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About the MTA Journal

Description of the MTA Journal

The Market Technicians Association Journal is published by the Market Technicians Association, Inc., One World Trade Center, Suite 4447, New York, NY 10048. Its purpose is to promote the investigation and analysis of the price and volume activities of the world’s financial markets. The MTA Journal is distributed to individuals (both academic and practitioner) and libraries in the United States, Canada, Europe and several other countries. The MTA Journal is copyrighted by the Market Technicians Association and registered with the Library of Congress. All rights are reserved.

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Member and Affiliate Information

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MTA JOURNAL • Summer - Fall 1997
An All-Star Team of Referees

Behind the scenes at the Market Technicians Association toil a talented group of technicians who devote numerous hours to scrutinizing articles submitted for publication. As a result of their presence and their critical comments that lead to revisions by most authors, and rejection in a few instances, the MTA Journal is able to claim the elite distinction as a "refereed journal." The purpose of this Editorial Commentary is to draw attention to these referees, whose efforts raise the professional stature of the Market Technicians Association and the professional stature of all technicians who possess the Chartered Market Technician (CMT) designation.

In any issue of the Journal, the central players are the authors. The Journal staff seeks to put together a team from five to seven authors for each issue. We want a balanced team of authors who have researched different topics in technical analysis. Not only must the quality of the content – the ideas, the research methodology, the soundness of conclusions and the relevance of the topics be of the highest quality to be accepted for publication, but also the clarity and the quality of the English used in articles must meet certain standards of clarity, syntax, grammar, punctuation and so on.

It is largely the referees of the Journal who make certain that standards of high-quality technical analysis are upheld, indeed continually raised, and that the rules of good English communication are followed. As a consequence, the referees may cause an author to undertake more than one revision of his/her article before allowing it to be published. Although the process is at times arduous and frustrating, the authors who undertake the revisions are almost invariably pleased with the improvement of their articles. They are proud to present their papers to peers, clients and superiors.

The referees are chosen to provide the Journal with talent in a variety of topic areas. For instance, if an article deals with oscillators and short-term trading, it may go to Connie Brown, CMT, who is an accomplished author as well as a trader. Or, if an article has a complex methodology or makes extensive use of a computer, few technicians around are as skillful and attentive to detail as John Carder, CMT. Then there are several referees who provide the Journal with depth in investment strategy as well as technical analysis, namely such levelheaded veterans as Ann Cody, CFA, David Upshaw, CFA, CMT and Don Dillistone, CFA, CMT. The aforementioned reviewers are all demanding. The special talents of Charles Kirkpatrick, CMT lie in detecting rubbish and casting a sound English sentence. Charlie is prized by the Editor for his toughness and thoroughness in English communication. Also, there are the two ex-editors of the MTA Journal, namely John McGinley and Michael Moody, CMT, whose judgment on technical analysis matters are particularly valued. Then there are the two "Ph.D.'s," Dr. Richard Orr and Dr. Robert Webb. It should be noted that Dr. Orr once headed a department of mathematics at a university and so, of course, he is an invaluable referee when the quantitative elements of an article are key. Over the years, Dr. Orr has been very generous with his time. Dr. Webb, in his capacity as a university professor, often serves as a model of how to properly do a review and uphold high standards. Ken Tower, CMT is the newest member of the referee team and will be a valuable help with point and figure.

As the Journal's work load expands, new faces will be added to this all-star staff of Manuscript Reviewers. We salute them all for their outstanding contributions to the discipline to technical analysis.
A Practical Application of Alpha and Beta to Portfolio Construction

Robert B. Peirce

Introduction

Alpha and Beta are products of Modern Portfolio Theory, which has been around for forty years or more. Early on, somebody developed a calculation to illustrate Alpha and Beta, and since then, the concept has been so closely associated with the calculation that most people have forgotten that the calculation is no more than a way to illustrate the concept. The calculation is not the concept.

Conceptually, Beta is a measure of how volatile a stock is compared to a universe and Alpha is a measure of how well the stock has performed after removing the effect of Beta. In other words, the Alpha of a stock is a form of volatility adjusted Relative Strength (RS). No matter how you calculate Alpha and Beta, this basic concept remains unchanged.

While technicians have used various RS techniques for years, they have always been faced with a serious weakness in the approach. There is a decided tendency for strong stocks to be among the more volatile at cyclical market tops and among the less volatile at cyclical market bottoms, precisely the opposite of what one would wish. Nevertheless, almost every test ever performed indicates the approach works to a greater or lesser extent. All it needs is a way to get around the volatility problem to become one of the best selection techniques available.

If one could break the RS of a stock into its Alpha and Beta components, one could solve the problem that has confronted the RS approach since its inception. However, the calculations are considerably different. Without getting too specific at this point, RS is a calculation of the rate of change of a stock's price over a period of time compared to a similar calculation for a universe of stocks. The time period is usually a couple of months to a couple of years. Alpha and Beta, on the other hand, have always been calculated through a statistical technique called regression analysis, performed on quarterly or annual data for the previous five to ten years! While this calculation may be terribly interesting to academics, it offers little of value to the practicing technician.

This paper describes a Beta Adjusted RS Technique, the basic mathematics of which have been in use, without change, since 1970. The technique is a variant of RS, but it allows the practitioner to construct portfolios to meet certain Beta requirements while maintaining positive Alphas for superior, risk adjusted results, and perhaps most important, it works in a one- to two-year timeframe.

To demonstrate that above average results may be achieved, the paper uses a real-time, ongoing test, begun in 1977, when the technique was first moved to a microcomputer. The paper then explores a series of historical tests designed to fine-tune the application and closes with a discussion of some of the ways the method has been used over the years.

Philosophy

Each person setting out to develop a new technical analysis technique has a philosophy to his approach. It may not be conscious, but it is there. You should know mine.

I use an a priori approach. I begin with my understanding of how the market operates and what I want to examine. Then I consider what data will best illustrate this factor. Finally I decide how I am going to analyze these data. This is all done prior to actually looking at the data.

I develop an hypothesis and a method to test it. If the hypothesis tests out, I accept it as tested. If it doesn't, I reject it. I never optimize after the fact or look to see if a different value might have made it work because, in my opinion, all optimization does is show you what worked best during the test period. It says nothing about what will work best from here on out.

This approach also allows me to use simple methods. My early work was done on slide rules, not digital computers, and I have a great appreciation for small, simple numbers. For example, it think an intermediate-term moving average makes sense, I will select 39 days because that is an exponential smoothing factor [2/(n+1)] of 0.05. It may be that the optimum value to use during the test period is 40 days (0.048780488) or 33 days (0.05882529), but who knows what will be optimum tomorrow?

The most important aspect of this philosophy is if you properly understand the process, and your hypothesis is confirmed, you can be reasonably sure it has a chance to work in the future. It may not work best, but it will work. On the other hand, if you carefully fine-tune a technique for its maximum return during the test period, substituting different values or factors to make it work, there is absolutely nothing to indicate whether it will work at all tomorrow. In the final analysis, getting the job done in a workable manner is usually more important than striving for ultimate elegance.

I believe one of the reasons RS works is that everybody's technique is slightly different and everybody's universe is slightly different. My universe happens to be the S&P 500 Stock Index plus another 100 stocks consisting of Pittsburgh companies and stocks I find interesting. Somebody else might use the Russell 1000, 2000, 3000 or the Wilshire 5000 or every stock traded on the New York and American Stock Exchanges and on Nasdaq, probably 10,000 stocks in all. Each universe coupled with each technique will provide slightly different rankings.

Another factor is that RS is a probability approach. If you take cash and buy the 20 strongest stocks, some small fraction will quickly lose rank and be replaced, another small fraction will do very well and the balance will be slightly above average market performers. When you look at the original list and the final result, there is nothing to suggest which would be the big winners and which the big losers. Consequently, the technique is not useful for the individual investor who can only buy a couple of stocks. The technique works best with portfolios of 15-25 stocks or so. However, such portfolios are usually professionally managed by people who became portfolio managers after long stints as security analysts. In other words, almost all portfolio managers are, at heart, stock pickers, and RS invalidates their world view. Therefore, a key reason RS continues to work is that the vast majority of people who could really benefit from using it would never consider doing so.

I also try to think about the big picture, and that is why RS is so exciting. RS, broadly defined, is probably the most used techni-
cal tool for comparing time series. A comparison of the performance of one stock to another, or to its industry or to a market index, is the most common use. However, the comparison of the performance of the Dollar to the Yen or to currencies in general also is a form of RS, as is the performance of May Wheat to December Wheat (spread analysis). Finally, what do we really mean when we say the A/D line has failed to confirm a new high in the S&P? We mean the A/D line is weaker than the S&P. I stress this because I want you to think broadly about these techniques and how they can be applied in technical analysis. The possibilities go well beyond the question of how IBM is doing versus the S&P.

Definitions

I am not going to attempt to cover all the definitions, just the ones I use and a few of historical importance. You may take it as a given, where RS is concerned, there are as many possible definitions as there are practitioners.

All my work is based on total return prices, price adjusted for dividends and other distributions. While I will try to use the phrase "total return price," price alone will mean the same thing. Likewise, universe refers to the selection universe and not to the total universe of all common stocks.

My definition of RS is the week-to-week rate of change of a 99-week (0.02 smoothing) moving average of the total return price of a stock compared to the same number for the other stocks in the universe and to the average for all stocks in the universe. A number greater than the average indicates the stock has been stronger than the universe. A number less than the average indicates it has been weaker.

The rank of the calculated number for all stocks in the universe, sorted from most positive to most negative, indicates the relative position of each stock in the universe. I prefer to use percentile ranks with 1 indicating the strongest RS or Alpha and the highest Beta, and 100 indicating the weakest RS or Alpha and the lowest Beta. One could just as easily do it the other way around. It is a matter of convention, but for me, it makes more sense to think of the "top quartile" as running from 1 to 25.

According to the quantitative academic definition, Alpha and Beta are the y-intercept and slope of a straight line fitted by the least squares method to a series of x-y pairs, where y is the performance of the dependent variable, usually a stock or a portfolio, and x is the corresponding performance of an independent variable, usually an index such as the S&P 500 Stock Index. The comparison is usually done for calendar quarters or years, and one generally wants at least ten pairs to lend some statistical validity. (Chart 3, which will be discussed later, shows the form this work usually takes).

The classic calculation of Alpha and Beta is not very practical for real-time application, and it obscures the qualitative possibilities. Therefore, I dropped the math and used the concept to develop a technique which retains the qualitative aspects in a way that is useful for a practicing technician or portfolio manager.

My calculation for Beta takes into account the fact that positive percentage changes do not offset equal negative percentage changes. For example, a 50% decline requires a 100% advance to break even. Therefore, I look at the total return price for this week and last and calculate the percentage change from the low price to the high price. For any given stock, the percentage change could be based on this week divided by last week or last week divided by this week. This avoids any bias between a stock in a cyclical decline and another stock in a cyclical advance. If the percentage change from low price to high is the same, their Beta will be the same.

I define Beta to be a 39-week (0.05 smoothing) moving average of the weekly percentage change for each stock and I average these numbers for the universe. This permits the same kinds of comparison for Beta as for RS, with a rank of 1 being the highest Beta and a rank of 100 being the lowest. I use 39 weeks instead of 99 weeks because I believe Beta should be somewhat more stable than RS and Alpha, and I want to be a more sensitive to changes. Earlier I said that Alpha was volatility (Beta) adjusted RS. Therefore, the calculation for Alpha is just RS/Beta. This number is calculated for each stock and averaged for the universe leading to the same comparisons as for RS and Beta. A rank of 1 is the strongest Alpha and a rank of 100 is the weakest.

Selection Methods

There are two basic approaches to using RS, and therefore, Alpha. One technique (upgrading) is to buy the strongest stocks and to continually upgrade your portfolio by selecting the new strong stocks and using them to replace the weakest stocks in the portfolio. The other technique (replacement) is to wait for a holding to reach a certain relative level; e.g., weaker than the universe, at which point it is replaced by the currently strongest stock(s).

Each technique has its advocates, and not surprisingly, based on what I said above, both work. However, I prefer the replacement method and that is the method I have used in all the studies we will be reviewing. You need to be aware of that because these results would be different using the upgrade approach, and I have no way to say exactly how they would be different.

My choice of replacement, as with everything else, was a priori. I deal with individual clients for whom turnover is always an important consideration. First of all, they do not like a lot of turnover, and secondly, turnover costs them more than it costs an institutional account. Replacement leads to significantly lower turnover because I continue to hold stocks which I would not currently buy. This leads to comfortable and happy clients who are getting good results without a lot of stress. Maybe they could do better by upgrading, or maybe not. It doesn’t matter. The key is to make money for them and to keep them happy. It does no good to produce extraordinary results if you have frightened the client so much that he is no longer there to enjoy them.

The Real-Time Study

My first position after college was with the B&O Railroad, which was part of the C&O Railway, now CSX Corp. In 1968 I moved to the C&O Finance Department, where I began my early work in RS, Alpha and Beta. I used a Texas Instruments Programmable Calculator to track about 25 stocks.

I moved to C. S. McKee, in Pittsburgh, in late 1970. Over the next couple of years I began to follow several thousand stocks using a mainframe computer. I used the output for an institutional product called Portfolio Assistance in Strategy and Selection. In 1975, McKee made the decision to leave the brokerage business and to become a full-time investment management concern. The same basic technique was applied to this task.

The first microcomputers became available around 1975 and McKee purchased one of the first machines to offer a floppy disk based operating system. I began to track about 300 stocks on this machine, and after shaking down the programs, I began the study.

If I were starting this study today I would make certain methodological changes. However, once it was running, it was more important not to change anything. I used a very simple set of
rules. Begin by buying all stocks with *Alpha* ranks of 20 or less. Each month, sell any stock whose rank has dropped to 40 or higher and buy any stock not currently held whose rank had improved to 20 or less. Rebalance to equal weights.

The key weaknesses in this methodology were that all purchases and sales were made at the end of the month, but the data did not become available until later. Furthermore, slippage and commissions were ignored. Of course, the problem of handling these three factors was compounded by only doing the study once a month. My recent historical studies address these points. Another problem was that the model, especially in recent years, often held 150 stocks or more. To some extent, this over-diversification offset the other three problems, but it leaves the question of whether smaller portfolios would have done better or worse. The model also ignored industry group concentration, which my current studies address.

Chart 1 shows the results of this study over the first 18 years. The important things to note are that the technique, as evaluated, certainly outperformed the universe from which it was selected. The gross return was 18.1%/year, while the ratio line (relative performance) returned 7%/year. Another insight, which only became clear in recent years, was the degree to which the performance of selected stocks. This has led to two current practices.

- Make the universe look as much like my bogey as possible.
- Limit database changes to no more than one a week on average.

The universe returned 10.4%/year. During the same period, the Capital Weighted S&P returned 15.5%/year. If the S&P was your bogey, it did not help to give up five percentage points/year going in! Therefore, while you may follow any number of stocks, use a comparison base that looks as much like your bogey as possible. Keep in mind, here, that if your typical portfolio is less than several billion dollars, your bogey cannot be the Capital Weighted S&P, because you cannot capital weight small portfolios. We use the Equal Weighted S&P for that reason. Our version is based on an average of the weekly total return percentage change in the 500 stocks that make up the index.

Database changes are more subtle. There are periods when the technique will underperform just because nothing is perfect. However, it also is quite clear that some periods of underperformance occur immediately after large database changes. This makes sense if you think about it. After all, this is a relative approach. If the universe you are relating to becomes radically different, it will take a while to lock into the new base. Therefore, avoid shooting yourself in the foot and keep changes to the minimum possible. In my case, that pretty much means tracking S&P changes and the occasional merger replacement.

An interesting question is: How did the *Alpha* approach compare to the underlying RS technique? I found it did one percent point/year better. That isn't much. Of course, compounding does add up and over 18 years, $1000 invested using *Alpha*, grew to $19,876, while only growing to $17,228 using RS. Still, if it were not for some unique possibilities provided by this approach, that might not be enough to recommend it over straight RS.

The Historical Study

The unique thing about the *Alpha/Beta* approach is that it allows you to build portfolios to meet different client needs. At Cookson, Peirce and Co., we have Conservative clients who only own stocks selected from the bottom 1/3 *Beta* ranks, Moderate clients who own stocks selected from the bottom 2/3 and Aggressive clients who own stocks selected from the top 2/3 *Beta* ranks. Of course, with this degree of overlap, it is not surprising that performance among these styles does not vary by very much, but that is intentional. The technique is sufficiently flexible to allow a wide degree of variation among styles where that is important. In our case, even the Aggressive clients are pretty conservative.

In 1994, with 16 full years of history from my ongoing study, I undertook to obtain weekly historic total return data on about 700 common stocks. I ran the stocks through my analysis and tested what happened when I built portfolios using my actual rules.

My portfolio rules are fairly simple. The above *Beta* rules apply. The portfolios are targeted to hold about twenty stocks. I use the replacement method on a weekly basis, selling stocks which become weaker than the market (*Alpha* > 50) to buy currently strong stocks. No other rebalancing is done. Profits are allowed to run. However, no more than 5% of assets may be invested in one stock at the time of purchase, and no more than 90% of assets may be invested in one industry at time of purchase. (I break my stocks down into 28 industry groups). Industry selection is limited to those groups with *Alpha* ranks of 25-50.

On the surface you would think it would make the most sense to buy the strongest groups. However, the only way for a group to be strongest is for just about everything in it to be strong, including the laggards. This is too late. Ideally, what every-
body would like is the weakest group or stock that is about to become the strongest. Unfortunately, all my tests indicate that the bottom half of Alpha must be avoided. Certainly, future leaders come from there, but it is like buying a cheap stock. Nobody can be sure when (or if) it will become dear.

If the bottom half is no good and the top quartile is no good, the only thing left is the second quartile, and it has worked just fine. Note, however, that nothing in my tests indicated any advantage to how a group got into the second quartile. Weakening or strengthening seems to work equally well. I believe this is the case because a strong group, when consolidating, may weaken enough to drop it into the second quartile at close to the point where it is about to resume its superior performance.

For testing purposes, I assumed that all trades would take place one week after action was indicated. In today's equity markets, slippage swamps commissions and slippage is unpredictable. Waiting one full week to take action seemed like an excellent way to handle all the possibilities that might occur, but I also included a round trip 0.5% commission.

In Chart 2, I repeat the top clip from Chart 1 and add similar charts for the three styles under review. Table 1 provides the test portfolio values at the end of each year. While the real-time study began at the end of 1977, the historic study began at the end of 1972. Thus, it ran for 21 years.

The first thing to note is that real portfolios, even Conservative portfolios, did better than our original study and Aggressive did much better. The universe for this test was stable, but there still were periods of a year or longer when the selections underperformed the universe. Conservative, in particular, underperformed slightly during the high beta, small stock market of 1974-1978. This was masked by the generally upward trend, but it happened.

Chart 3 provides a standard quantitative Alpha/Beta analysis of all four portfolios, which I use to test the validity of the qualitative concept. Note that all portfolios had positive Alphas and the Betas were in the right direction, with Aggressive over 1.0 and Conservative under 1.0. Moderate was exactly 1.0, but it may have hit that by chance. However, the important thing is the direction. In view of the above-average returns in the original study, I believe there is an excellent chance this technique will continue to produce positive Alphas, and appropriate Betas.

A third variable, $r^2$, measures how closely the data fit the line. 1.0 would be a perfect fit, with every data point falling exactly on the line, while 0.0 would be completely random. It is a rough measure of how much of the performance in the portfolio is explained by the performance of the universe. It is not surprising that the original study, with large numbers of stocks, tracks its universe better than the smaller portfolios.

What one desires for $r^2$ depends on what one is trying to accomplish. An index fund should be 1.0, while the perfect timer-selector might approach 0.0, meaning nothing in the underlying market can
explain the performance; it is independent of the market. These portfolio values of around 0.7 indicate about 70% of the results can be attributed to the market, which means 30% cannot. In my opinion, this is desirable since clients do not like to see results that are too far out of gear with what is going on in the market. It makes them uncomfortable.

Other Applications

Although these techniques are not generally applicable to selecting an individual stock, there is one situation where it can be done. Originally, I used the technique to identify the time to buy a cheap stock. It is fairly easy to identify cheap stocks. It is a good deal more difficult to determine when they are going to become dear. The Beta Adjusted RS technique will indicate that interest is developing in a stock.

Unfortunately, there is no good way to determine when a stock is too dear. Consequently, these techniques are even more useful to decide when to sell. As long as the stock maintains an Alpha in the top half, hang onto it. Sell it as soon as it becomes weaker than your universe and replace it with something from the top quartile of Alpha.

As time went on, I discovered that looking for cheap stocks did not help results. The technique works just as well, perhaps even better, when used without other inputs. However, currently I am experimenting with adding Point & Figure analysis in two ways. One is to identify apparently equal stocks where one is closer to its base and has more upside potential. The other is to avoid buying stocks on spikes, a not uncommon problem with all RS techniques. Since it takes at least a full market cycle to test something like this, there are no firm conclusions to report, but so far, it looks like avoiding spikes works better than buying break-outs.

For really large portfolios, which can actually capital weight, the techniques I used at C.S. McKee in our Portfolio Assistance in Strategy and Selection product are worth considering. Here I took the top Alpha quartile and calculated the capital weight of the stocks within their groups. This produced a group strategy which was highly effective. At the time, it was still difficult to get institutional portfolio performance, but I could get portfolios and estimate performance. I found that those portfolios which most closely matched the recommended strategy were getting clearly superior results while those which matched the least were clearly lagging behind. The only thing I could not tell for sure was by how much.

If a client has a small portfolio but insists that it be compared to the Capital Weighted S&P, it is worth noting that the 50 largest stocks in the 500 account for about 50% of the total weight. The top quartile of Alpha among the Nifty fifty will account for 30-40% of the total weight of the S&P when the S&P is strong, as in recent years. Restricting selection to this group will greatly improve the chances of outperforming the Capital Weighted S&P.

These techniques may also be applied to mutual funds. I have tracked a number of funds on a weekly basis for years and I am currently in the process of building a fund product around the same kind of techniques I use with individual stocks. There was one peculiarity of which you need to be aware. When I built test portfolios using funds, I was not happy with the results. At a loss as to why a technique that has worked so well with stocks was failing with funds, I examined the actual returns of the funds I was using. I found that my models were actually hitting consistently in the top 10% of the funds we were testing. However, the funds,
as we all know, were not doing very well compared to the S&P and other popular indices. Once again, the universe is key to producing the desired, superior results.

Further Reading

Most of the historical material that relates to this work appeared in the market letters of George Chestnut and Sedge Coppock. One important book, The Relative Strength Concept of Common Stock Price Forecasting, written by Robert Levy and published by Investors Intelligence, Larchmont, NY, is well worth tracking down, because it was the first work I saw that explored the replacement method in some depth. Chestnut and Coppock tended to prefer upgrading. Within the past few years, Art Merrill alluded to the possibility of using Beta Adjusted Relative Strength but I do not know how much research he has done in this area.

Robert B. Peirce

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Introduction

Moving averages (MA) have been used for years by technicians for data smoothing, and in various trading systems because of their calculation simplicity. Investors know prices vary greatly, and will easily embrace anything that seems to simplify the confusing patterns raw prices sometimes produce. Many use moving averages in place of, or together with, other studies, such as trendlines. It is the contention of this paper that moving averages are often overused, can be inappropriately applied, and most importantly, provide at least one overriding problem not hitherto effectively overcome, a problem this paper will address.

Consider: in one market a 10-day average might be a propos, but in the next, a 21-day might be better, as one market might be faster or slower than another. Most moving averages are fixed in length and never change, a senseless restriction that hamstringsthe user and that frequently leads to inaccurate smoothing and possibly erroneous conclusions. To adjust a moving average to its best length is a time-consuming exercise demanding extensive trial and error; not to mention the programming changes required. Better would be a type of moving average that adapts itself automatically to the situation, speeding up when the market accelerates and slowing down when the market decelerates.

This paper will profile the representative types of moving averages, detail their benefits and shortcomings, and finally provide an effective new solution to the problems raised: the McGinley Dynamics.

Moving Average Background, Calculation, and Benefits

There are numerous ways to calculate a moving average. There are also very sophisticated replacements for it, such as various types of weighted, exponential, power fits, up to even the Savitsky-Golay calculation. Each has its good and bad points. We will touch on several other techniques as we go along. A relatively simple calculation will be found to solve a number of the problems previously identified.

The basic moving average calculation simply totals the last \( x \) days’ data and divides by \( x \). There are many common lengths of moving average. One sees 10, 21, & 200-day averages, to mention only a few. In their periodic writings, for example, analysts such as Tillman, Crawford, and Prechter among others, have proposed well-considered arguments for utilizing the length of the lunar cycle, with quarter, half, and doubled cycles thrown in. Many stick with standard 50, 100, 200 or other-day moving average lengths; others optimize to find the best-fitting moving average for the current data. None of these lengths are THE answer. Logically, there is no one “right” window for a moving average in all markets, at all times; markets can and do vary between fast and slow, requiring moving averages of different lengths to track the data. Personal preferences also come into play; some want to track the data more closely than others.

Most importantly, and oft forgotten in people’s use of a moving average, is just exactly what it was created to do. A moving average is not a trading system, a magic wand, or a signal giver. It is nothing more than a mathematical smoothing mechanism and a very simple one at that. When data are highly volatile, a moving average can often “tame” its gyrations and expose a trend that might otherwise not be evident. Attempts to make more of a moving average than this forget its basic raison d’être.

A feature of the moving average calculation is its ability to rise in the face of a falling datum; this occurs when the dropped datum \( x_1 \) days ago is much less than the new one, and the average surprisingly rises. This can be good or bad, for the moving average either whipsaws about the data badly, or on the other hand it smooths/filters outlying data that may appear ominous but that in reality are not. We will shortly see how the McGinley Dynamics makes use of this ability.

The moving average is used in other mathematical calculations. While the calculation details are not important, examples are the standard deviation of which it is a part, and John Bollinger’s Bands, set two standard deviations above and below the moving average. Percent bands above and below the MA, as used by Gerald Appel, are along the same idea, they are although calculated differently. All of these calculations anchor themselves to the moving average running through the raw data.

Moving Average Problems

The simple moving average has several well-known problems. First, it is always out of date by half its length; e.g. in a 10-day moving average, the average is that of 5 days ago and much of importance may have happened since. Practically, the moving average is usually placed/graphed incorrectly - at the end of the period, i.e. in the example, on the 10th day. Technically, while rarely done, to describe the data properly, it should be plotted at the 5th day, i.e. five days ago.

A real problem is that of the large dropoff. The reverse of the above, a new data item at the same level as the current, say ten-day, moving average would be expected not to alter it. However, if the data item being dropped \( x_1 \) days ago is much larger than the present average reading, the moving average will inexplicably drop in the face of flat new data. This could cause the unwary to draw incorrect conclusions about what is happening.

Yet another problem is all the data one must remember/keep. In this day of computerization it is not as great a problem as in the day of pen and pencil; nevertheless, the computer code changes required, if one wishes to alter the length of the moving average frequently, are complicated and time intensive.

It is my feeling, however, that the moving average’s major problem is its fixed length. In a market that suddenly becomes fast rising, the market frequently far outruns the moving average. Notice how in chart A (see over), circa September 1984, the length of the double-headed arrow indicates how much the price has outrun the moving average. (Note as well how the average goes into the middle of the consolidation area, indicated by the arrow at the right, an additional problem we will deal with later.) If the market suddenly turns down, the market must fall a long way before it finally contacts the slow moving average. This does the technician no service, as it does not describe the fast-moving data.
The Exponential and Other Moving Averages

The exponential moving average (EMA) improves on the simple moving average. It requires only two pieces of data: the previous average and the current datum. The classic calculation is $A \times (9 + \text{times})$ the previous MA $+ B \times$ the new datum, where $A + B = 1.0$. Usually a small part of the new datum is added to a large piece of the old average. For instance, in an 18% exponential, $A = 0.82$ and $B = 0.18$. To relate that to the "real" world – the normal moving average – one uses the equation $B = 2 / (x + 1)$. In other words, a 18% exponential ($x = 10$) hugs the data about as closely as does a 10 day MA ($2 / [10 + 1] = .18$). The shape of the exponential is different because of the calculation; note in chart B the sharp angles as opposed to the more smooth normal moving average in chart A. Also, and importantly, it is much quicker to adjust to changing data. The length of the double-headed arrow is shorter because the exponential catches up to the data more quickly. Note, too, how it also gets detrimentally involved in the consolidation at the right.

An exponential, unlike the normal MA, cannot rise in the face of falling data, and vice versa. The exponential goes up and down in concert with the index it smooths. In some applications this is good. How fast it reacts to changes in the index it smooths is dependent upon the size of $B$. Too large and it moves too quickly; too small and it moves not swiftly enough. Again, some fitting is required to make it reflect the current situation. Certainly, it is much easier to adjust $B$ mathematically than it is to adjust $x$ in the simple moving average.

But note: if you “adjust” it well, it may fit today’s data; but it most likely will not fit next year’s, etc. Because it is fixed, it cannot adjust itself to the changing market, to the changing circumstance. This not withstanding, most people still fix $x$ in stone. But the lengths of stock market cycles are not fixed in stone.

the Solution: The McGinley Dynamic

The calculation I propose meets all of the above criteria. It uses the rough format of Lloyd’s Modified Moving Average in that we modify the previous Dynamic (the first term) to come up with the current one; i.e. the second term of the equation is added to the first. The equation:

$$\text{New Dynamic} = \text{Dynamic}_r + (\text{Index-Dynamic}_r) / (N^4(\text{Index-Dynamic}_r)^3)$$

Here the Index might be the Dow, the S&P or a stock. By way of explanation, we’re dividing the difference between the Dynamic and the index by N times the ratio of the two. The numerator difference gives us a sign, up or down, and the denominator keeps us percentage-wise within bounds defined by N. The 4th power

Criteria for an Improved Smoothing Technique

In the ideal world, I submit the best smoothing technique would touch most of the following bases:

1. It would get whipsawed infrequently. It would stay on the "right" side of all moves of any real meaning. This certainly leaves much open to interpretation, but intentionally so. The user should have the ability to create his own definition, about which more is discussed below. Adjustment to circumstances is a minimum requirement.

2. It would "hug" the index as closely as desired, a corollary to the above. This presumes the calculation would be adjustable to your taste, i.e. if you like a 10-day MA, you could emulate its "closeness."

3. Most importantly, when the index slows, the average should also slow, and vice versa. When the index enters a trading range, ideally the average would stay out of that range as long as possible.

4. I believe a certain amount of being able to rise in the face of falling data and vice versa, similar to the moving average, is also desirable. Some might dispute that, but I believe this is in the nature of smoothing. My good friend Abe Savitsky (Savitsky-Golay, op. cit.) agrees because you need a certain degree of persistence.

5. Finally, it should be relatively easy to calculate. K.I.S.S. (Keep It Simple, Stupid). People will not adopt something that has too many Greek symbols, is too complicated, or that can be calculated only by a Cray computer, i.e. no boolean logic (ands, ors, ifs, if only, go froms, etc.).
gives the calculation an adjustment factor which increases more sharply the greater the difference between the Dynamic and the current datum. This makes the size of the adjustment — the second term — change not linearly, but logarithmically, a desirable feature, required in criteria 2.

N should be 60% of the normal moving average you are trying to emulate; e.g. to imitate a 20-day MA, use an N of 12. Refer to it as a Dynamic 12.0. From then on the Dynamic will adjust itself, speeding up or slowing down as the situation may dictate. The second term only comes into play in any meaningful way when the difference between the index and the Dynamic is relatively large. In effect this is like manually changing the length of a moving average as you go along, or changing B in the normal exponential; but here it happens automatically, dynamically.

Chart C shows how the Dynamic is an improvement over the normal moving average. You can see how in its crossing and recrossing the normal moving average it is slowing down and speeding up. Notice too how it almost avoids the whipsaw in the spring of 1984 (left arrow), but nevertheless comes out of it higher than it went in. In August it sharply moved upward (short double-headed arrow) in response to the breakout of prices. Finally, it stays out of the consolidation on the right hand third of the chart until the last moment, unlike the other methods (right arrow).

Chart D illustrates the effect of changing N from 7.0 to 12.0; it does not respond as quickly to changes in prices similar to a longer moving average, nor does it hug the data as closely; that however, might be desirable to some in certain circumstances. The Dynamic avoids whipsaws caught by the normal moving average by speeding up and slowing down appropriately, just as desired. In short, it outdoes a moving average by adapting quickly and automatically to the changing market, which is just what we’re looking for.

Benefits of The McGinley Dynamic

The benefits are legion: the Dynamic can rise in the face of falling data, similar to the normal moving average, but unlike the exponential. Additionally, as it only uses today’s datum and yesterday’s Dynamic, it avoids the “large dropoff” problem discussed above. Finally, of course, it uses only one piece of back data, unlike the normal moving average. In trending markets and in trading markets, it needs no adjusting, backtesting or optimizing because it is dynamic; it adjusts itself.

As you can see from the charts, the Dynamic avoids of most whipsaws the normal moving average gets involved in, and it rapidly moves up or down in concert with a swiftly changing market. Even in those whipsaws where it does get caught, it sells high and buys low. (It shouldn’t be used as a trading vehicle, but some inevitably will try, so we must comment.)

It must be noted the complete second term (after the plus sign) acts differently in up markets than in down markets. Fast up markets dampen (slow down) the Dynamic much less than down markets do. In down markets, the effect of the 4th power speeds up the Dynamic, making it catch up to the data faster than it does on the upside. To see this effect, use 10 for the old Dynamic, 6 for the close and use $N = 7$; you get $-6.66$. Alternatively, make the close – 14 and you get 0.15, quite a difference in as much as 14 is as far above the old Dynamic (10) as 6 is below it.

At first glance, this might be seen as a detriment. However, the rule is to let your profits run, yet be quick to jump when the market drops. This is exactly what the McGinley Dynamic does: it “babys” the market on the upside, staying far enough away to let profits run and not get whipsawed. Yet on the downside, it adjusts more quickly to any drop in order to cut losses.

Future Challenges

Down the line, we want to add the ability to include some measurement of volatility in order to crank the Dynamic up/down more effectively. A calculation less complicated than the usual standard deviation is being sought for simplicity’s sake. When the market loses volatility and enters a trading range, we want the McGinley Dynamic to stay out of the trading range as long as possible.

There are number of alternate techniques other authors have put forth to accomplish the task we have set out here. A summary is in the Appendix.

Addendum

Unfortunately it is not possible to program The McGinley Dynamics into most of the popular charting programs at present. This is because the Dynamic calculation requires “recursive” programming, i.e. the ability to utilize a calculation from yesterday in today’s calculation. Any spreadsheet can do this, but not many charting programs for reasons which I’ve had explained to me, but which, given how valuable a recursive ability could be, I find hard to understand. Most charting programs can do this only with their hard-wired functions. I, in other words, if an exponential MA had not been
hard-wired into some of these programs, you wouldn’t be able to program one in because an exponential requires recursive programming. Window on Wall Street will be able to do it when an upgrade to the next version arrives, probably in the winter of 1997-8. TechniFilter includes recursive ability in its testing module, Supercharts can do it with difficulty and TradeStation can do it easily. The current Windows 95 version of Metastock finally can now do it as well.

Footnotes
1 See detailed chapter on various moving averages in Kaufman.
2 A paper applying this calculation to the stock market by Abraham Savitzky and John McGinley is in the works. One of its most important contributions to technical analysis is the ability to calculate the first derivative of the data at a given point, something not otherwise possible at present.
3 A detailed discussion of applying a single moving average to the market may be found in Colby and Meyers. Even the "best" moving average lengths, 54 weeks and 11-12 months, were only marginally profitable after taxes and commissions.
4 An idea of Humphrey Lloyd, the "modified moving average" is a simplified version of the EMA. It does away with A and uses only B. If B is calculated properly, it will almost exactly reproduce the Exponential but with a little less math. The calculation is old average + B * new datum.
5 See Dobson for details and construction and use of Bollinger Bands.

Bibliography
Colby and Meyers, Encyclopedia of Technical Market Indicators, Dow Jones, Irwin, 1988
Dobson, Edward D., Understanding Bollinger Bands, Traders Press, 1991
Savitzky & Golay, Smoothing and Differentiation of Data by Simplified Least Squares Procedures, Analytical Chemistry, Vol. 36, July 1964

Appendix
New Directions In Smoothing Techniques
1. McGinley Dynamics ©1990
   MD = MD_1 + (DJIA - MD_1) / (N * (DJIA / MD_1))
   where: MD_1 = McGinley Dynamic yesterday
           N = 60% of equivalent MA (e.g. for 10da, use 6)
           * = multiplication
2. New McGinley Dynamics ©1994
   Same as above only final term is raised to 4th power:
   (N * (DJIA / MD_1))^4
3. Adaptive MA
   (Perry Kaufman, Smarter Trading, p.140)
   Adaptive MA (AMA) = A_1 + ((0.6022 * ER) + 0.0645) * (DJIA - AMA_1)
   where: ER (Efficiency Ratio) = Directionality / Volatility (ie., noise or choppiness)
   Directionality = gross change over period (n days)
   Volatility = sum of absolute individual changes over period (n days)
4. Metastock Variable MA
   (Equis International, T. Chande, Stocks & Commodities, 3/92)
   VMA = (T * VR * DJIA) + ((1 - T) * VR * VMA_1)
   where: VR (Volatility Ratio) = VHF / VHF_1
   VHF (Vertical Horizontal Filter) = (Highest close - Lowest close over (n) periods), divided by sum of the absolute changes in the (n) periods. (Adam White, Futures, August 1991)
   T = 2 / (N + 1) where: N = equivalent length MA
5. Variable Length MA
   (An experimental idea in Stocks & Commodities, June 1991)
   If DJIA outside 1 standard deviation, decrease n by one day.
   If DJIA outside 2 standard deviations, decrease n by 2 days.
   ...... and vice versa. But how often?
6. Choppiness Index
   (E.W. Dreiss, Futures, 10/93)
   CI = (sum of n days' True Ranges / (highest true high - lowest true low)) / log (n)
   * * * and vice versa. But how often?

John R. McGinley, Jr.

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Legend, technician Arthur Merrill began Technical Trends in 1960. John began assisting him in 1982, ultimately taking over as editor when Mr. Merrill retired in 1987, and has been keeping the flame alive ever since.

Previously, John had worked on both sides of the street, but was unable to get them together. On graduation from Harvard, he began financial training at Citibank prior to discovering the alluring charms of the stock market.

He appears periodically on CNBC and has published numerous articles on technical indicators in various media. He is the inventor of the Double Power Scale method of constructing charts and is creator of the McGinley Dynamics, a superior calculation to the moving average. Technical Trends is the unique source of several indicators; many original and some created by others, such as the Wysong Value-Weighted Put/Call Indicator, invented by Perry Wysong and their version of Richard Russell's Primary Trend Index. (www.capecod.net/techtrends)
The Gabriel Linear Regression Angle Indicator:  
A New Indicator for Intermediate-Term Trading

Terence J. Gabriel

Overview

This paper presents a new tool for market timing and intermediate-term trading, the Gabriel Linear Regression Angle Indicator (GLRA). The GLRA Indicator is based on information provided by the Linear Regression Line Function, but overcomes a weakness of that parameter of a price series when it is exclusively relied on for investment decisions. The argument which follows outlines the genesis of the GLRA Indicator, sets forth its theoretical basis, and demonstrates its effectiveness when used to trade a variety of financial instruments, including individual equities, mutual funds, and indices. Furthermore, the mathematical and programming information necessary for the calculation and graphic representation of the GLRA Indicator is provided so that other technicians can evaluate the claims made here for its effectiveness.

The Linear Regression Line

Most technical analysis software packages allow the technician to plot a linear regression line over the price action of a security, mutual fund, or index. "A linear regression trendline uses the least squares method to plot a straight line through prices so as to minimize the distance between the prices and the resulting trendline." On the assumption that a trend in motion tends to continue in motion, technical analysis can use linear regression to predict future prices from past prices. However, as the chart below demonstrates, a linear regression line is only a parameter of a price series and can, in fact, fail to represent significant sections of that series.

Linear Regression Trading Systems

One approach to trading using linear regression is the Linear Regression Channel developed by Gilbert Raff. The Raff Channel is constructed by plotting two parallel, equidistant lines above and below a Linear Regression trendline. The distance between the channel lines and the regression line is the greatest distance that any one closing price is from the regression line." In Raff's system, as the technician looks forward, the lower channel line provides support and the upper channel line constitutes resistance. When price reaches the lower band, it is a buy, and when price reaches the upper band, it is a sell. Raff assumes that if price penetrates a channel line for more than a short time, a reversal may be in progress.

It should be apparent that Raff's approach to linear regression provides nothing more than a way for the investor to organize his guesswork. How does one know what action to take when price touches the upper or lower channel line? Will prices be contained at the band limit, or will they violate that limit and begin a reversal of the trend? Furthermore, how does an investor decide what constitutes a short term penetration of the channel line, indicating the trend is intact, or a long term penetration, indicating a major reversal is underway? Waiting to resolve this uncertainty may prove costly to an investor, but so might not waiting. It is simply impossible to devise clear and effective trading rules based on Raff's concept of the Linear Regression Channel.

John Bollinger's general caution about trading bands makes plain the problem with using Raff's Linear Regression Channel idea as an independent trading tool: "Trading bands are one of the most powerful concepts available to the technically based investor, but they do not, as is commonly believed, give absolute buy and sell signals based on price touching the bands. What they do is answer the perennial question of whether prices are high or low on a relative basis. Armed with this information, an intelligent investor can make buy and sell decisions by using indicators to confirm price action."

Another approach to linear regression is that developed by
Robert Colby and Thomas Myers in their monumental The Encyclopediа of Technical Market Indicators. The authors tested Linear Regression Lines over two 9.75-year test-periods of weekly data for the NYSE Composite Index. (The first period ran from January 5, 1968 through September 30, 1977 and the second period ran from April 8, 1977 through December 31, 1986.) Their work confirmed the obvious inference: that buying and selling when price crosses the Linear Regression Line is not an effective strategy. Since the Linear Regression Line runs through the middle of a price series, such a strategy precludes buying and selling at price extremes or even at relatively advantageous prices.

Having rejected as ineffective the strategy of buying and selling when price crosses the Linear Regression Line, Colby and Myers adopted the alternative strategy of using the direction of the Linear Regression Line (rising is bullish, falling is bearish). The only variable they optimized was n, the number of time periods (weeks) that went into their calculations. Testing Linear Regression Lines from 50 to 80 weeks, the authors found that the 66-week line gave the best result when applied to the NYSE composite over the 19-year period studied. Total profit of 127.39 NYSE points was well above the "40-week simple moving average crossover rule standard of comparison" they used for all of their indicator studies throughout the Encyclopedia. There were 57 trades of which 25, or 44%, were profitable.

While Colby and Myers regard their linear regression strategy as relatively successful, it appears that their approach, like Raff's, has its deficiencies. The problem is that by the time something as ponderous as a 66-week Linear Regression Line changes direction, profits will be either seriously eroded or lost, since the trading signal will be late. In effect, the same objection that Colby and Myers found to buying and selling when price crosses the Linear Regression Line holds for their strategy of acting on gross shifts in the direction of the line. See Charts 3 and 4 below.

**Chart 3**

66-Week Linear Regression Line
Cirrus Logic (NASDAQ: CRUS)

Cirrus hit an intraweek low of $10.5 the week of 12/23/94 and rocketed to a close of $27.50 on 5/23/95 when the slope of the 66-week linear regression line shifted to positive. Thus, the opportunity cost of waiting for the slope to change direction (the Colby and Myers strategy) was $17.00 a share.

**Chart 4**

66-Week Linear Regression Line
Cirrus Logic (NASDAQ: CRUS)

CRUS hit an intraweek high of $61.125 the week of 9/12/95 and collapsed to a close of $28.00 on 12/11/95 though the slope of the 66-week linear regression line remained strongly positive.

One might, of course, depending on the individual equity or index being traded, employ several different Linear Regression Lines, some perhaps significantly shorter than 66 weeks. But then one would be called upon to determine which Linear Regression Line to act on. Nor would such a maneuver be sufficient to rectify the basic flaw in the linear regression strategy advocated by Colby and Myers, as the legend beneath Chart 5 makes clear.

**Chart 5**

66, 45, And 20-Week Linear Regression Lines
Caeere (NASDAQ: CAER)

Notice that all 3 linear regression lines are strongly positive, failing to warn of an impending decline which will carry the stock below $10.00 by May 93.

The essential problem with the trading rule employed by Colby and Myers is that it takes account only of whether the Linear Regression Line has turned up or down, ignoring the more critical matter of changes in the acuteness of the angle of ascent or descent. If the regression line of prices is rising at a 50 degree angle, a decline in the angle of ascent to 40 or 30 degrees signals a significant waning of momentum and should be acted on. The investor who waits for the angle to turn negative (the line to turn down) would be late and would sacrifice too many points.

It is necessary to acknowledge that part of the difficulty with the efforts of both Raff and Colby and Myers is inherent in the
Linear Regression Line itself. The problem is that linear regression, at least as heretofore conceived, has no way of signaling what to the technician is the most vital information: a change in both the direction and momentum of that trend. More specifically, the deficiency of linear regression is that, unlike MACD or Stochastics, it does not provide a signal line, the crossing of which indicates a violation of the established trend, that is, a breakdown or breakout. It is this particular deficiency that I have attempted to remedy in this paper.

**GLRA Hypothesis**

Because the Linear Regression Line itself provides the technician with little help in making timely and reliable buy and sell decisions, the focus of my thinking shifted from the Linear Regression Line and the price series through which it is drawn to the Linear Regression Angle and a moving average of prices. I theorized that, if an investor could not afford to wait for gross shifts in the direction of the Linear Regression Line, perhaps a more effective signal could be generated by taking account of incremental changes in the angle of the Linear Regression Slope. And indeed, this shift in focus led to the central hypothesis of this paper that a new technical indicator could be constructed incorporating a moving average of the Linear Regression Angles of a moving average of prices. Investigations conducted with this hypothesis in mind and utilizing the programming capabilities of Omega Research’s Super Charts 2.1 led to the development of what, I believe, is a new and valuable addition to the arsenal of technical analysis: the Gabriel Linear Regression Angle Indicator (GLRA).

**Theory**

The theory on which the GLRA is based has its roots in calculus. Technical Analysis utilizes moving averages which are a function of price and time. Typical applications include using the moving average as support and resistance or comparing the current price to the moving average or examining moving average crossovers as harbingers of future price action. However, one extremely important characteristic of a moving average, often overlooked, is its slope or angle of ascent or descent. The slope of a line measures the inclination of the line relative to the positive x-axis. It is equal to the change along the vertical axis divided by the change along the horizontal axis. Slope can be positive, negative, or 0. It should be stressed that having a slope of 0 and having no slope are not the same. Horizontal lines have a slope 0, while vertical lines have no slope (undefined).

But a moving average is not a straight line; it is a curve. In order to determine the slope of a moving average one could consider utilizing one of the cornerstones of calculus and one of the major tools in analyzing functions: the 1st derivative. The derivative is the value of the slope of a tangent line to a curve at any given point. This assumes that the curve can be represented by a differentiable function, in other words, that the slope of the tangent line at any point will exist.

If we could calculate the slope of the tangent line to the moving average (see Fig. 1) at, for example, point \((x_1, y_1)\) and then at point \((x_2, y_2)\) important information about whether momentum is increasing or decreasing could be determined. In theory, the peaks and troughs of the slopes of the tangent lines to the moving average should warn of an impending change in trend as much as they occur by definition early. That is, the rate of ascent or descent of prices must first peak and then go to zero for prices themselves to top or bottom. However, the problem is that one cannot calculate the slope of a tangent to a moving average because the equation of the moving average is indeterminable. Therefore, we must fall back on linear regression to create lines which simulate the tangent lines along the moving average curve. The slopes of these regression lines can then be determined and their changing Linear Regression Angles can be analyzed to provide a leading signal as to whether internal momentum is accelerating or decelerating.

The relationship of the tangent lines to the curve is critical. When a curve lies above its tangents, it is oriented like a bowl with its opening facing up and is said to be concave up. Conversely, when a curve lies below its tangents, it is oriented like an overturned bowl with its opening facing down, and is said to be concave down (see Fig. 2).

A horizontal tangent signals that the preceding trend has at least temporarily halted (see Fig. 3).
Figure 3
Pattern of tangents to the moving average when a stock's momentum inflects from bearish to bullish at local minimum.

Pattern of tangents to the moving average when a stock's momentum inflects from bullish to bearish at local maximum.

A curve will have an inflection point if it changes from concave up to concave down or vice versa. It is necessary to note, however, that, instead of changing direction, it could simply resume the prevailing trend. One of the virtues of the GLRA, as we will see, is that it tends to correct itself quickly with minimal losses in such situations (see Fig. 4).

Figure 4
Case 1: Inflection point at \((x_1)\) as a stock's downside momentum peaks.
Case 2: Inflection point at \((x_1)\) as a stock's upside momentum peaks.

As indicated in Figure 4, Case 1, as the price pattern approaches the top at point \(A\), the slope decreases (lower chart), until at point \(X\), the price top, the slope is zero (flat), and the price is about to turn down. The slope now increases negatively, as price falls, and reaches its greatest downward rate at point \(X\). Note at point \(X\), that the slope bottoms and turns up as the downward rate of price decline cases prior to the price bottom at point \(X\). It should be clear now that the slope changes direction prior to prices doing so. Figure 4, Case 2, simply presents the opposite pattern for the behavior of the slope (tangent line angles) and prices.

GLRA Construction
The specific problem I addressed then, was how to transform a function or tool into an indicator, that is, into an instrument of technical analysis capable of signaling, objectively and reliably, changes in both the direction and momentum of the trend. The underlying assumption of this endeavor was that, though an individual Linear Regression Angle does not itself constitute an indicator, it does provide useful information which can be used to create one. The first step was to base the indicator on a simple moving average of prices in order to avoid the volatility of the raw price series. The next step was to use the regression beta, or slope, of the moving average and convert it to an angle. I derived the angle from a regression line using the last 3 points of the moving average. Finally, I smoothed these angles with a weighted moving average to constitute a fast line, and then created a second weighted moving average from the first weighted moving average to constitute a slow, or signal, line. Weighted moving averages speed up the signals.

GLRA Plots
In the GLRA, 3 oscillators are generated (see appendix) which move above and below zero:
1. Plot 1: the angles of progressive regression lines calculated over 3 points along the 10-week simple moving average of closing prices (see Fig. 5). Note, Plot 1 will be concealed in the graphic representation of the GLRA Indicator.

Figure 5

Haemonetics (NYSE-HAE)
Weekly Bar with 10-week moving average and simulated 3-point regression lines drawn on moving average.
GLRA Plot 1 default setting (10-2)

Plot 1 construction: Linear regression angle calculated using linear regression line drawn through the last 3 points on the 10 week simple moving average of prices. As demonstrated in fig. 4) note bottoms and tops in regression angles prior to price bottoms and tops.

2. Plot 2: the fast line, a 9-week weighted moving average of Plot 1 (see Fig. 6).

3. Plot 3: the slow, or signal, line, a 14-week weighted moving average of the Plot 2 (see Fig. 6).
Penetration of the slow or signal line by the fast line (the more important indicator) signifies a steepening or flattening of the linear regression series angle, that is, an acceleration or deceleration of momentum. Thus, when the fast line moves up through the signal line, generating a buy signal, negative momentum is decreasing or positive momentum is increasing; when the fast line moves down through the signal line, generating a sell signal, positive momentum is decreasing or negative momentum is increasing. Penetration of the zero line by the fast line signifies a shift in the linear regression series angle from positive to negative or negative to positive; that is, it signals a major change in the direction of the trend. Thus, when the fast line moves from above to below the zero line, the trend has turned down (the linear regression series angle has pivoted from positive to negative). When the fast line moves from below the zero line to above the zero line, the trend has turned up (the linear regression series angle has pivoted from negative to positive).

Initial testing has determined that a 10-week simple moving average, a 3-week regression line, a 9-week (fast) weighted moving average, and a 14-week (slow) weighted moving average appear to work best. Obviously, constructing the indicator using daily or monthly data would require an adjustment in the numerical parameters. Experience so far indicates that the GLRA is a powerful intermediate-term trading tool when using weekly data and in trending markets. As the following charts and performance summaries demonstrate, the GLRA Indicator successfully signals both tops and bottoms, and appears to be more consistently effective for long trades rather than short trades probably because, as Colby & Meyers argue, the market has had a strongly bullish secular bias. While the GLRA Indicator cannot entirely escape the conditions of its rationale, it is an attempt to overcome the weakness inherent in all trend-following indicators by using small shifts in the Linear Regression Angle to signal major change in the price trend. I have included the calculation of the reward/risk ratio (total net profit/maximum intraday drawdown) for each of the following securities. The GLRA compares favorably against the maximum cumulated drawdown figure of 6.13 cited by Colby and Meyers for their 40 week simple moving average crossover strategy.

Performance Summary of CAER (Weekly 12/28/90 - 12/15/95)

<table>
<thead>
<tr>
<th>Reward/Risk Ratio - All Trades: (42.24 / 6.0 = 7.04)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Net Profit $42.24 Open Position P/L $ 2.06</td>
</tr>
<tr>
<td>Gross Profit $45.88 Gross Loss $ 3.64</td>
</tr>
<tr>
<td>Total # of trades 13 Percent Profitable 69%</td>
</tr>
<tr>
<td>Number winning trades 9 Number losing trades 4</td>
</tr>
<tr>
<td>Largest winning trade $11.50 Largest losing trade $ 1.82</td>
</tr>
<tr>
<td>Average winning trade $ 5.10 Average losing trade $ 0.91</td>
</tr>
<tr>
<td>Ratio avg win/avg loss 5.60 Avg trade (win &amp; loss) 3.25</td>
</tr>
<tr>
<td>Max consec. winners 4 Max consec. losers 3</td>
</tr>
<tr>
<td>Avg # bars in winners 19 Avg # bars in losers 8</td>
</tr>
<tr>
<td>Max intraday drawdown $ 6.00</td>
</tr>
<tr>
<td>Profit factor 12.60 Max # contracts held 1</td>
</tr>
<tr>
<td>Account size required $ 6.00 Return on account 704%</td>
</tr>
</tbody>
</table>

Performance Summary of CAER - Long Trades

<table>
<thead>
<tr>
<th>Reward/Risk Ratio - Long Trades: (22.87 / 2.50 = 9.15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Net Profit $22.87 Open Position P/L $ 0.00</td>
</tr>
<tr>
<td>Gross Profit $23.14 Gross Loss $ 0.57</td>
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<tr>
<td>Total # of trades 7 Percent Profitable 71%</td>
</tr>
<tr>
<td>Number winning trades 5 Number losing trades 2</td>
</tr>
<tr>
<td>Largest winning trade $11.50 Largest losing trade $ 0.38</td>
</tr>
<tr>
<td>Average winning trade $ 4.69 Average losing trade $ 0.29</td>
</tr>
<tr>
<td>Ratio avg win/avg loss 16.45 Avg trade (win &amp; loss) 3.27</td>
</tr>
<tr>
<td>Max consec. winners 2 Max consec. losers 1</td>
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<tr>
<td>Avg # bars in winners 22 Avg # bars in losers 1</td>
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<tr>
<td>Max intraday drawdown $ 2.50</td>
</tr>
<tr>
<td>Profit factor 41.12 Max # contracts held 1</td>
</tr>
<tr>
<td>Account size required $ 2.50 Return on account 915%</td>
</tr>
</tbody>
</table>

Chart shows GLRA crossed bullishly the week of 8/21/92 at a close of $10. Sell signal given week of 1/1/93 at $16.00. Note bearish divergence when price spike to $24.50 was not confirmed by GLRA. CAER then plummeted. GLRA covered shorts and went long week ending 5/16/93 at close $7.375. Compare to Chart 5 and notice that 66, 45, and 20-week linear regression lines all failed to warn of impending top and subsequent sell-off in late 1992/early 1993. Performance summary below is based on data from 12/28/90 to 12/15/95. To avoid problem with resolution, chart shows stock only from week of 8/19/92 to 12/15/95. Performance summary follows:

SuperCharts 2.1 System Results
Performance Summary of CAER - Short Trades

**Reward/Risk Ratio - Short Trades:** \((19.37 / 9.07 = 2.14)\)

- **Total Net Profit:** $19.37
- **Open Position P/L:** $2.06
- **Gross Profit:** $22.44
- **Gross Loss:** -$3.07
- **Total # of trades:** 6
- **Percent Profitable:** 67%
- **Number winning trades:** 4
- **Number losing trades:** 2
- **Largest winning trade:** $10.50
- **Largest losing trade:** -$1.12
- **Average winning trade:** $5.61
- **Average losing trade:** -$1.54
- **Ratio avg win/avg loss:** 3.65
- **Avg trade (win & loss):** 3.23
- **Max consec. winners:** 4
- **Max consec. losers:** 2
- **Avg # bars in winners:** 15
- **Avg # bars in losers:** 14
- **Max intraday drawdown:** -$9.07
- **Profit factor:** 7.31
- **Max # contracts held:** 1
- **Account size required:** $9.07
- **Return on account:** 214%

**GLRA run on CAERE CP Weekly 12/28/90 -12/15/95**

- **LExit = Long Exit, SExit = Short Exit**

**Trade Signals Detail**

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Cnts</th>
<th>Price</th>
<th>Entry P/L</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/13/91</td>
<td>Buy</td>
<td>1</td>
<td>6.500</td>
<td>$0.01</td>
<td>$0.01</td>
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<tr>
<td>01/31/92</td>
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<td>7.310</td>
<td>-$0.01</td>
<td>-$0.01</td>
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<tr>
<td>01/31/92</td>
<td>Sell</td>
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<td>7.310</td>
<td>$1.82</td>
<td>$1.82</td>
</tr>
<tr>
<td>03/06/92</td>
<td>SExit</td>
<td>1</td>
<td>9.130</td>
<td>-$0.38</td>
<td>-$0.38</td>
</tr>
<tr>
<td>03/06/92</td>
<td>Buy</td>
<td>1</td>
<td>9.130</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td>03/13/92</td>
<td>LExit</td>
<td>1</td>
<td>8.750</td>
<td>-$0.38</td>
<td>-$0.38</td>
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<tr>
<td>03/13/92</td>
<td>Sell</td>
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<td>8.750</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>08/21/92</td>
<td>SExit</td>
<td>1</td>
<td>10.000</td>
<td>-$1.25</td>
<td>-$1.25</td>
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<tr>
<td>08/21/92</td>
<td>Buy</td>
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<td>10.000</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td>12/18/92</td>
<td>LExit</td>
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<td>18.500</td>
<td>$8.50</td>
<td>$8.50</td>
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<tr>
<td>12/18/92</td>
<td>SExit</td>
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<td>18.500</td>
<td>-$0.38</td>
<td>-$0.38</td>
</tr>
<tr>
<td>06/11/93</td>
<td>Buy</td>
<td>1</td>
<td>8.000</td>
<td>$10.50</td>
<td>$10.50</td>
</tr>
<tr>
<td>02/18/94</td>
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<td>02/18/94</td>
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<td>9.380</td>
<td>-$2.13</td>
<td>-$2.13</td>
</tr>
<tr>
<td>06/10/94</td>
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<td>7.250</td>
<td>$2.13</td>
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<td>06/10/94</td>
<td>Buy</td>
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<td>-$0.92</td>
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<td>06/17/94</td>
<td>LExit</td>
<td>1</td>
<td>7.060</td>
<td>-$0.19</td>
<td>-$0.19</td>
</tr>
<tr>
<td>06/17/94</td>
<td>SExit</td>
<td>1</td>
<td>7.060</td>
<td>$0.83</td>
<td>$0.83</td>
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<tr>
<td>06/24/94</td>
<td>SExit</td>
<td>1</td>
<td>6.630</td>
<td>$0.43</td>
<td>$0.43</td>
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<tr>
<td>06/24/94</td>
<td>Buy</td>
<td>1</td>
<td>6.630</td>
<td>$0.43</td>
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<tr>
<td>12/30/94</td>
<td>LExit</td>
<td>1</td>
<td>10.130</td>
<td>$11.50</td>
<td>$11.50</td>
</tr>
<tr>
<td>12/30/94</td>
<td>SExit</td>
<td>1</td>
<td>10.130</td>
<td>-$0.25</td>
<td>-$0.25</td>
</tr>
<tr>
<td>04/21/95</td>
<td>SExit</td>
<td>1</td>
<td>8.750</td>
<td>$9.38</td>
<td>$9.38</td>
</tr>
<tr>
<td>04/21/95</td>
<td>Buy</td>
<td>1</td>
<td>8.750</td>
<td>-$0.19</td>
<td>-$0.19</td>
</tr>
<tr>
<td>10/06/95</td>
<td>LExit</td>
<td>1</td>
<td>10.000</td>
<td>$1.25</td>
<td>$1.25</td>
</tr>
<tr>
<td>10/06/95</td>
<td>SExit</td>
<td>1</td>
<td>10.000</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

**GLRA net profit of $42.24 against Buy & Hold net profit of $1.44.**

Chart 7

Cirrus Logic (NASDAQ: CRUS) with GLRA (10-2-9-14) - Weekly

GLRA gave a buy signal the week ending 1/27/95 at $14.125 and a sell signal the week ending 10/6/95 at $50.81. Subsequently CRUS fell to a low of $23 the week of 11/24/95. This compares favorably to the 66 week linear regression line approach discussed earlier. See Charts 3 and 4.

Chart 8

EMC Corp. (NYSE: EMC) With GLRA (10-2-9-14) - Weekly

Test period is from 04/24/92 to 12/29/95. Experience suggests, as demonstrated in this chart of EMC, that crossovers at indicator extremes are more reliable than those closer to the zero line. Additionally, attention should be paid to the decisiveness or sharpness of the crossover.

Performance Summary of EMC - All Trades

(Weekly 4/24/92 - 12/29/95)

**Reward/Risk Ratio - All Trades:** \((38.30 / 1.81 = 21.16)\)

- **Total net profit:** $38.30
- **Open Position P/L:** $-1.25
- **Gross profit:** $36.30
- **Gross loss:** $0.00

- **Total trades:** 8
- **Percent profitable:** 100%
- **Number winning:** 8
- **Number losing:** 0

**NOTE:** GLRA net profit of $42.24 against Buy & Hold net profit of $1.44.
Performance summary below is based on data from 08/24/90 to 12/29/95. To avoid problem with resolution, chart shows index only from week of 6/19/92 to 12/29/95.

**Performance Summary of NASDAQ Comp. - All Trades**

(Weekly 8/24/90 - 12/29/95)

<table>
<thead>
<tr>
<th>Reward/Risk Ratio - All Trades: (564.30/74.15 = 7.61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total net Profit                                      $564.30</td>
</tr>
<tr>
<td>Open position P/L                                     $ 0.00</td>
</tr>
<tr>
<td>Gross Profit                                          $704.67</td>
</tr>
<tr>
<td>Gross Loss                                            $140.37</td>
</tr>
<tr>
<td>Total # of trades                                     14</td>
</tr>
<tr>
<td>Percent Profitable                                    57%</td>
</tr>
<tr>
<td>Number of Winning trades                              8</td>
</tr>
<tr>
<td>Number losing trades                                   6</td>
</tr>
</tbody>
</table>

**Performance Summary of NASDAQ Comp. - Long Trades**

(Reward/Risk Ratio - Long Trades: (554.06/29.22 = 18.96)

| Total net Profit                                      $554.06 |
| Open position P/L                                     $ 0.00  |
| Gross Profit                                          $567.14 |
| Gross Loss                                            $13.08 |
| Total # of trades                                     7     |
| Percent Profitable                                    86%   |
| Number of Winning trades                              6     |
| Number losing trades                                   1     |

**Performance Summary of NASDAQ Comp. - Short Trades**

(Reward/Risk Ratio - Short Trades: (10.24/60.23 = 0.17)

| Total net Profit                                      10.24  |
| Open position P/L                                     $ 0.00  |
| Gross Profit                                          $137.53 |
| Gross Loss                                            $127.29 |
| Total # of trades                                     7     |
| Percent Profitable                                    29%   |
| Number of Winning trades                              2     |
| Number losing trades                                   5     |

Test period is from 04/24/92 to 12/22/95. To avoid a problem with resolution, chart shows mutual fund only from week of 11/5/93 to 12/22/95. Note leading nature of September 95 decisive sell signal prior to actual onset of decline in price trend. Fund tumbled $4.85 from last GLRA sell signal to 12/22/95.

Given this is a mutual fund, only results of long trades are presented.

**Performance Summary of FDCPX - Long Trades**

(Weekly 4/24/92 - 12/22/95)

<table>
<thead>
<tr>
<th>Reward/Risk Ratio - Long Trades: (25.14/0.51 = 49.29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total net profit                                       $25.14</td>
</tr>
<tr>
<td>Open position P/L                                      $ 0.00</td>
</tr>
<tr>
<td>Gross profit                                           $25.14</td>
</tr>
<tr>
<td>Gross loss                                             $ 0.00</td>
</tr>
<tr>
<td>Total trades                                           5</td>
</tr>
<tr>
<td>Percent profitable                                     100%</td>
</tr>
<tr>
<td>Number winning                                         5</td>
</tr>
<tr>
<td>Number losing                                          0</td>
</tr>
</tbody>
</table>

Test period is from 11/01/91 to 12/01/95. To avoid a problem with resolution, chart shows mutual fund only from week of 5/15/92 to 12/01/95. Note leading nature of decisive March 95 buy signal which caught absolute intermediate-term bottom.

Given this is a mutual fund, only results of long trades are presented.
Performance Summary of LEXGX - Long Trades  
(Weekly 11/01/91 - 12/01/95)

Reward/Risk Ratio - Long Trades: (6.48/0.84 = 7.71)
- Total net profit $ 6.48
- Open Position P/L $0.00
- Gross profit $6.48
- Gross loss $0.00
- Total trades 5
- Percent profitable 100%
- Number winning 5
- Number losing 0

This is a limited sample comparing the GLRA to the MACD using weekly data. It is designed to show that the GLRA is competitive as an intermediate-term trading indicator when compared to a well accepted standard. The writer invites further investigation.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>From</th>
<th>To</th>
<th>Net Profit</th>
<th>% Profitable</th>
<th>Net Profit</th>
<th>% Profitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC Corp.</td>
<td>04/23/92</td>
<td>12/29/95</td>
<td>-$ 2.06</td>
<td>50%</td>
<td>$ 36.30</td>
<td>100%</td>
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<tr>
<td>LSI Logic</td>
<td>04/24/92</td>
<td>12/29/95</td>
<td>$27.63</td>
<td>56%</td>
<td>$ 14.18</td>
<td>45%</td>
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<tr>
<td>Philip Morris</td>
<td>05/11/88</td>
<td>12/29/95</td>
<td>$46.48</td>
<td>47%</td>
<td>$ 36.89</td>
<td>37%</td>
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<tr>
<td>Symbol Tech</td>
<td>03/04/88</td>
<td>12/29/95</td>
<td>$ 0.77</td>
<td>30%</td>
<td>$14.30</td>
<td>50%</td>
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<tr>
<td>Storage Tek</td>
<td>12/31/90</td>
<td>12/29/95</td>
<td>$29.00</td>
<td>67%</td>
<td>$ 53.24</td>
<td>60%</td>
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<tr>
<td>Teradyne</td>
<td>08/10/90</td>
<td>12/29/95</td>
<td>$20.83</td>
<td>55%</td>
<td>$ 31.83</td>
<td>53%</td>
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<tr>
<td>Apple Comp.</td>
<td>01/06/84</td>
<td>12/29/95</td>
<td>$17.29</td>
<td>37%</td>
<td>$118.17</td>
<td>51%</td>
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<tr>
<td>Trimble Nav.</td>
<td>07/27/90</td>
<td>12/29/95</td>
<td>-$ 3.93</td>
<td>35%</td>
<td>$ 12.87</td>
<td>50%</td>
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<tr>
<td>S&amp;P 500</td>
<td>02/12/82</td>
<td>12/29/95</td>
<td>-31.11</td>
<td>24%</td>
<td>47.98</td>
<td>44%</td>
</tr>
<tr>
<td>ValueLine Arith.</td>
<td>09/27/91</td>
<td>12/29/95</td>
<td>$00.10</td>
<td>42%</td>
<td>1133.70</td>
<td>57%</td>
</tr>
<tr>
<td>FBIOX*</td>
<td>01/08/88</td>
<td>12/29/95</td>
<td>$12.59</td>
<td>48%</td>
<td>$ 10.95</td>
<td>57%</td>
</tr>
<tr>
<td>FMAGX*</td>
<td>01/05/88</td>
<td>12/29/95</td>
<td>$19.19</td>
<td>27%</td>
<td>$ 20.78</td>
<td>39%</td>
</tr>
<tr>
<td>FSAGX*</td>
<td>07/22/88</td>
<td>12/29/95</td>
<td>$ 7.88</td>
<td>50%</td>
<td>$11.43</td>
<td>46%</td>
</tr>
<tr>
<td>PCOCX*</td>
<td>01/15/88</td>
<td>12/29/95</td>
<td>$10.92</td>
<td>38%</td>
<td>$ 16.66</td>
<td>54%</td>
</tr>
</tbody>
</table>

Indicator Parameters Used: MACD 12 - 26 - 9; GLRA 10 - 2 - 9 - 14. Results include closed trades only.

Summary

The Linear Regression Line and the Linear Regression Channel, the only linear regression tools heretofore available to the technician, appear to be unreliable and ineffective instruments for market timing and intermediate-term trading. It is not, however, that linear regression is without value to the technician. Rather, technical analysis must go further to exploit the possibilities for indicator formation inherent in linear regression.

The Gabriel Linear Regression Indicator (GLRA) is a new technical analysis tool which uses the important information provided by linear regression to overcome the weaknesses of linear regression as commonly employed. The foundation of the GLRA Indicator is a fundamental shift of focus to the linear regression angle of a moving average of prices. In its final form, the GLRA indicator uses two weighted moving averages, a fast line and a signal line of the linear regression angles of a simple moving average of prices.

The GLRA Indicator is an attempt to overcome the weakness associated with trend following systems by using small shifts in the Linear Regression Angle of a moving average of prices to signal a change in trend prior to the actual breakdown or breakout in prices.

Testing of the GLRA indicator confirmed its value both for market timing and intermediate-term trading of financial instruments. Experience indicates that when the GLRA gives a false signal, it tends to correct itself with minimal losses.

Appendix

Indicator Calculation

SuperCharts 2.1 indicator library includes several tools that can be applied to determine the slope of a curve. Linear Regression Slope (LinearRegSlope) returns the slope (0 = neutral, positive number = upslope, negative number = downslope) of the linear regression line for the period of x bars counting back from the current bar. Thus, the larger the absolute value, the steeper the slope of the linear regression line. Linear Regression Angle (LinearRegAngle) is similar to LinearRegSlope except that the slope of the line is converted to an angle and returned in terms of degrees.8

Figure 7
Slope Intercept formula: y = a + bx.
LinearRegAngle = ArcTangent (Slope)

Using SuperCharts 2.1 function library:

Indicator Editor - create -(Gabriel - LRA)
Plot 1 = LinearRegAngle(Average(Close, Length1), Length2)
Returns the Linear Regression Angle for an n period simple moving average of closing prices (length1) back x number of points along that moving average (length2). This plot is not depicted in the presentation of the indicator.
Input Plot 1 Length1 default setting n = 10, Length2 (x) = 2

Plot 2 = WAverage(Plot 1, Length3) * 1000
Returns the n period weighted moving average of Plot 1 multiplied by 1000 for presentation purposes. The angle of ascent cannot be greater than 90 degrees (+90,000) and the angle of descent cannot be greater than minus 90 degrees (-90,000).
Input Plot 2 Length3 default setting n = 9

Plot 3 = WAverage(Plot 2, Length4)
Returns the n period weighted moving average of Plot 2. This creates a slow or signal line above and below which Plot 2 oscillates.
Input Plot 3 Length4 default setting n = 14

Plot 4 = 0
Places a zero line on the chart.
Endnotes


2. Ibid.


5. Ibid.

6. Ibid., p. 28.

7. Ibid., p. 42.


Bibliography


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Terence J. Gabriel

Terence J. Gabriel is a New York-based Technical Strategist with I.D.E.A., an international consulting company providing economic research, market commentary, and trading recommendations to major financial institutions throughout the world. At I.D.E.A., he is responsible for the technical analysis of equity indices, bonds, and commodities. He holds a BS in Finance from the University of Connecticut and an MBA from Syracuse University.

The Editor wishes to thank Professor Jack Healey, Golden Gate University, for his review of this article.
Combining Indicators

Matthew A. Pats

Introduction

Technicians use various indicators to help design effective investment strategies, and then use trading system tests to assess the efficacy of those indicators over extended time periods and in varied market conditions. Moving averages and percent price change are two indicators used to develop investment strategies. Both moving average and percent price change indicators can be optimized. Optimization identifies the parameters that have, in the past, produced the highest returns. For optimal performance, combined, optimized indicators should avoid duplicating variables, but should instead add trading system parameters that enhance the performance of the combined indicator. Combining optimized moving average and percent price change indicators meets any criteria and creates a superior indicator that further reduces risk and enhances return. Backtesting of the moving average indicator, price percent change indicator, and the new, combination indicator shows that the combination indicator can generate higher returns than either of the other two indicators. In addition, the combination indicator offers more protection against risk than does the % up/% down indicator by reducing the average loss incurred on losing trades. Using the two optimized assessment methods in combination, however, can point to a strategy for trading investment vehicles that provides both further reduced risk and enhanced return. Based on the evidence provided by backtesting, the models included here show that combining the two indicators creates a better indicator.

Assumed Framework

Technical analysis attempts to determine the impact of market psychology. The technician generally believes that human psychology both drives market trends and repeats in cycles. Therefore, backtesting conducted over an adequate length of time and in a variety of market conditions should encompass varied behavior patterns and cycles, and the statistical findings of backtesting are likely to hold validity for the future. When backtesting a particular indicator over a variety of market conditions demonstrates superior results, it is reasonable to assume the same indicator will also produce superior results in the future. In fact, performance history, as revealed through backtesting, provides the only real concrete and objective assessment data available.

A technician can use backtesting to optimize the variables in any indicator. Robert Pardo, in Design, Testing, and Optimization of Trading Systems, says, 'The model parameters that have the largest impact on performance are the ones to be used in the optimization framework. If a parameter has little impact on performance, there is no reason to make it a candidate for optimization. Instead a fixed value or constant should be used during optimization.'

After a trading system is developed and tested, it should be evaluated by analyzing the relevant statistics. This analysis should include the following:

- Comparison of the risk and return associated with the model to those of alternative investments.
- Comparison of the standard statistical findings of the selected indicator to those of other indicators.
- Analysis of annual profit vs. annual drawdown.
- Comparison of the biggest winning trade to the average winning trade.
- Comparison of the average winning trade to the average losing trade.
- Comparison of the total number of winning trades to the total number of losing trades.
- Comparison testing on out-of-sample time periods to confirm results.
- Repeat testing over two distinct, long-term time periods to evaluate consistency of results. Further testing over several short periods may offer additional insights.
- Appropriate consideration of any applicable sales charges or transactions fees.
- Evaluation of the various trading systems and indicators discussed here is based on the cumulative performance (both risk incurred and return) of an initial $1000 investment, backtested over two contiguous 15-year periods.

Buy and Hold

The buy-and-hold system is the benchmark against which the indicators models are compared. During the test period, the Dow Jones was adjusted for reinvested dividends, and the assumed money market rate was 6%. The worst year on a total return basis was 1974, during which the Dow dropped 23.79%. The worst 2-year period was from 1973 to 1974, when the Dow was down over 37% on a total return basis. The first seven years of investment resulted in a total 11.97% profit. All of the tested indicators performed significantly better than the buy and hold strategy.

Indicator 1

Indicator 1 is based on a Metastock's Classical Moving Average Penetration System. This software system, which technicians commonly use to identify trends, finds the most profitable moving averages for generating buy and sell signals by optimizing two variables from weekly data on the Dow.

Profits are maximized when the indicated MAs are heeded at both ends of the trade. The optimal moving averages, determined by testing each combination of MAs from 1 week through 51 weeks, was a price penetration of a 35-week MA for entering the market, and a price penetration of a 32-week MA for sell signals.

Indicator 1 places the investment in the money market when market prices are declining, reducing overall risk. The investor survived the difficult Bear market of the early 1970s without much risk and loss of capital because the investment was in the money market position for a significant portion of the time. From 1968 until 1980 the annual gain averaged 5%.

Indicator 2

Indicator 2, called % up/% down, issues buy and sell orders based on the percent the market has fallen from a high or risen from a low during the preceding week. This indicator searches

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all percent price changes from market highs and lows in the prior week to determine the optimal percent price movement, and indicates which price changes represent the most potentially profitable trades. Because the buy and sell percentages are interdependent, using both produces the highest profit.

During the test period, Indicator 2 produced a cumulative return inferior to that of Indicator 1 (14.36% vs. 17.03%). Furthermore, the smaller return was not accompanied by any compensatory reduction in risk, because Indicator 2 kept the investor in the market most of the time.

**Indicator 3**

Indicator 3 is a combined indicator developed by combining the moving average and price penetration indicators outlined above. By joining the buy/sell criteria of the two single-method indicators, Indicator 3 issues allocation directives based on both price penetration of a moving average and a percentage change from a market high or low after finding the best MA given the best percentage change.

This combination system provides some protection against the deficiencies of the other two indicators. Adding the price shift component makes this enhanced moving average indicator more sensitive to market corrections and may identify imminent periods of decline more readily than a simple moving average. Indicator 3 also exposed the investor to less risk because the funds were in the money market about 33% of the time. This combination indicator also produced the best average gain (18.32%) by buying into the market when prices crossing the 27-week MA coincided with the designated positive % changes from a market bottom.8 Selling was indicated when a 13-week MA coincided with a 3.0% price decline from the previous week.

**Comparative Performance Of The 3 Tested Indicators**

(Based on initial $1000 investment, cumulative over the test period. All figures rounded to nearest whole dollar.)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Moving Average</th>
<th>%Up/Down</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total net profit</td>
<td>$17,033</td>
<td>$14,363</td>
<td>$18,325</td>
</tr>
<tr>
<td>Average win</td>
<td>$ 898</td>
<td>$ 993</td>
<td>$ 1,132</td>
</tr>
<tr>
<td>Average profit per trade</td>
<td>$ 448</td>
<td>$ 505</td>
<td>$ 591</td>
</tr>
<tr>
<td>Average loss</td>
<td>-$ 69</td>
<td>-$ 206</td>
<td>-$ 108</td>
</tr>
<tr>
<td>Total closed trades</td>
<td>38</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>Total # winning trades</td>
<td>18</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Total # losing trades</td>
<td>20</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>% Gain</td>
<td>17.03</td>
<td>14.36</td>
<td>18.33</td>
</tr>
<tr>
<td>Profit/Loss index</td>
<td>92.52</td>
<td>90.87</td>
<td>91.90</td>
</tr>
</tbody>
</table>

**Multi-Period Test**

The multi-period test divides a set of data and then tests the smaller samples separately. The multi-period test results included here show the gains of the buy and hold and the three indicators during two periods. The data were divided into two long test periods to encompass different market conditions and repeatable cycles.

<table>
<thead>
<tr>
<th>Gross Gain on $1000 Investment Over 2 Equal Time Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/68-4/1/81</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Buy and Hold</td>
</tr>
<tr>
<td>Indicator 1</td>
</tr>
<tr>
<td>Indicator 2</td>
</tr>
<tr>
<td>Indicator 3</td>
</tr>
</tbody>
</table>

The profit analysis of the multi-period test shows that each indicator's original optimization performed well during the two distinct periods.

**Analysis of Results**

The results discussed above are based on trend-following indicators. These tend to be most useful when the market is moving in one direction for an extended period of time and are likely to falter when the market repeatedly lingers in non-trending phases. Because the market's trend during the test period was primarily up, the indicators worked well. When the market enters a non-trending period, trend indicators do not work well; during such periods, indicator results may not beat a buy and hold return. However, during trending periods, when use of trend indicators, such as the three discussed here, is appropriate, backtesting an indicator can help produce an optimized indicator.

**Conclusion**

Many indicators and combinations of indicators can be backtested to determine if they have worked well in the past. The results of the backtested and optimized indicators presented here suggest that backtesting and optimizing can be powerful tools for a technician. Furthermore, the results of Indicator 3 suggest that combining moving average and percent price change indicators provides two distinct advantages:

- The combination indicator reduces risk and is more sensitive to sudden market corrections than a conventional, optimized moving average indicator.
- The combination indicator also enhances returns over both the single-method indicators.

**Exhibits**

**Symbols and Formulas**

1A. Buy and Hold

Enter Long:

\[ (C, =, C) \]

1B. Classic MA Penetration with Optimization

Enter Long:

\[ (C, >, mov(C, opt1, S)) \] AND \\
\[ (ref(C, -1), <=, ref(mov(C, opt1, S), -1)) \]

Close Long:

\[ (C, <, mov(C, opt2, S)) \]

Enter Short:

\[ (C, <, mov(C, opt2, S)) \]

Close Short:

\[ (C, >, mov(C, OPT1, S)) \] AND \\
\[ (C, 1, <=, ref(mov(C, opt1, S), -1)) \]
1C. % Up & Down
Enter Long:
when \((C + (C^*opt1), \geq, (\text{ref} (\text{hhv} (C, 1), -1)))\)
Close Long:
when \((C + (C^*opt2), \leq, (\text{ref} (\text{llv} (C, 1), -1)))\)
Enter Short:
when \((C + (C^*opt2), \leq, (\text{ref} (\text{llv} (C, 20), -1)))\)
Close Short:
when \((C + (C^*opt1), \geq, (\text{ref} (\text{hhv} (C, 20), -1)))\)

1D. Combined % Up & Down with MA
Enter Long:
when \((C + (C^*opt1), \geq, (\text{ref} (\text{hhv} (C, 1), -1)))\) AND
when \((C, >, \text{mov} (C, \text{opt} 2, E))\) AND
when \((\text{ref} (C - 1), < =, (\text{ref} (\text{mov} (C, \text{opt} 2, E), -1)))\)
Close Long:
when \((C + (C^*opt3), \leq, (\text{ref} (\text{llv} (C, 1), -1)))\) AND
when \((C, <, \text{mov} (C, \text{opt} 4, E))\)

**Key**
- C = close
- hhv = highest high value
- llv = lowest low value
- E = exponential
- > = greater than
- < = less than
- = = equal to
- opt = optimization
- -1 allows reference to look back to prior close
- AND allows another constraint in the test

* Explanations of these numerals are found in the text.

**Notes**
1. For the purpose of this paper, the author used the Metastock software optimization program.
2. Most software that includes optimization tests allows for such considerations.
3. See Exhibit 1A.
4. Source: I.D.C., Lexington, MA.
5. See Exhibit 1B for a description of the program.
6. All of the following buy/sell MA price penetrations produced profit exceeding $17,000: 32 & 40, 32 & 41, 32 & 39, 32 & 42, 40 & 38, 40 & 37. The range of spans which produced consistently good results indicates that the results can be duplicated and the trading system is reliable.
7. See exhibit 1D.
8. According to this indicator, the following positive percent changes from a market low, when occurring simultaneously with a 27-week MA price penetration, justified a buy signal: 0.01, 0.02, 0.03, 0.04, 0.05.
9. For the purposes of this paper, a non-trending phase is defined as a multi-month period during which the market trendline cannot be graphically represented as clearly sloping either up or down. During such periods the market makes only incremental movements up or down and reverses direction after a relatively short time.

**Biography**
Matthew Past is President, Treasurer and a Director of BTS/Asset Management, Inc. Mr. Past joined BTS in 1989. Since that time, he has performed various roles in the marketing, accounting and technical research departments. Mr. Past graduated with honors from Babson College, receiving a BSBA in Finance and Investments, and also attended Babson Graduate School of Business Administration. Since 1991, he has been an officer and Registered Principal of BSTC Corp., a broker/dealer registered with the SEC and NASD, which is an affiliate of BTS/Asset Management, Inc. Mr. Past has been an affiliate of the MTA since 1991.
There are many ways to define the concept of volatility. Some use the standard deviation, some the historical volatility or Chaikin’s Volatility. Most of the time I use historical volatility: the standard deviation of the natural logarithm of the price change multiplied by the squared root of the yearly trading days.

Many software programs can calculate this indicator, but the current analysis of this indicator is quite simple. Every trader uses a different length, but very few analyze this indicator in depth. In my opinion, this is a mistake. Compared to momentum indicators, the analysis of volatility gives you an advantage. Oscillators tell you what is happening, while volatility tells you what is likely to happen or not.

Every trader considers a different historical volatility, thus I tried to create for my studies something similar to Pring’s KST, a weighted mix of different historical volatilities in order to obtain an indicator that considers several cycles.

FC HistVol is a weighted average of five different historical volatilities. I found the following parameters based on Fibonacci series work well in most markets:

<table>
<thead>
<tr>
<th>Historical Volatilities</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 days historical volatility</td>
<td>3</td>
</tr>
<tr>
<td>21 days historical volatility</td>
<td>3</td>
</tr>
<tr>
<td>34 days historical volatility</td>
<td>2</td>
</tr>
<tr>
<td>55 days historical volatility</td>
<td>1</td>
</tr>
<tr>
<td>89 days historical volatility</td>
<td>1</td>
</tr>
</tbody>
</table>

For currencies, it’s probably better to use higher parameters because the cycles of volatility are longer. In any case, you can change weights and lengths of volatilities in order to find what works best for a market. The idea behind this indicator is a kind of “mix and match” of volatilities that have different behaviors such that the influence of every cycle is included.

The cyclicity of FC HistVol is evident. One can use trendlines, find supports, resistances and the most common reversal patterns. Remember this indicator is an algorithm of the price action, so its behavior is, or should be, technical.

The indicator that must be built on FC HistVol is called FC StochVol. It is a 30-day stochastic of FC HistVol with a 5-day slow stochastic. This indicator can be read as a common stochastic. With this indicator, it is possible to estimate if the level of FC HistVol is extremely high or low, entering positions when volatility is bottoming. If you enter a trade when volatility is low, and you are on the right side of the market, the next increase of volatility will push the market up; while if you are wrong and the volatility is increasing, you still have time to reverse your position. Many times the increasing volatility will sustain the trend, pushing the market up to cover your previous loss.

75% of the time, trend following systems perform better with a low volatility filter based on the equation FC StochVol < α, where α is a number defined after backtesting. Since I always look for a robust system, I tried to define this parameter in a statistical way without any optimization. Let’s suppose that the distribution of the values of the FC StochVol indicator is similar to a Gaussian bell curve.

This hypothesis seems fair, especially if we consider that FC StochVol has a range between 0 and 100. Then, we can create a 126 days Bollinger Band of the indicator with one standard deviation. I chose a 126 days Bollinger Band because 126 days are equal to six months of trading days, and one standard deviation because it identifies an 84.13% interval of confidence that seems to be a meaningful parameter to activate an entry rule for a trading system.

This means every time the indicator falls below its lower Bollinger Band, it tells us that the market is living an “extreme situation” of low volatility that will not last for long.

Orson System is a trading system based on a Moving Average Convergence Divergence (MACD) model with a low volatility filter. If the price oscillator crosses the zero line while the FC StochVol is below its lower Bollinger Band, the system enters the trade; exiting the position at the crossing of the price oscillator with its trigger line. The length of the exponential moving averages (7 and 23) and the length of the trigger line were defined through a statistical analysis after backtesting on 30 securities to determine the parameters that provided steady and consistent results.

This system enhances the features of a simple MACD trading model. It works well in trending markets; avoids the trades with toppish or decreasing volatility, exactly when trading ranges are likely to occur and enters a trade only when a trading range is likely to be broken, or when volatility is compressed and has bottomed. Orson System can also be used to trade options, buying At the Money (ATM) calls when it enters long and buying ATM puts when the system enters short. The exit signals must be used to close the options positions.
Sometimes this system enters too early, so you will have to wait a few days for the move, or it requires a reversal of position, but you will be in the market in the next sharp move.

I tested this filter with several entry and exit points such as RSI overbought/oversold crossovers, Directional Movement Index (DMI) and breakouts, and 75% of the time it increased performance and the average win/average loss ratio. On the other hand, the main disadvantage of this filter is that it reduces the number of trades. An end-of-the-day trader needs to run a system based on this filter on many instruments, because the number of trades is really low. As for real-time trading, I strongly suggest using this filter, but using a time frame higher than 30 minutes, because many times volatility at lunch times decreases during those hours; the system could be whipsawed.

Obviously, this indicator is helpful in options trading. It tells you when it is better to buy or sell options, or, as options traders say, "buy or sell volatility." With this indicator, one can trade just one options strategy: long Out of the Money (OTM) strangle and short OTM strangle. When the volatility is extremely low and the indicator is below α, you can buy some straddle or OTM strangle. In that situation you will pay a low implied volatility, and when volatilities are so compressed, it is likely that a sharp move will occur in the next few days.

You can also wait for a crossing of the FC StochVol above its trigger line before entering the trade; but you will pay a little higher implied volatility because the first step of the move, which causes the increase in the FC StochVol indicator, has already been made. Then, it is possible to close the wrong side of the strangle and transform it into a long call or a long put. In this part of the volatility cycle, when the volatility is extremely low and it starts to increase very quickly, it is very risky to trade against the trend; every reversal signal should be used just as an exit point.

This oscillator can be used as a trend forecaster indicator. Compared to conventional trendiness indicators, FC StochVol has an advantage. While ADX, Vertical/Horizontal Filter (VHF), R-Squared tell you the trendiness and the strength of the current move, FC StochVol tells you what is likely to happen, or not. This means that in some cases one can't say what will happen but one can say what is not likely to happen. Consider an upside move and resistance that are going to be tested with a toppish FC StochVol above both 80 and α. In my opinion, this resistance is likely to be confirmed because volatility reached its top. This does not mean that I know if the market will reverse the trend or if it will form a congestion phase; it only means that I can suppose what the market will not do. This is a major advantage if one writes options. In this case, one can sell some OTM calls or strangles-taking advantage of a very high implied volatility.

My personal theory is that markets work as a spring-loaded toys. When the FC StochVol is very low and is bottoming, the spring is charged and the strength of the next move will be related to that low, while price tops and bottoms following a sharp vertical move are related to toppish behavior. Ralph Acampora taught me, "the longer the base, the longer the trend." Think about it in terms of volatility: a long and narrow trading range reduces the standard deviation and, consequently, the volatility. Length and magnitude of the trading range charge the spring, creating a stronger move; we can say "the lower the volatility, the stronger the move."

Let's look at a few charts:

Exhibit 1 shows the perpetual contract of the Italian Stock Index Future FIB 30. Every rectangle shows a situation of very low volatility with the FC StochVol below its lower Bollinger Band. The vertical lines indicate the crossing of FC StochVol with its trigger line while the price is in a trading range and ready for a vertical move. In April 1996 there was very low volatility, followed by a big vertical move and an explosion of FC StochVol. Just after the rally, the oscillator FC StochVol above 80 and its upper Bollinger Band indicated that market and volatility were toppish. Think about selling some OTM calls!

After several days, the market formed a narrow trading range and volatility reached its lowest low. The FC StochVol indicator was telling us that something was going to happen. Even if we didn't know where the market was going, we could have purchased some ATM strangle, paying low implied volatility. In the next few days the market had a strong correction. But after this move, we could identify another trading opportunity with toppish volatility, playing the trading range after the identification of the support or selling some OTM put. Time and decreasing volatility did the rest.

Again, after the activation of the "low volatility filter," it was possible to enter a new trade. Even if one couldn't identify the direction of the next move, buying an ATM strangle would have been a good idea. Usually, when the indicator crosses below its adaptive level, the market is ready for a new vertical move that will increase the implied volatility. In this case, the long strangle position would take advantage from this phenomena on both sides: the price of the put would be sustained a little because of the increase of volatility, while the price of the call would explode.

I sold a strangle 15000-16500 January at 142 and I recovered it on January 8 at 31 because the volatility was too low and I was waiting for another vertical move. The next few days were an "inferno" for traders that shorted calls. The market and implied volatility exploded and the call I recovered at 19 went up to 1200 in three days.

Now let's look at an American stock: Motorola. The rectangles indicate the bottoms of volatility while the ellipses indicate the tops. Again, lows of volatility are related to horizontal moves while tops of volatility are related to important tops or bottoms. This means we can realize when a new move is likely to occur or when the market is going to form a congestion phase.
In June 1995, a consolidation phase reduced volatility, then there was a vertical move to the upside. Please note that the first top of the double top was made with toppish volatility and FC StochVol above 80. During the formation of the reversal pattern, the indicator collapsed, but after the breakout of the support at $70, the volatility reached a relative top above 90. That was the time to sell options and wait for a possible confirmation of major supports and resistances. In fact, since FC StochVol crossed below the trigger line, it took 18 trading days to break the support at $60. The indicator formed three higher lows in August, November and December. Volatility continued to be high—a sign of the strength of the current trend. At the end of December 1995, volatility reached a relative low and then the stock collapsed because earnings were worse than expected.

In March 1996, FC StochVol was below its lower Bollinger Band boundary but after its crossing of the trigger line a nice rally occurred. In June and July 1996, Motorola was in a trading range between $60 and $67, volatility reached lows, FC StochVol was constantly below 20, then the stock gapped down and collapsed. Just when volatility reached the top and the FC StochVol indicator crossed below the trigger line, the security found and confirmed support at $52-1/2.

Between June and July 1996, the FC StochVol showed very low volatility and when the indicator crossed above the trigger line, the market made a 10% downside move finding the bottom in conjunction with the top of FC StochVol. In the last half of December 1995, the FC StochVol fell below its lower band, while the DAX was testing major resistance at 2300. The volatility charged the "spring-loaded toy" and the German index rallied 200 points, reaching 2500 at the end of March while the indicator was crossing the trigger line in overbought area.

In July 1996 the DAX was in a narrow trading range and the indicator was close to zero. Then, the market collapsed from 2570 down to 2450 in three trading days while the FC StochVol was rising quickly. Again, when FC StochVol reached the top boundary and crossed below the trigger line, the market confirmed support at 2450. In the first half of September, the FC StochVol indicator fell below 20 and crossed above the trigger line. The DAX broke resistance at 2570 and rallied another 200 points up to 2750.

Exhibit 4 shows the Nikkei 225 Index between August 1994 and July 1995. In the last half of December 1994, the Nikkei formed a narrow trading range between 19500 and 20000. When the indicator fell below 20, the "spring was loaded." In the next few days the market suffered a 1000 points correction testing and confirming support at 18000. When the indicator rose above 80, the market confirmed support at 18000, and when the indicator crossed below the trigger line, the Nikkei ended its pullback, finding a short-term resistance.

Nevertheless, during those days, the Japanese market remained very volatile and continued its correction. The indicator crossed above the moving average confirming the extreme volatility of the market, but when FC StochVol crossed for the second time below the trigger line and fell below 80, it stated that the market had reached major support. Between April and May, the Nikkei made a pullback, retested the 17500 resistance, while the FC StochVol indicator fell below 20. Then, the market continued the previous downtrend, breaking down support at 16500 while the indicator crossed above the trigger line, another confirmation of the strength of the current trend.

The volatility reached the top and FC StochVol rose above 80. The index formed a double bottom between 14500 and 15500 that decreased volatility and the oscillator crossed below the trigger line.

This chart also displays the Relative Strength Index. Note the long-term positive divergence RSI—Nikkei—FC StochVol. Three consecutive lower lows for the price, three consecutive higher lows
for the RSI, and three consecutive lower highs for the FC StochVol with the first two highs above the upper boundary and the third that failed the crossing of the adaptive level. This can be read as a loss of momentum of volatility, something like “the spring charge is weakening,” confirmed by the RSI that formed a positive divergence. We can say that a divergence between price and RSI (or any other momentum indicator), confirmed by toppish FC StochVol, means that the current trend is ending. In fact, divergences in momentum indicators imply a loss of momentum of price, weakening of the current trend and possible reversal, while toppish FC StochVol is related to possible consolidation phases. Divergences in momentum indicators, filtered with toppish FC StochVol above its upper Bollinger Band, provide fewer whipsaws because the loss of momentum of price action is confirmed by a loss of momentum of volatility. This is an excellent entry point for options writers who want to sell volatility.

**Summary**

- Historical volatility is useful for both technical analysis and options trading.
- Bottoms of volatility confirmed by FC StochVol indicator below 20 and/or below its lower Bollinger Band boundary are related to possible breakout of congestion phases.
- Tops of volatility confirmed by FC StochVol indicator above 80 and/or above its upper Bollinger Band boundary are related to temporary interruption of the current trend and formation of congestion phases (rectangles, triangles, flags, pennants).
- Higher lows of FC StochVol indicator are related to strength and continuation of the major trend.
- Lower highs of FC StochVol indicator are related to maturity of the major trend and formation of important peaks or troughs, especially if the most recent highs fail to cross the upper boundary.
- Divergences in price-momentum oscillators confirmed by toppish FC StochVol above 80 and/or above its upper Bollinger Band boundary are more reliable.
- Traders should consider volatility more precisely. Too often I meet traders considering volatility as “the unknown beast” or, more commonly, talking about it in a very confusing manner and many of them, when they lose money, accuse “the volatile market” for their losses. I hope this article will help them because volatility helps me every trading day.

**Footnotes**

1. Many thanks to Martin Pring; KST is for “Know Sure Things.”
2. Where FC HistVol is for “Francesco Cavasino Historical Volatility.”
3. Where FC HistVol is for “Francesco Cavasino Stochastic of FC HistVol.”
4. The length of the stochastic can be modified to change the reactivity of the indicator. I found that lengths from 21 up to 80 work well on a daily basis.
5. Or down.
6. $N(0,1)$.
7. The likelihood of the hypothesis (lower band < FC StochVol < higher band) is asymptotic to 68.6% but the likelihood of the hypothesis (lower band < FC StochVol) is asymptotic to 84.13% based on the hypothesis that the distribution of the values of the indicator is similar to a standard bell curve $N(0,1)$.
8. A trading system based on crossing of two moving averages and a low volatility filter usually enters from 5 to 12 trades per year.
9. Where $u$ is the value of the upper Bollinger Band of FC StochVol.
11. This means a low value of FC StochVol.
12. From $57 up to $67.

**Dott. Francesco G. Cavasino**

Dottore Francesco G. Cavasino was graduated in 1996 from Bocconi University in Milan, and wrote a thesis entitled “Comparing Western and Japanese Technical Analysis Charting Techniques,” which was published by Società Italiana di Analisi Tecnica (SIAT), the Italian member of IFTA. He studied technical analysis at the New York Institute of Finance and he is a professional trading systems developer and options trader. Francesco will teach the forthcoming options course of SIAT. He dedicates this paper to Orson Indios dell’Armida.
Time of the Daily High and Time of the Daily Low

Arthur A. Merrill, CMT

Does the time of the high for the day and the time of the low give a clue to the performance on the following day?

For example, suppose that the market high point was at the opening, the low at noon, followed by a rally in the afternoon. What are the prospects for a rise on the next day?

The answer can be found by consulting the record. For classification, the hours of the day could be expressed by digits:

1. 10 AM (in the early part of our data bank the opening was at 10 AM; to be consistent we use 10 AM throughout the report.)
2. 11 AM
3. Noon, etc.
7. Close

The location of both high and low could be a two-digit number. For example, a day with the high at 11 AM and the low at 3 PM would be classified as 26.

The results were checked for significance by the Chi Squared test. For example, if the market rose four times on the following day and declined on three, the difference could be expected to occur by chance only once in 20 repetitions, the result was labeled "PS" or "probably significant." You would have 90% confidence that the difference was meaningful and not a lucky score. If the Chi Square test showed only one in 100, or 99% confidence, the result was labeled "S" or "Significant."

The computer was first put to work on the single-digit classification. The data bank included the hourly record for a 21-year (1971-1991) span. The position of the high for the day was found "probably significant" only at 10 AM, when it gave a bearish indication for the next day. However, the probability isn’t startling; the next day rose 602 times and declined 650 times; the odds for a decline are only about 11 to 10. This isn’t very useful, even though there appears to be a definite bias.

The position of the low showed a probably significant bullish bias when it occurred at 10 AM, with odds of about seven to five. The last two hours are interesting: When the low occurred at 3 PM, the indication is bullish! In both cases, the confidence level was 99%. The odds were seven to five at 3 PM, and only seven to six at the close. While there appears to be a definite bias, the odds aren’t very useful.

The computer was then asked to look at the two-digit classification; i.e. the position of both the high and low. The results are in the table to the right. The first column is the two-digit classification. You can get an idea of probability by comparing the number of times the market rose on the following day (U) with the number of declines (D). The results marked with an "N" are interesting, but with a confidence level below 95%.

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<th>Two Digit Classification</th>
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