OWN MOUNTAIN TRADING COMPANY PRESENTS

BackTesting Report #13

ADX Alchemy

EXCLUSIVE PAID EDITION

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This report builds upon the previous twelve BackTesting Reports. Reading them first is highly recommended. You can start by downloading Issue # 1 – Baseline (it's free) from http://www.backtestingreport.com/BackTestingReportBaseline.pdf
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Letter from the Editor

Dear Reader-

In previous BackTesting Reports we learned that several indicators profited in favorable market conditions and lost money when the market turned the other way. Therefore, what is needed is a trend-finding indicator or method to help inform us on how to selectively deploy our growing cache of fair-weather indicators. We have a plethora of trigger signals, so now it is time to seek out an over-arching strategy. This search will ultimately take us into the realm of broad market indicators and gauges of market internals. Now, while we have our backtesting environment setup to investigate 7,147 stocks, we’ll first use it to test out a directional indicator that uses the stocks’ own price action. The ADX, along with the rest of the Directional Movement Indicator, promises to give us what we seek, so let’s investigate it thoroughly!

ADX is actually a classic example of how easy it is to be overly optimistic about an indicator. I was first introduced to ADX by Chuck LeBeau in his workshop who presented a balanced view of its performance. It also came highly recommended by a trader friend – one who seems to be doing well over the years. To top it off, I’d done a manual back test, stepping through a chart bar by bar to figure out what’s what with all the moving parts of the ADX. With those three data points from professionals, friends and my own investigation, I formed the expectation that performance of the ADX was at least decent.

Then I did the rigorous back test across 7,147 stocks! You have, in this report, the opportunity to base your decisions on a much larger set of more objective data than typically available through workshops, friends, and even manual back tests. This report covers not only the ADX alone, but in combination with the other leading indicators from previous reports.

As it turned out, there were winning combinations and unfortunate losers. As usual, you can rule out the losers directly while the potentially profitable combinations deserve more research. In fact, at the end of this report, we take the leading candidate through the next level of analysis – it looks that promising.

Regardless of whether you choose to use the strategies back tested in this report, I hope it will serve you in better understanding the market, technical analysis, and what it takes to create a winning trading plan of your own.

Sincerely,

Jackie Ann Patterson

Editor, BackTesting Report
Director, Own Mountain Trading Company
**The Strategy Evaluation Process**

You’ll find background information about how to use this report in the grey boxes. Generally it doesn’t change much from report to report. The blue words are usually links to the BackTestingBlog.com online glossary. If you are already familiar with BackTesting Report, just skip ahead to the next section if you wish.

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**BackTesting Review**

Backtesting measures the relative performance of a set of trading strategies on historical price data. Since backtesting relies on past data, it makes no guarantees about future performance and can’t say whether a strategy will do as well in the future as it did in the past. However, if a strategy didn’t perform in the past, there’s no reason to believe it will suddenly turn into a winner. It pays to avoid strategies with a losing track record.

Although most traders agree that backtesting is useful, many people don’t do it because of the time, expense, and expertise required. Backtesting Report gives you a leg up on the markets without doing all the work yourself.

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**How to Compare Entry Strategies**

Picking entry strategies which have win rates above the baseline is a good start. Also use win rate as a hint on the ease of following a system. For example, consider if you can really stick to a trading plan that only wins 10% of the time. Most importantly, remember that win rate alone doesn’t determine if a strategy is profitable — the size of the wins and losses matters, too.

**How to Compare Exit Strategies**

Most complete strategies have two types of exit tactics: taking profits and stopping losses. To keep the exploration to a manageable size, first we will compare profit-taking without stops, with the same criteria to sell the stock as to buy the stock. This also gives a fantastic what-if scenario to see what can happen if you run without limiting risk. Next we add a couple different stops losses and compare them both to the stop-less run and to each other. Keep the following criteria in mind while comparing different exit strategies.
**Strategy Definitions**

**Average Directional Index (ADX) Basics**

The Average Directional Index (ADX) is part of the Directional Movement Indicator (DMI) by J. Welles Wilder. The indicator as a whole monitors the highs and lows of price action to report if a trend exists and, if so, what direction.

The ADX is responsible only for indicating the presence or absence of a trend. Experts differ on the usage. The most common way is to declare an ADX value, such as 20, as the demarcation point between trending and range-bound markets. ADX readings less than 20 are said to indicate trendless markets while readings greater than 20 signify a trend. The higher the ADX, the stronger the trend. Chuck LeBeau’s research suggests that ADX slope is the most informative, with a rising ADX indicating increasing trendiness, almost regardless of absolute value. Both usages are employed in this report.

![Figure 1](image1.png)

**Figure 1 - ADX (brown line) shows trend. After 09/10/07 ADX rises and breaks the 20 mark just before 09/24/07**

![Figure 2](image2.png)

**Figure 2 - ADX also rises on downtrends (TradeStation screenshot)**
Note that the ADX is concerned only with the presence or absence of a trend. It doesn’t tell us anything about the trend’s direction. For that, we rely on the other parts of the DMI, the +DI and -DI lines. Because of the way the DMI is constructed, the +DI line rises on successively higher highs while the –DI line rises on successively lower lows. Repeat, as the price drops lower, the –DI line RISES (see Figure 4). The commonly accepted way to interpret the +DI and –DI is bullish when +DI is above –DI and bearish when –DI is the greater of the two.

Taken in whole, an uptrend is signaled by a rising ADX and +DI greater than –DI as in Figure 3. A downtrend is signaled by rising ADX and –DI greater than +DI as in Figure 4. A falling ADX signals a trendless market.

Figure 3 +DI on top signifies uptrend (TradeStation Screenshot)

Figure 4 +DI on bottom signifies downtrend (TradeStation screenshot)
**ADX Solo**

The first back tests simply measure the ADX’s ability to identify uptrends. (See Figure 5.) A rising ADX – defined as value 0.25 above the last bar – combined with +DI above –DI, serves as a buy signal. The strategy sells when one of two things happen:

1. The –DI rises above the +DI signifying that price is moving predominantly down
2. The trend weakens enough that a stop loss is hit. When the ADX flattens, an ATR stop is calculated for the current price bar. Note that while the ADX is rising, the uptrend is assumed intact and the stop is not moved upwards.

![Figure 5 - ADX Solo Strategy (TradeStation screenshot)](image)

Variations on this theme are also back tested. The strategy is fine-tuned by waiting for ADX to actually fall, not just level off. Restricting entries to the times when ADX is rising under 15 is also tested in an attempt to catch larger price moves.

A key question is whether ADX can help us get better results in combination with other indicators. The next three sections explore that with other indicators tested by BackTesting Report: Stochastic Oscillator, Moving Average Channels, and MACD.

**ADX and Stochastic Oscillator**

Stochastic Oscillator is legendary for under-performance in trending markets and we saw evidence of that in *BTR #12 – Stochastic Oscillators*. We apply ADX to filter out markets that are trending and check results. Specifically, the Stochastic Oscillator buy signal is the Fast (14,3,3) %K and %D lines crossing up while below 20 on the stochastic scale. This signal is only taken if the ADX line is below its own 20 mark. See Figure 6. This combination indicates an oversold but recovering Stochastic Oscillator and a trendless ADX. This back test is designed to reveal how the Stochastic Oscillator performs in its sweet spot of ranging markets.

For comparison, we also check Stochastic + ADX in trending markets. The idea is not to flog the poor Stochastic Oscillator but to use its capacity to identify a pullback within a slightly longer-term trend. Towards that end, the ADX +DI/-DI complex signals an uptrend with ADX over 20 and +DI over –DI. For further confirmation of bull market, the price must be over the 200-day
Then the strategy looks for Fast Stochastic (5,3,3) lines below their 20 mark, signaling oversold, and crossing upwards, signaling a potential resumption of the uptrend. This strategy is conceptually similar to Dr. Alexander Elder’s Triple Screen\(^2\) approach, although very different in implementation.

Figure 6 – Stochastic (14,3,3) rebounding from oversold and ADX trendless forms the buy signal (TradeStation Screenshot)

The backtesting engine enters trades under the circumstances outlined in the paragraph above. It exits once the Stochastics cross down while in the overbought area over 80 or the price drops below the 200 day MA, without consideration of the ADX. See Figure 7. This strategy is back tested without stops and again with a 5% fixed stop.

Figure 7 – Backtesting strategy buying on Stochastics pullback within ADX trend and selling on Stochastic lines cross over 80 (TradeStation Screenshot)
Note in Figure 7 how that strategy does not register a sell signal unless the Stochastic lines are above 80, even though they cross downwards while below 80. This situation is carried to an extreme in Figure 8 below where the three sets of light blue vertical lines mark times when Stochastic lines crossed above 80. Looking closely, in each case the crossover happened in between daily bars. By the time the daily bar closes and the strategy evaluates the situation, it sees the %K line below 80 and so does not recognize a sell signal. It doesn't chase the price with the upshot that it stays in the trade longer and rides through a retracement.

![Figure 8 - Strategy doesn't chase after falling Stochastic signals](image)

Since this no-chasing behavior is not intended, another back test run, labeled “chasing”, is presented for comparison. It keeps track of whether the %K achieves overbought status, and if so, that strategy exits any position when the lines cross down, regardless of the current reading of %K. In effect, it “chases” falling prices to get out of the trade.

**ADX and Moving Average Channels, a.k.a Bollinger Bands**

The idea behind the moving average (MA) channel is to catch a small segment of a trend by entering when price crosses up through the 20-day MA. We check for ADX over 20 and +DI above -DI to see if the ADX uptrend signal improves results for previous tests. One variation is symmetric and exits when price crosses down through the 20-day MA (see Figure 9). Another variation takes profits at the upper boundary of a 2 standard deviation channel – that is the upper Bollinger Band. (See Figure 10.) See BTR #3 – Price Crosses Moving Averages and BTR #11 – Profit Targets for more background information and back test results of MA channels and Bollinger Bands without ADX.

The third variation of Moving Average Channel trading filters the candidate stocks by volatility. The strategy only enters a trade if the recent 20-day Average True Range (ATR) is at least 3% of price. This is intended to focus on stocks that are actually moving in the hopes that will increase the potential for profit.
MACD Divergence with ADX < 20 to Spot Reversals
This is a non-standard usage but it makes sense in the context of previous back test results. The MACD/H Divergences emerged as the strongest of the MACD signals. However, many false positive signals gave divergences an unprofitable track record in down markets. Since unsuccessful divergences come about in gentle trends, we want to test whether it is advantageous for ADX to indicate a trendless market along with the divergences.

This combination is back tested for divergences on the MACD lines and MACD histogram. The buy signal is a positive divergence accompanied by ADX under 20. The basic sell signal is a negative divergence. See Figures 11 and 12 for MACD lines example.

One additional run relies upon the ADX to indicate trendless markets for both the buy and sell signals. In Figure 13, you can see that the strategy does not act on the negative MACD divergences marked in red because the ADX is indicating that the trend is in force. A choppy
range drives down the ADX without a MACD negative divergence, and again no sell signal. Finally, both conditions are present and the strategy exits.

Figure 11 – buys on MACD divergence with ADX < 20, sells on MACD neg div only (TradeStation Screenshot)

Figure 12 - Zoom out on same trade as above (TradeStation Screenshot)

Figure 13 - Same entry but wait to sell until MACD Negative Divergence with ADX < 20 (TradeStation Screenshot)
Backtesting Setup Details

**Markets:** US Stocks and international stocks represented by ADRs on NYSE, AMEX, NASDAQ including delisted tickers.  *(Click here for stock lists.)*

**Time Periods:** May 1994 - April 2008, divided into three samples to prevent over-optimization.
- May 1994 – April 2004 denoted by darker blue
  - Ten-year period chosen to include major up, down and sideways movements.
- May 2004 – April 2007 denoted by medium blue
  - *Out-of-sample* data for the original period. At 3 years, it’s 1/3 as long as original.
- May 2007 – April 2008 denoted by light blue
  - Current data. It’s 1/3 of the previous sample and is more out-of-sample data.
  *(Click here for background on time period selection.)*

**Direction:** Long Only

**Entry Strategy:** Enter any stock with buy signals as described above, and when volume criterion is met (more than 500,000 shares daily). All entries are next day via Market on Open orders.

**Exit Strategy:** Exit all stocks according to the signals described above. Profit-taking is done next day via Market on Open orders. Stop losses, where applied, are simulated as stop orders which may be executed intraday. This combination doesn’t exactly model a nimble trader who may grab profits from an exit signal early in a day in which those waiting for end-of-day miss out due to a sell-off before the close. It does model end-of-day trading and investment though.

**Sizing:** Where no stops are involved, size is fixed at 1000 shares. With stops, the risk amount was fixed at $1000 and the size computed as the number of shares that would risk $1000 between the anticipated entry and the stop.

**Backtesting Engine:** TradeStation version 8.6, Build 2525

**Data Vendor:** CSI Data  This data set was specially selected for accuracy after extensive testing. *(Click here for background on data preparation.)*
**Backtesting Results – Win Rates with Real Exits**

**How to Read the Results Tables**

The tables below summarize the results for selected back tests. In general, potentially profitable strategies have a positive expectancy, shown in green. Losing strategies have their negative expectancies colored red. Yellow indicates that the expectancy was slightly positive, but rounded down to zero – indicating caution.

With exit strategies the key criteria are *Expectancy* and *Maximum Adverse Excursion (MAE)*, described in detail below. The number of trades measured how often the strategy had an opportunity to trade. The average hold time measures how long each trade went on. Between them you can get an idea of how productively each strategy put its funds to use. Keep in mind that the average hold times are just that – an average. Winning trades tended to go on longer while losing trades were often shorter.

### ADX Solo

**Table 1 – Back Test Results for ADX 14 Solo**

<table>
<thead>
<tr>
<th>Name of Strategy Under Test</th>
<th>Productivity</th>
<th>Reliability</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Trades</td>
<td>Avg Hold</td>
<td>%Wins</td>
</tr>
<tr>
<td>Baseline 1994 - 2004, 20 days</td>
<td>140473</td>
<td>20</td>
<td>54%</td>
</tr>
<tr>
<td>ADX Rising 1994-2004</td>
<td>84710</td>
<td>8</td>
<td>37.15%</td>
</tr>
<tr>
<td>ADX Rising Risk-Sized No Stops 1994-2004</td>
<td>84710</td>
<td>8</td>
<td>37.15%</td>
</tr>
<tr>
<td>ADX Rising Adjusting Stops 1994-2004</td>
<td>56250</td>
<td>21</td>
<td>38.05%</td>
</tr>
<tr>
<td>ADX Rising / Falling Adjusting Stops 1994-2004</td>
<td>55848</td>
<td>22</td>
<td>38.14%</td>
</tr>
<tr>
<td>ADX Rising Under15 Adjusting Stops 1994-2004</td>
<td>14107</td>
<td>18</td>
<td>37.79%</td>
</tr>
<tr>
<td>Baseline 2004 - 2007, 20 days</td>
<td>41980</td>
<td>20</td>
<td>55%</td>
</tr>
<tr>
<td>ADX Rising 2004-2007</td>
<td>28187</td>
<td>8</td>
<td>38.36%</td>
</tr>
<tr>
<td>ADX Rising Risk-Sized No Stops 2004-2007</td>
<td>28187</td>
<td>8</td>
<td>38.36%</td>
</tr>
<tr>
<td>ADX Rising Adjusting Stops 2004-2007</td>
<td>18994</td>
<td>18</td>
<td>35.12%</td>
</tr>
<tr>
<td>ADX Rising / Falling Adjusting Stops 2004-2007</td>
<td>17941</td>
<td>21</td>
<td>37.89%</td>
</tr>
<tr>
<td>ADX Rising Under15 Adjusting Stops 2004-2007</td>
<td>5398</td>
<td>18</td>
<td>38.22%</td>
</tr>
<tr>
<td>Baseline 2007-2008, 20 days</td>
<td>12597</td>
<td>20</td>
<td>44%</td>
</tr>
<tr>
<td>ADX Rising 2007-2008</td>
<td>7692</td>
<td>6</td>
<td>32.19%</td>
</tr>
<tr>
<td>ADX Rising Risk-Sized No Stops 2007-2008</td>
<td>7692</td>
<td>6</td>
<td>32.19%</td>
</tr>
<tr>
<td>ADX Rising Adjusting Stops 2007-2008</td>
<td>5108</td>
<td>14</td>
<td>25.43%</td>
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<tr>
<td>ADX Rising / Falling Adjusting Stops 2007-2008</td>
<td>5092</td>
<td>15</td>
<td>25.39%</td>
</tr>
<tr>
<td>ADX Rising Under15 Adjusting Stops 2007-2008</td>
<td>1867</td>
<td>12</td>
<td>24.53%</td>
</tr>
</tbody>
</table>

Overall, the ADX results were mediocre. However, we can gain more insight into the effects of stop losses and sizing from these runs. The first two runs are alike except for one aspect: the second run is risk-sized for stop losses but the stop losses are never set. By comparing these
two runs, we see that the effect of sizing on expectancy is relatively small in good markets and slightly larger in 2007 – 2008. Engaging the stop losses in the market in the later runs had a much more pronounced effect on expectancy.

Still, the ADX (with +DI/-DI) produced short term trades with win rates under the baseline and unremarkable expectancy.
The combination of ADX in uptrend and Stochastic Oscillator in pullback stands out because it demonstrated positive expectancy in all three time periods. This is extraordinary for the long-only strategies back tested to date. Both the original strategy and the revision to chase the exit signals showed positive expectancy in the tough 2007 – 2008 time period. Before concluding that this strategy can’t lose, however, please read the commentary in the Frequency Distribution section. That will also explain why the standard deviation of these strategies was so much higher than the others.

Without stops, the Stoch + ADX Uptrend runs exceeded the win rate baseline. See Figures 17-19. Chasing signals gave better win rates and shorter trades at the expense of expectancy. The highest expectancy strategy consistently turned in the lowest win rate.

**Stochastic pullbacks in an ADX uptrend performed well, even in down markets**
The other combinations of Stochastic Oscillator and ADX performed abysmally. Surprisingly, this includes the strategy of using ADX to detect trendless markets where the Stochastic was supposed to shine as an oscillator.

**Figure 17**

*Stochastic and 200-day MA, with ADX filter 1994 - 2004*

<table>
<thead>
<tr>
<th>Win Rate</th>
<th>Baseline</th>
<th>Stoch with ADX Uptrend</th>
<th>Stoch with ADX any trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.0%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>65.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60.0%</td>
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<td></td>
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<tr>
<td>55.0%</td>
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<td>50.0%</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 18**

*Stochastic and 200-day MA, with ADX filter 2004-2007*

<table>
<thead>
<tr>
<th>Win Rate</th>
<th>Baseline</th>
<th>Stoch with ADX Uptrend</th>
<th>Stoch with ADX any trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.0%</td>
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<tr>
<td>60.0%</td>
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</tr>
<tr>
<td>55.0%</td>
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<tr>
<td>50.0%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>45.0%</td>
<td></td>
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</tr>
</tbody>
</table>

**Figure 19**

*Stochastic and 200-day MA, with ADX filter 2007 - 2008*

<table>
<thead>
<tr>
<th>Win Rate</th>
<th>Baseline</th>
<th>Stoch with ADX Uptrend</th>
<th>Stoch + ADX Uptrend Chasing Signals, 5% Stop</th>
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<tbody>
<tr>
<td>55.0%</td>
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<td></td>
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<tr>
<td>40.0%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>35.0%</td>
<td></td>
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</tr>
</tbody>
</table>
## Moving Average Channels and ADX

### Table 3 – Back Test Results for 20-Day MA Channel Trading with ADX

<table>
<thead>
<tr>
<th>Name of Strategy Under Test</th>
<th># Trades</th>
<th>Avg Hold</th>
<th>%Wins</th>
<th>Expect</th>
<th>StdDev</th>
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</thead>
<tbody>
<tr>
<td>Baseline 1994 - 2004, 20 days</td>
<td>140473</td>
<td>20</td>
<td>54%</td>
<td>0.02</td>
<td>0.23</td>
</tr>
<tr>
<td>Symmetric, 2 std dev stop 1994-2004</td>
<td>11108</td>
<td>13</td>
<td>28.54%</td>
<td>0.03</td>
<td>0.90</td>
</tr>
<tr>
<td>Targets 2 Std Dev Channel 1994-2004</td>
<td>29715</td>
<td>7</td>
<td>35.28%</td>
<td>0.02</td>
<td>0.35</td>
</tr>
<tr>
<td>ATR &gt; 3%, Symmetric 1994-2004</td>
<td>19095</td>
<td>9</td>
<td>33.21%</td>
<td>0.00</td>
<td>0.20</td>
</tr>
<tr>
<td>Baseline 2004 - 2007, 20 days</td>
<td>41980</td>
<td>20</td>
<td>55%</td>
<td>0.01</td>
<td>0.14</td>
</tr>
<tr>
<td>Symmetric, 2 std dev stop 2004-2007</td>
<td>10688</td>
<td>9</td>
<td>33.53%</td>
<td>0.01</td>
<td>0.39</td>
</tr>
<tr>
<td>Targets 2 Std Dev Channel 2004-2007</td>
<td>10720</td>
<td>7</td>
<td>34.92%</td>
<td>0.01</td>
<td>0.34</td>
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<tr>
<td>ATR &gt; 3%, Symmetric 2004-2007</td>
<td>3745</td>
<td>9</td>
<td>31.54%</td>
<td>-0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>Baseline 2007-2008, 20 days</td>
<td>12597</td>
<td>20</td>
<td>44%</td>
<td>-0.02</td>
<td>0.13</td>
</tr>
<tr>
<td>Symmetric, 2 std dev stop 2007-2008</td>
<td>3176</td>
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<td>27.05%</td>
<td>-0.06</td>
<td>0.30</td>
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<tr>
<td>Targets 2 Std Dev Channel 2007-2008</td>
<td>3187</td>
<td>5</td>
<td>29.53%</td>
<td>-0.05</td>
<td>0.29</td>
</tr>
<tr>
<td>ATR &gt; 3%, Symmetric 2007-2008</td>
<td>1720</td>
<td>6</td>
<td>26.10%</td>
<td>-0.02</td>
<td>0.08</td>
</tr>
</tbody>
</table>

The Moving Average Channels or Bollinger Bands turned out to be another short-term trading strategy which did not benefit by the addition of ADX. As shown in Table 3, the results were quite poor with low win rates and even lower expectancy. This compares unfavorably to the original back tests of Moving Average Channels without ADX in *BTR #11 – Profit Targets*.

Filtering the trades to select stocks with higher volatility brought the expectancy to near zero in all time periods. These runs were performed with a stop loss and sized to maintain constant risk – usually the combination that increases expectancy. That makes these results all the more disappointing.

*Adding ADX totally decimated this Bollinger Band trading strategy.*
Figure 20

Bollinger Bands with ADX 1994 - 2004

Win Rate

Baseline

Strategy

Targets 3 Std Dev

Channel

ATR > 3%

Symmetric

25.0%

30.0%

35.0%

40.0%

45.0%

50.0%

55.0%

Figure 21

Bollinger Bands with ADX 2004-2007

Win Rate

Baseline

Strategy

Targets 3 Std Dev

Channel

ATR > 3%

Symmetric

25.0%

30.0%

35.0%

40.0%

45.0%

50.0%

55.0%

60.0%

Figure 22

Bollinger Bands with ADX 2007 - 2008

Win Rate

Baseline

Strategy

Targets 3 Std Dev

Channel

ATR > 3%

Symmetric

20.0%

25.0%

30.0%

35.0%

40.0%

45.0%

50.0%
Table 4 – Back Test Results for MACD and MACDH Divergences with ADX < 20

<table>
<thead>
<tr>
<th>Name of Strategy Under Test</th>
<th>Productivity</th>
<th>Reliability</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td># Trades</td>
<td>Avg Hold</td>
<td>%Wins</td>
<td>Expect</td>
</tr>
<tr>
<td>Baseline 1994 - 2004, 20 days</td>
<td>140473</td>
<td>20</td>
<td>54%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 1994-2004</td>
<td>1537</td>
<td>93</td>
<td>21.28%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 1994-2004</td>
<td>1555</td>
<td>49</td>
<td>26.62%</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 1994-2004</td>
<td>1833</td>
<td>88</td>
<td>20.84%</td>
</tr>
<tr>
<td>Baseline 2004 - 2007, 20 days</td>
<td>41980</td>
<td>20</td>
<td>55%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 2004-2007</td>
<td>544</td>
<td>95</td>
<td>35.11%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 2004-2007</td>
<td>561</td>
<td>53</td>
<td>39.04%</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 2004-2007</td>
<td>709</td>
<td>89</td>
<td>34.41%</td>
</tr>
<tr>
<td>Baseline 2007-2008, 20 days</td>
<td>12597</td>
<td>20</td>
<td>44%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 2007-2008</td>
<td>385</td>
<td>25</td>
<td>23.64%</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 2007-2008</td>
<td>385</td>
<td>25</td>
<td>24.16%</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 2007-2008</td>
<td>473</td>
<td>27</td>
<td>24.10%</td>
</tr>
</tbody>
</table>

Requiring a MACD/H positive divergence with ADX under 20 whittled the number of trades down considerably. Also requiring the ADX again under 20 for the MACD/H negative divergence almost doubled the average hold time for the first two time periods. The last, difficult time period did not lend itself to increased average hold time and the expectancy remained deep in the red zone for all MACD + ADX runs.

The expectancy of trades with ADX in the exit criteria increased substantially in the good years. Unfortunately, expectancy also grew more negative in the tough time period of 2007 – 2008.

Nothing beneficial happened with the win rates. They were as low as ever for MACD divergences with stops in place. Quite possibly the increase in positive expectancy was not due to any predictive powers of ADX. It could simply mean that adding another, fairly rare, exit criteria extended the time in trade during what happened to be an up market.

**ADX postponed exits with MACD Divergences which looked good only as long as the market went up**
Figure 23

MACDL and MACDH with ADX < 20
1994 - 2004

Win Rate

Baseline
MACDL Div
ADX 2 ATR
SymADX
MACDL Div
SymDiv

Baseline
MACDH Div
ADX 2 ATR
SymADX

Baseline
MACDL Div
ADX 2 ATR
SymDiv

Baseline
MACDH Div
ADX 2 ATR
SymADX

Figure 24

MACDL and MACDH with ADX < 20
2004-2007

Win Rate

Baseline
MACDL Div
ADX 2 ATR
SymADX
MACDL Div
SymDiv

Baseline
MACDH Div
ADX 2 ATR
SymADX

Baseline
MACDL Div
ADX 2 ATR
SymDiv

Baseline
MACDH Div
ADX 2 ATR
SymADX

Figure 25

MACDL and MACDH with ADX < 20
2007 - 2008

Win Rate

Baseline
MACDL Div
ADX 2 ATR
SymADX
MACDL Div
SymDiv

Baseline
MACDH Div
ADX 2 ATR
SymADX

Baseline
MACDH Div
ADX 2 ATR
SymADX
**BackTesting Results – Expectancy and MAE**

**How to Use Expectancy**
When testing a real strategy with exits, *expectancy* becomes more important than win rate. As the name suggests, expectancy guides you in understanding what to expect by giving you the mathematical average result you could expect from each trade. As with any average, results of any single trade will vary but expectancy shows you how they evened out over time. BackTesting Report scales expectancy by the amount risked to make it possible to compare vastly different strategies across a very broad selection of stocks.

*A positive expectancy means the strategy was profitable in the past. A negative expectancy flags a strategy that lost money during the time period under test and is something to avoid.*

For example, an expectancy of 0.09 means an average of 9% of the amount risked was returned per trade. If a stop was employed and the position scaled to limit risk, this will be 9% of the total dollar amount between entry price and stop price. With no stop, we assume the entire position was at risk, and in that case, a 9% expectancy implies a 9% return, on average per trade. Again this doesn’t mean every trade returns 9%, a big loss and even bigger gain could amount to an average of 9%.

Obviously, bigger is better and you should seek the highest expectancy within your risk tolerance. A key question is: how much is enough? Only you can answer that for sure. As a rough guide, the graphs of results are set up to plot any strategy on a color-coded gradient with a red zone for losses, cautionary yellow zone for strategies which demonstrated a very thin edge, and a green zone for those that performed better. In the graphs below, you’ll notice the color scale is shifted such that strategies with expectancies just above zero are coded red because you need more than break-even to show a profit.
Figure 26 graphically shows that relying on ADX (and +DI/-DI) alone did not create much positive expectancy in good times and lost plenty in tough times.

Figure 27 below highlights the outstanding results of applying a Fast Stochastic Oscillator when

---

**How to Read the Expectancy Graphs**

The colorful graphs below plot the expectancy for all of the strategies under test plus the baseline. Each strategy occupies one space along the horizontal axis and is in the same order as in the data table.

All the data for one strategy is aligned in a vertical column. As shown in the legend, each time period has a particular shape to identify its data point. For example, 1994-2004 is denoted with a diamond. If a shape is not visible, it is hiding behind a larger shape which had roughly the same value. The vertical axis displays the expectancy. Negative expectancies (unprofitable) are color-coded red. Notice that the red extends above the zero line. That is not an accident. A strategy that comes out marginally positive in hypothetical backtesting is unlikely to be profitable in real situations. The colors gently fade to yellow to indicate caution. Then they go on to green to signify strategies that were more profitable in backtesting and have a chance at real-world profitability.

As the data points spread apart from the zero line, they reveal that increasing risk goes with increasing returns. It’s relatively easy to find rules and leverage that increases the expectancy in good times but it usually comes at the expense of a greater negative expectancy when conditions deteriorate. **Look for strategies that go further into the green zone and less into the red zone than others.**
ADX signals an uptrend. Notice how the triangle for 2007-2008 is in the green zone!

Adding ADX brought the MA Channel trading strategies down into the red unprofitable zone as shown in Figure 28 above.
How to Assess Risk with Maximum Adverse Excursion (MAE)

Equally important to understanding the potential for gain is assessing the risk of loss. Drawdown is frequently quoted in the industry but, because most of us are not managing a portfolio of 7147 stocks, it’s not very useful here. Instead we can gain knowledge of the risks by tracking the Maximum Adverse Excursion (MAE). Don’t let that technical term put you off, it really just means knowing how much the position went against you. MAE is not the same as the biggest losing trade because a stock may wander down for a huge open loss and come back before the exit. To stay in the game, the MAE needs to stay under the size of your account. To be successful, the MAE needs to be limited to a fraction of your account.

In the table below, the baseline “no-strategy” strategy shows how far awry trades can go. The 20-day timed exit functions as the baseline because that most closely matches the average number of days that the other strategies held their stocks.

As shown in Figure 29 above, the difference in results between MACDL and MACDH is not as great as the difference caused by waiting for trendless ADX and a negative divergence to exit.
Risk as Measured by MAE

Table 5 – Max Adverse Excursion for MACD with ADX Strategies

<table>
<thead>
<tr>
<th>Name of Strategy Under Test</th>
<th>Viability</th>
<th>Per Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ MAE Avg</td>
<td>$ MAE Max</td>
</tr>
<tr>
<td>Baseline 1994 - 2004, 20 days</td>
<td>$1,953</td>
<td>$518,000</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 1994-2004</td>
<td>$664</td>
<td>$1,169</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 1994-2004</td>
<td>$643</td>
<td>$1,169</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 1994-2004</td>
<td>$660</td>
<td>$1,161</td>
</tr>
<tr>
<td>Baseline 2004 - 2007, 20 days</td>
<td>$1,644</td>
<td>$207,600</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 2004-2007</td>
<td>$648</td>
<td>$1,163</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 2004-2007</td>
<td>$637</td>
<td>$1,163</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 2004-2007</td>
<td>$645</td>
<td>$1,151</td>
</tr>
<tr>
<td>Baseline 2007-2008, 20 days</td>
<td>$3,121</td>
<td>$75,660</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymADX 2007-2008</td>
<td>$694</td>
<td>$1,176</td>
</tr>
<tr>
<td>MACDL Div ADX 2ATR SymDiv 2007-2008</td>
<td>$693</td>
<td>$1,176</td>
</tr>
<tr>
<td>MACDH Div ADX 2ATR SymADX 2007-2008</td>
<td>$675</td>
<td>$1,168</td>
</tr>
</tbody>
</table>

This table is included so that you can compare it to the MAEs for the MACD Divergence strategies in BTR #8 – Finding Big Bottoms with MACD Bullish Divergences. Overall, these MAEs look reasonable.

Selected Results Distributions

This report contains the backtesting results for many runs. We will focus on the one area that is most enlightening rather than print every single frequency distribution.
The Stochastic Oscillator with ADX Uptrend shows the most potential in that it is a long strategy that actually produced a positive expectancy in the down markets of 2007 – 2008. Looking at the frequency distribution of results in Figure 30, a few important points jump out.

**Distribution of Results**
Tables of results give a good summary but necessarily leave out detail. For deeper insight, check out the results distribution graphs. They indicate whether to expect big losses often or a multitude of little hits. Likewise, some strategies will have many small gains and others earn their keep in a few large paydays. Click here for more about distribution graphs. Next box too.

Remember that R is the amount risked per trade, in our test $1000. R-Multiple is the number of times that risk is returned, so +5R is $5000 profit while -1R is a $1000 loss. The trades are sorted into “bins” which correspond to a bar on the graph. The label of the bin is the mid-point of its contents so the 0.5 bar represents all trades that returned between 0 and 1 R. Anything more negative than -1 R means those trades gapped past their stops or jumped the risk limits due to opening gaps.

There are relatively few trades in this time period, making it very manageable for an individual to actually trade this strategy. Note also that the losses were contained, mostly within -1.5R. This says very few trades gapped up on the buy day or later jumped stops.

![Long Stoch with ADX 5% Stop 2007-2008](image)

A critical point is that the 18.5 R trade at the far right and one more outlier not shown on the graph (it was too far outside the scale) are clearly not typical. Who knows whether the strategy will always capture those very few big gains?
Let’s study the frequency distribution graphs for the other time periods as well. For 2004 – 2007, two additional losing trades went beyond the scale of the graph below. Those trades are included in the tables of results above in this report. There is only one profitable trade in this time period that might be called an outlier; it sits alone in the 17.5R bin.

The frequency distribution of results for the same strategy in the time period 1994 – 2004 is shown in Figure 32 below. Three trades are off the positive scale of the graph, although they are included in the original analysis of backtesting results. Relatively few trades exceeded the initial stop loss in this time period.
To understand what reality might be like trading this strategy, look at the back test results without the outlying profitable data points:

Table 6

<table>
<thead>
<tr>
<th>Name of Strategy Under Test</th>
<th># Trades</th>
<th>Avg Hold</th>
<th>% Wins</th>
<th>Expect</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoch &amp; ADX Uptrend 5% stop - top 3 trades 1994 - 2004</td>
<td>2639</td>
<td>14</td>
<td>43.84%</td>
<td>0.36</td>
<td>2.12</td>
</tr>
<tr>
<td>Stoch &amp; ADX Uptrend 5% stop - top 1 trades 2004 - 2007</td>
<td>1067</td>
<td>17</td>
<td>49.67%</td>
<td>0.17</td>
<td>1.59</td>
</tr>
<tr>
<td>Stoch &amp; ADX Uptrend 5% stop - top 2 trades 2007 - 2008</td>
<td>173</td>
<td>16</td>
<td>38.15%</td>
<td>-0.08</td>
<td>1.33</td>
</tr>
</tbody>
</table>

The outliers were the key to profitability of the strategy in 2007 – 2008. Not so for the easier time periods of 2004 – 2007 and 1994 – 2004 where there was a broader base of profitable trades.

**Conclusion**

The combination of ADX and Stochastic Oscillator showed promise in the least expected manner possible. Using the ADX to identify an uptrend and the Stochastics to identify a resumption of the uptrend following a pullback produced results that initially appeared very resilient in even adverse market conditions. However, further analysis proved that resilience was based on a small number of outlying data points. While that does not inspire complete confidence in this particular strategy, the results look promising enough to warrant further study of the practice of buying the reaction to pullbacks within a larger trend.
The value of ADX, as the trend-sensing element of the Directional Movement Indicator, is not compelling when the Directional Movement Indicator is applied alone without another indicator to trigger trade entries and exits.

Adding ADX actually destroyed our MA Channel / Bollinger Band trading strategy.

ADX added value to MACD divergences, mostly by creating a reason to stick with trades longer.

**How to Apply This Strategy**

You can add ADX and the DMI complex to existing charts. Most charting packages support these indicators under one name or the other. Obviously, based on the back test results, ADX alone is not too interesting or useful. But you can combine with other indicators if you wish to further your study.

To apply ADX and MACD/H Divergences, see Figures 11 – 13. They show MACD Divergences using Appel’s Histogram. You can also plot the more common MACDH histogram if you decide that suits you. With either histogram, look for a divergence between the indicators and price. The strategies tested in this report only took action if the ADX line was below 20.

To apply ADX with Stochastics, see Figures 6-7 for TradeStation screen shots and Figure 33 below for StockFinder.

![Figure 33](image)

**TradeStation and StockFinder Support**

Please email support@backtestingreport.com if you are interested in BackTesting Report add-in software for StockFinder® or TradeStation® that implements any of the strategies discussed in this report. To check out the most recent accessories visit: [http://backtestingblog.com/code/](http://backtestingblog.com/code/)
Appendix

How to Read the Entry Testing Graphs
This section emphasizes Win Rate, which is the metric to beat for entry strategies. Three time periods are tested separately to help guard against curve fitting. In the graphs, each set of bars represents the time period indicated on the horizontal axis. They are also shaded differently for each period with 1994 - 2004 the darkest and 2007-2008 the lightest. The blue bars are from BackTesting Report #1 – the baseline for comparison. The other colorful bars are the results from this particular set of tests. See the legend on the graph to map the color to a strategy.

Active Investors

Win Rate

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Blue Bars</th>
<th>Red Bars</th>
<th>Price Crosses 20-Day MA with ADX &gt; 20 and DI+ Above DI-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994 - 2004</td>
<td>57%</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>2004 - 2007</td>
<td>62%</td>
<td>64%</td>
<td></td>
</tr>
<tr>
<td>2007 - 2008</td>
<td>24%</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 34
Figure 35

Position Traders

- **Win Rate**
  - **Price Crosses 20-Day MA with ADX > 20 and DI+ Above DI-**
  - **1994 - 2004:** 54%
  - **2004 - 2007:** 55%
  - **2007 - 2008:** 44%

Figure 36

Swing Traders

- **Win Rate**
  - **1994 - 2004:** 49%
  - **2004 - 2007:** 51%
  - **2007 - 2008:** 48%
Figure 39
Resources

Free Charts
You can simply plot the MACD lines and histogram on a chart. Most tools can do this with built-in functions. For detailed instructions on how to use a free tool, see http://www.backtestingreport.com/MACD_on_BestFreeCharts.pdf.

FreeStockCharts.com - free interactive charts made with BATS real-time data

Yahoo.com – free, online stock charts made with CSI Data for historical charts

Automated Scans for MACD Divergences
To save yourself hundreds of hours searching for MACD Divergences, check out the BackTesting Report custom scans for MACD Divergences. Check out BackTesting Report’s package of TradeStation (TS) strategies and functions which highlight MACD Divergences on a chart. The TS strategies generate MACD Divergence buy and sell signals that can be used (at your own risk), with either the TS automated trade execution, the backtesting engine, the scanner, the RadarScreen®, or simply to see the strategy trades highlighted on the chart.

For more information visit: http://backtestingblog.com/code/macd-divergences/

Figure 40 - TradeStation screenshot of the MACD Divergence strategy and RadarScreen
Understanding Technical Indicators Made Easy with BackTesting Report

BTR1: Baseline (Free Bonus Report)

Buying New Trends Series

BTR2: Trading Above the Moving Averages: Shows you when it made sense to wait for a market ripe for buying by highlighting which MAs worked and which didn’t.

BTR3: Price Crossing the MA: Learn simple ways to trigger an objective buy signal on a rising trend

BTR4: Moving Average Crossovers
Tests out the buy signals from this classic strategy. Plus a free bonus!

Best of Moving Average Buy Signals, comparing the best signals from previous reports plus introducing a new strategy with promising results, especially for swing traders. This bonus is exclusively for BackTesting Report package customers. All four moving average issues are zipped into one download.

Custom Strategies and Scans

EasyLanguage® for TradeStation enables you to scan the markets for opportunities to use the strategies tested by BackTesting Report. Mark charts with the buy and sell signals taken by the most promising strategies. TradeStation strategies also support RadarScreen to scan a symbol list in real time. For example, you can save hours each day in identifying the elusive and powerful MACD divergences on US stocks.
THE TRUTH ABOUT MACD

WHAT WORKED, WHAT DIDN’T WORK AND HOW TO AVOID THE MISTAKES EVEN EXPERTS MAKE

BTR5: Anticipating the Cross with MACD Buy Signals  Get-started guide explains the moving parts of the MACD, clearing up the mysteries of the multiple histograms.  Pits MACD lines versus histograms to choose an entry signal.  Popular parameter settings covered as well.

BTR6: Catching the Wiggles with MACD Sell Signals  Backtests basic MACD signals - buys and sells - seeking the ways to capture profits from usual end-of-day action in the stock market.

BTR7: Missing Link Between MAs and MACD  See how the 12/26 moving average crossover compares.  This moving average combination is singled out because it forms the basis of the MACD.

BTR8: Finding Big Bottoms with MACD Divergences  Get a handle on divergences between indicator and price.  Explore the combination of MACD bullish divergences as buy signals and MACD bearish divergences as sell signals.
Related Reading
The author’s current reading list is posted at http://backtestingblog.com/order/books/

Bibliography


Videos
http://truthaboutmacd.com – free video on MACD technical indicator and in-depth video course

Software
MACD Divergence Detectors – scanners to automatically find several kinds of MACD divergence, see backtestingblog.com/code/macd-divergences/

TradeStation® – the backtesting engine used in this report, see tradestation.com

Web Sites
BackTestingBlog.com – background information on backtesting, including glossary

Divergence-Alerts.com – daily alerts on MACD Divergences in stocks, ETFs and futures. Also tracks an ETF rotation investment strategy.
Disclaimer

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