Technical Analysis of Commodity Price Behavior

by

Joel Fingerman

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Introduction

In the day-to-day world of Futures Trading and Data Analysis the dominate mode of analysis is the technicals method. Methods such as moving averages, stochastics, oscillators, etc. are used to analysis and forecast price moves in commodities.

Traditional academic business forecasting methods are based on statistical theory, regression analysis, and statistical time series methods whereby the practitioner can directly judge the quality of the forecasting method through standard statistical methods.

The academic business community tends to scoff at technical methods as being superficial or naive. Yet, the "technical trading" methods must, in some sense, work. They are used, with apparent success, otherwise, considering the importance of these exchanges and the amounts of money that are at stake in these markets, the techniques would not be employed.

Thus, the aim of my research is to reconcile and understand the distinctions between these two broad approaches to the futures markets.

Previous Studies in this Area

I wish to thank Professor Scott Irwin of the Ohio State University and Professor B. Wade Brorsen for supplying me with numerous references and studies that they and their colleagues have conducted in this area. See citations 4., 5., 11., 12., 16., 17., 18., 19., 20., 23., 24., and 25. in the list of References. Professors Irwin, Brorsen, and Neftci as well as Lukac and others have demonstrated the profitable use of technical trading tools in particular circumstances. Irwin, Brorsen and others have shown technical trading systems can improve efficiency in markets, can improve gross trading returns, and are thus not a worthless tool for a trader.

The Concept of Rational Belief

In this paper I am not distinguishing between a trader who takes hedge positions from a trader who takes speculative positions. The trader is in a position where he/she collects information about the market, the market history, the current market conditions. The trader must consider the current financial position, winning trades, losing trades, etc. As I have observed traders in action I have been struck by their level of *rational belief*. That is, in order to make a decision about a buy, a sell, or a do-nothing, the trader must believe in the decision, and the trader, we hope, has a rational belief to direct or support the decision.

Indeed, I have witnessed traders make very successful trading decisions on very strongly felt beliefs which they could neither articulate nor defend. In philosophical terms, to have *knowledge* about a market situation, there must be *belief* about the market, and that *belief* must be linked somehow to some *fact or proposition* that is believed. If there is no linkage, there may be *true belief*, but we cannot term this knowledge. I call this *true belief without rational basis*.

[†]Associate Professor of Management and Quantitative Methods, Roosevelt University, Chicago, Illinois.

I have also observed traders who *understand and accept rational arguments*, who have before them compelling facts and information as to the current and future nature of a market, and yet because *they do not have a concurrent belief*, they will not make the trading decision in keeping with the accepted rational arguments. I observed traders who have a good opportunity to make a successful trade let the opportunity pass because they ultimately do not have the true belief in the facts presented to them. I call this *facts and rationality without concurrent belief.*

The Philosophical Notion of Rational Belief

While the concepts of knowledge and rational belief go back to Aristotle, I shall summarize the some of the more recent philosophical positions on rational belief (See Nozick [1981], Putnam [1977], as examples.) There are essentially four parts to the concept of rational belief. We have a trader which we denote T and some fact or proposition about the market which we denote p. Examples of a fact or a proposition:

p: The USDA has released a report of a bumper crop of wheat and therefore it is expected that prices will drop.

p: Two moving averages of prices have crossed (they have equal value) and this means that the change in the price trend is definitely confirmed.

p: The RSI of a price is now above 80 for the second time in recent price moves, this means the commodity is overbought.

For the trader T to have a rational belief regarding p requires:

1   That p is true

2   T believes that p

3   There is a justification for the belief in p, and T can supply that justification.

4   There is a one-to-one correspondence between the evidence and the belief.

In this setting points 3 and 4 are the most important for the trader using technical analysis. The trader who uses technical analysis collects a set of mathematical formulas about which he/she has a rational belief that they are accurately and usefully describing market behavior. The information/evidence available to the trader is usually in the following categories:

1   The current and recent past behavior of the market.

2   The technical indicators.

3   A system of combining the information and evidence of the market behavior.

4   Some "fundamentals", which are usually used to confirm the belief the trader has gained from the technical indicators.

5   Basic trading rules and discipline.

6   Risk management rules.

7   Money management.
               asset allocation and portfolio management

Points 5, 6, and 7 are important issues for any trader to have under control, but are beyond the scope of this paper. Points 1 and 4 could be termed the basic information or understandings the trader has about the commodity market. The focus of this paper is on points 2 and 3 in that my interests lie in what the technicals reveal about the market and the thought processes and logic a trader uses when incorporating technical methods in his/her rational beliefs and decision making. The technicals tools and the traders logic are both deductive and inductive in their approach.

Philosophy of Science: Distinctions between Deductive and Inductive Logic

In recent years that has been considerable activity in the academic philosophy community in the philosophy of science, especially in the areas of deductive and inductive logic. In the last 35 years, starting with Karl Popper [1959, 1963, 1972], through to Imre Lakatos [1974, 1976, 1978], and Thomas Kuhn [1962], there have been very interesting studies in the growth and progression of scientific knowledge, as well new understandings of the distinctions (or lack of distinctions) between "deductive" and "inductive" logic. This has recently been taken up in the area of the development economic theory and economic history by Weintraub [1991], McCloskey [1986], and deMarchi [1988].

One of the most interesting depictions of the difference between deductive and inductive logic was developed by Lakatos. As described by Lakatos [1978], Euclidian geometry was one of the first examples of a purely "deductive system," different from natural science which is a "quasi-empirical inductive system."

> . . . [Euclidian geometry] is a deductive system with an indubitable truth-injection at the top (a finite conjunction of axioms) — so that truth, flowing down from the top through the safe truth-preserving channels of valid inferences, inundates the whole system.

> It was a major shock for over-optimistic rationalism that [natural] science — in spite of immense efforts — could not be organized in such Euclidean theories. Scientific theories turned out to be organized in deductive systems where the *crucial* truth value injection was *at the bottom* — at a special set of theorems. But *truth* does not flow upwards. The important logical flow in such *quasi-empirical theories* is the not the transmission of truth but rather the retransmission of *falsity* — from special theorems at the bottom ('basic statements') up towards the set of axioms.

> A Euclidean theory may be claimed to be true; a quasi-empirical theory — at best — to be well-corroborated, but always conjectural. Also, in a Euclidean theory the true basic statements are at the 'top' of the deductive system (usually called 'axioms') *prove*, as it were, the rest of the system; in a quasi-empirical theory the (true) basic statements are *explained* by the rest of the system.

> Whether a deductive system is Euclidean or quasi-empirical is decided by the pattern of truth value flow in the system. The system is Euclidean if the characteristic flow is the transmission of truth from the set of axioms 'downwards' to the rest of the system — logic here is an *organon of proof*; it is quasi-empirical if the characteristic flow is retransmission of falsity from the false basic statements 'upwards' towards the 'hypothesis' — logic here is an *organon of criticism.* [pp. 28-29]

Diagrammatically, we can illustrate the philosophical distinctions between the two forms of reasoning:

Deductive Reasoning	Inductive Reasoning
(Mathematical, Euclidean Systems)	(Scientific, Statistical Systems)
Set of Axioms Truth Statements	Set of Hypotheses Conjectural Statements

⇓   Organon of Proof
     Transmission of Truth
	⇑ Organon of Criticism
	     Retransmission of Falsity

Solving Problems	Basic Statements

Examples

Galois Theory	Perihelion of Mercury
Fibonacci Sequences	Moving Average Systems

Two Examples of Deductive Reasoning

As one example of these distinctions, we consider the mathematics of Galois Theory that was developed in the early nineteenth century. A group theoretic system in modern algebra discovered around 1820, it was not until the 1930's that Galois Theory was found to have an important application in the description and characterization of crystal structures in physical chemistry. Because Galois Theory was developed through an abstract, deductive mathematical system there was no question of the truth and validity it brought to chemistry in its application to crystal structures. There are many examples of the application of pure, abstract mathematics to science in which there was no intended application of the mathematics for a particular use. The physicist Eugene Wigner once described this phenomena as the "unreasonable effectiveness of mathematics to science."

Similarly, technical traders who use the theory of the Fibonacci Sequence are beginning with a mathematical deductive system of properties and ratios associated with the Fibonacci sequence. The major idea of using Fibonacci sequences and ratios for estimating the future changes of commodity prices come from the trader's belief that price behavior is a semi-regular, cyclic behavior which is dependent on the way price behavior has gone on before. Since Fibonacci sequences originated from pure, abstract mathematics the truth flow starts at the top and goes down through the system. From the trader's perspective, the validity and truth of the Fibonacci values of price moves is established by the validity and truth of the mathematics of Fibonacci sequences.

Two Examples of Inductive Reasoning

The key ideas of the logic of inductive reasoning is that a the process begins with hypotheses or conjectures (not basic axioms) which are repeated tested by increasing more severe tests of the conjectures. Historically, Einstein's Theory of Special Relativity gained considerable acceptance when the Theory of Special Relativity was able to both explain and predict the change in the perihelion of the planet Mercury in its orbit around the Sun. Einstein's theory explained the effect of the Sun's gravitational pull on the light waves reflecting off of Mercury on route to Earth and therefore changing

the measurement of the perihelion of Mercury.

If a scientific or statistical theory fails a severe test (some Basic Statement) then there is a Retransmission of Falsity "upwards" towards the "hypothesis." Inductive hypotheses or conjectures are never formally "proved," they are repeated subjected to ever more severe tests. The tests corroborate the hypotheses, provide the hypotheses with more convincing evidence.

Similarly, moving averages technique is based on the idea that a market tends to trend in the same direction as it has been going. Therefore, if the technician can find an underlying smoothing of the data he/she may clearly distinguish the trend.

Another common use of moving averages is the combination of two moving averages of differing length (say a 5-day and a 35-day moving average). When the the two moving averages cross this is a signal or confirmation of a price trend change.

In both examples of moving averages the logic of reasoning is inductive. The conjecture to be tested is that moving averages provide a filter of the noise in commodity data. Underlying price trends or changes in price trends are revealed through moving averages. The support of the conjecture is through "backtesting" as several of the technicians described it. Essentially they are doing in-sample testing of their conjecture. They will test a whole collection of moving averages and moving average combinations to determine the best period length and/or combination of moving averages. Obviously, the most severe test of this system is the profitability of the system.

The technical indicators or methods are the propositions, p, discussed above, which the technical analyst comes to rely upon to support his/her rational belief in the trading decision. The truth or validity of the propositions is, in part, dependent upon whether the logical basis of the proposition is deductive or inductive.

A rough categorization of technicals methods by deductive or inductive approach would divide the technicals would be as follows:

Deductive Technicals	Inductive Technicals
Fibonacci Systems	Moving Averages
Elliot Waves	Moving Average Systems
Gann Analysis	Point-and Figure Charting
Momentum	Swing Trading
Oscillators	Channel Rules
Relative Strength Index	Spreads and Spread Relations
Velocity and Acceleration	Regression Methods
	Volume-Open Interest Methods
	Time Series Methods

The Logic of the Thought Processes for a Technicals Analyst

There are a several fundamental concepts which form the foundation for using technical analyses and for a trader to have a rational belief in their value.

A   Both Deductive and Inductive Technical Methods Exist

There are technical indicators which are deductive in their approach and their are technical indicators which are inductive in their approach. While a trader who uses technicals would not explicitly state whether the system they are using is deductive or inductive, I have observed that the technical analyst will intuitively understand the distinction between the two approaches when he/she is in the position to defend a particular technical method.

B   The Market has a Memory

The price history of a market is useful and often a valid indicator of future price moves. We observe this in that a technician will use "backtesting" for both developing and validating the most appropriate system. The implicit belief is that if the system works well over the last five years, then it should work well for at least the next year.

That the market has a memory also means that every market has a particular character for a technical analyst. This means that if a technician recognizes the current market conditions as being very similar to a previous market, then the technician expects the market to behave as it did in the past.

One trader who is representative of this approach stated to me that he uses an "eidetic" method where he will compare the current year's market behavior with several other years market behavior. He will look for all the parallels between today's market conditions and some previous time when it had closely similar conditions. He will look for that particular year whose past behavior is most similar to the current. From his memory about the similar previous year's behavior he will determine the particular character of the current year's market behavior.

C   The Market Moves in Cycles or Patterns

That the market has a memory also means that cycles or patterns exist. It is therefore the opportunity for the technician to understand the underlying cycles or patterns that exist in the market prices and exploit that understanding. This is certainly the basis for Elliot Wave or Gann Analysis.

D   There is almost an Organic Character to the Markets: Distinguishing between Forecasts and Predictions

A major distinction between the trader using technical methods and an academician using statistical methods are the assumptions about the character of the data and information available.

For example, one important assumption for the econometrician is the random nature of the innovation term. A statistical forecast uses a statistical model which is in large part based on both the characterization of the random error term and the minimization of the squared random error term, the usual OLS method of regression models.

The regression models

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t$$

or

$$Y_t = \delta + \phi_1 Y_{t-1} + \epsilon_t$$

are based on the stochastic nature of ϵ_t and are statistical forecasts of future values of Y_t. These equations are *descriptive* and *normative*. They are describing correlation not causation. *The statistical analyst makes forecasts, not predictions.*

Whereas for the technicians, commodity price behavior can often be understood in terms similar to physical formulas.

The physical formulas

$$Y_t = \tfrac{1}{2}gt^2$$

or
$$F = ma$$

are based on physical laws. These equations are *prescriptive* and *explanatory*. *The physicist makes predictions, not forecasts.*

I have observed with different technicians that they tend to view their analysis form the perspective of physical law-like formulas. The market is obeying some prescribed organic or physic-like law. An excellent example is the fascination that many technicians have with Fibonacci series. Formulas which are describing some physical or organic nature of the commodity markets.

As a simple example, consider a high-low-close bar chart time series of a commodity price. From the perspective of basic statistics, we first ignore the highs and lows of the daily data, and just consider the daily close. We then use OLS to find an equation of a straight line to the data as a first order approximation of the behavior of the data. The data has stochastic properties around the fitted line, there is randomness surrounding the fitted line.

From the perspective of a technician who uses a pure "Chartist" system approach to the bar chart time series there is much less random behavior. The open-high-low-close bar chart is displaying an almost "organic" behavior of forming patterns and relationships. It is as though the commodity price behavior is following some physical, biological law as the price pattern develops and is revealed.

E   Technical Indicators are often a Measure of Market Psychology: The Psychology of the Perception of the Market

From one perspective technical analysis is not a measure of the value of the commodity that is being analyzed. I would argue that technical methods are a measure of the *psychology of the perception of the market*. Several of the technical indicators, such as RSI, Slow and Fast Stochastics, are more a measure of market conditions, of what the market believes the price should or should not be, and then how to react to the market conditions.

F   Technicians use "Fundamentals" Information

While the Technical Analysts believe that the Market discounts everything, that all the information about the Market is measured by its essence: Market Price, they certainly do not ignore fundamental information about supply and demand issues. In fact some of the Technical Analysts with whom I have discussed technical methods are extremely knowledgeable when it comes to fundamental conditions in the market.

However, Technicians tend to use "fundamentals" for purposes of confirmation of their beliefs or even to act as "contrarians." In other words, after the technical analyst has developed his/her rational belief based on technical methods, the analyst will compare and confirm his/her belief through fundamentals.

Two Major Criticisms of the Technicians Systems

A   The Lack of Falsifiability Tests or Conditions

Often the systems cannot be tested for a Popper-Lakatos notion of falsifiability. The Eliot Wave Theorists, the Chartists, etc. cannot offer a clear, severe test that can potentially falsify their system. In one sense a clear, severe test of a technical system is quite simple: does the system save money for the hedge trader or does the system make money for the speculative trader? If the answer is negative, then the technician tends to have additional clauses or conditions to explain away why the system did not perform. And while the system did not work this time, according to the technician, it has not be proven to be false or incorrect and should work in the future.

Technicians must offer tests, severe tests, of their system that potentially can falsify the system. There must be a falsifiablity test for any rational, explanatory system.

B   The Lack of the Ability to Replicate Results

If two technicians who claim to use essentially the same technical tools for their analyses and are supplied the identical data and the identical market information they will not reach the same conclusions.

This is quite different from econometrics. If two econometricians are provided identical data, and use the same modeling techniques they usually get identical results. In science, if results by one experimenter cannot be replicated by another experimenter, the results are questioned. For technicians this is the problem of replicability. In technical systems which are very "personal", i.e. dependent on the judgment on the individual trader, results often cannot be replicated.

If the trader is using a technical tool which has a "deductive basis" the trader is intellectually obligated to understand and justify the basic axioms of the the system, the truth-flow, and the appropriate applicability to the market moves.

If the trader is using a technical tool which as an "inductive basis" then trader is intellectually obligated to describe severe test that would falsify the system. And display occasions where the system has passed severe tests.

Technicals Mysteries Revealed!

We end with a simple example of a technical indicator, especially as measure of the psychology of perception in the market. Numerous technical rules or formulas are often a simple idea disguised by seemingly complicated algorithm.

The Relative Strength Index (RSI)

We reproduce a portion of an article by Peter Aan [1986] calculating the RSI for the closing price of hogs.

You must collect 14 days of closing prices to begin. Looking at the daily net changes (DNC) from the previous close, add all the *up* DNC's and divide by 14 to get the *up average*. Total all the *down* DNC's and divide by 14 to get the *down average*. Divide the average up DNC by the average down DNC. Add 1 to this result

and divide the new result into 100. Subtract this figure from 100 to get the first RSI. For each day thereafter, if today's DNC is up, multiply the previous average up DNC by 13, add today's DNC, and divide by 14. If today's DNC is down, use the same procedure with the average down DNC.

To work through a numerical example of starting the RSI, suppose the price action in hogs over the past couple weeks was:

Day	Nearby Futures Closing Price	Daily Net Change (DNC)	Up DNC	Down DNC
1	39.12			
2	40.15	+1.03	1.03	
3	40.80	+.65	.65	
4	41.15	+.35	.35	
5	39.90	− 1.25		1.25
6	38.70	− 1.20		1.20
7	39.12	− .58		.58
8	40.02	+.90	.90	
9	39.77	− .25		.25
10	39.05	− .65		.65
11	39.47	+.42	.42	
12	40.27	+.80	.80	
13	40.35	+.08	.08	
14	41.07	+.72	.72	
15	40.70	− .37		.37
Totals			4.95	4.30

$$4.95 \div 14 = .354 = \text{up average}$$
$$4.30 \div 14 = .307 = \text{down average}$$

$$\frac{\text{Up average}}{\text{Down average}} = \frac{.354}{.307} = 1.15 + 1 = 2.15$$

$$100 \div 2.15 = 46.5$$
$$100 - 46.5 = 53.5 = \text{RSI for Day 15}$$

The verbal description of the formula can be mathematically written as follows:

Let DNC_i^+ denote the absolute value of a positive daily net change.

Let DNC_i^- denote the absolute value of a negative daily net change.

Wilder's RSI is then, according to above description,

$$RSI \;=\; 100 \;-\; \left[\; 100 \div \left[\; \frac{\dfrac{\sum\limits_{i=1}^{14} DNC_i^{+}}{14}}{\dfrac{\sum\limits_{i=1}^{14} DNC_i^{-}}{14}} \;+\; 1 \;\right]\;\right]$$

After some examination of the formula we see that the formula is dividing by 14, then later multiplying by 14; adding 1, then later subtracting 1, and so on. The RSI formula simplifies to

$$RSI = 100 \times \frac{\sum DNC_i^{+}}{\sum DNC_i^{+} \;+\; \sum DNC_i^{-}}$$

The number of days for which the RSI is calculated is arbitrary and independent of the formula. Choosing 14 days, 9 days, whatever, is determined by the user of the formula.

So in the example reproduced above we simply calculate

$$RSI = 100 \times \frac{4.95}{4.95 + 4.30} = 53.5$$

It is not necessary to go through all the other calculations.

We note the obvious inequalities

$$0 \;\leq\; \sum DNC_i^{+} \;\leq\; \sum DNC_i^{+} \;+\; \sum DNC_i^{-}$$

$$0 \;\leq\; \frac{\sum DNC_i^{+}}{\sum DNC_i^{+} \;+\; \sum DNC_i^{-}} \;\leq\; 1$$

$$0 \;\leq\; 100 \times \frac{\sum DNC_i^{+}}{\sum DNC_i^{+} \;+\; \sum DNC_i^{-}} \;\leq\; 100$$

As constructed the RSI is always between 0 and 100.

It is easy to see that if the sum of the up moves is equal to the sum of the down moves, i. e.,

$$\sum DNC_i^{+} \;=\; \sum DNC_i^{-}$$

then the RSI = 50.

Wilder and others comment that an RSI above 50 means an up trending market and less than 50 means a down trending market. This is true since an RSI greater than 50 means that the sum of

the up moves is greater than the sum of the down moves in the market. And the converse.

As a signal of a market being overbought or oversold Wilder and others use informal rules of an RSI at 80 is a signal of the market being overbought and an RSI of 20 signals that the market is oversold.

Using the simplified RSI formula we see an RSI of 80 just means that the ratio of the sum of the up moves to the down moves is 4 to 1.

$$80 = 100 \times \frac{\sum DNC_i^+}{\sum DNC_i^+ + \sum DNC_i^-}$$

means

$$\frac{4}{1} = \frac{\sum DNC_i^+}{\sum DNC_i^-}$$

Consequently, the market psychology that is being measured by the RSI is that the market is viewed as overbought if the sum of up moves is four times the sum of down moves. It's time to sell.

And conversely, an RSI of 20 means that the ratio of the sum of up moves to the sum of down moves is 1 to 4. Market psychology is that the market is oversold if the sum of the down moves is four times the sum of the up moves. It's time to buy.

Summary

Technical systems can have useful value in anticipating short term market direction. However, it appears that most technical systems are developed and used because of their ease and comfort level they afford the analyst. Often there is not a lot of indepth analysis or understanding as to why the technical systems work and why they are are successful. If technical analysts understood better the foundations and logic of their technical systems they would understand why and when the systems work, and more important, why and when they do not work.

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