Tuning up the turtle

Dissecting the original Turtle strategy illustrates the difficulty of designing a system that can perform consistently over decades.

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Do markets change? Is it necessary to undertake continued research and development and adapt a trend-following system to maintain its profitability over the years?

To attempt to answer these questions, the following study tracks the strategy of the "Turtles," a group trained by legendary traders Richard Dennis and Bill Eckhart in the 1980s. The Turtles were used to conduct an experiment about whether it was possible to teach people to become successful traders.

One trading system salesmen recently argued that it is "nonsense" and a "specious argument" to suggest trend-following rules must adapt to changing market conditions. Others argue trend-following systems do not automatically adapt but need continued monitoring and refining. Some well-known trend-followers have indeed stated they still trade the same system they used 30 or 40 years ago. But what do those managers really mean?

Markets in flux

Suppose a trend-following commodity trading advisor (CTA) trades a simple channel breakout system with the following rules: buy when the market trades above an *x*-day high and reverse the trade to sell short when the market penetrates an *x*-day low. In addition, the system uses a fixed-fractional approach to sizing positions, risking *y* percent of total equity based on the channel's width (*x*-day high minus *x*-day low).

FIGURE 1: TURTLE SYSTEM TRADE EXAMPLE
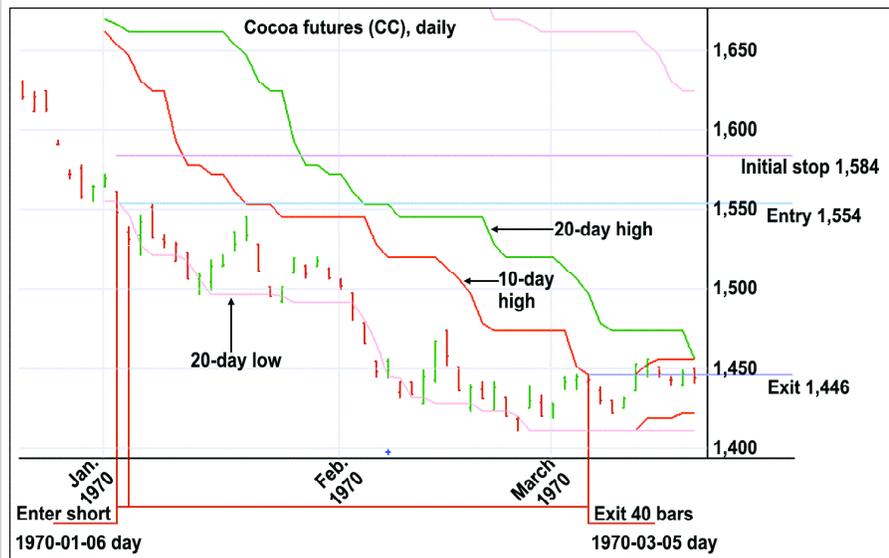
The original Turtle strategy shorted cocoa futures in January 1970 and exited at a profit in March.
Source: Trading Blox

KC *For more information about the following concepts, go to "Key concepts" on p. xx.*

- *True range*
- *Exponential moving average (EMA)*
- *Correlation*
- *Compound annual growth rate (CAGR)*

As markets change over the years, imagine the CTA adjusts the strategy in the following manner: He increases x's value in an attempt to avoid choppiness in the markets and increases the percentage of equity risked (y) to keep a similar exposure to the market after the stops and the channel itself are widened. As the CTA adds different markets, let's assume he introduces portfolio-wide and sector-specific risk limits. Perhaps he also adds profit-target rules, which lock in some profit before a trend begins to reverse.

Is the CTA trading the same system with which he started? Well, yes, he is still trading channel breakouts, but the system's profile is very different from the way it began. If you look at a few CTA disclosure documents, you are unlikely to find many that do not extol the benefits of continuing research and development. Changes to many systems have been cautiously implemented over the years.

Testing the Turtle

By back-testing the original Turtle strategy, we can find out whether this particular system, which was highly profitable back in the early 1980s, has adapted or needs updating.

At its core, the Turtle strategy is a trend-following system that attempts to capture short and medium-term trends in a portfolio of futures markets (Table 1). For example, Turtles bought the market after 20-day highs and sold short after 20-day lows. Figure 1 shows trade examples in cocoa futures (CC), which shows the effect of pyramiding: Units were entered short on Jan. 6 and 7, 1970, and all units were exited at the same time on March 5, 1970 as the market penetrated the 10-day high.

However, the details behind the system are fairly complex, especially steps involving risk management and position sizing. The following rules apply for the Turtles' shorter-term strategy, labeled "system 1." The Turtles also traded a longer-term system based on 55-day highs and lows ("system 2," not tested). The trade rules are:

1. **Go long** when price exceeds a 20-day high.
2. **Sell short** when price drops below a 20-day low.
3. **Exit long** when price drops below a 10-day low.
4. **Exit short** when price exceeds a 10-day high.
5. Ignore entry signals if the previous signal in that market produced (or would have produced) a winning trade. If a trade is skipped, enter after a 55-day high or low to avoid missing major moves.

The Turtle system normalized the dollar volatility of positions by trading more contracts in less volatile markets and

TABLE 2: POSITION THRESHOLDS

Level	Type	Max units
1	Single market	4
2	Closely correlated markets	6
3	Loosely correlated markets	10
4	Single direction	12

The Turtles limited portfolio risk by capping trade size according to contract size, volatility, correlation, and direction. They never traded more than 12 risk units in either direction.

Source: "The original Turtle trading rules," Curtis Faith, 2003.

TABLE 3: TEST SETTINGS

Interest earned on capital	90-day T-bill rate
Slippage on new entries/exits	7%
Slippage on rolls	3.5%
Round-turn commission per contract	$7
Starting capital	$1,000,000
Risk per trade	1%

Both sets of tests began with $1 million and included interest, slippage, and commission.

fewer contracts in more volatile markets. Volatility is expressed in terms of the 20-day average true range (ATR; this calculation uses an exponential moving average). One percent of capital is risked per "unit" or trade, the size of which is illustrated in the following example in heating oil futures (HO):

Contract size = 42,000 gallons, priced in U.S. dollars
20-day ATR on Nov. 23, 2009 = 0.0663
Account size = $1,000,000
Dollars per point = $42,000

Unit size $= \dfrac{0.01*\$1,000,000}{0.0663*42,000} =$

3.59 contracts (rounded down to 3)

The Turtles initially placed stops two ATRs above short positions or below long positions, effectively risking 2 percent per unit. This test will use 1-percent risk per unit to prevent the test from becoming unwieldy over the very long test period.

Positions were pyramided by adding more trade units each time a market moved 0.5 ATR in the right direction. To limit risk in specific markets, sectors, and portfolios, the maximum number of units never exceeded 12 in either direction (Table 2, p. xx). When pyramiding into a favorable trade, the system could add up to three additional units per market. If additional units were added to a position, the original stops were raised by 0.5 ATR. Generally, all stops were set two ATRs from the most recently entered trade.

To preserve capital, the notional account size was decreased by 20 percent each time the account value dropped 10 percent. For example, if a $1 million account fell 10 percent to $900,000, the account's size was lowered to $800,000

FIGURE 2: ORIGINAL TURTLE SYSTEM EQUITY CURVE
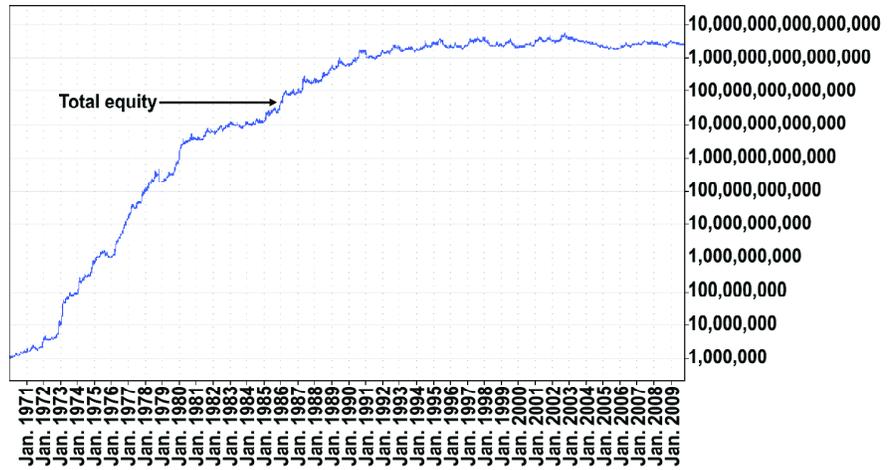
After impressive growth in the 1980s, the equity curve flattened in the early 1990s, suggesting the system has broken down.
Source: Trading Blox

for position-sizing purposes. Table 3 (p. xx) lists all other test details.

The strategy was tested on the futures markets in Table 1 from Jan. 1, 1970 to Sept. 23, 2009. These were the markets traded by the original Turtles. Note: French francs and the 90-day U.S. T-Bill were omitted from the original portfolio, and the Euro currency (FX) was substituted for the Deutsche mark.

The results

Table 4 lists the system's performance statistics and Figure 2 shows its equity curve. The strategy was highly profitable before and during the Turtle experiment, which spanned 1983 to 1988. Average trade length was relatively short: 43 calendar days for winning trades and 13 days for losing trades.

However, since the early 1990s, the

TABLE 4: ORIGINAL TURTLE PERFORMANCE SUMMARY

Compound annnual growth rate (CAGR)	72%
MAR ratio (CAGR/Max. DD)	1.09
Max. drawdown	66%
Longest drawdown (months)	85
No. of trades	11,440
Duration of average winner (days)	43
Duration of average loser (days)	13

The strategy had a 72-percent compound annual growth rate since 1970. However, it also suffered a maximum drawdown of 66 percent.
Source: Trading Blox

system has essentially been unprofitable. Large drawdowns — up to 66 percent — would have made this system difficult to trade unless you had exceptionally strong nerves. The original Turtle system needs considerable updating in the light of current market conditions.

Expanding the portfolio to include the many new markets that have been introduced over the past 20 years merely confirmed the system's demise. It failed to

respond to changing market conditions.

Bringing the Turtle back to life

Let's explore ways to make the Turtle system better suited for today's markets. Let's stick with the basic approach, but buy the market at a new 90-day high and sell short at a new 90-day low (rather than using 20-day thresholds). Also, the system will now wait to exit long (short) trades at a new 45-day low (high) instead of just 10 days. These changes produce a longer-term system that is more likely to avoid some of the increased noise in today's markets. Other suggested improvements include:

Widen the stop. Try a five-ATR stop instead of the original system's two-ATR stop. The wider stop will further help keep the system out of choppy, noisy markets.

Scale out, not in. Abandon the Turtles' complex scale-in rules and try scaling out of winning trades instead. Exit half the trade each time a profit target of, say, 10 ATRs is reached. Scaling out of winners can help reduce drawdown and smooth the equity curve.

Reduce sector risk. Continue to use risk-management rules, but only take trades when sector risk (e.g. softs, bonds, stock indices) is below 10 percent. Keep overall portfolio risk to 40 percent of the account, but abandon the rule that lowers risk after large drops in account equity. Without this rule, the strategy might recover faster from drawdowns.

Add markets. Expand the portfolio to include new futures contracts launched since the Turtle experiment ended in 1988. The increased diversity can help reduce drawdowns and smooth the equity curve.

FIGURE 3: REVISED TURTLE TRADE EXAMPLES
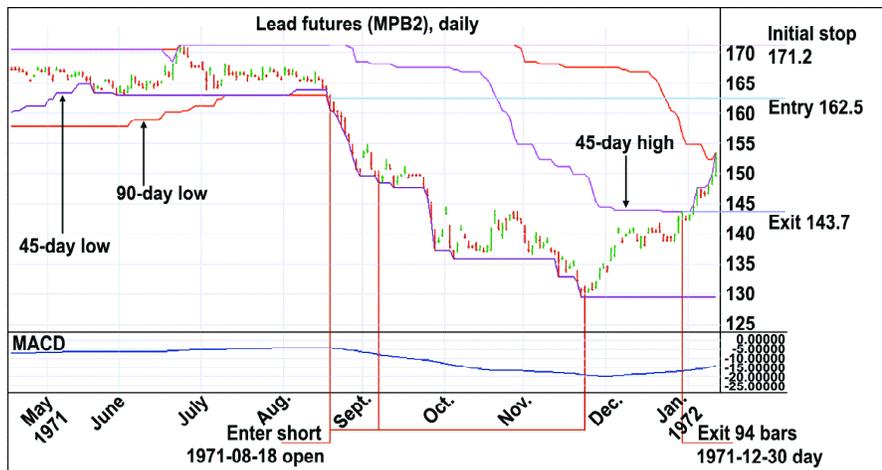
The revised system sold short after lead futures fell to a new 90-day low in August 1971. The strategy hit profit targets in September and November, and the remainder of the position was exited in December.
Source: Trading Blox

TABLE 5: REVISED TURTLE PERFORMANCE SUMMARY

	Orig.	Revised
Compound annnual growth rate (CAGR)	72%	35.28%
MAR (CAGR/Max. DD)	1.09	2.26
Max. drawdown	66%	15.60%
Longest drawdown (months)	85	16.3
No. of trades	11,440	3,205
Duration of average winner (days)	43	159
Duration of average loser (days)	13	63

The revised approach isn't as profitable as the original (35.3 percent CAGR vs. 72 percent, respectively). But the MAR ratio doubled from 1.09 to 2.26, and the number of trades declined by two-thirds — signs of a longer-term system that can navigate increasingly choppy markets.
Source: Trading Blox

Add filter. Finally, try adding a filter that takes trades only in the direction of a longer-term trend. One idea is to use a dual moving average crossover. For example, go long (short) only if the 50-day moving average (MA) is above (below) the 300-day MA.

Adjusted performance

Figure 3 shows a trade example in lead futures (MPB2). A total short position of 59 lead contracts was taken on Aug. 18, 1971 as the market breached the 90-day

FIGURE 4: REVISED TURTLE SYSTEM EQUITY CURVE
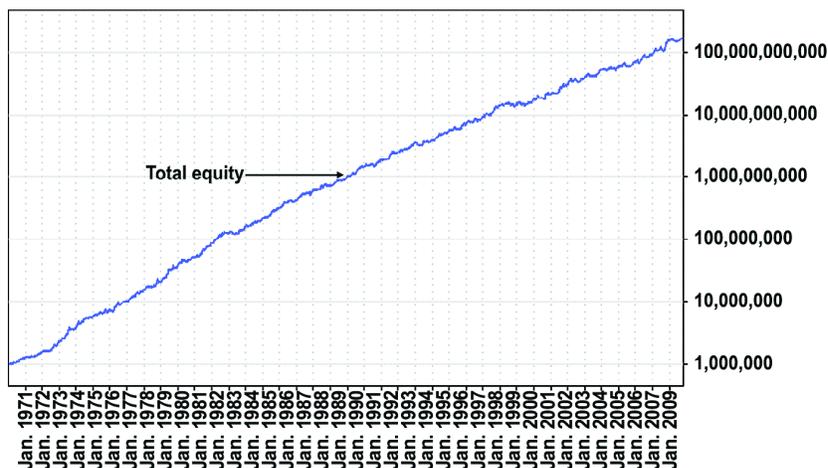
Unlike in the classic Turtle system, the revised strategy's equity curve continued to climb higher in recent years.
Source: Trading Blox

Related reading

"The original Turtle trading rules," Curtis Faith, 2003
http://originalturtles.tradingblox.com

"Breakout Trading Technique article collections: Basic and Advanced"
This 22-article set combines the advanced and basic collections of breakout strategies. The basic collection (12 articles) explains and illustrates basic break-out concepts, including breakout trading strategies based on chart analysis and simple breakout-channel calculations. The techniques cover time frames from intraday to multi-week.

   The advanced collection (10 articles) details different trading systems, strategies and concepts based on breakout trading. Also, there are special Trading System Labs that illustrate trailing stop and walk-forward testing techniques for breakout systems.

"System death: When good systems go bad"
 Active Trader, May 2008.
Not every trade can be a winner, and most traders endure losing streaks at some point. But if your trading system is losing money, how do you know if it is suffering just a brief drawdown or if the system is on its last leg?

"Turning systems upside down"
Active Trader, February 2007.
Inverting the rules of two popular trading techniques produces much better results than their standard applications.

low. The moving average convergence divergence (MACD) was negative, meaning the 50-day MA was below the 300-day MA.

   Profit was taken by exiting 29 contracts on Sept 7, 1971, and 15 more contracts on Nov. 23, 1971. The rest of the position was bought back on Dec. 30, 1971 as the trend reversed and the 45-day high was breached.

   Table 5 (p. xx) shows the revised system's performance statistics, and Figure 4 shows the equity curve. The updated strategy was tested on more than 100 futures markets from Jan. 1, 1970 to Sept. 23, 2009.

   Unlike the original system, the revised system remained profitable to the present day. Overall profitability, as measured by the compound annual growth rate (CAGR), is lower than in the original test (35.3 percent vs. 72 percent). CAGR can be increased to Turtle levels by increasing position size, increasing total and sector risk limits, reducing the size of the ATR stop, and altering the parameters of the filter. But these steps are likely to lead to higher drawdowns.

   In addition, the new rules considerably improve the system's MAR ratio (CAGR/maximum drawdown) from 1.09 to 2.26. The number of trades also dramatically decreased while trade length increased. This is a much longer-term, slower system designed to ride out increased market noise. Finally, the revised strategy is somewhat simpler than the original one.

   This study suggests markets may indeed change over time. The revised system itself may well become outdated. Thus, it is undoubtedly necessary to adapt a trend-following system to maintain its profitability over the years.☊

For information on the author see p. 6.