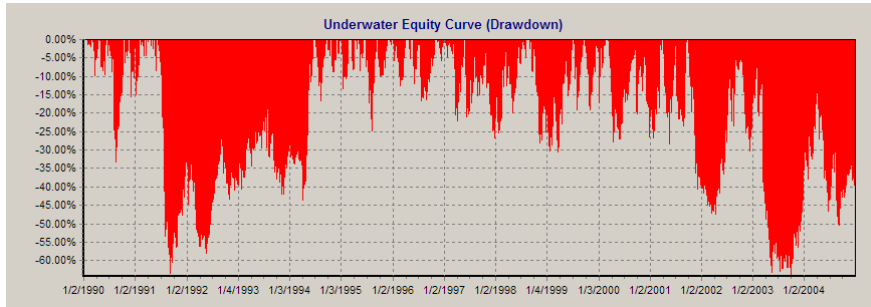


Figure 19

Performance Results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$28,508,580.00	\$14,571,771.00	\$14,936,809.00
Net Profit	\$27,508,580.00	\$13,571,771.00	\$13,936,809.00
Net Profit %	2,750.86%	1,357.18%	1,393.68%
Annualized Gain %	25.02%	19.55%	19.74%
Exposure	35.55%	40.44%	28.37%
Number of Trades	1,028	505	523
Avg Profit/Loss	\$26,759.32	\$26,874.79	\$26,647.82
Avg Profit/Loss %	1.39%	2.45%	0.36%
Avg Bars Held	78.94	83.48	74.55
Winning Trades	359	198	161
Winning %	34.92%	39.21%	30.78%
Gross Profit	\$212,883,447.74	\$100,225,367.85	\$112,658,079.90
Avg Profit	\$592,990.11	\$506,188.73	\$699,739.63
Avg Profit %	14.48%	15.03%	13.81%
Avg Bars Held	152.28	150.85	154.04
Max Consecutive	11	9	7
Losing Trades	669	307	362
Losing %	65.08%	60.79%	69.22%
Gross Loss	\$-185,374,870.05	\$-86,653,597.35	\$-98,721,272.70
Avg Loss	\$-277,092.48	\$-282,259.27	\$-272,710.70
Avg Loss %	-5.63%	-5.66%	-5.61%
Avg Bars Held	39.58	40.03	39.20
Max Consecutive	18	18	21
Max Drawdown	\$-30,615,356.00	\$-30,390,216.00	\$-25,157,492.00
Max Drawdown %	-64.28%	-120.49%	-117.91%
Max Drawdown Date	7/17/2003	3/31/2004	12/31/2004
Wealth-Lab Score	25.13	-9.90	-12.46
Profit Factor	1.15	1.16	1.14
Recovery Factor	0.90	0.45	0.55
Payoff Ratio	2.57	2.66	2.46
Sharpe Ratio	0.74	0.38	0.48
Ulcer Index	27.15	43.82	40.93
Wealth-Lab Error Term	31.89	102.95	47.63
Wealth-Lab Reward Ratio	0.78	0.19	0.41
Luck Coefficient	11.97	11.53	4.34

Pessimistic Rate of Return	1.26	1.51	0.96
Equity Drop Ratio	0.29	0.00	0.00

Stability test: Different parameter combinations

As with the original system, we want to test the parameter stability in the SMA Crossover Pyramiding system. So, we do various simulations with different parameters (lookback days) for our moving averages. Figure 20 shows the results. The different shadings represent different annualized profits (% p.a.). Again, the vertical axis represents the fast SMA and the horizontal axis the difference between the fast and the slow SMA.

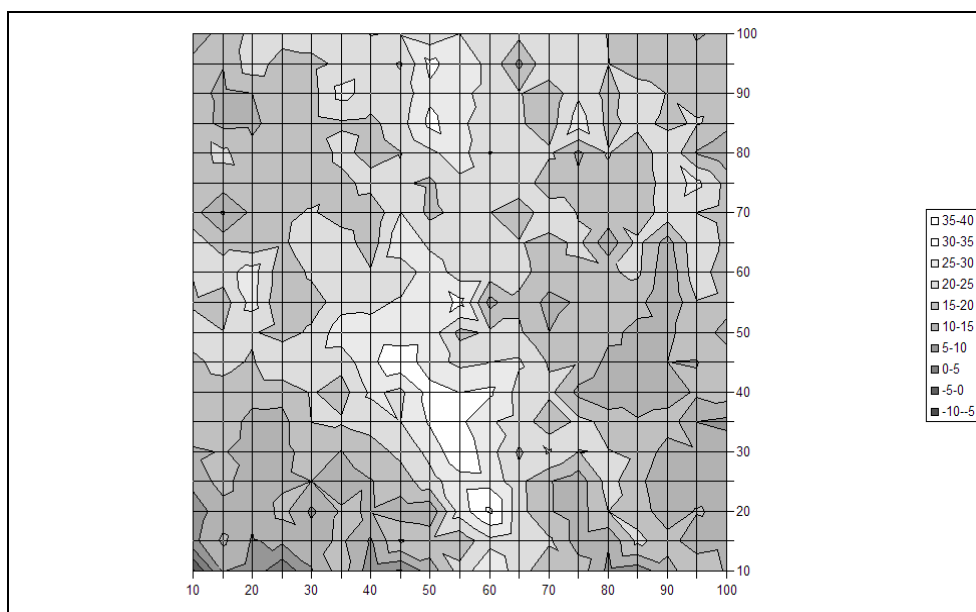


Figure 20

The global maximum (light area) can be found for combinations of 30-40 days for the fast SMA and 80-100 days for the slow SMA. These combinations achieve profits of over 35% p.a. However, when applying these parameters for your own trading one should expect profits of combinations adjacent to the optimum parameter, i.e. between 20% and 25%.

Trend Strength Indicator

The Trend Strength Indicator was created by José Cruset and first presented in the August 2005 issue of the Active Trader Magazine. It combines different moving averages into one indicator. Currently, four different variations exist: The first indicator (TrendStrength A) compares the price with various SMAs. The more moving averages price is above, the higher the indicator value; the more moving averages price is below, the lower its value. The indicator oscillates between +100 and -100, which means price is above or below all the SMAs, respectively. If the indicator value is zero, the price is in the middle of all the averages; i.e. it is above one half of them and below the other half. Positive indicator values reflect uptrends, and negative values indicate downtrends. The advantage of this indicator is that its result is an analysis of a broad range of parameters (i.e. different periods for the SMA) which provides usually more robust results than indicators that are based on one parameter only.

Figure 21 shows a chart of Corn together with 19 different simple moving averages ranging from 20 to 200 in steps of 10. The Trend Strength Indicator is drawn on the top of the chart.



Figure 21

Note how the indicator value follows big trends closely, especially the long bear trend starting in June 2004. However, during sideways markets the indicators values hop around from -100 to +100 (April 2003 until January 2004). Please note also how the distance of the various SMAs differs depending on the market volatility.

TrendStrength A system

We will test a system that uses the TrendStrength A indicator based on 19 moving averages ranging from 20 to 200 periods in steps of 10. The system will enter the market as soon as the price is above (or below) all SMAs, i.e. the indicator value reaches +100 (or -100). It will exit the market as soon as it is in the middle of all SMAs, i.e. the indicator value crosses zero. Additionally, it will use the distance between the different moving averages as a measure for volatility and will base the position size calculations on it. So, the more the different SMAs are apart from each other the smaller will be the position size for a new trade.

Rules:

- Go Long the next day at Market (=on the Open) as soon as the Trend Strength Indicator reaches +100
- Go Short the next day at Market as soon as the Trend Strength Indicator reaches -100
- Set a StopLoss at the value of the SMA which is farthest away from the current price
- Exit the position when the Trend Strength Indicator reaches or crosses zero

Position sizing:

2% based on stop loss (SMA value which is farthest away from the current price)

Example trade:

Figure 22 shows some example trades in Natural Gas:

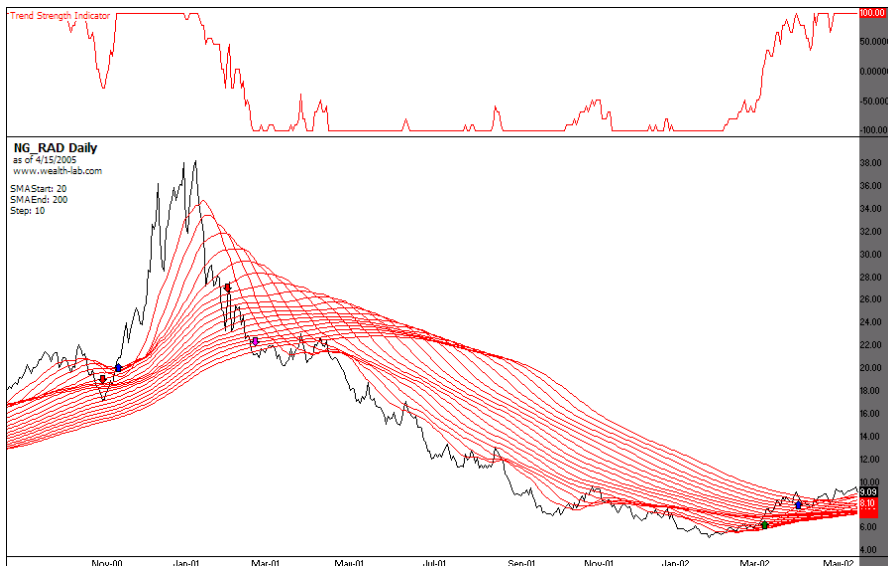


Figure 22

We can see how the TrendStrength Indicator catches long trends. During up-trends, it is above 50 most of the time and during down-trends, its value reaches mostly values below -50. However, during sideways markets it changes frequently and thus providing false signals. In our example, the system enters long the market at beginning of November 2000 as the TrendStrength indicator reaches +100. It exits beginning of February when the price drops below most of the SMAs and the TrendStrength Indicator falls below 0. Shortly afterwards, in the middle of February 2001 the price drops below all SMAs and consequently the indicator value reaches -100. The system enters short and stays in the market until beginning of March 2002. Thus, it catches most part of the downtrend. Note also how the distance between the SMAs differs depending on the market volatility. The system uses the difference between the current price and the SMA which is farthest away from this price to calculate the position size, i.e. the higher the difference the lower the position size.

Results:

Although the portfolio equity curve (Figure 23) shows a nice increase until mid of 1999, afterwards very high equity volatility with drawdowns of up to 60% is experienced. The percentage of profitable trades is with 24.6% the lowest of all presented systems (see performance data table). Still, the annualized profit reaches 16.9%, making this system very profitable. However, the drawdowns might be too high for the average trader. Especially, in the second half of the simulation period, various large drawdowns of more than 30% have to be withstood (see Figure 24).

One might want to do additional tests with different starting and ending parameters for the SMAs to prove the system's robustness. (We used SMAs from 20 to 200.) However, bear in mind that the TrendStrength indicator by design already analyzes various SMAs. Thus, this system is much more robust than other systems which rely only on one indicator (either SMA or any other comparable indicator).

Portfolio Equity Curve:

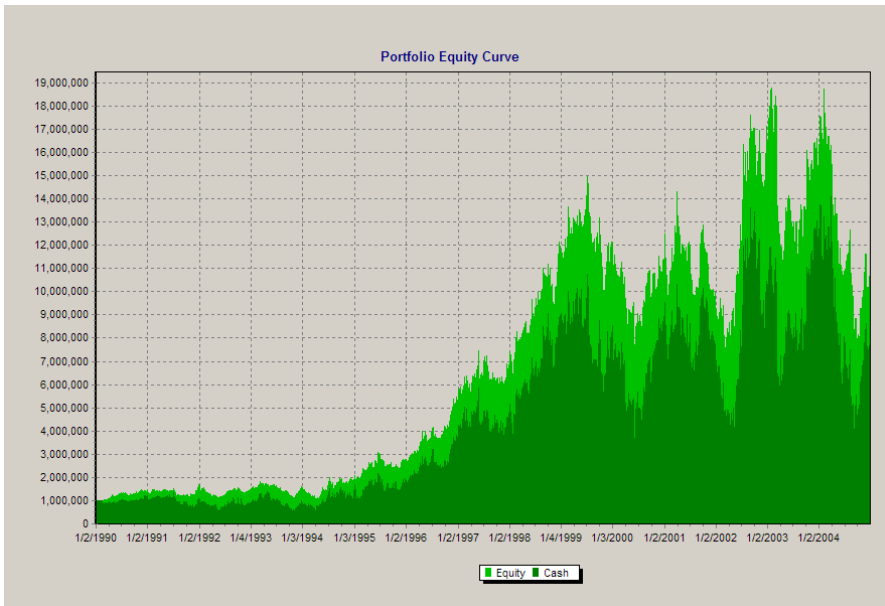


Figure 23

Drawdown Curve:

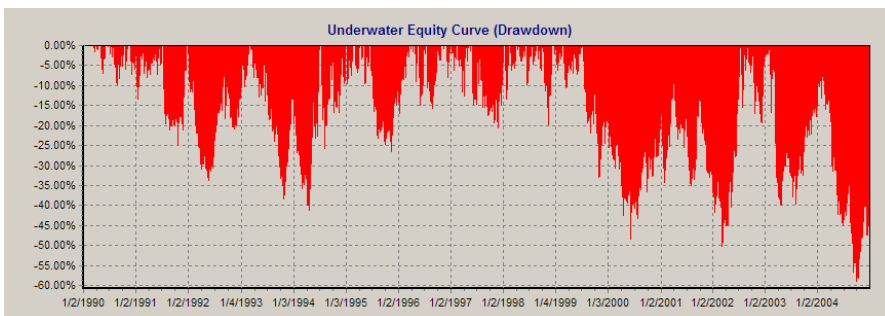


Figure 24

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$10,400,806.00	\$13,596,543.00	\$-2,195,737.25
Net Profit	\$9,400,806.00	\$12,596,543.00	\$-3,195,737.25
Net Profit %	940.08%	1,259.65%	-319.57%
Annualized Gain %	16.89%	19.00%	0.00%
Exposure	31.57%	27.17%	28.03%
Number of Trades	1,255	628	627
Avg Profit/Loss	\$7,490.68	\$20,058.19	\$-5,096.87
Avg Profit/Loss %	0.45%	0.89%	0.01%
Avg Bars Held	44.08	43.88	44.29
Winning Trades	309	163	146
Winning %	24.62%	25.96%	23.29%
Gross Profit	\$86,379,710.42	\$50,119,174.91	\$36,260,535.52
Avg Profit	\$279,545.99	\$307,479.60	\$248,359.83
Avg Profit %	11.86%	12.77%	10.85%
Avg Bars Held	122.85	119.85	126.20
Max Consecutive	5	5	6

Analysis of Trend Following systems

Losing Trades	946	465	481
Losing %	75.38%	74.04%	76.71%
Gross Loss	\$-76,978,904.83	\$-37,522,631.79	\$-39,456,273.04
Avg Loss	\$-81,373.05	\$-80,693.83	\$-82,029.67
Avg Loss %	-3.28%	-3.27%	-3.28%
Avg Bars Held	18.36	17.25	19.43
Max Consecutive	29	18	32
Max Drawdown	\$-11,827,408.00	\$-9,113,687.00	\$-14,366,243.00
Max Drawdown %	-60.77%	-116.70%	-118.04%
Max Drawdown Date	10/13/2004	12/20/2002	12/31/2004
Wealth-Lab Score	20.99	-11.68	0.00
Profit Factor	1.12	1.34	0.92
Recovery Factor	0.79	1.38	0.22
Payoff Ratio	3.62	3.91	3.31
Sharpe Ratio	0.63	-0.16	0.30
Ulcer Index	21.63	32.71	48.85
Wealth-Lab Error Term	17.34	64.20	93.47
Wealth-Lab Reward Ratio	0.97	0.30	0.00
Luck Coefficient	9.98	9.27	6.14
Pessimistic Rate of Return	1.08	1.21	0.88
Equity Drop Ratio	0.37	0.00	0.00

Stability test: Out of sample simulation

To further test the accuracy of the indicator we test the same system on our out of sample portfolio which contains completely different securities than our usual portfolio. All other parameters remain the same.

Results:

At first glance, the equity curve of the out of sample test does not show large valleys. And the performance data table shows annualized profits of only 8.2%. However, our drawdown graph (Figure 26) shows a maximum drawdowns of 52% which was experienced once during the simulation. Drawdown peaks are mostly below 25% during most of the time. Compared to the system results on the in sample test, this is an improvement (while still very volatile).

The stability test showed us that the system is still profitable on out of sample data. However, profits are much less than at in sample simulations. When estimating system's performance you should expect results in-between these two simulation results.

Portfolio Equity Curve:

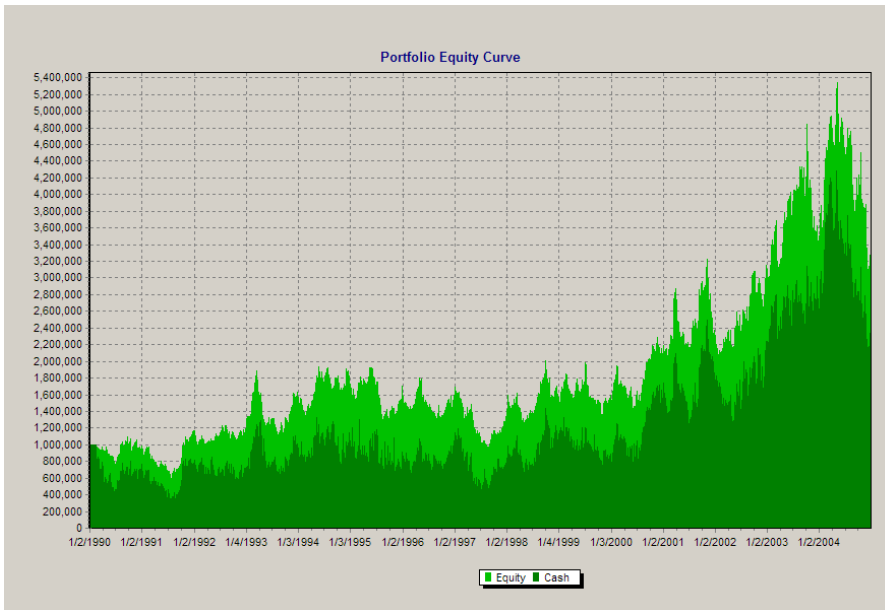


Figure 25

Drawdown Curve:

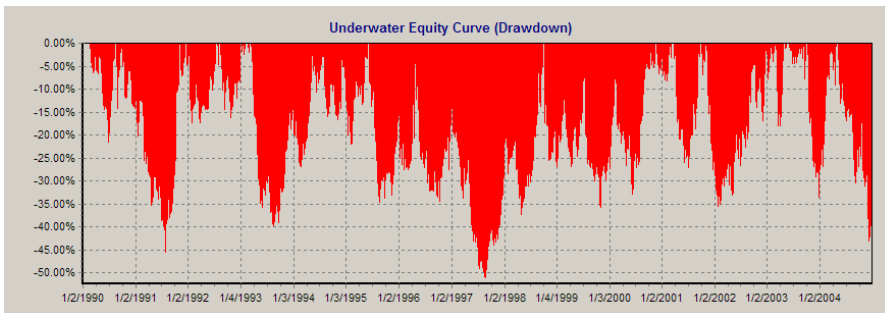


Figure 26

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$3,257,331.00	\$4,855,232.50	\$-597,901.75
Net Profit	\$2,257,331.00	\$3,855,232.50	\$-1,597,901.75
Net Profit %	225.73%	385.52%	-159.79%
Annualized Gain %	8.19%	11.10%	0.00%
Exposure	33.24%	19.39%	25.44%
Number of Trades	1,263	635	628
Avg Profit/Loss	\$1,787.28	\$6,071.23	\$-2,544.43
Avg Profit/Loss %	-0.08%	0.19%	-0.36%
Avg Bars Held	44.30	44.67	43.93
Winning Trades	306	159	147
Winning %	24.23%	25.04%	23.41%
Gross Profit	\$22,083,585.49	\$13,781,676.55	\$8,301,908.95
Avg Profit	\$72,168.58	\$86,677.21	\$56,475.57
Avg Profit %	11.11%	11.49%	10.69%
Avg Bars Held	123.59	125.15	121.90
Max Consecutive	5	3	5

Analysis of Trend Following systems

Losing Trades	957	476	481
Losing %	75.77%	74.96%	76.59%
Gross Loss	\$-19,826,254.66	\$-9,926,443.88	\$-9,899,810.78
Avg Loss	\$-20,717.09	\$-20,853.87	\$-20,581.73
Avg Loss %	-3.66%	-3.58%	-3.74%
Avg Bars Held	18.95	17.79	20.10
Max Consecutive	32	17	35
Max Drawdown	\$-2,432,458.50	\$-1,072,903.50	\$-2,786,843.75
Max Drawdown %	-52.37%	-41.12%	-127.31%
Max Drawdown Date	12/8/2004	12/10/2004	12/31/2004
Wealth-Lab Score	11.74	33.72	0.00
Profit Factor	1.11	1.39	0.84
Recovery Factor	0.93	3.59	0.57
Payoff Ratio	3.03	3.21	2.86
Sharpe Ratio	0.42	0.52	0.08
Ulcer Index	22.21	21.66	35.37
Wealth-Lab Error Term	12.33	13.71	66.59
Wealth-Lab Reward Ratio	0.66	0.81	0.00
Luck Coefficient	13.09	12.65	4.63
Pessimistic Rate of Return	0.89	0.94	0.77
Equity Drop Ratio	0.79	0.42	0.00

Concept: Donchian channel

The Donchian channel was created by Richard Donchian and is composed of a higher and a lower band. The higher band indicates the highest high of the past n days and the lower band indicates the lowest low. Lowest and Highest prices are usually support and resistance areas which are difficult to surpass. Common theory says that a crossover of these psychologically important lines is the result of a change in the market's opinion and thus a continuation of the initial movement should be expected.

So, many trend following systems are based on this concept. A breakout- (and entry-) signal occurs when the price crosses over one of these bands. When the opposite band is crossed the position is reversed. A variation uses two different bands, one with a long lookback period (and therefore a wider range) used for entries and one with a short lookback period (with a smaller range) used for exits.

Donchian channel breakout 100

Our next system uses the above mentioned Donchian channel of 100 days. It detects trends as soon as they break out of this price range. Figure 27 shows a typical chart of the S&P:

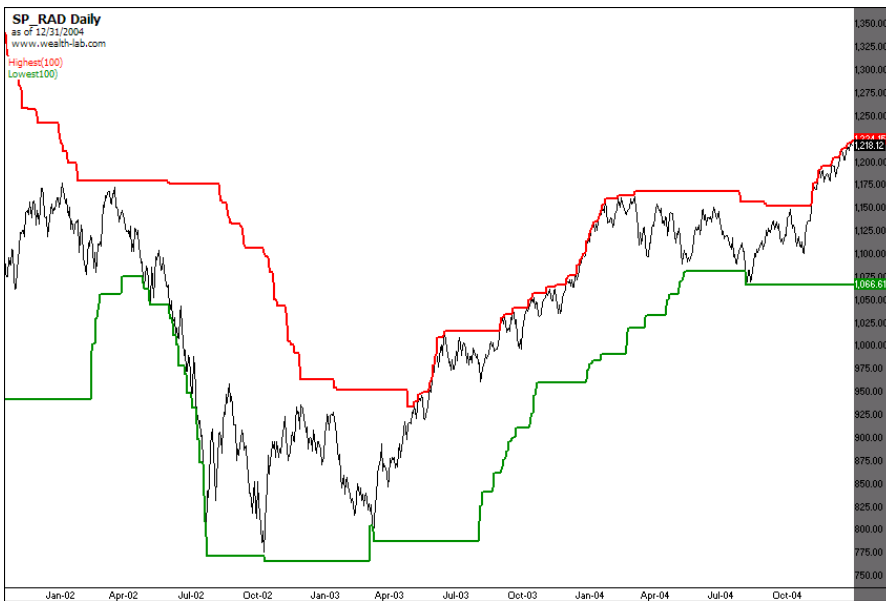


Figure 27

You can see in this chart that the Donchian channel increases its height according to the price volatility. For example, during August 2002, the distance from the higher band to the lower band was almost 400 points whereas in July 2004 the distance was less than 100 points. This behavior helps us in avoiding entries in the market caused by “noise” – which might produce false signals - instead of real trend changes.

Rules:

- Go long/short at Stop as soon as the price crosses the upper/lower Donchian band of 100 days
- Exit and reverse position as soon as the opposite Donchian band is crossed
- Use 4 times ATR of 10 days as parameter for the maximum risk to calculate the position size

Position sizing:

2% based on initial stop loss (based on 4 times the 10-day-ATR)

Example trade:

Figure 28 shows some typical trades in the Nasdaq100. The system was able to catch the long downtrend in June of 2000. It entered short and held the position until November 2002 when it switched from short to long position. When the system entered the market in June 2000, the Nasdaq already lost almost 2,000 points from its top. However, the system still caught 2,500 points when it exited its short position in November 2002. As we know, trend following systems never get in at the bottom and never get out at the top. But as we can see in this example they are able to catch the main move in long trends.

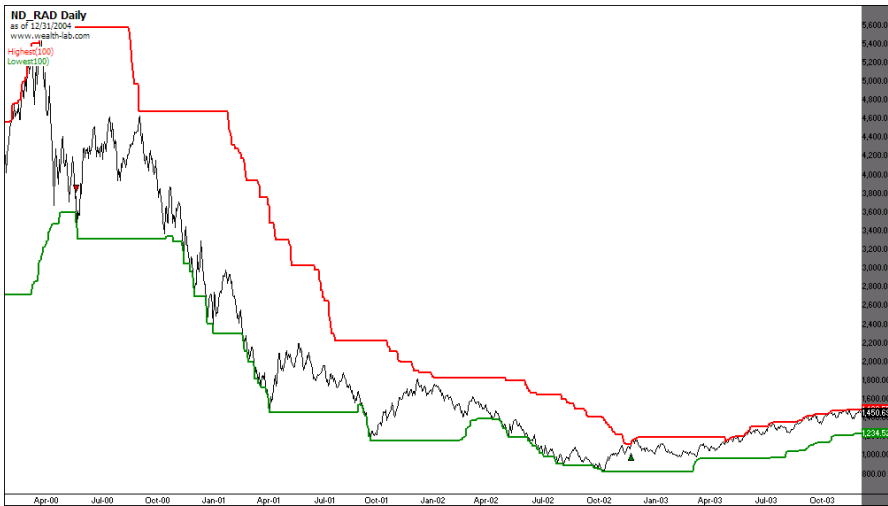


Figure 28

Results:

The portfolio equity curve (Figure 29) shows a nice increase over the complete simulation period with only few and short valleys. As we can see from the performance data table, the annualized profit reaches 21.2%. Most drawdowns (Figure 30) are below acceptable 15% with a fast recovery. The maximum drawdown of 32.7% is reached only once. Overall, this system shows a nice performance over the whole simulation period.

Portfolio Equity Curve:

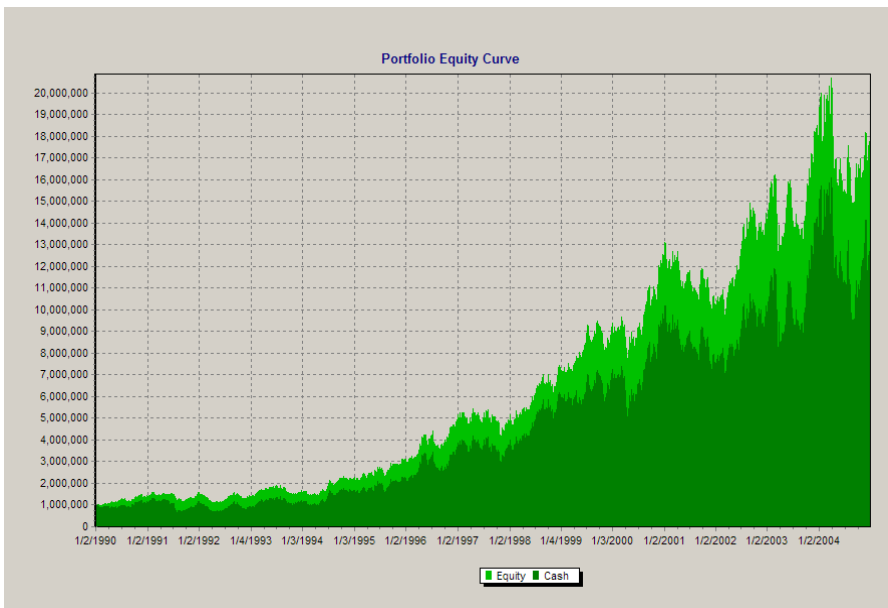


Figure 29

Drawdown Curve:

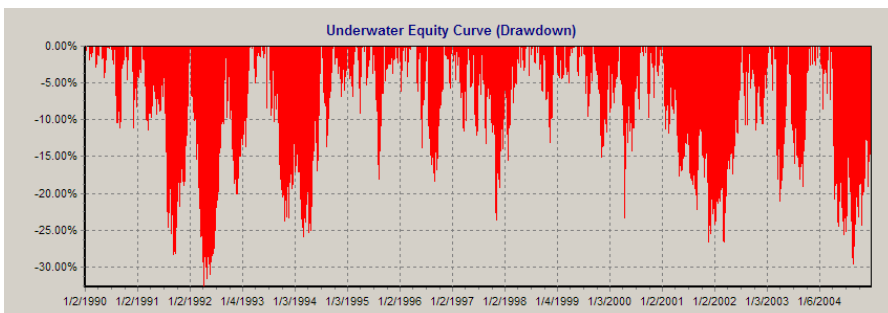


Figure 30

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$17,986,668.00	\$19,171,986.00	\$-185,319.63
Net Profit	\$16,986,668.00	\$18,171,986.00	\$-1,185,319.63
Net Profit %	1,698.67%	1,817.20%	-118.53%
Annualized Gain %	21.24%	21.75%	0.00%
Exposure	26.25%	20.61%	26.92%
Number of Trades	409	206	203
Avg Profit/Loss	\$41,532.20	\$88,213.52	\$-5,839.01
Avg Profit/Loss %	2.32%	4.18%	0.43%
Avg Bars Held	171.06	172.86	169.22
Winning Trades	161	93	68
Winning %	39.36%	45.15%	33.50%
Gross Profit	\$48,632,918.02	\$31,222,964.54	\$17,409,953.48
Avg Profit	\$302,067.81	\$335,730.80	\$256,028.73
Avg Profit %	19.98%	20.06%	19.87%
Avg Bars Held	289.81	268.23	319.34
Max Consecutive	6	6	4
Losing Trades	248	113	135
Losing %	60.64%	54.85%	66.50%
Gross Loss	\$-31,646,251.76	\$-13,050,978.50	\$-18,595,273.26
Avg Loss	\$-127,605.85	\$-115,495.38	\$-137,742.76
Avg Loss %	-9.15%	-8.90%	-9.36%
Avg Bars Held	93.96	94.38	93.61
Max Consecutive	11	9	22
Max Drawdown	\$-6,305,069.00	\$-5,858,167.00	\$-9,604,234.00
Max Drawdown %	-32.74%	-65.73%	-105.67%
Max Drawdown Date	9/2/2004	8/26/2004	12/31/2004
Wealth-Lab Score	54.42	36.17	0.00
Profit Factor	1.54	2.39	0.94
Recovery Factor	2.69	3.10	0.12
Payoff Ratio	2.18	2.25	2.12
Sharpe Ratio	0.88	0.84	0.05
Ulcer Index	12.09	18.44	37.45
Wealth-Lab Error Term	9.14	11.74	47.87
Wealth-Lab Reward Ratio	2.32	1.85	0.00
Luck Coefficient	6.49	6.47	3.47
Pessimistic Rate of Return	1.23	1.52	0.87
Equity Drop Ratio	0.23	0.26	0.00

Stability test: Out of sample simulation

We will run the system on the out of sample portfolio to test its stability across various markets. All other parameters remain the same.

Results:

The simulation on out of sample data showed very similar performance to the in sample test. The annualized profit is 21.5% (compared to 21.2%) with maximum drawdowns of 33.7% (compared to 32.7%) which occurred twice during the simulation. The portfolio equity curve (Figure 31) shows a

smooth increase over almost the whole simulation period. And most drawdowns persist only for a short time as can be seen in Figure 32.

This stability test showed us that the system performs well across a variety of markets and is likely to show this performance in the future. However, more stability tests are advisable to further prove the system's robustness.

Portfolio Equity Curve:

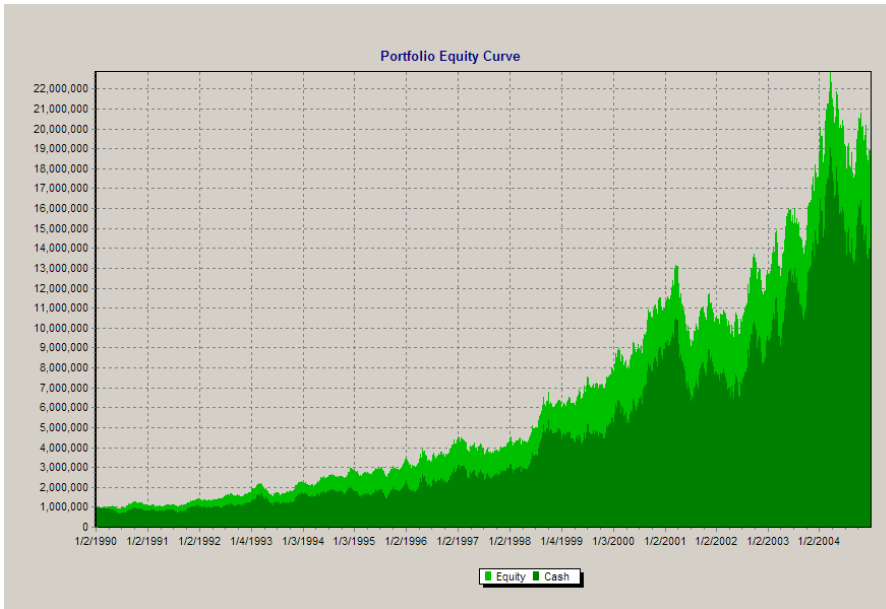


Figure 31

Drawdown Curve:

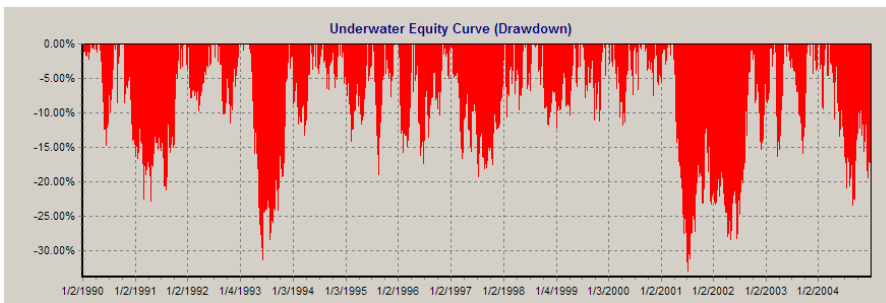


Figure 32

Performance results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$18,659,290.00	\$23,326,314.00	\$-3,667,022.00
Net Profit	\$17,659,290.00	\$22,326,314.00	\$-4,667,022.00
Net Profit %	1,765.93%	2,232.63%	-466.70%
Annualized Gain %	21.53%	23.35%	0.00%
Exposure	26.19%	19.26%	30.79%
Number of Trades	386	190	196
Avg Profit/Loss	\$45,749.46	\$117,506.92	\$-23,811.34
Avg Profit/Loss %	2.22%	4.37%	0.14%
Avg Bars Held	173.59	176.01	171.26
Winning Trades	153	77	76
Winning %	39.64%	40.53%	38.78%

Analysis of Trend Following systems

Gross Profit	\$48,136,018.19	\$34,384,462.21	\$13,751,555.98
Avg Profit	\$314,614.50	\$446,551.46	\$180,941.53
Avg Profit %	19.76%	22.92%	16.55%
Avg Bars Held	300.67	296.25	305.16
Max Consecutive	6	6	7
Losing Trades	233	113	120
Losing %	60.36%	59.47%	61.22%
Gross Loss	\$-30,476,726.10	\$-12,058,148.59	\$-18,418,577.51
Avg Loss	\$-130,801.40	\$-106,709.28	\$-153,488.15
Avg Loss %	-9.29%	-8.27%	-10.25%
Avg Bars Held	90.15	94.07	86.45
Max Consecutive	10	9	19
Max Drawdown	\$-5,675,776.00	\$-3,379,750.00	\$-10,980,358.00
Max Drawdown %	-33.75%	-32.03%	-150.14%
Max Drawdown Date	8/31/2004	6/9/2004	12/31/2004
Wealth-Lab Score	54.48	82.40	0.00
Profit Factor	1.58	2.85	0.75
Recovery Factor	3.11	6.61	0.43
Payoff Ratio	2.13	2.77	1.61
Sharpe Ratio	0.93	0.96	0.35
Ulcer Index	11.63	12.32	40.88
Wealth-Lab Error Term	5.41	11.40	140.00
Wealth-Lab Reward Ratio	3.98	2.05	0.00
Luck Coefficient	5.40	4.65	3.86
Pessimistic Rate of Return	1.20	1.53	0.83
Equity Drop Ratio	0.21	0.19	0.00

Usage of two different channels for entry and exit

The longer the lookback period for the Donchian channels is the wider are the two bands apart from each other. Thus, we might run into situations in which we give away a large part of our profit when exiting from a trade. So, we want to see if it makes sense to use two Donchian channels, a wider one for our entry rules and a tighter one for our exit rules. In this case, the system would have periods in which it stays flat.

Donchian channel breakout 100-50

The following system differs from the above used system in that it uses different Donchian channels for entry and exit. We will still use a 100-day channel for entries but in order to avoid giving away too much profit, we will use an additional 50-day Donchian channel to determine our exits. All other rules remain the same.

Rules:

- Go long at Stop as soon as the price crosses the upper Donchian band of 100 days
- Exit long at stop as soon as the price crosses the lower Donchian band of 50 days
- Go short at Stop as soon as the price crosses the lower Donchian band of 100 days
- Exit short at stop as soon as the price crosses the upper Donchian band of 50 days
- Use 4 times ATR of 10 days as parameter for the maximum risk to calculate the position size

Position sizing:

2% based on initial stop loss (based on 4 times the 10-day-ATR)

Example trade:

Figure 33 shows some trades in Corn. The system enters long in January 2004 when the price crossed (intraday) the 100-day High. It stays in the market until the price crosses the 50-day Low in May 2004. Thus, it exists earlier as the original system thus not giving away too much profit. It then enters again short in June 2004 because the price crossed the 100-day Low. It catches a long bear trend and exits as soon as the price crosses the 50-day High which occurs in February 2005.

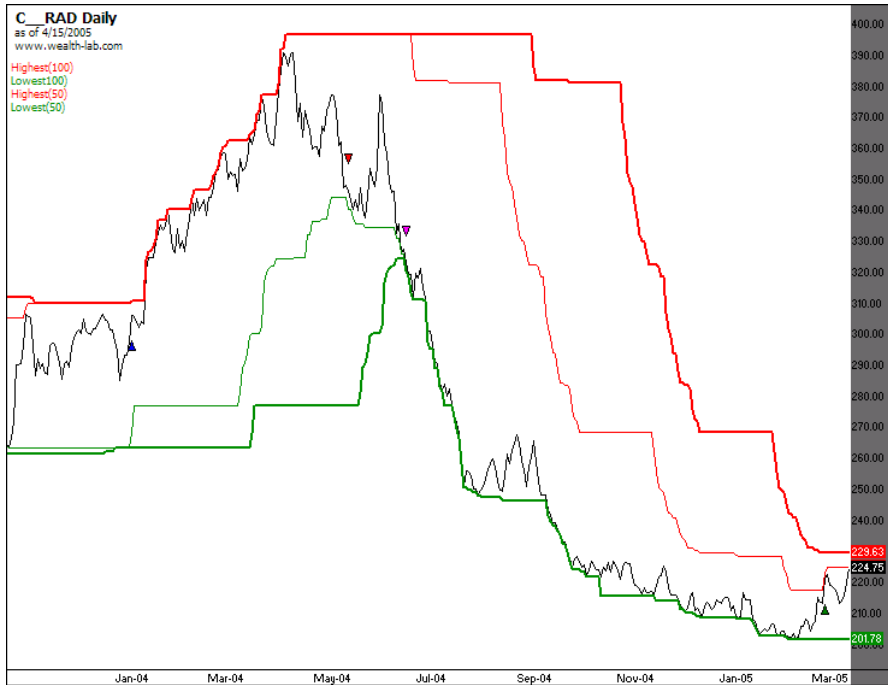


Figure 33

Results:

The system performs well over most part of the simulation period. However, the portfolio equity curve (Figure 34) shows higher volatility in the equity over the last years. This is confirmed by the drawdown curve (Figure 35) which shows drawdowns of up to 37%. The annualized profit per year still reaches an acceptable 16.3%.

Compared to the initial system, the yearly profit is lower (16.3% vs. 19.8%) and the maximum drawdown increased (37.2% vs. 33.8%). Bear in mind that the modified system now has a lower exposure (20.7% vs. 26.2%) as it exits each trade earlier. So, you might want to consider increasing the position size to improve profits.

Portfolio Equity Curve:

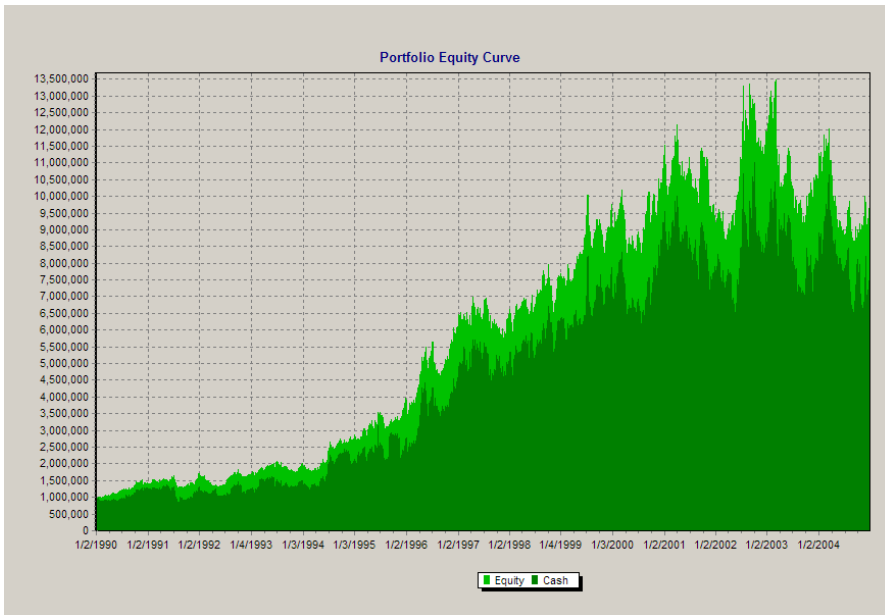


Figure 34

Drawdown Curve:

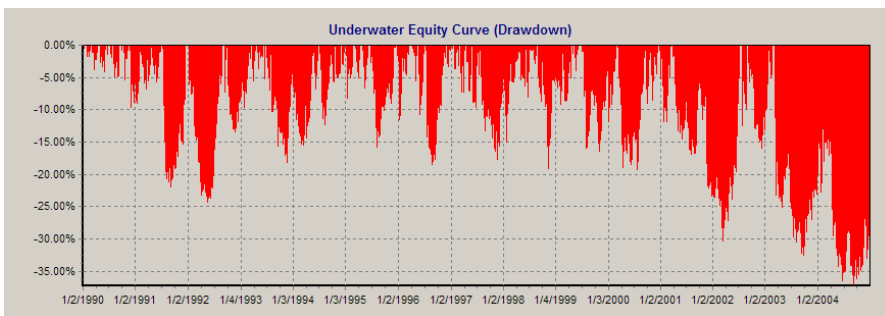


Figure 35

Performance Results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$9,636,187.00	\$10,836,180.00	\$-199,993.06
Net Profit	\$8,636,187.00	\$9,836,180.00	\$-1,199,993.06
Net Profit %	863.62%	983.62%	-120.00%
Annualized Gain %	16.30%	17.21%	0.00%
Exposure	20.68%	13.87%	26.38%
Number of Trades	596	299	297
Avg Profit/Loss	\$14,490.25	\$32,896.92	\$-4,040.38
Avg Profit/Loss %	1.13%	2.58%	-0.32%
Avg Bars Held	85.01	85.50	84.52
Winning Trades	236	133	103
Winning %	39.60%	44.48%	34.68%
Gross Profit	\$42,207,607.80	\$25,400,407.15	\$16,807,200.64
Avg Profit	\$178,845.80	\$190,980.50	\$163,176.71
Avg Profit %	12.98%	13.85%	11.85%
Avg Bars Held	139.37	131.38	149.70
Max Consecutive	8	7	7

Analysis of Trend Following systems

Losing Trades	360	166	194
Losing %	60.40%	55.52%	65.32%
Gross Loss	\$-33,571,420.52	\$-15,564,226.98	\$-18,007,193.54
Avg Loss	\$-93,253.95	\$-93,760.40	\$-92,820.59
Avg Loss %	-6.63%	-6.46%	-6.78%
Avg Bars Held	49.38	48.75	49.91
Max Consecutive	14	10	21
Max Drawdown	\$-5,099,812.00	\$-3,769,825.50	\$-7,447,581.00
Max Drawdown %	-37.24%	-47.52%	-105.41%
Max Drawdown Date	9/13/2004	3/18/2002	11/17/2004
Wealth-Lab Score	49.46	65.13	0.00
Profit Factor	1.26	1.63	0.93
Recovery Factor	1.69	2.61	0.16
Payoff Ratio	1.96	2.15	1.75
Sharpe Ratio	0.75	0.80	0.23
Ulcer Index	13.70	15.55	39.96
Wealth-Lab Error Term	12.85	12.58	64.56
Wealth-Lab Reward Ratio	1.27	1.37	0.00
Luck Coefficient	9.45	8.85	5.16
Pessimistic Rate of Return	1.14	1.46	0.78
Equity Drop Ratio	0.28	0.32	0.00

Stability test: Out of sample simulation

As with the original system, we want to do an additional simulation on our out of sample portfolio to see how the system performs on various markets.

Results:

Running the system on a different portfolio gives us even better results. Yearly annualized gain on the out of sample portfolio is now 19.3% (in sample: 16.3%) and maximum drawdown is now 32.1% (was 37.2%). The portfolio equity curve (Figure 36) together with the drawdown curve (Figure 37) show a steady increase with only very little drawdowns from which the system is able to recover quickly.

Both portfolios showed good performance over the whole simulation period. Although more robustness tests are necessary we already can conclude that Donchian channels can help in detecting trends and taking advantage of them.

Portfolio Equity Curve:

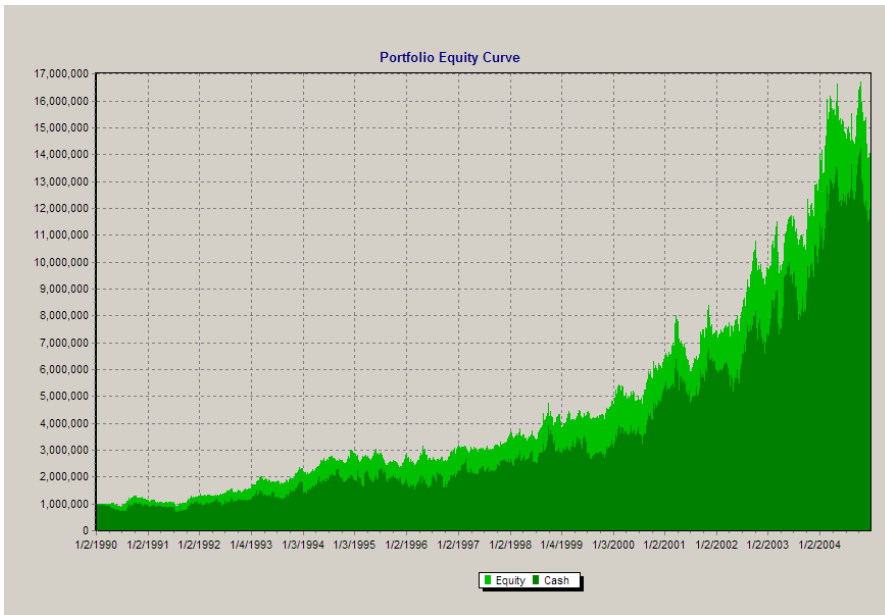


Figure 36

Drawdown Curve:

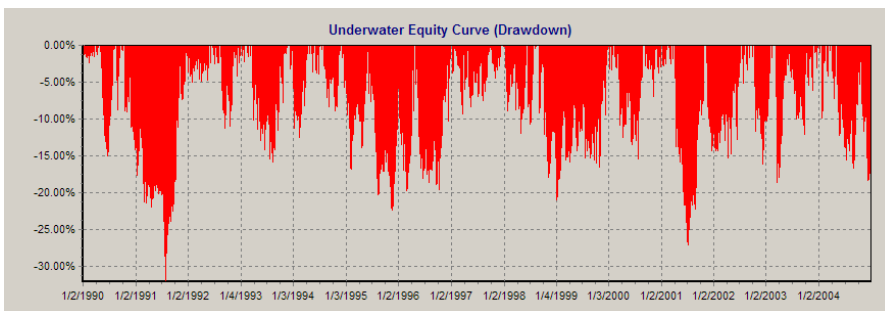


Figure 37

Performance results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$14,060,681.00	\$15,016,886.00	\$43,794.25
Net Profit	\$13,060,681.00	\$14,016,886.00	\$-956,205.75
Net Profit %	1,306.07%	1,401.69%	-95.62%
Annualized Gain %	19.26%	19.79%	-18.82%
Exposure	22.37%	16.98%	21.44%
Number of Trades	580	305	275
Avg Profit/Loss	\$22,518.42	\$45,957.00	\$-3,477.11
Avg Profit/Loss %	1.13%	1.71%	0.49%
Avg Bars Held	90.24	87.20	93.61
Winning Trades	245	135	110
Winning %	42.24%	44.26%	40.00%
Gross Profit	\$35,745,952.46	\$25,423,046.79	\$10,322,905.67
Avg Profit	\$145,901.85	\$188,318.87	\$93,844.60
Avg Profit %	11.85%	12.00%	11.66%
Avg Bars Held	141.57	132.80	152.33
Max Consecutive	7	7	5

Analysis of Trend Following systems

Losing Trades	335	170	165
Losing %	57.76%	55.74%	60.00%
Gross Loss	\$-22,685,271.80	\$-11,406,160.45	\$-11,279,111.35
Avg Loss	\$-67,717.23	\$-67,095.06	\$-68,358.25
Avg Loss %	-6.70%	-6.45%	-6.96%
Avg Bars Held	52.71	50.99	54.47
Max Consecutive	15	8	16
Max Drawdown	\$-3,355,445.00	\$-2,231,752.00	\$-4,394,277.00
Max Drawdown %	-32.13%	-30.45%	-99.01%
Max Drawdown Date	12/22/2004	12/10/2004	12/31/2004
Wealth-Lab Score	58.44	81.07	-174.68
Profit Factor	1.58	2.23	0.92
Recovery Factor	3.89	6.28	0.22
Payoff Ratio	1.77	1.86	1.68
Sharpe Ratio	0.88	0.87	0.08
Ulcer Index	10.61	10.96	28.66
Wealth-Lab Error Term	7.24	12.68	18.62
Wealth-Lab Reward Ratio	2.66	1.56	-1.01
Luck Coefficient	10.12	9.99	4.19
Pessimistic Rate of Return	1.15	1.25	0.94
Equity Drop Ratio	0.23	0.21	-0.73

Concept: Bollinger bands

Bollinger Bands are developed by John Bollinger. They are a type of price envelope and are plotted at a standard deviation level above and below a simple moving average of the price. Because the distance of the bands is based on standard deviation, they adjust to volatility swings in the underlying price. Thus, Bollinger bands help determine whether prices are high or low on a relative basis.

Bollinger band breakout

The following system waits for a crossover of the price crosses over the upper or lower Bollinger band. As soon as the price crosses over one of the bands an entry signal is generated. Crossing the upper band causes a long-trade and crossing the lower band a short-trade. We will use a 100 day Bollinger band with a 1 time standard deviation.

Rules:

- Use upper and lower Bollinger bands of 100 day SMA +/- 1.0 times standard deviation
- Go long at Stop as soon as the price crosses the upper Bollinger band
- Exit long and go short at Stop as soon as the price crosses the lower Bollinger band
- Go short at Stop as soon as the price crosses the lower Bollinger band
- Exit short and go long at Stop as soon as the price crosses the upper Bollinger band

Position sizing:

2% based on initial stop loss (based on the opposite Bollinger band)

Example trades:

Figure 38 shows example trades in the Treasury Bonds. The system experiences some whipsaws beginning in May 2001 until May 2002. During this period it produces some small losses because after crossing the lower or upper line the price changes its direction and the system has to reverse its position. However, in May 2002, the system enters long as soon as the price crosses over the upper

Bollinger band and stays in this position until July 2003 and is thus able to catch 12 full points in the T-Bonds.



Figure 38

Results:

The portfolio equity curve (Figure 39) shows nice increases until beginning of 2002. Afterwards, it shows high volatility with drawdowns of up to 54.7%. The drawdown curve (Figure 40) confirms this result with several drawdowns at 30% and the largest drawdown at the end. Still, the annualized profit reaches an acceptable 17.1%. But the drawdowns might be too high for the average trader. More investigation of different parameters and a test on a different portfolio is recommendable to prove its stability.

Portfolio Equity Curve:

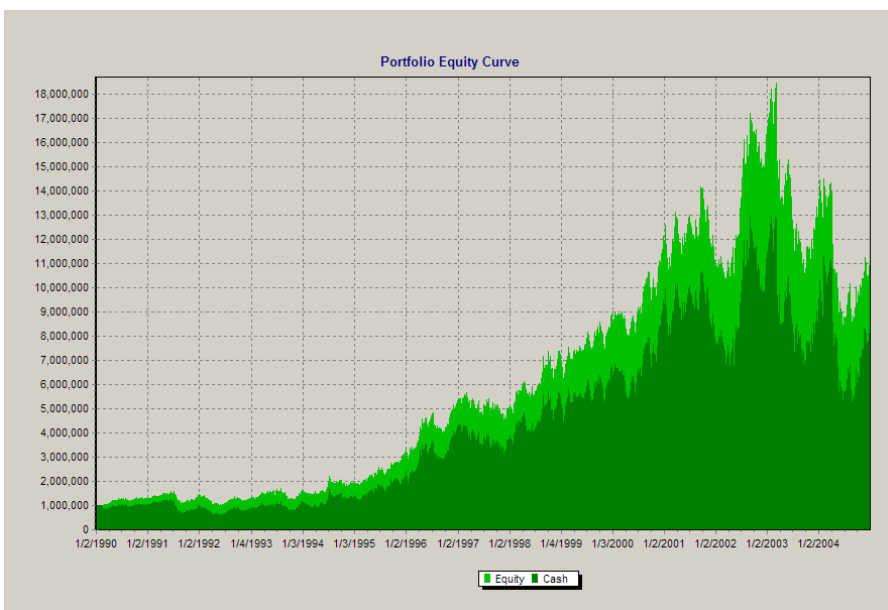


Figure 39

Drawdown Curve:

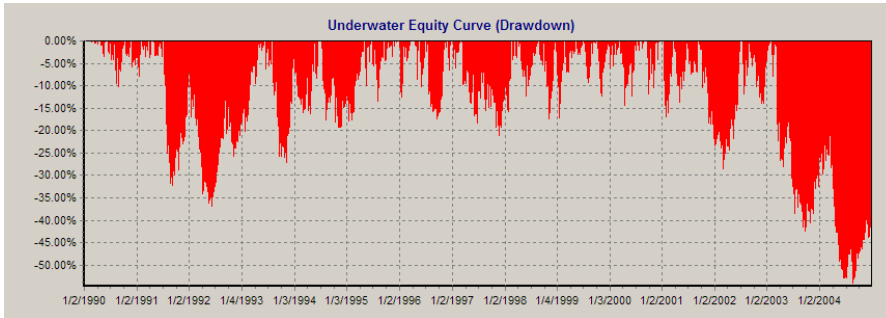


Figure 40

Performance data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$10,722,086.00	\$11,827,215.00	\$-105,129.68
Net Profit	\$9,722,086.00	\$10,827,215.00	\$-1,105,129.68
Net Profit %	972.21%	1,082.72%	-110.51%
Annualized Gain %	17.13%	17.90%	0.00%
Exposure	28.11%	23.73%	24.83%
Number of Trades	675	342	333
Avg Profit/Loss	\$14,403.09	\$31,658.52	\$-3,318.71
Avg Profit/Loss %	1.37%	2.31%	0.39%
Avg Bars Held	102.89	101.23	104.60
Winning Trades	245	136	109
Winning %	36.30%	39.77%	32.73%
Gross Profit	\$51,812,712.69	\$31,007,497.72	\$20,805,214.96
Avg Profit	\$211,480.46	\$227,996.31	\$190,873.53
Avg Profit %	15.39%	16.04%	14.58%
Avg Bars Held	191.16	177.54	208.17
Max Consecutive	7	8	9
Losing Trades	430	206	224
Losing %	63.70%	60.23%	67.27%
Gross Loss	\$-42,090,627.26	\$-20,180,282.79	\$-21,910,344.47
Avg Loss	\$-97,885.18	\$-97,962.54	\$-97,814.04
Avg Loss %	-6.62%	-6.75%	-6.51%
Avg Bars Held	52.60	50.86	54.21
Max Consecutive	18	11	16
Max Drawdown	\$-10,222,820.00	\$-5,674,973.50	\$-11,401,489.00
Max Drawdown %	-54.68%	-83.04%	-102.93%
Max Drawdown Date	6/28/2004	7/18/2002	12/31/2004
Wealth-Lab Score	27.61	12.79	0.00
Profit Factor	1.23	1.54	0.95
Recovery Factor	0.95	1.91	0.10
Payoff Ratio	2.32	2.38	2.24
Sharpe Ratio	0.72	0.60	0.10
Ulcer Index	17.70	21.99	39.75
Wealth-Lab Error Term	13.91	16.01	54.39
Wealth-Lab Reward Ratio	1.23	1.12	0.00
Luck Coefficient	10.44	10.02	4.30

Pessimistic Rate of Return	1.18	1.34	0.92
Equity Drop Ratio	0.29	0.41	0.00

Stability test: Different Parameters for SMA and Standard Deviation

To further test the stability of our parameters we want to do various tests across different Bollinger Band parameters. Thus, we will do various simulations in which we change the settings for the number of days and for the standard deviation. All other parameters remain the same.

Results:

Figure 41 shows the annualized profit in a surface chart. The vertical axis indicates the standard deviation (multiplied by 10) and the horizontal axis shows the number of days used for the Bollinger bands.

We can see that by changing the parameters to 40-60 for the SMA and to 0.6-1.2 for the standard deviation, the performance increases to values of over 20% p.a. Peak values show gains of over 30% p.a., however, these results appear only seldom in the result set and thus, we should not expect these results in real trading.

Optimization results graph:

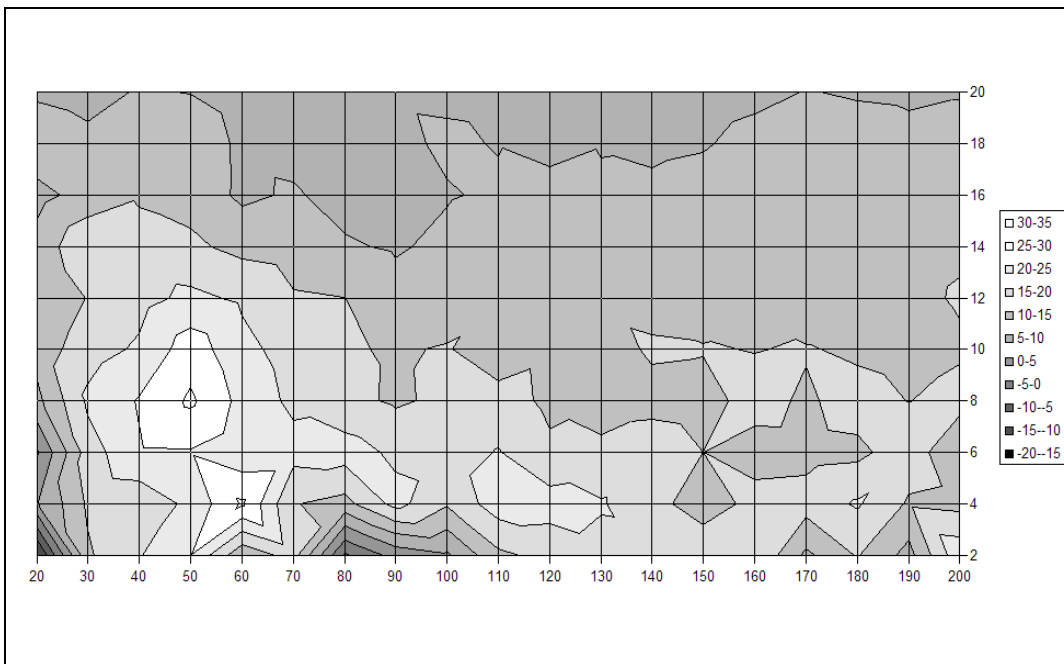


Figure 41

Stability test: Out of sample simulation

Additionally to the parameter tests, we do a simulation with the initial parameters on our out of sample portfolio to further test its robustness.

Results:

The results are better on the out of sample portfolio than on the in sample portfolio. Annualized profit jumped to 23.0% and maximum drawdown decreased to 28.3%. Except for the last year, the portfolio equity curve (Figure 42) shows a nice and continuous increase with only little volatility. The drawdown curve (Figure 43) shows most drawdowns between 10% and 20% from which the system is able to recover quickly.

The test on out of sample data confirms the good performance of this system. It is recommendable, however, to do further tests and to do a Monte Carlo simulation.

Portfolio Equity Curve:

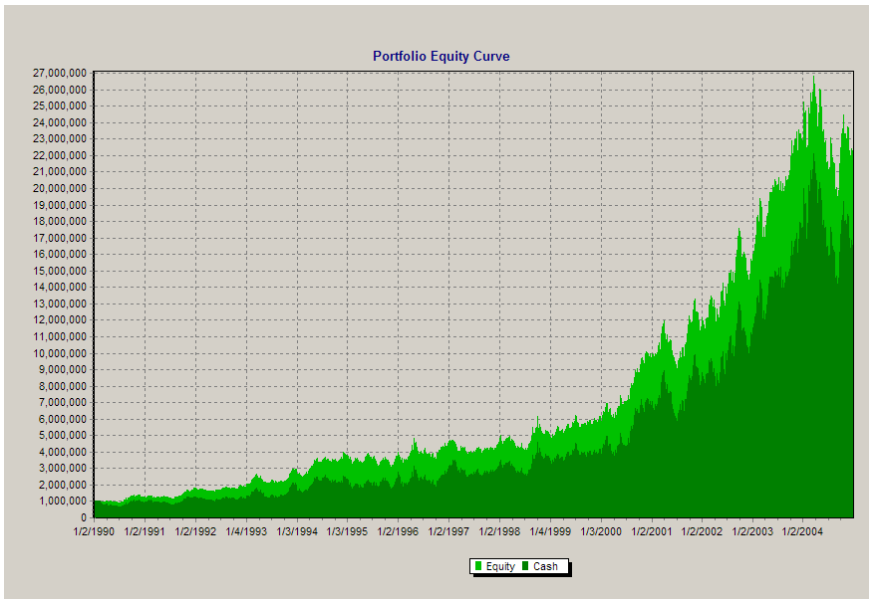
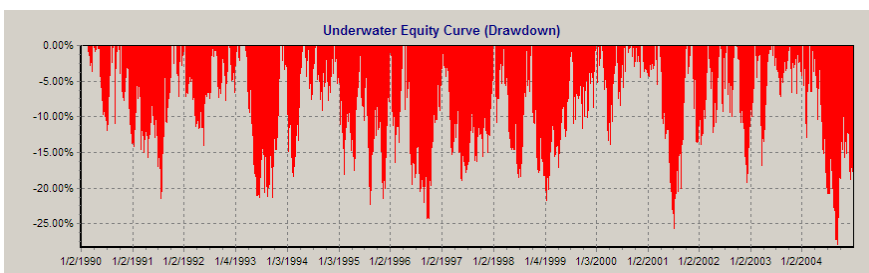


Figure 42

Drawdown Curve:



Performance Data:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$22,253,874.00	\$29,544,212.00	\$-6,290,334.50
Net Profit	\$21,253,874.00	\$28,544,212.00	\$-7,290,334.50
Net Profit %	2,125.39%	2,854.42%	-729.03%
Annualized Gain %	22.97%	25.31%	0.00%
Exposure	28.87%	21.00%	36.50%
Number of Trades	637	316	321
Avg Profit/Loss	\$33,365.58	\$90,329.78	\$-22,711.32
Avg Profit/Loss %	1.54%	2.65%	0.45%
Avg Bars Held	107.30	109.15	105.49
Winning Trades	229	124	105
Winning %	35.95%	39.24%	32.71%
Gross Profit	\$64,689,434.08	\$46,567,133.65	\$18,122,300.43
Avg Profit	\$282,486.61	\$375,541.40	\$172,593.34
Avg Profit %	15.79%	16.79%	14.62%
Avg Bars Held	204.95	200.48	210.22
Max Consecutive	7	4	6
Losing Trades	408	192	216
Losing %	64.05%	60.76%	67.29%

Gross Loss	\$-43,435,556.36	\$-18,022,921.03	\$-25,412,635.33
Avg Loss	\$-106,459.70	\$-93,869.38	\$-117,651.09
Avg Loss %	-6.46%	-6.48%	-6.44%
Avg Bars Held	52.50	50.16	54.58
Max Consecutive	17	12	33
Max Drawdown	\$-7,683,386.00	\$-5,849,510.00	\$-14,299,884.00
Max Drawdown %	-28.32%	-49.89%	-190.76%
Max Drawdown Date	9/15/2004	6/29/2004	9/14/2004
Wealth-Lab Score	57.02	60.40	0.00
Profit Factor	1.49	2.58	0.71
Recovery Factor	2.77	4.88	0.51
Payoff Ratio	2.45	2.59	2.27
Sharpe Ratio	0.92	0.90	0.17
Ulcer Index	10.86	17.42	49.01
Wealth-Lab Error Term	8.43	19.16	195.84
Wealth-Lab Reward Ratio	2.72	1.32	0.00
Luck Coefficient	9.15	8.61	3.80
Pessimistic Rate of Return	1.22	1.42	0.93
Equity Drop Ratio	0.18	0.20	0.00

Concept: Symbol Rotation

All before mentioned systems had independent entry and exit rules which decided whether to enter or exit into a market. Each market was treated separately from the others and trading decisions for one market did not influence trading decisions for any other market. Thus, the number of markets in which the systems were invested varied from day to day. The following system is different in that it is always invested in exactly 6 futures (3 short positions and 3 long positions out of 20 futures in total). Each market will be analyzed how much it is “trending” and the most trending markets will be included in the portfolio. Thus, our portfolio will always consist of exactly 6 (most trending) futures. As soon as a market does not show a strong trend anymore it will be replaced by another (more trending) market.

TrendStrength C Symbol Rotation

To determine how much a market shows a trend-movement we will use the TrendStrength C Indicator from the TrendStrength family (introduced above). This indicator was developed by José Cruset and works similar as the TrendStrength A indicator but instead of comparing the price with the price of various SMAs it counts how many SMAs are rising or falling. The higher its value (in absolute terms) the more SMAs are rising and consequently the stronger is the trend. The higher the indicator value, the more likely will the corresponding future be included in the basket of held futures.

Additionally, we will use this system on monthly data, i.e. we will trade only once a month (at the first trading day each month). So, we will use the closing price of the last day of each month as input for the trading system. This makes this system easy to trade and it assures that the system stays a minimum of one month in a position after it enters the market. The TrendStrength C indicator used here will monitor SMAs ranging from two months to one year, i.e. 11 SMAs in total. Figure shows a monthly chart with the TrendStrength C indicator.

As the system holds only 6 futures at a time the exposure (margin to equity ratio) drops in our simulation to 10%. We thus doubled the risk stop parameter in our simulations to 4%. We are aware that by doing this the maximum risk of each position is doubled. But in contrast to the TrendStrength A system presented above, this system holds only 6 (risky) positions instead of up to 20. So, it is reasonable to increase our risk parameter.

Trend Strength C indicator:

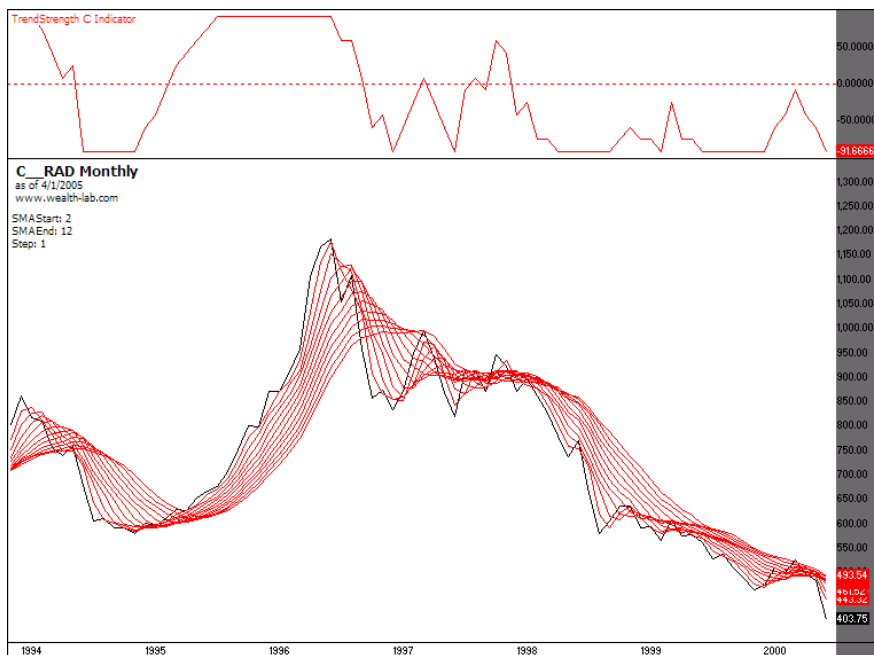


Figure 43

Rules:

- For each market, compute the monthly TrendStrength C indicator value
- Go long the three markets with the highest indicator value the next day at market
- Go short the three markets with the lowest indicator value the next day at market
- Always stay invested in 6 future positions and exit a position the next day at market when another contract has (in absolute terms) a higher TrendStrength C indicator value

Position sizing:

4% based on the difference of the current price to the SMA value which is farthest apart from the current price

Results:

Figure 44 shows the portfolio equity curve.¹ Although strong equity increases are experienced until beginning of 1999, the portfolio equity curve shows only little increases and high volatility during the last six years of the simulation period. During this time, the maximum drawdown of 49.8% is experienced. Still, the overall profit per year is at an acceptable 14.9%. The drawdown curve (Figure 45) confirms this observation as it shows the largest drawdowns at the end of the simulation period. Until 2003, most drawdown peaks were around 20% and they persisted only short time periods.

¹ We did the simulation over the same time period as the other simulations. However, the system needs 12 months to initialize its (TrendStrength C) indicator; therefore, trading could not start until beginning of 1991. You will therefore see a flat period at the beginning of the portfolio equity curve. All performance calculations ignore this flat period and start at 1/1/1991 thus reflecting correct numbers.

Portfolio Equity Curve:

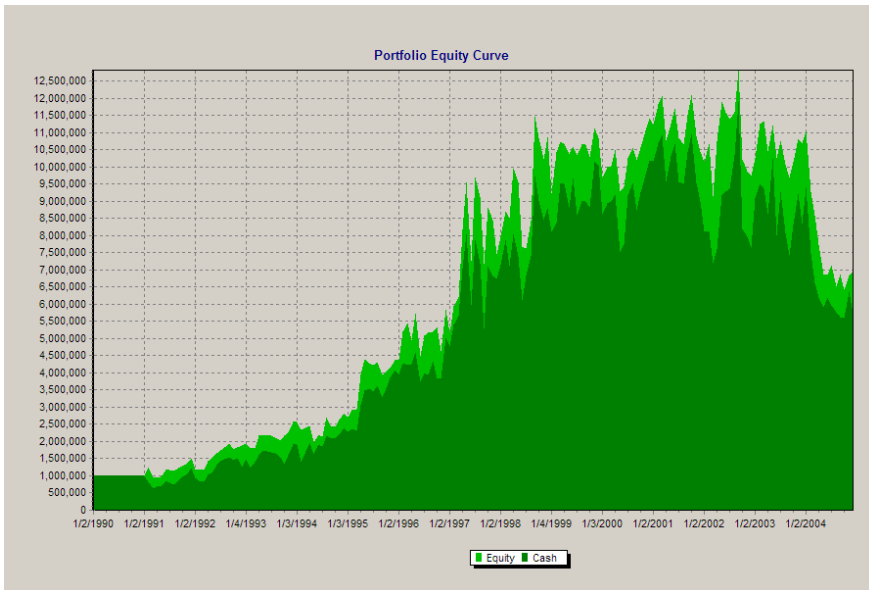


Figure 44

Drawdown Curve:

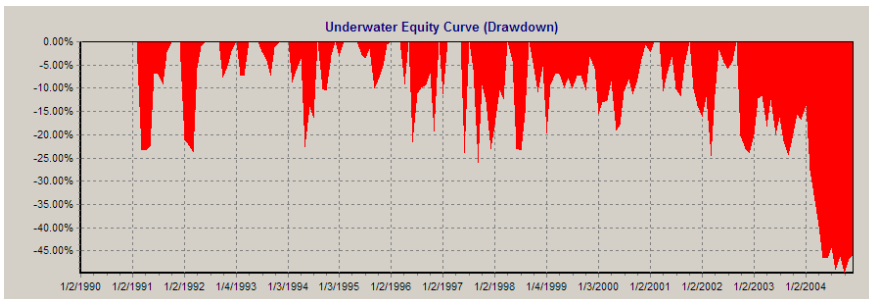


Figure 45

Performance Results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$6,930,113.00	\$14,294,521.00	\$-6,364,409.00
Net Profit	\$5,930,113.00	\$13,294,521.00	\$-7,364,409.00
Net Profit %	593.01%	1,329.45%	-736.44%
Annualized Gain %	14.92%	21.05%	0.00%
Exposure	15.76%	8.00%	42.77%
Number of Trades	411	211	200
Avg Profit/Loss	\$14,428.50	\$63,007.21	\$-36,822.05
Avg Profit/Loss %	1.16%	2.69%	-0.46%
Avg Bars Held	2.44	2.37	2.51
Winning Trades	188	113	75
Winning %	45.74%	53.55%	37.50%
Gross Profit	\$39,775,837.70	\$27,757,194.00	\$12,018,643.70
Avg Profit	\$211,573.60	\$245,638.88	\$160,248.58
Avg Profit %	8.91%	9.47%	8.06%
Avg Bars Held	3.13	3.07	3.21
Max Consecutive	6	9	6
Losing Trades	223	98	125

Analysis of Trend Following systems

Losing %	54.26%	46.45%	62.50%
Gross Loss	\$-33,845,725.07	\$-14,462,672.57	\$-19,383,052.50
Avg Loss	\$-151,774.55	\$-147,578.29	\$-155,064.42
Avg Loss %	-5.37%	-5.12%	-5.57%
Avg Bars Held	1.86	1.57	2.08
Max Consecutive	8	5	16
Max Drawdown	\$-6,385,357.50	\$-3,142,832.00	\$-10,849,616.00
Max Drawdown %	-49.78%	-31.47%	-252.85%
Max Drawdown Date	10/1/2004	3/1/2002	10/1/2004
Wealth-Lab Score	47.54	180.34	0.00
Profit Factor	1.18	1.92	0.62
Recovery Factor	0.93	4.23	0.68
Payoff Ratio	1.66	1.85	1.45
Sharpe Ratio	0.55	1.00	0.55
Ulcer Index	15.84	8.19	75.71
Wealth-Lab Error Term	19.47	13.72	277.13
Wealth-Lab Reward Ratio	0.77	1.53	0.00
Luck Coefficient	13.13	12.35	6.81
Pessimistic Rate of Return	1.21	1.76	0.70
Equity Drop Ratio	0.52	0.21	0.00

Stability test: Out of Sample simulation

Again, we test the same system with the same parameters as before but now on our out of sample portfolio. Thus, we want to test the stability of our parameters and want to make sure the performance of the in sample simulation are not the result of luck.

Results:

The annual performance (13.7%) is a little bit worse than in the in sample simulation but still acceptable. On the positive side we have to note that the maximum drawdown is lower now (34.8%) and both the portfolio equity curve (Figure 46) as well as the drawdown curve (Figure 47) show a steady increase with only little equity-valleys.

The test with the out of sample portfolio showed similar and still acceptable results. We can conclude that this system works across a broad range of markets. However, more stability tests like parameter stability tests and a Monte Carlo Simulation are highly recommended before you want to trade this system with real money.

Portfolio Equity Curve:

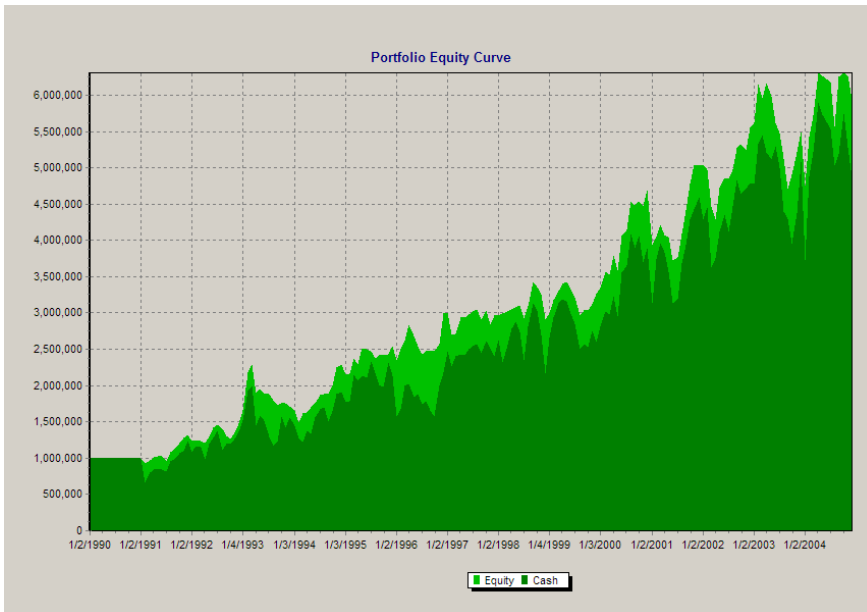


Figure 46

Drawdown Curve:

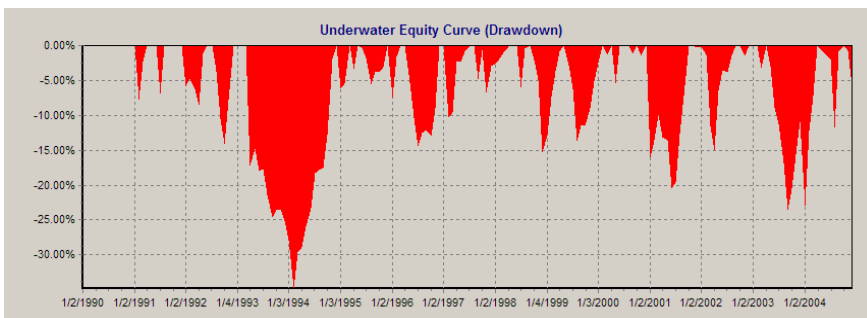


Figure 47

Performance Results:

	Long + Short	Long Only	Short Only
Starting Capital	\$1,000,000.00	\$1,000,000.00	\$1,000,000.00
Ending Capital	\$5,944,193.50	\$4,659,096.50	\$2,285,096.50
Net Profit	\$4,944,193.50	\$3,659,096.50	\$1,285,096.50
Net Profit %	494.42%	365.91%	128.51%
Annualized Gain %	13.66%	11.69%	6.12%
Exposure	13.95%	9.43%	12.26%
Number of Trades	417	217	200
Avg Profit/Loss	\$11,856.58	\$16,862.20	\$6,425.48
Avg Profit/Loss %	0.49%	0.67%	0.29%
Avg Bars Held	2.40	2.31	2.51
Winning Trades	193	95	98
Winning %	46.28%	43.78%	49.00%
Gross Profit	\$18,176,975.90	\$10,309,559.60	\$7,867,416.30
Avg Profit	\$94,181.22	\$108,521.68	\$80,279.76
Avg Profit %	8.40%	8.36%	8.43%
Avg Bars Held	3.20	3.29	3.10
Max Consecutive	9	7	7

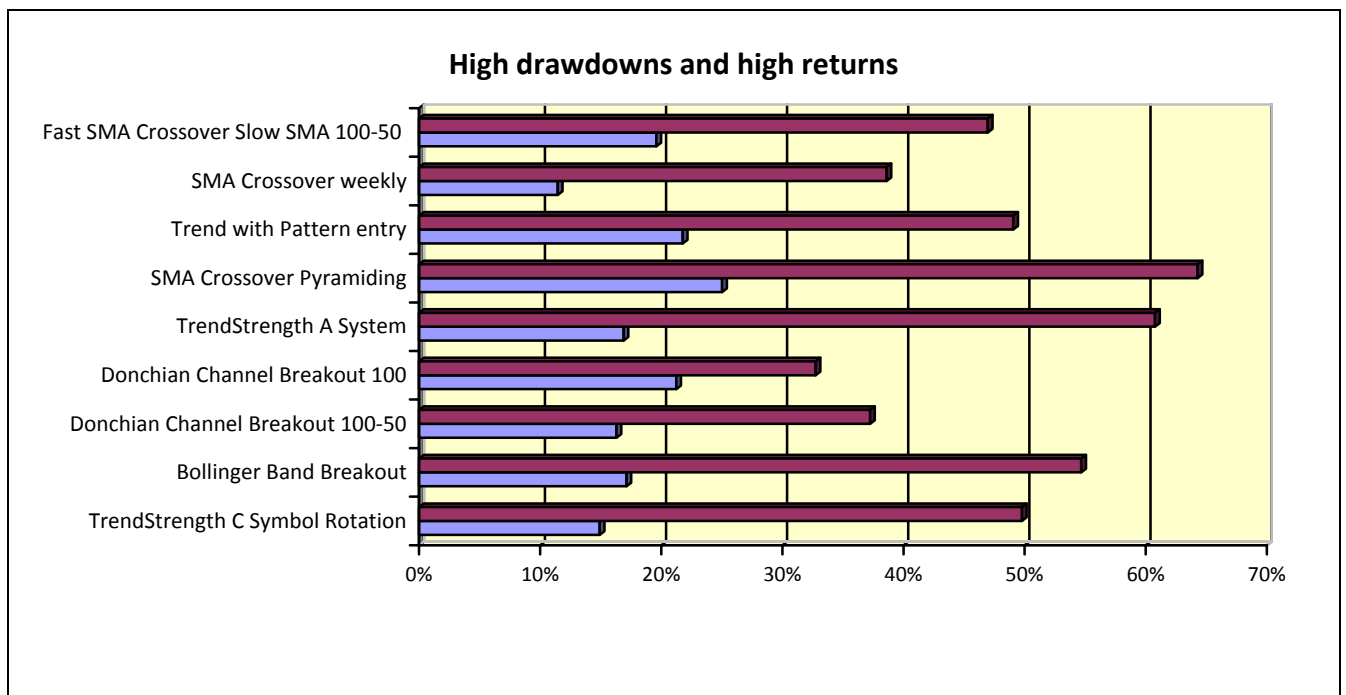
Analysis of Trend Following systems

Losing Trades	224	122	102
Losing %	53.72%	56.22%	51.00%
Gross Loss	\$-13,232,782.87	\$-6,650,463.02	\$-6,582,319.86
Avg Loss	\$-59,074.92	\$-54,511.99	\$-64,532.55
Avg Loss %	-6.33%	-5.32%	-7.53%
Avg Bars Held	1.72	1.54	1.93
Max Consecutive	18	9	14
Max Drawdown	\$-1,457,545.00	\$-758,639.25	\$-1,725,856.25
Max Drawdown %	-34.82%	-35.15%	-50.88%
Max Drawdown Date	9/2/2003	2/1/1994	8/2/2004
Wealth-Lab Score	63.84	80.37	24.50
Profit Factor	1.37	1.55	1.20
Recovery Factor	3.39	4.82	0.74
Payoff Ratio	1.33	1.57	1.12
Sharpe Ratio	0.69	0.63	0.36
Ulcer Index	10.46	11.65	15.27
Wealth-Lab Error Term	6.16	8.43	9.19
Wealth-Lab Reward Ratio	2.22	1.39	0.67
Luck Coefficient	8.99	9.03	5.32
Pessimistic Rate of Return	0.99	1.01	0.88
Equity Drop Ratio	0.52	0.62	1.88

Summary

The following table summarizes the profit and drawdown results from all presented system in one table for comparison purposes. All results are simulation results with the original parameters run on the in sample portfolio.

System	Profit p.a	Max. DD
Fast SMA Crossover Slow SMA 100-50	19.59%	46.96%
SMA Crossover weekly	11.45%	38.60%
Trend with Pattern entry	21.77%	49.06%
SMA Crossover Pyramiding	25.02%	64.28%
TrendStrength A System	16.89%	60.77%
Donchian Channel Breakout 100	21.24%	32.74%
Donchian Channel Breakout 100-50	16.30%	37.24%
Bollinger Band Breakout	17.13%	54.68%
TrendStrength C Symbol Rotation	14.92%	49.78%



We can see that all systems have high drawdowns (all above 30%) but also high profits (all above 11% p.a.) The systems are overall very profitable even with these high drawdowns. However, you should also be aware that drawdowns can occur at the very beginning of your trading. So, after you start the losses can be very high even before you make any money. So, you should ask yourself if you are able to withstand a high drawdown at the beginning of your trading or not. Only if you are you should consider using these systems as your investment approach.

And like always, more weight should always be put on the analysis of the risks (i.e. max drawdown) than on the maximum profit.

Conclusion

In this essay, we showed several trend-detection concepts. Based on these concepts we presented several profitable systems and simulated the over a 15-year period and across different markets. We showed that by detecting trends, it is possible to make large profits in the financial markets, although the risks are very high, too.

As we pointed out at various occasions it is very important to prove the stability of your rules in changing market conditions before risking real money. So, we showed also the outcome of different stability tests for the presented systems. Before risking money you should be aware that all simulations are based on past data and that performance of the past is never a guarantee of the future. However, by doing as many stability tests as possible one can reduce the probability of a failure of a tested system in the future.

Appendix

These internet addresses provide additional information about the product and indicators mentioned in this chapter:

System Trader 24 site:

www.systemtrader24.com

Wealth-Lab Developer:

www.wealth-lab.com

TrendStrengthA indicator:

<http://www.wealth-lab.com/cgi-bin/WealthLab.DLL/libraryview?item=396>

TrendStrengthC indicator:

<http://www.wealth-lab.com/cgi-bin/WealthLab.DLL/libraryview?item=394>

TrendStrength Demo Script:

<http://www.wealth-lab.com/cgi-bin/WealthLab.DLL/editsystem?id=39161>