RELATIVE PRICE PERFORMANCE: THE THEORY AND AN EMPIRICAL TEST

by

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ABSTRACT

This study has a twofold purpose. The primary purpose is to examine empirically the hypothesis of relative price performance. This hypothesis states that issues in the stock market which have recorded a price performance superior to the market for a period of time will tend to continue to record a superior price performance relative to the market. Conversely, those issues which have recorded an inferior price performance relative to the market will tend to maintain an inferior relative performance. The secondary purpose of the study is to develop a theoretical framework that attempts to explain how complexity in corporations is a constraint on the analysis of those corporations and is a determinant of security price behavior.

The data consisted of a sample of 124 companies which constituted those stocks included in the four major indices on the Toronto Stock Exchange as of January 1, 1965. The data tested were adjusted monthly stock prices covering the period January, 1965 to November, 1969. The methodology employed was the estimation of regression equations to determine the relationship between historical measures of relative price performance and subsequent relative price performances.

The results of the empirical testing provide no support for the hypothesis. In practically every regression equation estimated the significance of the findings was almost negligible. The findings inferred that the hypothesis should be rejected.

The development of a theoretical framework involving complexity in corporations and information types demonstrated that trends in security price movement are logically possible but only in certain cases.

As a consequence of the two purposes of the study two conclusions were arrived at. Firstly, the hypothesis as tested here must be rejected due to an absence of any support for it. Secondly, recognition of the constraining influence of complexity on the security valuation process revealed that certain categories of companies would tend to exhibit a consistency in their securities' relative price performance. Therefore it was suggested that future research in the field of security price behavior should give consideration to disaggregating the sample into categories of complexity.

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INTRODUCTION

> There is nothing as disastrous as a rational investment policy in an irrational world.
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> - John Maynard Keynes.[1]

The above quotation summarizes very nicely a major dilemma that has faced the investment community for years - the rationality of the stock market. Investors, investment managers and economists have attempted for decades to understand the rationality of the market's behavior. Throughout the years a diversity of opinions and explanations have been espoused and employed in attempting to forecast stock prices. Many of these explanations have been applied and developed into more mature theories while others have been disputed and rejected. In spite of the fact that the stock market has been a subject of enquiry for many years the investment community and academics continue to debate the basis of its behavior.

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[1]Jerome B. Cohen, Edward D. Zinbarg, Investment Analysis and Portfolio Management. (Homewood, Ill.: R.D. Irwin, Inc., 1967), p. 503.

Amidst the arguments two schools of investment analysis are predominant. The fundamentalist school proposes that the basics or fundamentals of corporate and economic data can be analyzed to forecast the earnings flow of firms to determine their present value. The present value is then compared to the market value and if greater, the issue is suggested for purchase, if less then the issue is suggested to be sold. From the fundamentalist theory numerous valuation models have evolved hypothesizing the relationship of the fundamental variables. While the "technical" school of analysis puts forth the theory that various market indicators are more useful in forecasting stock prices rather than analyzing the fundamentals of companies. The technical approach has resulted in the creation of different measures and indices to gauge the sentiment of the market and the demand-supply forces behind individual stocks within the market. The technical approach, however, has come under opposition in recent years from advocates of the random walk theory. The random walk model is based on the premise that successive price changes are independent which is in contradiction to the technical analyst's view that trends exist between successive price changes and can be detected by certain technical indicators.

This paper is an analysis of the relative price performance hypothesis or as it is more commonly referred to,

the relative strength hypothesis. It presents tests of several alternative formulations and specifications of the hypothesis.

PURPOSE OF STUDY

There were two purposes to this study. The first was to test the hypothesis of relative price performance and determine its validity. Relative price performance is a measure of an individual security's price performance for a given time period in the market relative to all other issues or a segment of all other issues' price performances. It is hypothesized that an issue which has recorded for a period of time a price performance superior to other issues will tend to continue to do so. Conversely, an issue which has shown an inferior price performance relative to other issues will tend to continue to record an inferior price performance.

As this study was undertaken it became clear that the theoretical underpinnings of technical analysis and that of the random walk model were inadequate. The theoretical inadequacy appeared to stem from a lack of consideration given to the limitations of uncertainty in the security valuation process. The neglected problem of uncertainty in the security valuation process prompted questioning of the analytical process from a general systems viewpoint.[2]

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[2]Refer to Chapter V for an explanation of general systems.

This is relevant to the second purpose of the study. This was to develop a theoretical framework that attempts to explain how complexity in corporations is a constraint on the analysis of those corporations and is mirrored in their stock's price movement. In essence, the framework developed is an attempt to explain the limitations placed on rational decision making in the market.

IMPORTANCE OF THE STUDY

The examination of relative price performance (relative strength) is important as it may indicate changing supply-demand factors of individual issues which can be used as a preselection technique in conjunction with fundamental analysis. A changing relative strength position for an issue and tending towards the same direction (i.e. a trend) may be of significance, as the first indication of a substantial change in that issue's valuation. Relative strength then, although a technical indicator, may be used as a complement to fundamental analysis by preselecting issues which should be analyzed.

The development of a theoretical framework revealing the constraint of complexity in the security valuation process is of value in illustrating the relationship of complexity to the degree of accuracy in analysis and the predictability of forecasts. In other words, the measurement of complexity may be of value in measuring the risk

of inaccurate investment forecasts. Therefore an understanding of complexity and the possibility of its measurement is an attempt to enlargen the body of financial valuation theory. Also, the development of such a framework is a demonstration of how financial theory can be developed if an interdisciplinary approach is taken. This should include concepts of general systems, information theory and knowledge from fields of psychology and sociology.

OUTLINE OF THE PAPER

The theory of relative strength will be expanded in Chapter II and a hypothesis will be formulated to enable testing. A more complete discussion of fundamental and technical analysis and the random walk model than was given above will be presented to draw a more complete picture of approaches to security price behavior. Chapter III will present the data collected to comprise the sample, the methodology used and the tests conducted on the sample. Chapter IV is a discussion of the statistical findings indicating either acceptance or rejection of the hypothesis. Chapter V, which might be viewed as a separate topic, covers the second purpose of the study - the development and explanation of complexity, its role and constraining influence and the importance of information in the security valuation

process. The last chapter is a conclusion of the findings and the implications for further research resulting from the recognition that complexity in corporations is a determinant of security price behavior.

CHAPTER II

THE HYPOTHESIS OF RELATIVE STRENGTH

The hypothesis stated in Chapter I shall now be elaborated on. In order to appreciate the value of the theory of relative strength and its reasoning it is necessary to discuss before hand the general process involved in any analytical function and the diverging "fundamental" and "technical" methods of investment analysis. The hypothesis of relative strength will be explained within the context of the two schools of investment analysis and how it is in contradiction to the model of the random walk.

The General Analytical Process

The function of analyzing anything whether it be a living organism, a social problem, a political system, or a corporate entity can be broken down into four facets of study. The first facet in the analysis involves the scanning of all the data available, recognizing which factors might be pertinent and attempting to comprehend them. This part of the study enables the analyst to conceive a list of those

variables or facts that should be given further study. The second aspect of the analysis is the attempt to derive or estimate the causal relationships between the perceived factors and to express these relationships in quantifiable terms. The third aspect is the summarization of these factors and their relationships to arrive at a conclusion or valuation of that which is being studied. The fourth aspect is the analyst's comparison of his findings and valuations with those of others. The comparison is to determine if the analyst has discovered something which is substantially different from other findings and if so, are his findings important.

Fundamental Analysis

The analytic process sketched above approximates quite closely the ideal function of the "fundamental" security analyst. The "fundamentalist" as the name implies analyses the fundamental or the important factors of companies that will be reflected in those companies' potential earnings and future dividends. The fundamentalist will peruse a company's financial history noting sales growth, rates of profitability, earnings stability and all other factors which have had or could possibly have an influence on the company's earnings. Along with various underlying or causal factors including costs, assets, management

abilities, product potentials, tax rates, etc., the analyst tries to extrapolate trends and forecast future earnings. He also notes past pay-out ratios and examines possible circumstances that might justify a possible change in dividend policy. He then estimates future dividends that would accrue to the security holder. The analyst in his summarization of the firm's value arrives at an appropriate capitalization rate for the firm's earning power and finally places a value on the securities available.[1] The fundamentalist in following the fourth aspect of analysis compares his valuation with that in the market. If a substantial difference exists he will recommend to other investors to either purchase, hold or sell the firm's securities.

The fundamentalist carries out this process with the additional insight of economic trends, general business conditions and industry potentials. It is assumed that the fundamentalist armed with his accumulated knowledge and analytical abilities to deductively forecast potential returns will benefit more so than that part of the market which does not share his insight. The above is based on the premise that the analyst has been accurate and correct in his analysis and also that the market will in time change its valuation of the particular security towards that of the

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[1]Benjamin Graham, David L. Dodd, Sidney Cottle, Security Analysis - Principles and Technique. (4th edition) (New York, N.Y.: McGraw-Hill Book Co., Inc., 1962) pp. 434 - 449.

analyst's.

Technical Analysis

Technical stock market analysis is an attempt to study the internal workings of the market activities to gain insight to changing supply and demand forces either for individual issues or for the market as a whole. In contrast to the study of corporate and economic factors technical analysis is a study of past and current market action of stocks as a basis for forecasting stock prices.

Technical analysis is based on the premise that all the factors affecting stock prices including economic, political, emotional and corporate influences in the market enter into the forces behind the supply and demand for stocks and are eventually reflected in the price changes of those stocks. The technical analyst argues that all these factors cannot be examined accurately because of their diversity and volume. In addition, he argues that stock price moves are the result of interacting supply and demand factors which are also the result of the changing flow of funds between the securities.[2] Hence he holds that the changes in the security prices are noted first by technical indicators rather than by fundamental analysis of financial and economic data.

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[2]Jerome B. Cohen and Edward D. Zinbarg, Investment Analysis and Portfolio Management. (Homewood, Illinois: R.D. Irwin, Inc., 1967), pp. 503 - 534.

Some technicians hold the view that certain privileged people may obtain pertinent information even before the fundamentalists and that the trading patterns may change before the fundamentalists complete their analysis.[3] Furthermore, the technician points out that the fundamentalists are faced with the problems of unavailable and unreliable information and the interpretation of that information. These are only a few of the difficulties of fundamental security analysis which are encountered, not to mention the doubtful methods of presenting and reporting of financial statements. There also is the problem of the voluminous flow of information which must be analyzed and from the individual investors point of view it is impossible to attempt to undertake such a feat as keeping up with the information in the market.

The technical analyst espouses that because of the many problems encountered in attempting a fundamental analysis of securities the forces behind the supply and demand for common stocks do not change rapidly. The reasoning is that the numerous problems and factors involved in a fundamental analysis prevents the pertinent information, which could change the supply-demand forces, from spreading quickly throughout the market. Because information spreads

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[3]J.B. Cohen and E.D. Zinbarg, loc. cit.

throughout the market slowly there emerges patterns and trends in price adjustments for an appreciable period of time. This is the result of the market gathering momentum in recognizing the changed valuation of the stock. As a greater part of the market moves to trade the stock and benefit from an early recognition of the new value the price adjusts slowly and creates a trend in the price adjustments until the new valuation has been fully realized by the market and a complete price adjustment has taken place.

In contrast to the fundamental analytical process the technical analyst attempts to interpret the trends of the stock market by using developed indicators to gauge the changes in the supply-demand forces of the stocks.[4] To mention just a few indicators that are fairly common to practitioners of technical methods one could include the following: breadth of the market, volume of trading, short selling interests, odd-lot trading, price chart patterns, the well known Dow theory, credit balances in brokerage houses, rate of change analysis, confidence indexes and relative strength measures.[5] There are many other technical indicators that are also widely used but as this study is

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[4]R.D. Edward and J. Magee, Technical Analysis of Stock Trends. (Springfield, Mass., U.S.: John Magee, 1966), p. 277.

[5]J.B. Cohen and E.D. Zinbarg, loc. cit.

not intended to examine all the various indicators but rather just relative strength these other indicators are not discussed here.

Relative Price Performance

Keeping in mind the context of the two differing methods of investment analysis we can proceed with the explanation of relative price performance or as it is more commonly referred to, as relative strength. As mentioned above, relative strength lies within the province of technical analysis and is considered an indicator of price trends for individual stocks rather than for the market as a whole.

The hypothesis of relative strength in simple terms states that common stocks which have and are outperforming or underperforming relative to the overall market for a period of time will tend to continue to do so. They will tend to maintain their relative positions in the same direction.

Relative strength indicates the existence of either a strong demand for a stock or an abundant supply of that issue in the market comparable to other issues. A consistent pressure either upward or downward on a stock which is greater than a commensurate pressure on other stocks is an exhibition of forces that must have a consistent source. If

a trend of relative strength is established for a company it must have a causal factor which is consistently prevalent in the market. A company which does not have a continuing source of pressure on its stock may exhibit a case of strong relative strength but it will, in all probability, not be a consistent position of relative strength over time.

There have been many suggestions advanced to explain the possible sources of pressure that may be manifested in a consistent relative strength position for stocks. Garfield Drew suggests that relative strength could result from the actions of company officers and executives who have inside information relating to the company's prospects and earning potential.[6] While Volkert Whitbeck and Manown Kisor Jr. suggest that companies with a high degree of volatility in their earnings will tend to exhibit a greater divergence from the market movement than those companies with a lower degree of volatility in their earnings. During periods of market appreciation the companies with the more volatile earnings will appreciate more than the other companies' issues. Moreover, during periods of market decline these companies with the volatile earnings will experience greater declines in their stocks relative to the other companies'

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[6]Garfield Drew, New Methods for Profit in the Stock Market. (Boston, Mass: The Metcalf Press, 1954), pp. 268 - 269.

stocks.[7] However G. Drew contrarily suggests that those issues which have demonstrated superior performances in advancing markets will be resistant to downward pressures in declining markets.[8] Another possible explanation of the cause of relative strength trends is the gradual spread of information throughout the market causing a slow process in recognizing the new value of the stock resulting from changed prospects of the company. The effect could be a gathering of momentum in the market's sentiment towards the issue.

Whatever the cause is for a stock to demonstrate a strong or weak relative price performance as long as it has established a trend in its relative position it is hypothesized that the stock will tend to maintain its relative position in the market. The relative strength for such a stock from one point in time to another not too distant point in time should not change substantially. Statistically the relationship between the two relative strengths should be a high positive correlation. The

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[7]S. Whitbeck and M. Kisor, Jr., "A New Tool in Investment Decision Making". Reprinted in Frontiers of Investment Analysis (Ed. E.B. Fredrickson) (Scranton, Penn.: International Textbook Co., 1965), pp. 335 - 350.

[8]Drew, loc. cit.

following equation illustrates the case.

$$R_t / R_{t+1} \simeq 1.0$$

where: R_t is a relative strength measure for a stock at time t

R_{t+1} is the relative strength measure for the same stock at time t+1

The relative strength is calculated as the percentage price change of a given stock for a given time interval divided by the percentage price change of the entire market or of a related market segment for the same time interval.

R.A. Levy revealed some interesting findings of relative strength to support the arguments of the technical analysts.[9] He found that a serial correlation study of performance ranks rather than successive first differences detected the existence of trends over the long term but not over the short term. Basing his work on the belief that the co-movement of stock prices might conceal existing dependencies in successive price changes he made use of relative strength ranks to eliminate this co-movement. He constructed ratios designed to measure historical strength and future performance and then employed the historical ratios

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[9]R.A. Levy, An Evaluation of Selected Applications of Stock Market Timing Techniques, Trading Tactics and Trend Analysis, (unpublished Ph.D. dissertation, American University, 1966) pp. 83 - 185.

to select issues at a point in time. The selected issues were then compared with their subsequent (future)ratios to measure the investment "success".

Levy calculated five price ratios for each issue at weekly intervals:

- the performance over the past 26 week period by dividing the current price by the average of the 27 prices of the immediately previous weeks including the current price.

- the performance over the past 4 week period by dividing the current price by the average of the 5 prices of the immediately previous weeks including the current price.

- the future performance over a 1 week period by dividing the current price by the price of the following week.

- the future performance over a 4 week period by dividing the current price into the price 4 weeks subsequent to the current week.

- the future performance over a 26 week period by dividing the current price into the price 26 weeks subsequent to the current week.

He then ranked the performances according to relative strength, volatility of performance, the overall market weekly performance, a misbehavior performance and the market's divergence of performances.

Levy reported that historical relative strength tends to continue for a period of time. The short term future ratios did not bear this out but the long term

ratios did substantiate the hypothesis. His hypothetical investment results showed that the 10 percent historically strong stocks gained an average of 9.6 percent while the 10 percent historically weak stocks gained only an average of 2.9 percent in the same period. His correlation of historical and long term future groupings of performances was found to be significantly high for both the grouped ratios and the grouped ranks. Levy concluded that selection of relatively strong and relatively volatile stocks resulted in gains greater than those possible by random selection. He also found that superior performances could be achieved by purchasing stocks in a market which historically had been strong.

The Importance of Relative Price Performance

A change in the relative position of an issue tending toward the same direction over a period of time could be considered as an indication that the issue's market condition is changing and that a fundamental analysis of the company might reveal the cause or causes of the changing conditions. Therefore, although relative strength is a technical indicator it may be viewed as a valuable tool to be used as a preselection method for fundamental analysis. The ranking of relative strength filters out the co-movement in the market and can provide the fundamentalist with the advantage of readily noting superior

or inferior performances of issues. This is a definite advantage over the technical analyst who uses individual price charts as an indicator of future price changes which are difficult to compare.

To keep the concept of relative strength in proper perspective the contradicting theory of the random walk is set out below.

The Random Walk

To obtain a broader perspective of stock price movements it is valuable to discuss the theory and rationale of the random walk model which is in opposition to the theory of relative strength. The adherents of the random walk model advocate that successive price changes for common stocks fluctuate randomly around the true intrinsic value of the issues. The reasoning behind this theory is based on the premise that the stock market approximates to a large degree that of a perfect economic market. It is argued that the market allows easy entry and exit at a low cost and ensures that the price is quite free to adjust to minor changes in expectations resulting from news which enters the market randomly itself. Hence the price adjusts randomly operating as the equilibrating mechanism between

supply and demand forces.[10] Moreover, it is argued, that the investment community and the financial press services are very competitive with efficient methods of retrieving, assembling, interpreting and disseminating news. The result of such a market is almost instantaneous investor reaction to the random entry of news items and information. The final result is automatic price adjustments in stocks to their new value and in the process of doing so evidence random price behavior.

This chapter has explained the facets involved in the general analytical process, the differences between fundamental and technical analysis and finally how the theory of relative strength fits into technical analysis. Also explained briefly was the random walk model which purports to refute technical analytical methods.

The next chapter shall explain the methodology and data used in testing the hypothesis of relative strength.

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[10]R.A. Brealey. An Introduction to Risk and Return from Common Stocks. (Cambridge, Mass.: The M.I.T. Press, 1969), p. 5.

CHAPTER III

NATURE OF THE DATA AND METHODOLOGY EMPLOYED

This chapter sets out the process which was used in the collection of the data and the methodology used in the tests that were conducted.

Data

With respect to the assembling of data a major point of concern that arises is the suitability of the population to the constraints of the hypothesis. In the discussion of the hypothesis it was stated that a stock tended to maintain a position of relative strength as a result possibly of information spreading throughout the market. It was also stated that the hypothesis was in contradiction to that of the theory of the random walk which assumes perfect or near perfect market conditions. Although this is not an attempt to refute the contradictory theory the market chosen as the population should

approximate as best as possible a perfect economic market as a protection against using data that might have aberrations in it. A distinction is made here between different stock exchanges as markets and prospective populations for the following reasons. Conclusions drawn from a study of a particular market may not hold true to other markets as stock exchanges have different standards, requirements for disclosure and properties which prevent these different exchanges from having the same degree of market perfection. Therefore, the conclusions drawn from this study may not be valid for other stock exchanges or markets.

The market chosen from the possible Canadian stock exchanges to be the universe or population is the Toronto Stock Exchange. The Toronto Stock Exchange was chosen because it has been the largest Canadian exchange in terms of shares traded, dollar value and in the number of participants including a range of institutional and individual traders and investors. In addition, its information services are nationwide and it maintains the highest standards of disclosure and has always been a leader among exchanges in the use of automatic quotation systems.[1]

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[1]The Investment Dealers Association of Canada, The Canadian Securities Course. (Montreal, Que., 1968) chapter 16.

Once the population is chosen the next point of concern is determining a relevant sample which can be tested. Drawing statistical inferences from a sample for an entire population requires that the sample be representative of the population. The question arises of what data are available in a collated form at a reasonable cost or are available to be collated for testing. As there were no suitable data available in a form such as on magnetic tape ready for electronic data processing the data consisting of monthly stock prices were collected manually from the Toronto Stock Exchange Reviews which are published monthly by the Exchange. The sample chosen consisted of those stocks constituting the Toronto Stock Exchange Indices as of January 1, 1965. It was felt that since the exchange selects these particular stocks to form the major indices to represent the movement of the entire market and that these particular stocks are selected impartially on the basis of their trading importance in the market that such a sample would fulfill the sample requirements mentioned above. However, it is recognized that there is no documented proof that the Indices are true representations of all the listings on the Toronto Stock Exchange. Therefore a bias may exist in the chosen sample.

The Toronto Stock Exchange's Indices at that point in time consisted of 124 stocks representing a

statistical cross-section of the Exchange's active listings.[2] The Industrial Index being the broadest based and most representative index of the exchange's four indices, was employed in calculating the relative price performances of all the stocks in the sample. The four indices each represent a segment of the exchange's listings and the industrial index is made up of 86 stock's classified as industrial companies. The other 38 stocks in the sample are classified as being either a gold, base metal or western oil producer and make up the three other respective indices. However as no composite index existed to cover the entire sample the Industrial Index was used. If a composite index did exist which included the gold, base metal and western oil stocks as well as the industrial stocks then the relative price performances calculated for each stock would be directly related to that stock's proportional contribution to the index's movement. The effect would be an accurate measurement of each stock's relative price performance and an accurate basis for comparison between the stocks. Although the Industrial Index does not include all the stocks in the sample it does include a majority (69.4%) of the sample and therefore provides a

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[2]Since that time the indices have been enlarged and adjusted for the growth and continual changes that have taken place in the Toronto Stock Exchange. As of June, 1970 the four basic indices: Industrial, Gold, Base Metal and Western Oils consisted of 214 stocks.

fairly direct relationship of the sample's stocks contribution to the index. The Industrial Index does provide an adequate representation of the major facets of Canadian business and permits ready adjustment when changes occur in outstanding capitalization and facilitates the addition, deletion and/or substitution of one stock for another without disturbing the index.[3]

For each of the stocks in the sample monthly prices were collected for 58 consecutive months starting at January 1, 1965. For each stock data were gathered to make the necessary adjustments throughout the test period for stock splits and appropriate adjustments were made dating back to the start of the time period. This time period, January 1965 - November 1969, was chosen as it was the most recent data available and covered at least one full market cycle including an upswing, a peak, a downswing and a trough in the market movement. The complete cycle started at its peak, in January 1965, and declined to a low in October, 1966 and then reversed its direction to reach another peak and complete the cycle in August, 1967. It was considered important to use such a period including the different market phases to determine if relative strength was valid

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[3]The Investment Dealers Association, op. cit.,p. 258.

in all phases of the market or if its validity might vary according to the market phases.

The data were collected in monthly intervals for the following reasons. If an adequate size sample was required and a time period that covered a full market cycle was also required then the collection of weekly prices manually would entail a substantial amount of time. Therefore monthly prices were given thought to whether they might produce the hypothesized results. First, the calculation of a monthly price performance for a stock is almost identical to the cumulative price performance of weekly or daily price changes. Second, evidence to support the use of monthly prices was found in R.A. Levy's study of relative strengths.[4] Although his data base made use of weekly prices he grouped his data into four and twenty-six week periods of relative strengths. Examination of the short term rankings (4 week period) suggested that there was no discernible pattern in stock prices. In contrast, examination of the longer term rankings (26 week periods) illustrated that patterns do exist and support was given to the relative strength theory. In light of Levy's

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[4]Robert A. Levy. An Evaluation of Selected Applications of Stock Market Timing Techniques, Trading Tactics and Trend Analysis. (Unpublished Ph.d. Dissertation.) (Ann Arbor, Michigan: University Microfilms Inc., 1966).

findings that relative strength rankings of periods approximating 6 months showed discernible patterns and that relative strength rankings of periods approximating one month did not show any patterns it was felt that monthly data would be adequate. Therefore because of the time element which would be required in collection of the data and because of Levy's results it was decided that monthly prices could be used.

Methodology and Approach Taken

The approach taken in testing the validity of relative price strength was to use electronic data processing (IBM 360/67) and to calculate the statistical correlation between the historical and future relative strengths. In this study historical is used in reference to past behavior of price strength up to a point in time and future is used in reference to price behavior from that point in time on.

The raw data including unadjusted prices, stock splits, and the Toronto Industrial Index were placed on magnetic tape for computer use. The stock prices were then adjusted to take into account stock splits that occurred throughout the 58 month time period.

Once the appropriate adjustments were made, relative points were then calculated for each stock for the full period. The relative points equaled the price of the stock divided by the Toronto Stock Exchange Industrial Index at each monthly interval. The equation below illustrates this.

$$R_{ij} = P_{ij}/M_j$$

where: P_{ij} is the price of stock i at time j

M_j is the market index at time j

R_{ij} is the relative point of stock i at time j

Then the relative price performances were calculated. These measure the positive or negative percentage changes of the relative points between successive months. The following equation sets this out.

$$C_{ij} = (R_{ij+1} - R_{ij})/R_{ij}$$

where: R_{ij+1} is the relative point for stock i at time j+1

R_{ij} is the relative point for stock i at time j

C_{ij} is the relative performance of stock i to the market at time j

The development of the above measure of relative price performance formed the necessary foundation upon which a variety of tests were conducted.

Method of Testing

After the data had been adjusted and the appropriate calculations of relative strengths were made the output was organized for testing using the TRIP library program.[5] The TRIP program consisting of a collection of routines computed either simple, multiple or stepwise multiple regression equations of the general form $Y_i=a+b\ X_i$.[6] The dependent variable, Y_i, in the general regression equation was the estimated relative price performance (R_t) and the independent variable(s), X_i, was the historical relative price performance (R_{t-n}). The routines in the program provided coefficients of correlation and determination which measure the amount of variation in estimated relative price performance that is explained by historical relative strength.

The relative price performance hypothesis proposing that relative price performance at one point in time is determined in a large part by the relative price performance of the immediately prior point in time leads us to the following expectations about the regression results. The

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[5]J.H. Bjerring, J.R.H. Dempster, R.H. Hall. U.B.C. TRIP (Triangular Regression Package), (U.B.C., Computing Center, January, 1968./360 Implementation Feb. 1969).

[6]It is assumed here that the reader has a general knowledge of linear regression techniques. Therefore no further elaboration of regression equations is given.

correlation between the historical and subsequent relative price performances should be significantly high. This would be confirmed if the coefficient of determination was greater than +.50 and approaching +1.0. We would also expect that a_o in the equation will approximate zero and that b_i will approach unity from +.50. We would not expect b_i to equal unity as this would infer that relative price performance is totally explainable by historical relative price, suggesting invariant relative performances for all issues. This would be suggesting the case of no change in relative positions for issues rather than suggesting a tendency to maintain relative positions as stated in the hypothesis.

The general form of the regression equation varied from simple to multiple or stepwise multiple regressions depending on the particular approach taken in each test.

Tests Conducted

In total 11 tests of the hypothesis were carried out on the sample. The tests approached the sample from a number of angles to ensure that the hypothesis was tested adequately. The tests conducted can be divided into two groups. The first group consisting of only two tests examined the relationships between historical and future relative price performances. The second group consisting of the remaining 9 tests examined the relationships between

historical and future rankings of relative price performances. The first essentially measured whether a stock maintained a consistent price performance relative to the market index. For example, whether a stock which out-performed the market in one month or over a period of time by a certain percentage would tend to maintain that relative percentage performance. While the second set of tests measured whether a stock's ranked relative price performance in one month or over a period of time would tend to maintain its ranked position in the list of performers. The ranking of relative performances was to demonstrate if stocks had a consistent ranking performance. For example, between two given intervals under examination the overall market may have a negligible change and the stocks in the market may not have a consistent performance relative to the market but they could very well be consistent to each other. Table 3-1 and Table 3-2 below elaborate on this point in a hypothetical case.

TABLE 3-1

STOCK PRICE PERFORMANCES RELATIVE TO THE MARKET

PERIOD	MARKET PERFORMANCE	STOCK A	STOCK B	STOCK C	STOCK D	MARKET PERFORMANCE SPREAD
1	0	+.25	+.37	-.42	-.20	.85(+.37 to -.42)
2	0	+.08	+.09	-.10	-.07	.19(+.09 to-.10)
3	0	+.02	+.04	-.01	-.05	.09(+.04 to-.05)

In this fabricated case the market performance was held invariant which in reality would be a rarity but was done here merely for illustrative purposes. The market's invariance here is indentical to the situation where the total market influence in a stock's movement has been subtracted to leave the stock's independent movement. As can be seen each stock's price performance is not consistent from one period to another and the inconsistency is explained by the varying spread between the performances exhibited in the last column. However, by ranking the performances of the stocks as done in Table 3-2 below, patterns may emerge in the rankings.

TABLE 3-2

STOCK PRICE PERFORMANCES RANKED
RELATIVE TO EACH OTHER

PERIOD	STOCK A	STOCK B	STOCK C	STOCK D
1	2	1	3	4
2	2	1	3	4
3	2	1	3	4

It may be that during times of overall market enthusiasm historically strong performers reveal greater strength than do historically weaker performers and during times of pessimism in the market the historically stronger stocks are resistent to downward movement and maintain their

positions in the listings. The above case of such a consistent pattern is highly unlikely, if not impossible, but was created as such to exaggerate the possible value of ranking the performances. R.A. Levy suspected that the ranking of performances might reveal greater consistencies in patterns and his study bore this out.[7] Therefore in light of his findings the ranking of relative strengths appears to us to be of greater importance in revealing trends than the study of unranked relative strengths.

Unranked Relative Price Performance Tests

Test I

The first test consisted of estimating regression equations of the general form: $R_{it} = a_o + b_1 R_{it-1}$

where: R_{it} = relative price performance for stock i at month t

R_{it-1} = relative price performance for stock i at month t-1

Equations were estimated for each of the 124 stocks in the sample resulting in 124 regression equations. There were 57 monthly observations. As pointed out in the foregoing

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[7]R.A. Levy, op. cit., pp. 115 - 180.

discussion the hypothesis leads one to expect a_0 to approximate zero and b_1 to approximate unity. It is also expected that the coefficient of determination calculated by the TRIP routine will approach unity.

Test II

The second test involved estimating regression equations with more than one independent variable in a stepwise manner. The equation had the form:

$$R_{it} = a_0 + b_1M_2 + b_2M_3 + b_3M_4 + b_4M_5 + b_5M_6$$

where: R_{it} = relative price performance for stock i at month t

M_2 = a two month moving average of relative price performances from month t-1 to month t-2

M_3 = a three month moving average of relative price performance from month t-1 to t-3

M_4 = a four month moving average of relative price performance from month t-1 to t-4

M_5 = a five month moving average of relative price performance from month t-1 to t-5

M_6 = a six month moving average of relative price performance from month t-1 to t-6.

All five of the moving averages were taken as independent variables. The equations were estimated for the entire sample of 124 stocks and included 51 observations in each equation.

The stepwise multiple regression routine allowed the entrance of the independent variables into the equation one at a time, in order of decreasing contribution to the reduction of variance of the dependent relative price performance. The independent variables already included in the regression were tested for significance and if any fell below the specified significance level of .05 the least significant was eliminated from the regression analysis. If no variable needed to be eliminated, the designated independent variables not yet included in the regression were tested for significance of the contribution each would make if included next. If any were above the significance level, the most significant was included in the regression.[8]

The rationale for employing multiple regression was to determine if the variance of future relative strengths

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[8]J. Dempster, Gagon, and Hogan. Triangular Regression Package, (U.B.C. Computing Center. April, 1965), p. 5.

is explainable in part by the relative strengths whose history is greater than one month. This reasoning was supported by Levy's findings that longer duration relative strengths had greater predictive validity than short duration measures of relative strengths. The stepwise technique was used to gain further insight in the question by helping to determine which period of historical relative strength had the greatest significance. In other words, whether a 4 month history of relative strength had more or less significance than a 6 or 3 month history would be revealed with stepwise regression by displaying which independent variable was considered most frequently.

Ranked Relative Price Performance Tests

Test III

The third test consisted of estimating regression equations of ranked relative price performances. The equations took the form: $R_{it} = a + b \sum_{i=1}^{124} R_{it-1}$

where: R_{it} = ranked relative strength for stock i at time t

R_{it-1} = ranked relative strength for stock i at time t-1

Unlike the previous two tests this one approached the sample by examining all the ranked relative strengths of the stocks one month at a time. Hence, there were 56 equations estimated in total each with 124 observations. The reasoning for taking a cross sectional approach is that relative strength may possibly have more validity at different times in the market than at others and sequential testing of individual stocks' rankings would not necessarily bear any such evidence.

Test IV

In this fourth test a cross sectional approach was taken again but the number of independent variables was increased from one to four. The estimated regression equation was of the form:

$$R_{it} = a + b_1 \sum_{i=1}^{124} \sum_{n=1}^{4} R_{it-n}$$

where:

R_{it} = the ranked relative strength for stock i at month t

R_{it-n} = the ranked relative strength for stock i at month t-n where n increases from one to four.

There were 53 estimated regression equations each with 124 observations. This increase of independent variables was done to take into consideration the possibility of a lagged effect

from the rankings. The reasoning for considering a lagged effect was the same as stated in Test II. The routine called for in the TRIP program was for computation of a multiple linear regression equation. As this routine had been deleted from the program, the program defaulted automatically to calling a stepwise multiple regression but one with unspecified significance levels which in effect is identical to a multiple regression. The multiple regression unlike that of the stepwise regression used in Test II included all the independent variables regardless of their significance to compute the total explainable variances. The equations were developed through months 5 to 57 to produce a total of 53 equations each with 124 observations.

Test V

This fifth test was a duplication of Test IV except that the number of independent variables was extended from 4 to 6 variables. The estimated regression equation had the identical form of Test IV:

$$R_{it} = a + b_1 \sum_{i=1}^{124} \sum_{n=1}^{6} R_{it-n}$$

However in this test n went from one to six. There were a total of 51 regression equations each with 124 observations.

Test VI

The cross sectional approach was maintained in this test however the sample was disaggregated into five groupings approximating 20 percentiles for the following reasons. As the entire sample was not divisible into five equal groups the sample was divided in the following groups.

TABLE 3-3

DISAGGREGATED SAMPLE - FIVE GROUPS

Group	Sample Size	Rankings
1	24	1 - 24
2	24	25 - 48
3	28	49 - 76
4	24	77 -100
5	24	101 -124

The groups are in descending order of the dependent month's rankings. The data were reorganized to test the correlations of the corresponding stocks of the immediately prior historical month's rankings. It was suspected that those stocks which have the most extreme relative price performances might tend to maintain their positions more so than those stocks which have a less extreme relative price performance. For example, those stocks with rankings in the

top 20% of the listings may be more consistent performers than those stocks with rankings in the middle 20% of the list. If the above suspicion could be proved true then the former tests on the aggregate sample would have confused the finding of any relative strength value. For example, the average relative performers, middle 20% may exhibit no consistency of relative performance, thus reducing any consistency that might be present in the rest of the data.

This test used the simple regression routine and regressed the historical month's rankings of the first group on the future month's rankings for the same group. This process was repeated for the other 4 groups. Five equations were estimated for each of the 56 months for a total of 280 equations.

Test VII

This test continued the logic of Test VI but the sample was further disaggregated into seven groupings. The rearrangement of the groupings was essentially a further refinement of the extreme performers from the 20 percentiles into groups approximating the top two 10 percentiles (1 - 10% and 11 - 20%) and the bottom two 10 percentiles (81 - 90% and 91 - 100%) while the rest of the sample was left

unchanged. The table below exhibits the disaggregation more clearly.

TABLE 3-4

DISAGGREGATED SAMPLE - SEVEN GROUPS

Group	Sample Size	Rankings
1	12	1 - 12
2	12	13 - 24
3	24	25 - 48
4	28	49 - 76
5	24	77 - 100
6	12	101 - 112
7	12	113 - 124

It was thought that if the validity of relative strength varied with the degree of relative strength then the refinement of the degree of relative strength may reveal greater validity of the technical indicator. Essentially this was testing if the validity of ranked relative strength was a function of the extreme rankings of relative strength.

Test VIII

This eighth test consisted of estimating regression equations of ranked relative performance in a similar

form to that in Test I where the data was examined serially one stock at a time. The equation is as follows:

$$R_{it} = a + b\, R_{it-1}$$

where: R_{it} = ranked relative strength for stock i at month t

R_{it-1} = ranked relative strength for stock i at month t-1

A total of 124 equations were estimated each with 56 observations.

Test IX

Test nine involved an extension of Test VIII by increasing the number of ranked relative performances from one to six. The equation had the form as follows:

$$R_{it} = a + b \sum_{n=1}^{6} R_{i(t-n)}$$

where: R_{it} = ranked relative strength for stock i at month t

$\sum_{n=1}^{6} R_{i(t-n)}$ = ranked historical relative strength for stock i at month t-n where n goes from one to six.

There were 124 multiple regression equations estimated with 51 observations in each.

Test X

This tenth test was an extension of Test VIII and Test IX but the number of monthly ranked historical performances was increased to ten. The form of the equation is identical to that in Test IX excepting that n went from one to ten (i.e. $\sum_{n=1}^{10} R_{i(t-n)}$.

Again 124 multiple regression equations were estimated but with the number of observations reduced to 46 in each equation.

Test XI

This last test examined the validity of relative strength rankings when the market was in either an uptrend or a downtrend. It appeared reasonable to suspect that relative strength may very well not hold as true in a "Bear" market as it might in a "Bull" market, or vice versa. At any rate it was felt that the time period under study should be divided into basic uptrends and downtrends. The criterion for the division of the trends was the performance of the Toronto Industrial Index. If the market index continued to increase from one month to the next it was viewed as an uptrend until the index decreased by more than an arbitrarily decided 5 percent. Then the market

was viewed as being in a downtrend until the index increased by an amount greater than 5%. Although it is recognized that four phases exist in the market cycle the exercise of defining these four phases with the use of monthly price data would be of little practical value. Such an exercise would define the four different phases in the market but they would not necessarily be coincidental with the monthly data base because a market phase could reverse its direction more than once within a monthly interval which would not be revealed in the data base. Therefore the market cycle was kept to the basic trends of being either a "Bull" or a "Bear" phase. Table 3-5 below displays the series of market phases used in the test.

TABLE 3-5

MARKET TRENDS - UPTRENDS vs DOWNTRENDS

DOWNTRENDS	UPTRENDS
Feb. 1965 - Nov. 1965	Nov. 1965 - Feb. 1966
Feb. 1966 - Oct. 1966	Oct. 1966 - Aug. 1967
Aug. 1967 - Mar. 1968	Mar. 1968 - Apr. 1969
Apr. 1969 - Aug. 1969	Aug. 1969 - Nov. 1969

This test examined the sample of stocks individually during periods of market uptrends and then downtrends. A total of 248 regression equations were estimated.

The following chapter will discuss the results from the tests explained above and will point out the significance of unranked and ranked relative strength measures.

CHAPTER IV

DISCUSSION OF THE FINDINGS

The results and interpretation of the series of tests conducted and outlined in Chapter III will be discussed here. Because each test generated a number of regression equations, the listing of all the equations and their statistical measures would create a voluminous number of tables that have little illustrative value. Instead, summaries of the tests will be given and will include the means and ranges of the relevant statistical measures indicating the extent of correlations and predictive value of relative strength.

Included in the discussion of each test is the coefficient of determination (R^2) which is that portion of the total variation in the estimated Y value (either the predicted relative strength or the predicted ranking of relative strength) that is explained by the significant historical relative strengths. The coefficient of determination is expressed as either a percentage or a real

number between 0 and 1. If this coefficient of determination is closer to 1, (i.e., $R^2 > +.50$), then the regression line is a good approximation of the observed data. With a good approximation of the data, the regression equation will have a high predictive value. Conversely, a coefficient of determination close to 0.0, (i.e. $R^2 < +.50$), will indicate a poor or insignificant approximation of the observed data by the calculated regression line. The relative strength as measured by the regression equation would be a poor or insignificant predictive tool.

In addition to the coefficient of determination the discussions will include the F - probability statistic which measures the significance of the regression coefficient (b_i) in the general equation of $Y_i = a_0 + b_i X$. An F - value is calculated by the TRIP routine and the probability of obtaining a value greater than this F - value is determined assuming $\beta_i = 0$ in the assumed true regression equation of $\hat{y} = \alpha + \beta_i x$. If the probability is less than .05 it is usually concluded that b_i is significantly different than zero. If the F- probability is greater than .05 then the regression coefficient b_i is not significantly different than zero in the computed equation.[1] As pointed out in Chapter III the b - value in the

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[1] J.H. Bjerring, J.R.H. Dempster and R.H. Hall, U B C TRIP (Triangular Regression Package). (The University of British Columbia, January, 1968), p. 49.

regression equation should approximate unity if the hypothesis is valid. That is, if future relative strength is determined in large part by historical relative strength then the regression coefficient, b, should be close to one. If the F - probability statistic indicates that the b - value is not significantly different from zero then the hypothesis has no significant validity.

The hypothesis leads to the expectation of a consistency of relative strengths between historical and subsequent months. Therefore a positive relationship is expected between the historical and subsequent relative strengths. In those tests where it was considered important to note the sign of the regression coefficient it was done so and will be discussed with the other relevant statistics. For those tests which purposely made use of the stepwise routine for multiple correlations the order of entry of the significant variables will also be discussed.

Results of the Empirical Test

The summarized findings are covered in the same order in which the tests were conducted and outlined in Chapter III.

Test I

The estimated regression equation for this first test as discussed in Chapter III had the general form:

$$R_{it} = a + b\, R_{it-1}$$

where: R_{it} = the relative strength of stock i at month t

R_{it-1} = the relative strength of stock i at month t-1.

The relevant statistics for this test are exhibited in Table 4-1 below.

TABLE 4-1

REGRESSION STATISTICS - TEST I

	Coefficient of Determination	F - Probability	Standard Error of the Estimated Y value
Mean	.0366	.4313	51.8276
Range	.7598 - .0000	.9437 - .0000	
Range (revised)	.1787 - .0000	.9437 - .0013	

The mean coefficient of determination derived from the sequential testing of the 124 company sample was .0366 and ranged from .7598 to .0000. The upper range limit in this test was considered an unexplainable abnormality because if the particular equation with this high correlation

was eliminated from the sample the upper range limit would drop to .1787. Also, although this particular equation reported a very significant correlation the standard error of its estimated Y value was 2278.0 which is completely useless for predictive purposes as an estimate based on the regression equation could not be made with accuracy. The mean of the F - probability statistic was .4313 indicating that the regression coefficient (b) is not substantially different from zero. With a low correlation coefficient and a high F - probability as in this test the regression line calculated is a poor or insignificant approximation of the data. Interpreted this means that relative strength as tested here has no significant validity.

Test II

The results of this test which examined five moving averages as possible independent variables in a stepwise multiple regression are exhibited in Table 4-2(a).

TABLE 4-2(a)

REGRESSION STATISTICS

	Coefficient of Determination	F - Probability	Standard Error of the Estimated Y value
Mean	.0448	.2858	.9876
Range	.6414 - .0024	.7825 - .0000	
Range (revised)	.1821 - .0024		

The mean of the coefficient of determination increased from the previous test but only minutely. Its range was from .6414 to .0024. The upper limit in the range, like the previous test, was exaggerated due to one equation which included more than 1 variable in explaining the total variation. The elimination of this equation would reduce the correlation range to .1821 - .0024 which is almost equivalent to Test I. The F - probability dropped but only to .2858 which reveals that the regression coefficient is not significant.

Although the test used stepwise regression to determine the order of entry and the number of significant variables at a significance level of .05, in all the equations except one the number of variables taken into consideration was only one. The singular case of exception included three independent variables. The frequency of the variables considered significant and which were the first entrants to the equations are exhibited below in Table 4-2(b).

TABLE 4-2(b)

FREQUENCY OF MOVING AVERAGES CONSIDERED SIGNIFICANT

Moving Average	No. of Times Included in the Regression Equation	Percentage of Total Significant Variables
2 months	42	33.9%
3 "	26	20.9
4 "	17	13.7
5 "	14	11.3
6 "	25	20.2
	124	100.0%

As can be seen the 2 month moving average was considered the most significant duration of historical relative strength while the other moving averages appear to be somewhat equal but of less significance in their contribution to explaining the variation in the estimated relative strengths.

A point of note is the sign of the regression coefficient, b, in relation to the different moving averages. Table 4-2(c) displays the signs associated with each variable and the total frequency of the signs.

TABLE 4-2(c)

FREQUENCY OF REGRESSION SIGNS

Moving Average	No. of Positive Signs Found	Percent of Total	No. of Negative Signs Found	Percent of Total
2 months	10	23.8%	32	76.2%
3 "	6	23.1	20	76.9
4 "	4	23.5	13	76.5
5 "	7	50.0	7	50.0
6 "	10	40.0	15	60.0
	37	29.8%	87	70.2%

A point of interest is that for the entire test 70.2% of the variables had negative signs and 29.8% had positive signs. The hypothesis inferred that the relationship between historical and subsequent relative strengths would be positive. But this test reported a predominantly

negative relationship. Also of interest is that the shorter historical moving averages were more negative than were the longer historical moving averages. This is evident from the fairly consistent negative correlations in the two, three and four month moving averages and the shift to a more equal weighting of positive and negative correlations in the five and six month moving averages. The overall negative correlation for the test disputes any positive correlation between historical and subsequent relative strength measures.

In view of the low correlation coefficient, the high F - probability and the negative correlations this test can offer no support for the hypothesis of relative strength.

Test III

The summarized results for this first test of ranked relative strengths are presented below in Table 4-3.

TABLE 4-3

REGRESSION STATISTICS OF RANKED RELATIVE STRENGTH

	Coefficient of Determination	Standard Error of the Estimated Y Value	Frequency of the Sign Positive	Negative
Mean	.0253	34.94	14 (25%)	42 (75%)
Range	.1535 - .0000	36.09 - 33.20		

The coefficient of determination as illustrated with a mean of .0253 and an upper range limit of only .1535 is quite insignificant. The mean standard error of the estimated Y value at 34.94 is too large to have any predictive validity. The frequency of the sign of the regression coefficient is quite heavily weighted negatively indicating a fairly consistent negative correlation. The frequency of the sign here demonstrates that if a high correlation was found the regression line would be negatively sloped and that a high ranking of relative strength in one month would be followed by a low ranking of relative strength in the next month. However because the correlation is not significant the negative sign is not really of great importance.

The results found here in this test provide no substantiation of the hypothesis.

Test IV

The pertinent statistics from this test of ranked relative strength using multiple linear regression techniques are presented in Table 4-4.

TABLE 4-4

MULTIPLE REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Mean	.0698	.2112	35.23
Range	.1886 - .0157	.8105 - .0001	36.30 - 32.91

In this test the coefficient of determination increased somewhat due to the inclusion of more historical rankings from the point of testing. Included were historical ranks up to 4 months past. But the coefficient of determination reported is still not significant as it explains only 6.98% of the variation in the estimated rankings of relative strength. The range of the coefficient points out that the highest correlation explained only 18.86% of the variation. The F - probability statistic at .2112 reveals that the regression coefficient is not significantly different from zero. The large standard error of estimated Y value points out that the equations have little predictive value. The signs of the regression coefficients, as in the previous test, indicate that the more distant ranks of relative strength have a more positive correlation than do the short term historical ranks. All in all this test gave no significant support to the hypothesis.

Test V

The results from this test which extended the length of historical ranks to include ranks six months past in the equations are presented in Table 4-5.

TABLE 4-5

MULTIPLE REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Mean	.1013	.1516	34.92
Range	.2365 - .0288	.7491 - .0000	36.32 - 32.20

The coefficient of determination increased once again but still the mean explainable variation reached only 10.13%. The range of the coefficient also increased slightly from the two previous tests to 23.65% - 2.88%. The F - probability statistic although improved from the previous test by dropping to .1516 is still not low enough to consider that the regression coefficient is significant. The standard error of the estimated Y value improved as well but again only very slightly as it dropped to 34.92. This size of error for the estimate creates a range of 69.84 within which the ranking of relative strength can be predicted. With such a large range for error the utility of such a prediction is quite meaningless.

Although improvements were found in the statistics by extending the multiple regression equation to include 6 months of historical ranks from the previous test of including 4 month historical ranks the improvements were too slight to warrant support for the hypothesis.

Test VI

The results of this test which disaggregated the sample into five groups approximating 20 percentiles are given below in Table 4-6.

TABLE 4-6

REGRESSION STATISTICS

Group	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
1	.0417	.5228	7.08
2	.0419	.4912	7.08
3	.0379	.4822	8.22
4	.0566	.4689	7.01
5	.0381	.4852	7.09

The coefficient of determination for any one group is no more than .0566 and no less than .0379 indicating that the consistency of relative strength is not related to superior, mediocre or inferior price performance in the market. The F - probability statistic indicates that the regression coefficient is not significantly different from zero for any

one group of rankings. The standard error of the estimated Y value for all the groups ranges from 7.01 to 8.22 which is too large to have any predictive value. This test gave no support to the hypothesis.

Test VII

This test refined the disaggregation of the sample into those stocks which were the strongest 10 percent and those that were the weakest 10 percent to examine the more extreme performers. The groups of ranks are arranged in the same manner as the previous test and the respective results are set out in Table 4-7.

TABLE 4-7

REGRESSION STATISTICS

Group	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
1	.0787	.4907	3.63
2	.0878	.5344	3.60
3	.0423	.4992	7.07
4	.0383	.4814	8.22
5	.0567	.4708	7.02
6	.0609	.5665	3.66
7	.0570	.5911	3.67

The groups to note are 1 - 2 and 6 - 7 as groups 3 - 5 were not modified in any way from the previous test. The dissection of the former group 1 into two groups of

ranks (groups 1 and 2) increased the coefficient of determination but only by a very small amount. Likewise, the dissection of the former group 5 into two groups of ranks (now groups 6 and 7) also increased the coefficient of determination but only by a minute amount. The F - probability for the groups indicates that the regression coefficients are not significant.

The results produced lead to the same inference made in the immediately above test that there is no substantiation of the hypothesis evident here.

Test VIII

The regression statistics generated from this test which took each stock separately and sequentially examined the correlation between a one month historical rank and the subsequent rank are displayed in Table 4-8.

TABLE 4-8

REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Mean	.0276	.4268	36.21
Range	.1569 - .0000	.9443 - .0026	47.18 - 23.24

The coefficient of determination with a mean of .0276 and a range of .1569 to .0000 is far too low to have any significance as it explains only a negligible amount of the variation in the rankings of a stock's relative strength. The mean F - probability statistic at .4268 is too high and reveals that the regression coefficient (b) is not significant. The standard error of the estimated Y value is also too large to predict accurately a stock's ranking of relative strength from past ranks. The findings of this test have not given the relative strength theory any foundation of support.

Test IX

This test which was an extension of the immediately prior test to include six months of historical ranks in a sequential examination of each stock's rankings report the findings in the following Table 4-9.

TABLE 4-9

MULTIPLE REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Mean	.1237	.4899	35.38
Range	.3272 - .0100	.9975 - .0068	52.36 - 23.53

The coefficient of determination increased with the inclusion of more distant historical ranks but the amount of variation explained by the regression equation still amounts to only 12.37% and the range of the explainable variation is from 1.0% to only a maximum of 32.72%. The F - probability at .4899 is an increase from the previous test indicating no improvement in the significance of the regression coefficient which was expected. The standard error of the estimated rank remained overly large for predictive purposes.

Test X

This test followed the method of the two previous tests but again extended the historical ranks included in the multiple regression equation to 10 months from 6 months. The findings are presented in Table 4-10 below.

TABLE 4-10

MULTIPLE REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Mean	.2122	.5178	35.50
Range	.4005 - .0548	.9907 - .0310	53.06 - 21.13

The coefficient of determination increased once again from earlier tests but at the expense of the significance of the regression coefficient. The coefficient of determination increased to explain 21.22% of the subsequent months' rankings in comparison to the former test's 12.37% but the F - probability statistic increased as well to .5178 from .4899 indicating no improvement in the significance of the regression coefficient. The standard error of the estimated Y value increased negligibly to 35.50 inferring no improvement in the predictive utility of the computed equations. The extension of the multiple regression equation to include more distant historical ranks proved of no value to substantiating the hypothesis.

Test XI

This last test examined each stock's rankings separately in a sequential manner when the market was in either a basic uptrend or downtrend. The findings are exhibited for both basic trends in Table 4-11.

TABLE 4-11

SIMPLE REGRESSION STATISTICS

	Coefficient of Determination	F - Probability Statistic	Standard Error of the Estimated Y Value
Downtrend	.0450	.4560	34.99
Uptrend	.0531	.3717	35.04

Perusal of the findings reveals that there is no substantial difference in the correlation of ranked relative strengths between uptrends or downtrends in the market. This is evidenced from the coefficient of determination: downtrend .0450; uptrend .0531. Both F - probabilities of the two trends illustrate that the regression coefficient is not significantly different from zero. The inference drawn here in this test is that ranking of relative strength has no more significant validity when the market is in an uptrend or a downtrend.

Summary

The findings of the tests, as reported in this chapter, on the hypothesis of relative strength indicate quite strongly that relative strength, ranked or unranked, has little significance. This is clearly seen in the low coefficients of determination which reveal the amount of the estimated relative strengths that are accounted for by the historical relative strengths. The lack of significance is also demonstrated by the F - probability statistic whose mean is above .05 in all the tests pointing out that the regression coefficient (b) is clearly not significantly different from zero. Hence the regression lines calculated do not have significant positive or negative slopes.

If the hypothesis is to be accepted the computed regression equations and lines must have significant regression coefficients to indicate a positive relationship between historical and subsequent relative strengths. In addition, the standard errors of the estimated Y value for the tests were too large to have any predictive value.

In summary, the statistical testing of the hypothesis from a number of different angles resulted in an absence of any support for the theory of relative strength.

CHAPTER V

A CONSTRAINING FRAMEWORK OF COMPLEXITY FOR SECURITY ANALYSIS

The findings reported in Chapter IV provide little substantiation for the hypothesis of relative price performance and it would appear adequate to conclude that the hypothesis has no significant validity and should be rejected. This chapter will attempt to demonstrate how the hypothesis may still be considered valid and how the "opposing" theory of random walk is also valid and compatible with the relative strength model in the same market if recognition is given to the constraints within which security valuation operates.

The approach taken here is to study valuation and security price movements from a general systems viewpoint which is a higher, more general level than the narrow utilitarian financial models. This approach creates the opportunity to fill in the gaps between the more specific "contradictory" empirically based security price movement

models. A short discourse explaining the systems concept, what general systems theory is and of what value it may be to the study of financial analysis is required here. First, a system is a whole which functions as a wholy body by virtue of the interdependence of its parts.[1] General systems theory attempts to classify systems, in this case corporations, by the way their components are organized or interrelated and to derive the patterns of behavior for the different classes of systems singled out by the typology.[2] The value of this approach is to point out how corporations may be classified according to their complexity and the consequent problems arising in their analysis.

Starting from the general systems viewpoint a theoretical framework is constructed revealing the constraints of complexity. The recognized constraint of complexity in analysis is then related to the market's problem of building "knowledge structures" and resorting to the fabrication of "images" for the purpose of attaining a required level of certainty in valuation. By viewing companies as systems and using two of three possible dimensions, which will be explained later on in the chapter, as yardsticks

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[1]Anatol Rapoport, "Foreward" Modern Systems Research for The Behavioral Scientist. Ed. W. Buckley. (Chicago, Ill.: Aldine Publishing Company, 1968) p.xvii.

[2]Loc. cit.

to measure complexity, companies can then be classified according to their degree of complexity. Information and its content is then introduced and the difference between a posteriori and a fortiori information is explained. These two types of information are then related to the categories of complexity to illustrate their resultant significance in the analytical process. An overall theoretical framework can then be constructed to provide the foundation for the rationale of conditions under which security price changes exhibit either trends or randomness. The thread of logic at this point may appear rather loose in relating these systems concepts and types of information to security valuation and stock price movement but if the reader keeps in mind that the role of information and its receipt is both a vital point of contention and a basic tenet of both trendists and advocates of the random walk this chapter will attempt to explain how complexity constrains the function of information. In spite of its importance in valuation processes and stock price movements information has yet to be properly elucidated by either school of price behavior.

Complexity and the Analyst

Complexity denotes something which has many varied interrelated parts, elements and patterns which are

consequently difficult to analyze.[3] Complexity is a relative term likened to a continuum where at one extreme pole there exists total simplicity and movement in degrees towards the other pole produces increasing complexity to the point of total obscurity and confusion. For a given system, here the corporation, the simplistic pole would apply to a company where all the elements and variables are recognizable and their relationships known to the mechanical degree where the attributes of importance are quantifiable and the outcomes are totally predictable. This is the case of complete determinism and certainty. The opposing case is at the extreme complex pole where the system is completely obscure allowing no possibility for quantification of the variables and their relationships. Here the behavior of the system is totally indeterminate and unpredictable. This is the case of complete uncertainty.

The degree of complexity within the parameters of a corporation therefore is of importance to the analyst who wishes to determine the value of a company. In the simplistic case the analyst, assuming a given level of intelligence and competence, can obtain a clearly definable understanding of the company and can predict with certainty the effect of

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[3]Webster's Third New International Dictionary (of the English Language Unabridged). (Springfield, Mass., U.S.: G. & C. Merriam Company, Publishers), p. 465.

changing or new attributes in the system. Automatically he can adjust his valuation of the company based on a calculated return and risk. In the theoretically opposite case of total complexity the analyst can obtain only a vague obscure understanding of the company and must operate in total uncertainty unable to predict outcomes with any degree of accuracy. Hence the degree of accuracy and certainty in analysis is an inverse function of complexity within the company.

Knowledge Structures and Images

Remaining for the moment with the idea of a one dimensional measure of complexity the concept of creating a knowledge structure or image fabrication should be introduced here. The human being is the only animal known to be capable of visualizing abstracts and in understanding the relationships of abstract variables.[4] A person performing an analytical function hopefully exercises this capacity of comprehending facts, constructs between facts and the valuation of these relationships. This summation can be viewed as the process of obtaining a structure of information or of knowledge. In short, this is a learning process for the individual. Now, the ability to obtain such a

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[4]K.E. Boulding, The Image, (Knowledge in Life and Society) (Ann Arbor, Michigan, U.S. 1968) pp. 19 - 31.

knowledge structure is dependent on the complexity of that which is being analyzed. In the case where there is a paucity of information, or where the salient attributes and their relationships cannot be comprehended clearly then the individual will not be able to develop a knowledge structure. Instead he will rely upon stereotyped images which essentially have an emotive basis. This resorting to an image is depicted fairly clearly with the analogy of an ignorant person who is incapable of comprehending certain events and will explain such events in terms of perhaps ritual, tradition, dogmatic slogans or an unconsciously memorized ideology. In a financial example, an individual unaware or ignorant of opportunities and the associated risks is assumed to be less likely to make a rational decision than what would appear to a more knowledgeable person. A rational decision is used here in the sense of an individual choosing among all known alternatives of opportunities which would maximize his utility function.

Why should an individual rely upon a stereotyped image when he is unable to obtain a clear understanding of something? The rationale is that man tries to reduce the level of uncertainty in the world in which he resides. This is done in the hope of attaining greater security. To accomplish this he tries to understand the world around

himself. However, in the situation where he is unable to acquire an understanding he will invoke a sense of certainty through the adoption of an image based on other than fact and concrete knowledge.[5] In other words an individual in this situation would exercise a preference to accept any explanation of his world rather than acknowledge total ignorance and be left with uncertainty. Connecting this discussion to security analysts and investors it is possible to hypothesize that in the situations where total information is not available the individual will resort to making estimations and projections based on the knowledge that he does have plus a fabricated image created by a concensus of the investment community.

Security analysts and the market are differentiated in terms of their analytical abilities and understanding of security values. Security analysts are assumed to be more knowledgeable because of the vast flow of information in the market which has resulted in development of specialists to interpret this information. Just as in any other field the study, analysis and acquisition of facts and information whether it be finance, medicine, law, or physics, will tend to create discrepancies of understanding throughout the population connected to that field of activity. The result

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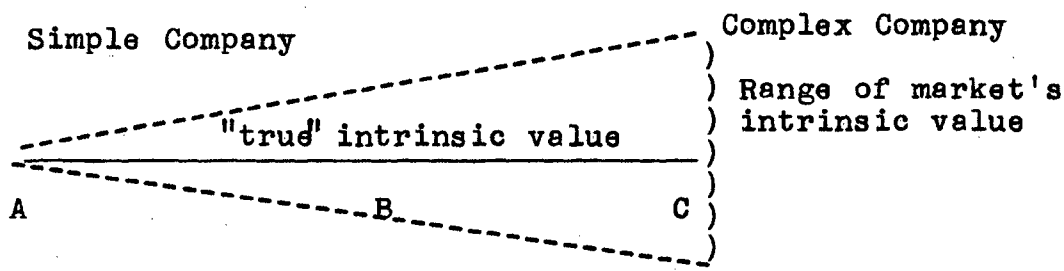
[5] Ibid., pp. 19 - 31.

is the development of "experts" whose function is to maintain a superior expertise in their field and to advise those persons less knowledgeable. This differentiation of analysts and others in the market is to point out that participants in the market are not uniform in their ability to comprehend opportunities and risks. This differentiation of capabilities will be elaborated on later in the discussion of classification of complex companies.

As established earlier the level of certainty or degree of accuracy in the analysis of a system is a function of complexity. As complexity increases in a system the level of certainty decreases - an inverse function. Now, the security analyst, as previously pointed out, encounters increasing difficulty in examining facts, in determining their relationships and in arriving at a total value of the particular corporate system and its respective common share value as the degree of complexity increases. The analysts' and the market's understanding of the company becomes more diffuse. Effectively the company's potentials becomes less amenable to analysis and a discrepancy of opinions as to the value of the common shares will arise. If a "true" intrinsic value could be determined and compared with the market's concept of an intrinsic value we could expect the following diagram to illustrate the divergence of opinion as companies are measured along a line of complexity. To

understand the relationship more clearly one could think in terms of companies such as Balco Forest Products or maybe B.C. Telephone Ltd., as being at point A, EDP Industries Ltd., one of the large chartered banks, or B.C. Forest Products Ltd., as being at point B and C.P.R., Neonex International or Noranda as being at point C in the diagram.

FIGURE I



As one moves along this line of complexity from the state of simplicity to complexity the market would be forced to replace its knowledge of the companies with an image. The understood value of the companies would become more diffuse and so would the assumed intrinsic value of the companies. Because of the diffuseness or obscurity and a reliance on an image fabricated and perpetuated by the investment community the valuation of the common shares for more complex companies are more dependent on the emotions of the investment community. The result, at any point in time, can be a larger deviation of the market valuation from the "true" intrinsic value for complex companies than for more simple companies.

Framework for Complexity

If the environment of a corporation is analogous to a system and that a system is taken as the set of all objects a change in whose attributes affect the system and also those objects whose attributes are changed by the behavior of the system[6] then the complexity of the environment of a corporation can be measured along the same three dimensions used in general systems. The first of these three basic dimensions is the domain which is the constituent parts of the system or organization. This could include the management, personnel, assets of the firm, its products, geographical locations, and all other attributes of the firm which have a functional value contributing to the organization. The second dimension is the dynamics of the organization which is the rate of change of all the functional parts making up the domain. This could be looked upon as the speed at which the parts develop, are replaced or improved and affect the behavior of the organization or system. For example, this could include the rate at which the firm is expanding, diversifying, changing its product mix, or developing either its capital or human resources. The last dimension is the ecological which is the relationship of the system's domain

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[6]A.D. Hall and R.E. Fagen, "Definition of System". Modern Systems Research For The Behavioral Scientist, (ed. W. Buckley) (Chicago, Ill.: Aldine Publishing Co., 1968) pp. 81 - 93.

to the outside environment. An example of this dimension is competitive pressures, global or national supply and demand factors, governmental influences on the firm or any other relationships beyond the immediate control of the organization. By employing the above dimensions it is possible to construct a set of classifications to discern companies as to their degree of complexity. This classification of companies is an attempt to refine the differences of the salient factors analyzed by noting their contributions to the complexity of the firm.

The employment of the dimensions of complexity can provide insight to understanding the effect that information or news will have on the current knowledge structures or images held by the market and in turn how the market will react to the news. If each dimension measured complexity in the extreme terms of being either simple or complex it would be possible to obtain eight permutations or classifications. However, these eight classifications can be reduced to four. The ecological dimension measuring the corporate relationship to the politico-economic environment may be removed in a rather facile manner. Because part of this dimension is common to most companies and part is common to companies in the same industries it is possible to remove a substantial part of this dimension. This can be accomplished by

subtracting a broad market index and the relevant industrial indices from the company's stock price movement. This is not perhaps the most acceptable way to reduce the number of classifications but is felt to be adequate as it is recognized that the framework which is being developed is being done so at a rather crude level. Recognition must be given to the crudeness of a theoretical construction when it is in its infant stage. The ecological dimension should be reintroduced at a later time when it is considered that the theoretical framework is at a more mature stage.

Making use of the two remaining domain and dynamic dimensions to measure complexity it is possible to arrive at four categorizations of companies. Table 5-1 below displays these categories and how they are arrived at.

TABLE 5-1

DIMENSION	CATEGORIES OF COMPLEXITY BY DOMAIN AND DYNAMIC DIMENSIONS			
	C_1	C_2	C_3	C_4
Domain	simple	simple	complex	complex
Dynamic	simple	complex	simple	complex

The first case, C_1, would be a company with a simple domain and a simple dynamic dimension. This could very well be a company which produces or handles one product, is established within a single geographical locality and has a rather mediocre growth rate. An example of this case could be B.C. Telephone Co. Ltd. This is not necessarily a stagnant company but one with an overall simple corporate structure that is amenable to analysis and to the development of a knowledge structure of the company's factors and potentials. Here the analyst and the investor will have a good understanding of the company and can predict its potentials with a high degree of accuracy and certainty.

The second case, C_2, could represent a company that has a narrow tangible corporate base of products, management qualities, and location but is rapidly changing that base. An example could be EDP Industries Ltd. It could be expanding its product base, developing and introducing new management, or perhaps changing its organizational functions. This rate of change in the corporate structure of this firm may be rather small in relation to other firms rate of growth but the functional change is in relation to the particular firm's domain or organizational base. It is possible to analyze the company and develop

a knowledge structure but it is difficult to forecast with accuracy the outcome and the potentials that will result from the changes which it is currently undergoing. The result is a fairly high degree of uncertainty in any predictions made.

The third case, C_3, would be a company with a complex domain but which is undergoing little functional change and may be perceived as a staid or a mediocre conglomerate. An example here could be International Nickel Ltd. Such a company may be one that has a large multiproduct base and a diverse organizational structure operating in and serving many markets. Because of the diversity of functions the company, although amenable to analysis, would require a highly competent analyst who could afford the time and expenditure of the analysis to arrive at an intrinsic value. The knowledge structure necessary for arriving at the valuation could be developed by such an analyst but due to its abstractness the market would tend to rely on a traditional image of the company. The market would rely on an image presented to it in the past because of its inability to obtain a complete understanding of the vital components of the domain. In addition, the analyst(s) would have difficulty conveying the effect of new information on the firm's earnings prospects. This would result as a consequence of the market trying to perpetuate

its perceived traditional image and invoking a greater sense of certainty. However, with analysts influencing the market in the face of difficulty the market over time would slowly change its image of the firm's value.

The last case, C_4, would be a company that has both a complex domain dimension and a complex dynamic dimension. A company of this type could very well be one that has a vast, diverse corporate structure, likened to a large conglomerate, but one that is undertaking or about to undertake a program of expansion that would have substantial ramifications on the earnings prospects of the Company. A case in point would be Litton Industries Ltd. Because of its conglomerate mix and the fact that it is changing its organizational structure the company would not be amenable to analysis and any forecasts of projected earnings would be highly uncertain and inaccurate guesses. Analysts as well as the remainder of the market would rely heavily on a fabricated image that appeared acceptable. The security analysts would have no better understanding of the firm's potentials than would the market because he would not be able to analyze the salient factors and therefore would not be able to develop any knowledge structure. The entire market then in its attempt to determine its value would rely upon an acceptable image. Any individual in the market trying to analyze such a company would soon

realize his inability to do so and would be extremely reluctant to suggest a value substantially different from that presented in the market. The image would tend to perpetuate itself as everyone in the market realizing his own inaccuracy would seek and accept that type of information that enhanced his perception of the imagined value and would conversely discredit that information which suggested a negation of the image. The market in its resistance to change would continue "believing" the current value until it could clearly be disproven.

The constructed categories of complexity and their associated amenabilities for analysis will be discussed further on in relation to information types.

Information Types and Content

Remembering that information in the market is a point of contention and a basic tenet of trendists and advocates of the random walk it is necessary to distinguish different types of information and explain the conditions required for information to be significant.

The point of contention between the two schools of price behavior is found in their arguments of how information is received and in how it is dissipated throughout the market. Proponents of the random walk argue that

information enters the market randomly and is dissected by the market quickly and adjustments in price of common shares are made with incredible speed as if instantaneously. The subsequent conclusion from almost automatic responses to random information can only be random price adjustments. While trendists contend that information is dissected much slower and dissipates throughout the market, perhaps gathering momentum but at least creating dependencies in successive price changes and creating trends in price changes. Both schools neglect to make any distinction between types of information, information content, and the type of analytical reasoning associated with the differing types of information. The above facets of information will be elucidated and related to complexity to outline the possible compatibility of both theories of relative strength and random walk.

The content or significance of a piece of information is the amount of change it generates for the receiver(s) of the information in his existing knowledge structure or image that he has of a system. Upon the receipt of information, one of three alternatives may be generated.[7] The first alternative is the situation where there is very low

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[7]K.E. Boulding, op. cit., pp. 3 - 18.

or nil content in a piece of information and does not generate any perceivable change in the receiver's knowledge structure. The second alternative is the situation where the content is meaningful and produces a change in the knowledge structure in some regular or well defined manner. The last alternative is the situation where the information content is highly potent and generates a revolutionary change in the receiver's knowledge structure or image.

Information content is not solely dependent on the amount or type of information in the "news" item but is more dependent on its relative effect on the knowledge structure. The effect of a "news" item on a knowledge structure can be very dependent on the complexity of that which it is providing information about. For example, two different news items containing identical types and amounts of information for different companies can in all probability have quite different effects on the known state of each company.[8] One piece of information could generate no change whatsoever in the knowledge structure of the company. While the other piece of information could generate a violent change in the knowledge structure of the company upon which it is reporting. Thus, the respective contents of

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[8]A case in point could be the reporting by two companies of each adding new product lines. One could be a logical complement to the firm's products and profits could be forecast whereas the other firm may be introducing a product quite different from its other lines and costs and profits are unpredictable.

the two pieces of information will differ in the extent to which they may expand or reorganize the comprehended structure of knowledge of the companies.

The next logical question to follow such an assertion is how can one determine the content of a piece of information and the effect that it may generate. To answer this question, information can be broken down into either a posteriori or a fortriori information. The general criterion for the distinction being whether deductive or inductive reasoning is used in the application of the particular piece of information. For the purposes of this study a posteriori information is information that provides the receiver with facts upon which he may deduce outcomes which should logically follow.[9] A realistic case in point would be a news item or piece of information revealing that a nation's currency is being revalued. One who is familiar with the economics of that nation can deductively conclude that exporting companies will be under greater competitive pressure and that the earnings potential of those companies will be reduced. While a fortiori information reveals to the receiver information marked by a certainty inferred from and taken to be even more conclusive than another reasoned conclusion of fact.[10] Continuing with the same case in

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[9]Webster's Third New International Dictionary, op. cit., p. 125.

[10]Ibid., p. 37.

point, a news item of this type would report that particular exporting companies for a fiscal period had a decline in sales and net income. A posteriori information has a significant content only when the receiver can make use of that information in changing his knowledge structure. If the receiver has only a vague knowledge structure or image of a company then he will not be able to make use of the information and its content or significance will be very low or nil to him. If on the other hand, the receiver has a very clear understanding of a company and has developed a good knowledge structure then a posteriori information would have a very high or meaningful content and significance to him. In the above cited situation where the receiver does not have a good knowledge structure and a posteriori information has little significance, a fortiori will have a greater content in revealing after the fact information which can be used inductively.

The Valuation Process Related to Complexity and Information Contents

Gathering the loose conceptual threads of complexity, knowledge structures, information contents and the capacities for analysis into a logical framework for financial valuation it is possible to gain insight into the market as a socio-economic phenomena. Table 5-2

below displays this constructed theoretical framework and the resultant constraints on "rational" security valuation which in turn is reflected in stock price movements.

The table is set up according to the varying degree of complexity for corporations and types of information and their respective contents. The constraints on the reasoning used in the valuation processes leads to a differentiation of the market's reactions to the receipt of information. The end result of the differentiation of market reactions is the exhibition of either randomness or dependencies in price changes.

The degree of complexity should not necessarily be taken as an increasing function from C_1 to C_4. Although it can be taken for granted that C_1 is less complex than either C_2, C_3, or C_4 and that C_2 and C_3 are less complex than C_4, it is not clear if C_2 is less complex than C_3. This judgment would depend on the greater importance of either the domain or the dynamic dimension.

TABLE 5-2

CONSTRAINTS OF COMPLEXITY AND CONSEQUENT STOCK PRICE BEHAVIOR

Dimension	C_1	C_2	C_3	C_4
Domain / Dynamic	Simple / Simple	Simple / Complex	Complex / Simple	Complex / Complex
Constraints	analyzable high level certainty "good" knowledge structure	analyzable low level certainty volatile knowledge structure	difficult to analyze (analyst expertise) for knowledge structure market=image	difficult to analyze high uncertainty emotive image
Information type a posteriori	significant for deductive reasoning good market comprehension and acceptance	fairly significant but leads to speculation	not too significant slow acceptance by market	insignificant no deductive value
a fortiori	quite insignificant mostly discounted by a posteriori	also fairly significant because a posteriori inaccurate	quite insignificant mostly discounted from a posteriori	significant inductive value
stock price behavior	random walk applicable	more volatile but random walk applies	relative strength applies as market slowly accepts a posteriori	relative strength could apply but vulnerable

By constraining the market's ability to develop the knowledge structure which is necessary as the foundation for analytical reasoning and the extrapolation of potential earnings, each category of complexity determines the amenability for analysis. The clarity of a company's knowledge structure will in turn derive the level at which analysts can forecast outcomes within a tolerated degree of uncertainty. The significance or content of a posteriori and a fortiori information will vary with each category of complexity. Also, the relative significance and relationship between the two types of information and the speed at which they are received, decoded, interpreted, disseminated and acted upon varies with the constraints of complexity. The type of information related to the constraints of complexity can illuminate the effect over time of the entrance of information in the market, its impact upon the valuation of common shares and the subsequent price adjustments. In short, the summarization of the attributes of complexity related to a posteriori and a fortiori information can determine whether successive dependencies will exist in price adjustments.

A company in the first category of complexity, C_1, with both the domain and dynamic dimensions being simple would be amenable to analysis. A knowledge structure could

be clearly defined and there would be a low level of uncertainty or a high level of certainty associated with reasoned forecasts. Because the analyst could comprehend the company clearly and develop a knowledge structure as a basis for reasoning, a posteriori information would be highly significant to deductively forecast potential outcomes. The entrance of a posteriori information in the market would be received, decoded, interpreted and disseminated throughout the market at a fairly quick pace if not almost instantaneously. With the high level of certainty associated with forecasts, predicted outcomes would be discounted well in advance of the occurrence and reporting of those outcomes. A fortiori information would therefore have little significance as this would merely be the reporting of outcomes already discounted and adjusted in the stock's price. As a posteriori information is significant in deducing valuation changes and in adjusting the knowledge structure and as it enters the market randomly the effect is rapid, almost automatic reactions in adjusting the price of a company's stock. The end result is the creation of price changes that exhibit randomness. Hence a company in this category of complexity, the weakest constraining case, would give support to the theory of the random walk.

In the second category of complexity, C_2, the domain dimension is simple but the dynamic dimension is complex. With a simple domain a company in this category would still be amenable to analysis for its valuation as a knowledge structure could be developed. However, because the dynamic dimension is complex a very low level of certainty would be associated with any predictions of potentials. A posteriori information would be fairly significant in revealing possible outcomes but in conjunction with a high level of uncertainty in trying to forecast the possibility of the suggested outcomes being realized the market would demonstrate quickly changing expectations. A case in point would be a company that is rapidly changing its corporate base or is undergoing a reorganization which the market has some pertinent information about but which cannot be forecast with accuracy. Such a company becomes succeptible to speculative expectations and quickly changing opinions as different segments of the market attempt to out reason other segments. A fortiori information would be significant in revealing actual outcomes as they unfold because the inaccuracy associated with forecasts derived from a posteriori information may have been misleading or confusing. Both a posteriori and a fortiori information may have a substantial effect on the price valuation of the company and could produce a great volatility in the

stock's price behavior. This is the result of inaccurate forecasts yielding divergent expectations in the market and the reporting of a fortiori outcomes which could be unexpected. The end result is the creation of volatile price changes and a randomness in these changes. This case could then also provide support for the theory of random walk.

The third category of complexity, C_3, has a complex domain but a simple dynamic dimension. An example of such a company is a conglomerate that has a vast organization but which is rather slow in changing its organizational base. This type of company is difficult to analyze for the purpose of developing a knowledge structure. The knowledge structure would be characterized by a lack of clarity. Essentially it would be rather abstract. Highly competent analysts could discern the relevant data and factors for valuation but due to the company's abstractness the remainder of the market would resort to an image of the company's value based on previously understood value. The simple dynamic dimension prevents the overall valuation of the company from changing rapidly and produces the situation where forecasts can be made by the competent analysts with a fair degree of accuracy. A posteriori information would be received, decoded, and interpreted at a fairly slow pace

because of the abstractness of the underlying knowledge structure. Also, because of the company's abstractness the cost of analysis would be relatively higher in comparison to the analysis of more simple companies yet the benefit would be only one investment opportunity. Therefore the cost-benefit factors would be an additional deterrent to analyze a posteriori information for such a company and would slow down further the pace at which the information is spread throughout the market. Therefore, although the posteriori information can be used deductively to forecast potential outcomes the number of analysts concentrating on this company is reduced and then they are faced with the problem of dissuading others of the adjusted value. The reason being for this latter problem is that the market in its relative lack of understanding of the company tends to be emotionally defensive over its current image of the stock's value.

This defensiveness stems from the attempt to maintain an acceptable level of certainty for something which is not fully comprehended and a method of maintaining a sense of certainty is to accept an image espoused by a concensus of the investment community which is continually being reinforced. As explained previously, a person who has accepted a belief in something for which

no clear explanation exists tends to accept readily information that reinforces his belief and tends to discredit information which criticizes or opposes his belief.

If superior analysts are capable of realizing valuation adjustments upon the receipt of pertinent posteriori information and if they attempt to spread their recommendations throughout the market, the acceptance by the market will be slow because of its defensiveness towards its current image of value. A fortiori information on the other hand will be mostly discounted by the time of its announcement. The slow movement of the newly recommended value will create a gathering momentum of buying or selling for the company's stock. The result will be the development of a trend in its price changes. For such companies relative strength would be discernible and would prove to be statistically valid if the sample tested gave recognition to the categorization of varying complexities in corporations.

The last category of complexity, C_4, is the severest case of complexity and has both a complex domain and a dynamic dimension. An example of this case is a company that has a vast, diversified organizational base which is undergoing a change in organization that is commensurate with its corporate base. This type of company

is very difficult if not impossible to analyze because of its abstractness. Any forecast attempts would be done so with a high degree of uncertainty and would have very little predictive value. Because the knowledge structure would be impossible to develop the market, including all analysts, would resort to an image of the company's value. The image in this case would be much more fixed and emotionally based than in the previous case of C_3. A posteriori information is insignificant as no one can determine the importance of the news item or information on the potential earning power of the company. No deductive reasoning can be applied here. However, a fortiori information may be of significance if the information is vital enough to effect questioning doubts as to the foundations of the image. If the fortiori information is concerned only with a minor aspect of the image then the market will tend to maintain the current image by rejecting information negating the image. Negative information of minor significance repeatedly entering the market will alter the image but the process could be slow. It should be kept in mind that negative information is merely information which opposes the current image and is not necessarily pessimistic news.

This category of complexity should yield patterns in price changes because of the image factor and the result

should be a trend in the stock's price movement. This above statement must be qualified with the understanding that if the image of a stock's value as expressed in the traded price has deviated excessively from its "true" value the price is vulnerable to a fortiori information entering the market, generating a substantial emotive change to bring about a sudden large price change. In this category relative strength may be valid but is vulnerable to experiencing a violent price change in the stock.

Summary

This chapter has been included with the purport of advancing the theory of common share price behavior and explaining the possible validity and compatibility of the theories of relative price performance and random walk. The theoretical framework has been developed from a general systems approach examining corporations as systems with differing degrees of complexity. Complexity measured along two of three possible dimensions has been related to the problems of analysis, understanding the relational components and factors for valuation and the development of knowledge structures of companies. Information, a necessary key to any analytical process, has been broken

down into two types depending on whether the information can be used deductively or inductively. Finally, the two types of information were applied to the categories of complexity to reveal the market valuation and price adjustment process. The end result demonstrated how the random walk model would be vulnerable to large price changes invalidating the use of relative strength techniques. It is hoped that this theoretical development will be given a critical appraisal and will be considered as a furthering of understanding the market place as a socio-economic phenomena.

CHAPTER VI

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This paper, as explained in the Introduction, has had two purposes. The first was an empirical examination of the hypothesis of relative price performance to determine its validity and possible use to supplement fundamental analysis by preselecting which issues to analyze. The second purpose was to develop a theoretical framework which attempts to explain the constraint of complexity encountered in security valuation. The conclusions drawn from both purposes are presented here in the respective order in which the two enquiries were covered in the paper. Although this dichotomy of purpose exists the conclusions reached are not totally independent. The recognition of the constraint of complexity and its relationship to information receipt qualifies the findings of the empirical examination by illustrating some of the necessary conditions for relative price performance to operate.

Conclusions from the Empirical Examination of Relative Price Performance

The 11 tests conducted on the data which examined the validity of the hypothesis that relative price performance of common stocks is dependent on recent historical relative price performance provided no significant support for the hypothesis. Correlations of historical and subsequent relative price performance, as measured here in the coefficient of determination, were insignificant. Also, in many cases the estimated regression equations were slightly negative when a positive relationship was hypothesized to exist.

The tests of the hypothesis varied in approaches from examining the entire sample of stocks one month at a time to examining each stock individually for the full time period under review. The approaches taken also varied from including only one month's historical relative performance as the independent variable in the regression equation to including up to ten months of historical relative performance. The results from the variations of approach were negligibly different in most cases. In those other cases where the correlation improved due to an inclusion of more independent variables the improvement was slight and was achieved at the expense of the error of estimate.

The findings in this study lead to the conclusion that historical relative price performance has no significant validity in predicting future relative price performance of common share prices and that the hypothesis as stated in this paper cannot be rejected.

Implications of the Constraints of Complexity

The theoretical framework of complexity developed in this paper revealed the constraining effect of complexity encountered in security valuation. It was shown that as the degree of complexity in corporations increases it becomes more difficult to analyze these companies and to arrive at an accurate valuation. It was then demonstrated that the degree of complexity can be measured in corporations by using the three dimensions of systems: domain, dynamic and ecological. However, by eliminating industry and general market movement from individual stock price movement the ecological dimension could be subtracted. Complexity in companies forces the market in an attempt to maintain a sense of certainty to rely on an image of value which is perpetuated by a concensus of the investment community. It was then shown that the reliance on an image stemming from an emotive basis creates a defensiveness as to news and information which might be negative to the image.

Complexity was related to types of information and revealed the constraining effect on understanding information that might be used deductively (a posteriori) and information that would be used inductively (a fortiori). The relationship of categories of complexity to information types presented a framework of variations in security valuation and hypothesized security price movements that would result. The rather crude framework of four categories of complexity for corporations illustrated that two categories would exhibit random security price movement, one would exhibit trends in security price movement and the last category should also exhibit trends but which could be vulnerable to dramatic price changes.

Recognizing the possible variations of security price behavior caused by differences of complexity leads to the inference that the findings of the empirical tests of relative price performance may have been more significant if the sample consisted of only those companies whose degree of complexity was conducive to trends in security price trends as revealed by the framework.

Suggestions for Further Research

Further research should be directed towards expanding and refining the framework of complexity. More

thought should be given to applying knowledge from psychology, sociology and other related disciplines to the framework to attempt to expand the understanding of behavior and decision making process of individuals in the market place. Thought should also be given to developing refined methods of measuring complexity and the related risk of inaccurate investment forecasts. Further research on relative price performance could be conducted on "selected" samples of corporations that are theoretically conducive to trends in security price movements. Finally, future research could be directed towards attempts to measure investment risk in cases of uncertainty through improved techniques of measuring complexity of investment opportunities. The application of general systems concepts and information theory should be considered as an aid to comprehending complexity and the limitations on "rational" investment decisions.

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APPENDIX I

INDUSTRIALS

BANK

Bank of Montreal
Bank of Nova Scotia
Canadian Imperial Bank of Commerce
Royal Bank of Canada
Toronto-Dominion Bank

BEVERAGE

Canadian Breweries
Distillers Corporation Seagrams
John Labatt
Molson Breweries 'A'
Hiram Walker-Gooderham

CHEMICAL AND TEXTILE

Canadian Industries
Chemcell
Dominion Textile
DuPont of Canada
Harding Carpets 'A'

CONSTRUCTION AND MATERIALS

Canadian Cement
Dominion Bridge
Standard Paving

FINANCIAL

Argus Corporation
Canada Permanent Mortgage
Imperial Life Assurance
Industrial Acceptance

FINANCIAL (continued)

Investors Group 'A'
Laurentide Finance
National Trust
Power Corporation of Canada
Traders Finance 'A'

FOOD AND RETAIL

Atlantic Sugar
Beaver Lumber
Canada Packers 'B'
Dominion Stores
Hudson's Bay Company
Loblaw Company 'B'
Oshawa Wholesale
Salada Foods
Simpson's Limited
George Weston 'A'
Woodward Stores

INDUSTRIAL MINE

Aluminium Ltd.
Cominco
Falconbridge
Hollinger
International Nickel
Noranda

METAL WORKING

Anthes Imperial 'A'
Dominion Electrohome
Ford Company of Canada
General Motors
Hawker Siddeley
Hayes Steel
Levy Industries
Massey-Ferguson
Slater Steel

OIL REFINING

B.A. Oil
Canadian Petrofina
Imperial Oil
Shell Canada
Texaco

PAPER AND FOREST PRODUCTS

Abitibi
B.C. Forest Products
Consolidated Paper
Domtar
Fraser Company
Great Lakes Paper
MacMillan, Bloedel
Price Brothers

PIPELINE

Alberta Gas 'A'
Interprovincial Pipe Line
Pembina Pipe Line
Trans-Canada Pipe Line
Trans-Mountain Pipe Line
Westcoast Transmission

STEEL

Algoma Steel
Dominion Foundries
Dominion Steel & Coal
Steel Company of Canada

UTILITY

Bell Telephone
B.C. Telephone
Calgary Power
Consumers' Gas
Northern & Central Gas
Union Gas of Canada

MISCELLANEOUS

Canada Steamship
Canadian Pacific Railway
Dominion Glass
Moore Corporation
Southam Press
Famous Players
White Pass & Yukon

GOLD

Aunor Gold
Bralorne
Campbell Red Lake
Cochenour Willans
Dickenson
Dome Mines
Giant Yellowknife
Kerr-Addison
Macassa
Madsen Red Lake
Sigma
Upper Canada

BASE METAL

Campbell Chibougama
Cassiar Asbestos
Craigmont Mines
Denison Mines
East Sullivan
Hudson Bay Mining & Smelting
Mattagami Lake
Normetal
Opemiska
Quemont
Rio Algom
Sherritt Gordon
Steep Rock
United Keno

WESTERN OIL

Canadian Superior Oil
Central Del Rio
Dome Petroleum
Great Plains Development
Home Oil 'A'
Hudson's Bay Oil
Husky Oil
Pacific Petroleum
Scurry Rainbow