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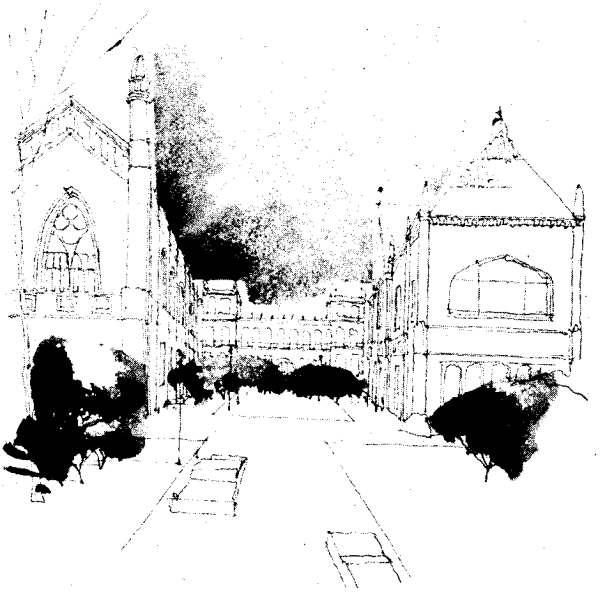
Current Controversies on the Stock Market

By JAMES H. LORIE



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JAMES H. LORIE is Professor of Business Administration, Director of the Center for Research in Security Prices (sponsored by Merrill Lynch, Pierce, Fenner and Smith Inc.), and Director of Research, Graduate School of Business, University of Chicago. He received the A.B. and A.M. degrees from Cornell University and the Ph.D. degree from the University of Chicago. He has been on the faculty of the Graduate School of Business since 1947, and was for several years Associate Dean of the School. Professor Lorie served as Consultant to the Board of Governors of the Federal Reserve System and as Senior Consultant for Joel Dean Associates, a management consulting firm. He is a Director of Gaertner Scientific Corporation, Standard Shares, Inc., Wallace Business Forms, and Hyde Park Federal Savings and Loan Association; and a member of the Board of Trustees of the Foundation for Economic Education, Inc. Professor Lorie has written and spoken widely about marketing, consumer spending, and business finance. At the beginning of 1964, Professors Lorie and Lawrence Fisher published the first detailed and comprehensive study of rates of return on all common stocks listed on the New York Stock Exchange. This report, based on the work of the Center for Research in Security Prices, received national and international attention. In a talk delivered by Professor Lorie at the annual meeting of the American Statistical Association in Philadelphia on September 8, 1965, he described the findings of this study and of related studies of the behavior of stock prices. This Selected Paper is based upon Professor Lorie's Philadelphia talk.

Current Controversies on the Stock Market

I AM VERY PLEASED to be here this evening, but I must confess to some surprise at having been invited. I am not a statistician, nor am I rich enough or influential enough to be the object of flattery by the head of a large, privately-supported university. In reflecting on possible reasons for Allen Wallis' invitation, I concluded that it sprang from a sense of brotherhood that he and I feel as members of the tiny group whose statistical training has been profoundly influenced by Mark Twain.

Twain is perhaps better known as a novelist and humorist than as a statistician, but Allen and I and a few others know that a perceptive reading of his writings reveals a foreshadowing of the work of such diverse statisticians as Fisher, David Wallace and Mosteller, Hansen, Hurwitz, and Alfred Cowles. (As you can see, I'm gradually converging on the stock market.)

In some early work on experimental design, Twain noted that a cat which had once jumped on a hot stove never jumped on a hot stove again-or a cold stove either, for that matter. Fisher, of course, with the benefit of more powerful analytical tools, would have jumped on a cold stove.

Twain wrote a fascinating book with the simple title, Christian Science. In it he tries to understand Mary Baker Eddy and the theory and mechanism of the Christian Science Church. He also tries to determine the authorship of the *Key to the Scriptures.* By comparing word patterns and vocabulary in that work with those in other writings *known* to be by Mrs. Eddy, Twain persuasively concluded that she did not write the *Key to the Scriptures.* By similar means, he concluded that the plays generally attributed to Shakespeare were really by

another man of the same name. These early efforts of Twain, though not so costly as later work on the ***Federalist Papers,*** were more entertaining.

Twain also worked as a demographer. He discovered through imaginative analysis of mortality statistics that it's impossible to live to be eleven, but that those beyond eleven are immortal. This seems obvious to us now-for instance, all of us here are over eleven or else not yet eleven-but in Twain's day his finding was received with incredulity.

Finally, I would like to comment on Twain's work on the stock market as a transition to the rest of my talk which is on more recent efforts in that field. Twain's work was elaborate and is worth your attention, but I shall mention here only his major conclusion: April is a dangerous month in which to speculate in Stocks; other dangerous months are October, June, March, November, January, August, February, May, December, September, and July.

Fluctuations Matter

Some people say that sex is not as important as Freud thought; and as I get older, I am increasingly inclined to agree with them. Others deny that money is as important as the Socialists say. They may be right. Nevertheless, sex and money are undoubtedly both popular and even important. Twenty million Americans and their families own about 600 billion dollars' worth of stock, and fluctuations in the value of stocks matter. I am going to talk about fluctuations in the value of the most important group of stocks in the world, those listed on the New York Stock Exchange.

There has been a very large amount of statistical work on stock prices-as one would expect when the relevant data are so freely available and the prizes for original, correct work are so large, tangible, negotiable, and automatically bestowed. Until recently almost all

of this work was by persons who knew a great deal about the stock market and very little about statistics. While this combination of knowledge and ignorance is not so likely to be sterile as the reverse-that is, statistical sophistication coupled with ignorance of the field of application-it nevertheless failed to produce much of value. The major enduring empirical work before World War II was Alfred Cowles' study of the rates of return on a substantial group of stocks for the period 1871-1940.

Rates of Return

Recently, scientific quantitative research has become much more voluminous and new results of importance have emerged, though some of the most interesting are still controversial. This upsurge of scientific labor has been facilitated by the availability of high speed computers and by the creation of two large files of tape of basic information on stocks.

The first file to be completed and used-and the one with which I shall deal primarily in this talk-is of stock prices and it was created by the Center for Research in Security Prices of the Graduate School of Business of the University of Chicago. The second file is called "Compustat" and contains about 60 kinds of information found on corporate balance sheets and income statements. The data are available for about 1,000 firms for about 15 years. Compustat tapes are sold by the Standard Statistics Corporation and have been given to a number of universities.

The Center for Research in Security Prices-hereafter referred to as CRISP-was started in March, 1960, by a grant of $50,000 from Merrill Lynch, Pierce, Fenner and Smith Inc., to the University of Chicago in order to answer a basic question-what has been the average rate of return on investments in common stocks? We hoped to answer this question better than

it had been answered before for $50,000 in one year. We spent $250,000 and took four years. Our optimistic naivete may have been inexcusable but it can be explained, and the explanation will hopefully be of some interest. The results which I will discuss later have attracted an almost incredible amount of attention with unknown but probably substantial practical consequences.

We decided to deal with all the common stocks on the New York Stock Exchange. These stocks account for over 85 per cent of the value of all common stock outstanding in this country and the data on New York Stock Exchange stocks are relatively complete and accurate. This exchange is by far the largest in the world, its listed securities being worth over four times those of the second largest exchange -London.

All Stocks Included

A sample of these stocks would have been adequate for many though not all reasonable purposes-for example, a study of optimum industry groupings in the construction of index numbers-but, curiously, we concluded that it would be more costly to achieve a satisfactory level of accuracy for an adequate sample than for the entire population. Experience in a pilot study indicated a sharp rise in the incidence of clerical error if a sample of stocks were selected from available comprehensive lists. Further, some efficient methods of quality control of the clerical processes would not be available if a sample were used.

We recorded monthly closing prices of these stocks for the 35 years beginning in January, 1926. We dealt with about 1,700 stocks and recorded all information necessary to compute rates of return. This information is voluminous and complex. It includes data on 39 different types of distributions of cash and property to shareholders-e.g., shares of stock, rights

to buy stock, warehouse receipts for whiskey -the dates of distribution and the tax status. Each dividend, for example, fell in one or more of seven different tax categories. Information was required on mergers, spin-offs, exchange offers, commission rates on the purchase and sale of shares, tax rates on income and capital gains for individuals with different incomes, name changes, etc.

Although the interpretation and coding of much of this information clearly required highly trained personnel, it was our original belief that the raw prices themselves could be recorded adequately by untrained clerks. Even this hope proved unfounded. The main difficulty was in deciding what was a common stock. We generalized from the work of Gertrude Stein, who, you may recall, said that a rose is a rose is a rose. We thought that a common stock is a common stock is a common stock; but it isn't. Further, some things not called common stocks are. Securities with over 50 different types of designations proved to be common stocks-e.g., American Depository Receipts, certificates old, certificates new, certificates black, certificates blue, preferred stock, and even debentures. That is, securities with such designations were residual claimants to the income of corporations and were therefore, by our definition, common stocks. On the other hand, the common stock of the Green Bay and Western Railroad, for example, had preferential rights to corporate income and was therefore not a common stock. Of our almost 400,000 price quotations, over 30,000 required more than clerical attention.

Refinement, Accuracy

The man largely responsible for the work of CRISP, Lawrence Fisher, was fanatical in his desire for refinement and accuracy in measuring the rate of return on investments in common stocks, and relatively indifferent to the

rate of return on the investment in making the measurement. He aspired to make the data on our tapes more accurate than the sources from which they came-a possibly laudable and assuredly extravagant ambition. Since we feel that he succeeded, our methods of quality control may be of interest. My account is taken in large part from a paper of Fisher's, "Use of Electronic Computers in the Quality Control of Financial Data."

Two principles proved useful: (1) Recording data as found in the sources without adjustment; (2) Using the computer to identify "suspicious," inconsistent, or impossible items. In accord with these principles, the following procedures were used. For each month that a company was listed, we prepared a prepunched card for use as a coding form. This coding form contained the name of the company, the date, and two numbers-a "company number" which referenced our information on listing and delisting, and an "alpha number" to aid in the alphabetizing of the cards.

Rather than coding and punching all prices twice and then resolving discrepancies manually, we found a better procedure. We know that the change in the price of a stock during one month is very nearly independent of its change during the next month. Therefore, if a price changes a large amount from one date to a second date, and by a similar amount in the opposite direction from the second date to a third, there is a reason to believe that at the second date the price was misrecorded. A "large change" was rather arbitrarily taken to mean a change in magnitude of more than 10 per cent of the previous price plus a dollar.

Test Sample

To see whether this method of finding errors would be successful and to test the accuracy of the original coding and punching of cards and their recording on magnetic tape, a

random sample of 100 clusters of 50 prices each was coded a second time, punched, and recorded as first recorded. This test revealed 132 errors in price in our original data collection. Of these errors, 72 were caused by failure to find any price for the stock that month, or were prices which were invalid on their face because the bid price was higher than the asked, or because the fractional part of the price was impossible, e.g., 7/7 and 3/1. The remaining 58 erroneous prices had face validity. Of these 58, 30 were in error by more than 10 per cent plus a dollar and 28 were not. Of these 28, 14 were too high and 14 were too low. The average magnitude of the error was 2 1/2 per cent of the price and the mean error was - 3/4 per cent. Thus the check we planned appeared to be satisfactory in that all errors were small and the process was unbiased.

Computer programs were written which, among other things, checked the validity of the fractions (before converting them to decimals), made sure wherever both bid and asked quotations (rather than sales prices) appeared that the bid was less than the asked, looked for missing price quotations, and finally made the comparison of consecutive prices described.

In collecting prices we could reasonably expect to find approximately one price for each month a security was listed. But in collecting data on cash dividends there was no way to predict the frequency of dividends for each company.

Dividend Guides

Annual dividend guides that list publicly-held companies in alphabetical order and that describe each dividend paid during the year are available for the period beginning in 1937. For earlier periods, quarterly guides are available.

To collect the data, clerks were given cards with a coding form printed on them, a list of

names and code numbers of listed companies, and a dividend guide. They filled out as many cards as there were cash dividends for listed companies. This information was then punched into the cards and the data were transcribed onto magnetic tape. For the last years of the study, the annual guides note the exchanges on which a stock was listed. For the earlier years they do not. Because it was so easy to make clerical errors, our method of collection could not be expected to produce a very complete list of dividends.

To check on the dividends, we turned to Moody's ***Manuals,*** which show annual dividends per share for each security described. We recorded these totals to the nearest cent, punched them into cards, and placed them on magnetic tape. A computer program was written which compared the sum of each company's dividends for a year, found by adding dividends copied from a dividend guide with the total for the year as reported in Moody's ***Manual.*** Whenever a discrepancy was found, a report was printed. This report showed the individual dividends in question, their total and the discrepancy.

The appropriate dividend guide or manual or both were then consulted to resolve the discrepancy, and the error in the file of dividends or annual totals corrected.

This process was repeated several times until there were no more discrepancies.

Capital Changes

The other events in our files are usually called capital changes. Since there are a large variety of capital changes, most such changes had to be punched into two cards in order to obtain a standard, legible format. These cards were listed and this printed copy was compared with the ***Capital*** Changes ***Reports.*** After errors were corrected, the cards were placed on magnetic tape, using a somewhat different format.

To this file we added an over-the-counter price for securities which had been delisted.

A computer program was written to take the coded information on each of these stock dividends, splits, rights, mergers, etc., and decode it to form a verbal description. The verbal descriptions were then compared with the *Capital Changes Reports.* As a result of this comparison approximately 2,000 errors were found and corrected.

Results **of** *Study*

Our results show the rates of return for 22 time periods between 1926 and 1960, with and without reinvestment of dividends, for persons in three different tax brackets, and with and without liquidation of the final portfolio and payment of the capital gains tax. Other time periods and tax brackets could easily and cheaply be added. Assuming equal initial investments in each company with one or more common stocks listed on the New York Stock Exchange, the rate of return for a tax exempt institution which reinvested dividends for the period 1926-1960 was 9 per cent per year compounded annually. The comparable rate was 7.7 per cent if the investments were made at the height of the bull market in 1929 and the securities were held till the end of 1960. Since 1950, the rates were over 10 per cent.

Incidentally, our work also showed that it paid to be tax exempt. If you had been exempt in 1926, an initial investment of $1,000 would have been worth about $20,000 in December, 1960. If you had an income of $50,000 in 1960 and comparable incomes in earlier years and were not tax exempt, your original $1,000 would have grown to only about $11,000.

Our results were distributed to over 700,000 individuals, were reprinted in a full page in the *Wall Street Journal,* and were presented orally to audiences from the financial communities of London, Geneva, New York, Boston,

Philadelphia, Chicago, Miami, Dallas, Los Angeles, and San Francisco. Why the interest? For all long periods and most short periods-reasonably defined-the rates are higher, often far higher, than for other types of financial investments for which we have data. This disturbed individuals whose savings were in bonds and savings accounts and even seemed to have some impact on the trustees of private pension funds, whose assets exceeded 60 billion dollars, and on state legislatures which in most states have legally prohibited the investment of the assets of state employee pension funds in common stocks. One of our insights which we shared widely was that the cost of providing a given level of benefits is many times greater if assets earn 3 per cent rather than 9. Also interested and disturbed were managers of mutual funds-assets more than 30 billion dollars-since on the average the returns to investors in such funds were slightly less than from investment in randomly selected portfolios.

Economists Interested

Academic economists were interested because of the persistence over long periods of time in such large differences in rates of return in different financial media. The standard explanation was and is that stocks are riskier than other investments and that higher rates are therefore necessary to induce investment in stocks. That is reasonable and probably true. Merrill Lynch and we were interested in some measure of this riskiness. Fisher in an article, "Outcomes for 'Random' Investments in Common Stocks Listed on the New York Stock Exchange," provided one measure of risk.

He did a relatively simple thing, namely, computed rates of return on an annual basis and compounded annually for all possible combinations of purchases and sales at the ends of months for all common stocks listed on the

New York Stock Exchange for the 35 years beginning in January, 1926. A simple stock listed for 420 months can be bought and sold at approximately 88,000 combinations of dates. Fisher calculated a frequency distribution based on about 57,000,000 rates of return. It would have taken him longer than it did, if he had not used a computer. We do not know how much longer, but we have authorized IBM to say that their computer speeded the work.

This frequency distribution shows the results of random selection of stocks and of the timing of purchases and sales. The median rate was 9.8 per cent. Seventy-eight per cent of the transactions yielded a positive return, even after allowing for transaction costs. The interquartile range was from approximately 2 per cent to approximately 17 per cent. Over two-thirds of the time the rate exceeded 5 per cent. Nearly one-fifth of the time the rate exceeded 20 per cent. Five times out of 100,000, the investor suffered a total loss, and 2 times out of a million, on the average, he earned money at the rate of a trillion per cent per annum-as would result from a stock's rising from r/s to 7/8 in a month.

Fisher also calculated frequencies for purchases and sales during the 16 business expansions and the 16 contractions, as defined by the National Bureau of Economic Research, for the period 1926-1960. The major lesson of this exercise is that generally it doesn't pay to try to be clever in timing one's purchases. That is, delaying the purchase of stocks did not on the average result in superior yields, as the improvement from guessing the cycle was about offset by failure to profit from the strong secular rise during the period under study.

Comments on Findings

Some general comments on Fisher's work are in order. The variability of rates of return is

much greater for short-term investments than for long-term and, consequently, the probability of gain for long-term investments was much greater than 78 per cent. Further, because the rates of return are positively skewed, the holding of groups of stocks rather than a single stock at a time would have led, on the average, to a positive return more than 78 per cent of the time and to returns greater than 9.8 per cent per annum more than half the time. A fortiori, holding groups of stocks for long periods of time would have resulted in a relatively small probability of loss and a relatively high probability of gains greater than from alternative investment media. None of this should be interpreted as a recommendation to buy stocks--I have scrupulously avoided prophecy-but it is surprising to me at least that the superior returns from stocks in the past have been associated with such little risk. Keep in mind that banks were known to fail in the 1930's and not all mortgages turned out as well as the lenders hoped.

Now let me turn to some closely related matters. The precise measurement of rates of return from all stocks on the New York Stock Exchange-and by implication from randomly selected portfolios-has caused renewed scrutiny of the performance of mutual funds and investment trusts. These organizations are in the business of investing funds, primarily in stocks. As I suggested earlier, returns to investors in such organizations on the average appear to have been slightly less than from direct investment in randomly selected portfolios. How can this result be explained? The managers of the funds controlled by these organizations are competent, responsible professionals whose careers depend in large part on success in selecting securities and in timing their purchase and sale, yet throwing darts at lists of stocks and dates is on the average as satisfactory a method of making investments as is

reliance on competent professional judgment. I have said this before and have been incorrectly interpreted as derogating the ability of the managers of such funds. While my remarks do not constitute extravagant praise, they are not an indictment of the competence of individuals or even of the usefulness of mutual funds and investment trusts.

Possible Reasons

To cast light on what may seem to be a paradox, let's seek an explanation of the apparent inability of these funds and trusts to outperform the market. One part of the explanation is that institutions-mutual funds, trusts, pension funds, etc.-themselves are an important influence on stock prices. Institutions now own over 20 per cent of New York Stock Exchange stocks and the percentage is growing. Clearly, if institutions have important influence on prices and their analysts are of approximately equal ability, however great, the stocks owned by such institutions will behave much as the market as a whole and even individual institutions will have difficulty in showing superior performance. Further, such institutions as a matter of policy or law hold widely diversified portfolios. The law requires extensive diversification among issues by mutual funds, and the size of many funds makes even more extensive diversification essential.

We have found in varied and extensive work on index numbers that it is difficult to pick a substantial sample of stocks at any time which, on the average, performs much differently from the market as a whole. Work by Benjamin King, Jr., for example, shows that on the average about 50 per cent of the variance in the prices of individual stocks is accounted for by movements in the market as a whole. Fisher has constructed indexes in which each stock receives equal weight-in marked contrast to the Dow-Jones and Standard and Poor's indexes

which are heavily dominated by a few large companies-and found that his indexes have long term movements very similar to those of Dow-Jones and Standard and Poor's. Further, except for 1929 when stocks of small companies turn down several months before those of large companies, the cyclical turning points in the various indexes have been virtually identical in time. Thus, competent people competing with other competent people in selecting groups of stocks largely influenced in the same way by the same set of factors have great difficulty in being consistently superior.

Before leaving this subject, I wish to tie up three loose ends. I said earlier that returns to investors in mutual funds would on the average probably have been slightly less than returns from investment in randomly selected portfolios. Why less? There are three reasons. First, such funds frequently charge 8 per cent for buying their shares. Second, management fees typically are .5 per cent per year. Third, such funds almost never are continuously fully invested in common stocks and the portion of their assets not so invested on the average yields a lower rate of return than the portion in stocks-hence the lower average yield to investors in such funds.

Funds Provide Services

The second loose end is my statement that such funds and similar institutions can be-and almost certainly are-useful. The simplest and most comprehensive affirmative evidence to a believer in free competitive markets is the very rapid growth of such funds. The funds provide valuable services. They persuade many individuals to invest in stocks rather than other things which in the past have been less profitable than stocks. They provide valuable bookkeeping and custodial services, a relatively efficient means of achieving diversification and associated risk reduction for small in-

vestors, and reduction in the agony of choice and responsibility.

The third loose end was implicit. I have said that on the average mutual funds-and by implication, other institutionally managed funds -have selected stocks which have performed about the same as all stocks or randomly selected groups. So far, I have said nothing explicit about variability among funds in any given period or variability from period to period. What I ***have*** said would lead you to infer -correctly-that in any given year the common stocks for about half the funds do slightly better than all stocks and half do slightly worse. This is also obviously true for periods of 5 or 10 years. What accounts for the variability? Is it more than the result that could be expected from a random sampling process? William Sharpe has a plausible explanation which will be published in January 1966 in the ***Journal*** **of** Business. He finds that much of the variance among funds in rates of return from investment in their shares is explained by risk-measured by variance in the net asset value per share-and by costs of management. The correlation between risk and rate of return is, as would be expected, positive. The correlation between costs of management and rates of return is negative, a result which no longer surprises you, I hope.

Before moving on to the final section of my talk, which is on the great random walk controversy, I would like to pause for a moment of pontification. It is worse than useless to do investment research which is conventional in method and speed, since such research costs money and results in decisions only as profitable as random selection.

Random Walk Controversy

The great random walk controversy has aroused passion and occasionally bitter acrimony. It is an unusual controversy in that

those on one side only are passionate. The angry ones are those who sell investment advice based on "technical analysis," which is analysis designed to predict price movements in stocks on the basis of interpretations-often allegedly objective or scientific-of recent movements in the level of prices or indexes and of trading volume.

iness ***and Financial Weekly,*** an old and respected publication, had in its August 30, 1965, issue offers to sell advice on investments by 21 different technical analysts. Although these persons may not believe that you can buy happiness, they believe or say they believe that you can buy dollars or wealth at a great discount. For a few dollars you are offered allegedly reliable information about future movements of individual stocks or the market as a whole. The technical analysts believe that there are recurrent, discernible patterns in stock prices or prices and trading volume and that such movements are assuredly not random.

The bemused and detached parties to the controversy are typically academic economists and statisticians, unembarrassed by the question, "If you're smart, why aren't you rich?," who present strong though not definitive evidence of the statistical independence or randomness of successive changes in stock prices. If such randomness exists, most technical analysis is silly and the advice of many persons is revealed to have no value. So far, the random walkers have dealt extensively only with stock prices and not with prices and trading volume considered together.

The first random walker is believed to have been Louis Bachelier who first presented evidence in 1900, ***La Thtorie de Speculation.*** His work was seminal but the gestation period was long. Only within the last 10 years has his work ben rediscovered by persons interested in testing it and extending it with other data.

Test for Randomness

Those walking randomly through the financial community include Cootner, Fama, Roberts, Granger, Clive and Morgenstern, Arnold, Moore, and others. Several have tested for serial correlation in successive price changes and in all instances the coefficients were extremely close to zero. Fama used a runs test and Morgenstern *et al.* used spectral analysis. All concconcluded that the evidence was consistent with randomness. The chartists are unimpressed by this conventional statistical evidence and they buttress their skepticism with arguments that the models underlying the statistical tests used are too simple to identify the complicated patterns which exist and can be perceived and used with profit.

One non-believer in randomness, Sydney Alexander, took another tack. He proposed an objective decision rule for investing which he claimed yielded profits far greater than a simple policy of buying and holding stocks. His device, called the "filter-technique," was designed to time purchases and sales and was based on persistence or trends in prices-allegedly profitable departures from randomness. His scheme, which I will divulge only if you promise not to use it till tomorrow, worked as follows:

(1) After a stock has risen X per cent buy-
(2) Hold till it has declined x per cent and then sell short-
(3) Repeat ad nauseum or bankruptcy.

Alexander presented evidence for filters of many sizes, many of which for the periods under study yielded profits greater than could be obtained by buying and holding the same securities. Fama, the most energetic and prolific randomist, redid Alexander's work, taking into account transaction costs and the fact that dividends are a cost rather than a benefit when

stocks are sold short. These details revealed that all filters are extremely unprofitable, compared to buying and holding, except to the broker.

So far, the randomists are unscathed and generally poor. There will be more debate and more attacks on the randomist stronghold, but there is a haunting fear that those with the best arguments are silently sunning and swimming at St. Tropez.