

# Stock Market Pricing: Anomalies and Fallacies

Book Proposal

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R. D. Coleman, Ph.D.

numeraire @ earthlink.net

## PREFACE

This book is an inquiry into the nature and causes of the stock market pricing process and its contribution to the wealth of nations. It is a sequel to Adam Smith's classic *Wealth of Nations*. The Smithian factors of production are land, labor, and physical capital. A neoclassical factor is entrepreneurship, viewed as the ability to raise financial capital and invest it to create new economic wealth for the equity owners.

Today, equity capital and the other productive factors move more freely in the world of increasingly global markets and rapidly advancing technologies. A national economy's total factor productivity and its unit factor costs relative to those of other nations, in great part, influence its ability to compete globally and thereby create new wealth. We study the relationship between two components of global competitiveness: finance as indicated by the cost of capital; and science and technology as indicated by private industrial research and development (R&D).

The stock market pricing process determines the cost of equity capital. Private industrial firms that conduct and fund R&D in sustained programs are referred to individually as R&D firms and collectively as the R&D enterprise. A distinction is made between proprietary R&D and contract R&D. Proprietary R&D is financed with stockowners' money from paid-in capital and accumulated retained earnings. Contract R&D is financed with customer payments and thus, from the perspective of the R&D firm, with other people's money. A major contract customer is the federal government, in which case the other people ultimately are the taxpaying citizens.

### Anomalies: R&D-Related Effects

The primary purpose of this book is to study the competitive free market pricing of the common stocks of firms in the R&D enterprise. National societal values of freedom and competitiveness provide a framework for the problem of anomalies in the market pricing of common stocks. Newly discovered anomalies that result from this study include firm-level R&D expense, firm-level proprietary R&D expense, and industry-level research group code or R&D group. R&D group is a nominal-scale variable that entails the four-digit industrial classification (SIC) code.

These and other anomalies based on R&D herein are referred to collectively as R&D-related effects.

We adopt modern portfolio theory (MPT) for this study because our interest is in the “portfolio” consisting of all common stocks traded in organized markets rather than in any individual common stock. With MPT, the investor maximizes the expected utility of the trade-off between the mean and the variance of the distribution of returns for a portfolio of common stocks. Return herein refers to expected return, the explained variable in the equilibrium capital asset pricing model (CAPM, pronounced CAP-M). The pricing metric for the CAPM is total return, a linear transform of prices and dividends, adjusted for capital changes.

Equilibrium analysis is adequate as far as it goes. It usually assumes a representative market participant or, what amounts to the same thing, homogeneous information available to all market participants. We assume a world of equilibrium, not because we believe equilibrium is ever attained or even closely approached, but because it simplifies the analysis and is the approach most commonly taken in the literature on capital market efficiency.

Simple models with a few factors are often adequate for predictions based on the simple laws of the physical sciences. On the other hand, complex models with many factors are usually required to describe and explain the patterns formed by the complex systems of the social sciences such as markets. The simplicity of the monocausal CAPM, derived from theoretical economic principles, is atypical. The single causal risk factor in the conventional CAPM is the explanatory variable herein referred to as market-beta. We accept the conventional equilibrium CAPM for our analyses. We use the multivariate form of the CAPM to refine our initial results based on the univariate form of the CAPM.

We assume rational markets and the efficient markets hypothesis (EMH) for the sake of a fixed standard for comparison, not because we believe that market participants are “rational” or that markets are “efficient” in any sense of those terms. As Mark Twain expressed aphoristically, “When we remember we are all mad, the mysteries disappear and life stands explained.” It is a matter of individual taste whether one prefers Keynes’ irrational positive “animal spirits” or Markowitz’s rational normative utility-maximizing mean-variance trade-off between return and a tractable measure of so-called portfolio risk. The word rational as used in rational markets,

rational action, rational choice, and rational expectations herein refers to phenomena that are quantifiable, monetizable, and consistent.

As used to describe markets, the word efficiency pertains to the processing of information. One common definition of an efficient market asserts that prices at any time are based on “correct” evaluation of all information available at that time and “fully reflect” available information. The two terms within quotation marks in this definition are never realized. A presumption based on simplifying assumptions is required to connect the operational CAPM of price theory to the optimal allocation of societal investment risk-bearing of social welfare theory. In addition, the EMH applies to the complete worldwide market of all capital assets, including human capital and all other investment assets, i.e., those on which a return is expected in future years.

Since the EMH applies to an overall market in the aggregate, the empirical tests of the EMH reflect statistical averages both across individual stocks and over multiple holding periods. Such tests do not pertain to individual stocks either at a point in time or over a period of time. Occasionally something can be said with confidence about the mean of a distribution of returns for a large number of common stocks. In contrast, little can be said with confidence about the return for a single common stock.

Statistically significant pricing effects that are attributable to specified risk factors are measured by their model-specific risk premia and constitute anomalies in market pricing. Such anomalies indicate inefficient market pricing. Anomalies thus offer potentially profitable arbitrage opportunities to exploit the temporary divergences of stock prices from their intrinsic equilibrium values.

Alleged stock pricing anomalies abound in the literature. We offer a typology of asset pricing models designed to quickly separate the wheat from the chaff. The typology applies to conceptual models as well as to their corresponding empirical estimating equations. The typology has two major criteria for classification. Each major criterion has two principal categories.

The first major criterion concerns the risk factors specified in the asset pricing model. The two categories are circular and non-circular. The circular models are classified further as

identities, autoregressions, or combinations of identities and autoregressions. The non-circular models are classified further as either temporal such as a seasonal or non-temporal such as a firm-specific characteristic.

The second major criterion concerns the theory and corresponding type of investor preferences directly supporting the asset pricing model. The two categories are general arbitrage theory with state preferences and the special case of expected-utility theory with parameter preferences. Arbitrage theory specifies state-of-the-world variables, either identifiable real factors or unidentifiable factor-analytic factors. In contrast, utility theory specifies parameters of the distribution of returns — either the moments, including mean, variance, skewness, kurtosis, and beyond, *ad infinitum*, or other statistical descriptors such as semi-variance and standard deviation. After the mean, each higher moment entails the prior moment. In a “compact” distribution, the first two moments approximate the full infinite series of moments.

Most stock market pricing anomalies based on the conventional CAPM are either temporal or circular effects. Non-temporal, non-circular anomalies are uncommon. Theoretical temporal anomalies such as the January effect, for example, inexplicably are not eliminated by arbitrage operations. Circular anomalies understandably are not eliminated, being non-existent in the first place.

Circular factors are found in either mathematical identities (e.g.,  $A_t = bA_t$ ) or autoregressions (e.g.,  $A_t = bA_{t-1}$ ). Identities are not valid explanations, being merely tautologies. The CAPM autoregressions are dubious because they are data-instigated.

With identity models, by definition, it is impossible to isolate the explained variable from the explanatory variables. Even when identities are not specified in the estimating equation or entailed through the variables used to partition the sample into portfolios, they may emerge from improper usage of a data sample. Whether the identities are either full or partial, the specified variables in question are circular.

Autoregression is a valid econometric technique, but it can be used for invalid purposes. Autoregressions of certain types can be inverted into mathematically equivalent moving averages. Autoregression is the basis of feedback trading, a form of market timing. Some academics and practitioners think market timing is voodoo economics because there is no

theoretical rationale for the underlying models. In autoregression models, stock price predictions are based on levels of share prices in prior periods.

Feedback trading is based on so-called technical analysis of market-generated share price, share volume, and share dividend data as opposed to so-called fundamental analysis of firm-reported external accounting data. Technical analysis, also known as charting, typically relies on impressionistic interpretations of graphical charts or alleged “sightings” of turning points at market peaks and troughs.

The interpretation of graphical manifestations of fluctuations in economic time sequences is not scientific. Such acyclic fluctuations in and of themselves are historical rather than scientific whether they are putatively generated by an oscillator, a strange attractor, or some other unidentified fluctuant object. In capital markets, these fluctuations are poetically named “bull market” expansions and “bear market” contractions.

Fundamental analysis is not inconsistent with rational pricing and the EMH. Nevertheless, academic journals and the business press seem inconsistent on these subjects. The apparent inconsistency is due partly to institutional dynamics. It also is due partly to confusion of the levels of analysis. This confusion is attributable either to the fallacies of division and composition or to literary synecdoche. Whereas fundamental analysis pertains to individual stocks evaluated *ad seriatim* at the level of a single stock, the EMH pertains to the aggregate market as a whole or a number of stocks analyzed ensemble at the level of a multiple-stock portfolio. Fundamental analysis takes a going-concern firm as its unit of analysis. In contrast, the EMH takes the stock market as its unit of analysis.

#### Fallacies: Random and Circular

A related purpose of this book is to reconcile the pronouncements of academics and business journalists about significant pricing effects and associated investment strategies. The factors causing these effects are asserted to offer competing or alternative explanations of return in the conventional CAPM.

Anomalies are constructive in the sense that they contribute to fair pricing. Fallacies are destructive in the sense that they undermine weak arguments. The title and preface of this book

emphasize anomalies over fallacies. Yet it is more logical to consider fallacious anomalies before testing for possible valid anomalies in order to avoid confounding circular effects with valid effects. Thus, in the text of this book, fallacies precede anomalies.

Each stock market pricing anomaly can be exploited by a suitably designed investment strategy. One well-known combination of anomaly and strategy is the random-walk effect and index investing or indexing. Indexing involves passive management of a portfolio of stocks that is constructed to match a broad index of the stock market. The Standard & Poor's 500 composite stock price index is frequently chosen for this purpose. Low-turnover, low-cost indexing is contrasted with high-turnover, high-cost, active selection of individual common stocks. According to the argument for indexing, an investor might as well buy and hold an indexed portfolio because most investors cannot consistently outperform the market.

The strategy of indexing is usually predicated on a martingale return-generative process rather than a random walk. A martingale is the general form that includes the stricter special case of a random walk. Martingales theoretically entail the assumption of some form of risk-neutrality to describe the behavior of market participants. Yet risk averse behavior as opposed to risk neutral and risk seeking behavior is commonly observed to be characteristic of most market participants. Evidence of risk-aversion is seen in the preference most investors show for investing in several securities at a time, i.e., in a well-diversified portfolio, rather than in only one security at a time.

Institutional and individual investors behave toward the market differently. It is fallacious, therefore, to apply the theory of risk-neutral martingales or random-walks to risk-averse individual investors and to recommend indexing to them, all else equal. Some institutional investors may follow a risk-neutral policy, but few individual investors are risk-neutral.

There are many more individual investors than there are institutional investors. Among investors, the individual on average holds much fewer shares than does the institution on average. Institutional share holdings held by pension funds, investment companies (open- and closed-end mutual funds), insurance companies, bank trusts, and college endowments of the

1,000 largest market-value publicly-traded companies passed 50 percentage in 1990 and reached 57 percentage in 1994.

If a predictable, market-average return is satisfactory, then index investing is appropriate. If exceeding the market-average return over a long-term investment horizon is desired, then buying and holding a portfolio designed to mimic a market index is a self-defeating strategy. Outperforming the market in the long run requires active management.

Another well-known combination of anomaly and strategy is the so-called size effect and small-cap investing. Size here refers to common stock capitalization, also known as market value of equity. Since size equals the product of share price and the number of shares of common stock outstanding, both size and return entail share price.

Size, dividends, and number of shares outstanding are the three ancestral sibling members of the family of circular variables in the conventional CAPM. These variables are circular if specified as explanatory variables in any asset pricing model with total return as the explained variable.

The size effect was originated by academics. Some of them continue to assert the validity of size as a CAPM risk factor. Authors of some recent, refereed academic journal articles interpret their findings to show that size is dominant over market-beta as a risk factor in the CAPM. Other authors of more-recent articles assert that the size factor should be specified in every CAPM. Given these assertions by leading academics, we cannot avoid considering the size factor.

The size effect serves as the justification for investing in small-capitalization stocks. Yet the size effect is fallacious because specification of the size factor in the CAPM reduces the model either to an invalid identity or to a dubious data-instigated market-timing autoregression. The small-cap financial fad has been growing for 15 years and in early 1996 accounts for more than \$100 billion invested in the U.S. alone. Predictably, the spurious size effect has not disappeared after all the money invested to exploit it over all these years.

Ironically, the academics who advocate rational markets and the EMH include the same persons who are behind the irrational small-cap financial fad. There is evidence that suggests that these academic advocates most likely know about the partial identity involved in their usage

of data samples to estimate the CAPM. Interestingly, in their published articles they are silent about embedded identities and the market timing character of embedded autoregressions.

In spite of its lack of validity and lack of rationale, size is used in this study as an upper benchmark for the practical explanatory power of any valid, theoretically-sound factor specified in the CAPM. The lower benchmark is lexical order of firm name, a random factor equivalent to a market-index portfolio. Surprisingly, we find that the R&D group factor dominates even the circular size factor as an explanatory variable in the CAPM when nested portfolios are formed on both R&D expense and either R&D group or circular size.

#### Policies: Public and Private

An additional purpose of this book is to consider the public-sector and private-sector policy implications of our conclusions. Fortunately, the recommended policy initiatives in the two sectors reinforce one another.

From a public policy perspective, a stock market pricing mechanism that is more transparent can increase efficiency by reducing the occurrence of underpricing and overpricing. Such oversold and overbought prices are signals for potentially profitable arbitrage opportunities. A market with fewer arbitrage opportunities is deemed to be more efficient and thus lower-cost for all participants. Market efficiency translates into lower share-cost for buyers or bulls and lower opportunity-cost, i.e., higher price, for sellers or bears.

Greater transparency in the pricing mechanism operates simultaneously to decrease the opportunity cost of equity capital and to increase the rate of return on equity. The market system and its price mechanism equalize the average cost of equity and the average risk-adjusted return on equity across all common stocks traded at any given time for market-clearing equilibrium and across time for intertemporal equilibrium.

Greater transparency results from the fuller disclosure in annual reports of information that impacts share prices, such as R&D expenses. In a transparent market, prices that move away from their intrinsic values due to non-fundamental forces tend subsequently to move back toward their intrinsic values due to fundamental forces. The convergence of price and value is one definition of fair pricing. Such perception of fairness over the long-term also increases

confidence in the market and leads to greater trading volume. This increased confidence, in turn, contributes to lower unit market operating costs in addition to lower capital costs relative to other competing capital markets worldwide.

For public regulatory policy, we recommend fuller corporate disclosures of R&D expenditures and activities on Form 10-K submitted to the U.S. Securities and Exchange Commission (SEC). This could include forward-looking data. Partly due to competitive strategic reasons and partly due to costs, firms generally comply minimally with the disclosure requirements concerning R&D expenditures. Disaggregation of a firm's total annual R&D expenditures into categories is not commonly included in annual reports to stockholders or to the SEC.

Meaningful categories include: (1) the entity actually performing the R&D work, (2) the source of money to pay for the R&D work, (3) the number of R&D facilities by national domicile and their physical address, and (4) the industry segment of individual R&D projects. Additional useful information to be disclosed includes: (5) the number of consecutive years of reporting R&D expenses, and (6) the cumulative R&D expenses incurred over the preceding ten years. Any such disclosures to be mandated by federal regulations are subject, of course, to a favorable analysis of societal costs and benefits.

From a private policy perspective, the potential for profitable investment opportunities resulting from closer scrutiny of data about R&D justifies greater detail in public disclosures of such data. The R&D-related effects can be applied to the formulation of new and valid investment strategies. Investor-specific arbitrage operations are suggested by the new pricing anomalies. The direct beneficiaries of these fuller disclosures include individual and institutional investors, money managers, securities analysts, and financial advisors.

For private investment policy, we recommend that investors consider strategies that exploit the R&D-related effects. We also recommend that market participants attend to the distinctions between so-called technology stocks and R&D stocks; between firms with a sustained R&D program and firms that enter and or exit R&D activity; and between industry groupings of firms and R&D groupings of firms. In addition, we recommend serious reconsideration of indexing and small-cap investment strategies.

### New Research Standard

A final purpose of this book is to demonstrate a new standard of scientific research in financial economics that meets strict scholarly standards. Both in time and in logic, the research question is followed and served by every other aspect of the research project. Given this question and the corresponding research problem, we then choose the methodology, arguments, sample selection, and research design. The results of all tests performed in this research project are reported.

We use the simplest techniques consistent with the purposes of this research project. Where bias is unavoidable in design choices, we choose an approach that makes it more rather than less difficult to have significant test results. Approaches that are more sophisticated can be employed to increase the power of the tests and thereby strengthen the results. These refinements are left for other researchers to pursue.

This book is intended to be self-contained except for statistical theory. For non-specialist readers, intuitive explanations of statistical hypothesis testing and econometrics are available in introductory books written for that purpose. We employ arguments of increasing complexity, but technical portions can be skipped over without loss of continuity.

Statistical association, explanation, and causation are used herein synonymously. In the quasi-experimental social sciences, the basic econometric technique for analyzing causality is regression analysis. Since both regression estimation and portfolio selection are optimizations, the CAPM can be estimated using the regression techniques ready to hand. However, the objective function, constraints, and standard assumptions are interpreted differently. Nevertheless, the anomalies and fallacies are based on generally accepted theories and methodologies appropriately applied.

### Freedom of Inquiry

The perspective of this book is free from study-related preconceptions and from concern for the particular outcome of the study. The absence of these sources of researcher bias is motivated by two practical reasons. The first reason is that the author's intellectual ability and

integrity are on review. The second reason is that not only has the author invested his money pursuant to the study findings, but also other people have invested their money in indexed stock portfolios, small-cap stocks, and technology stocks. This perspective as an outsider to both academia and Wall Street obviates the defects that result from local and institutional tyrannies.

The author began by acquiring and maintaining both the positive freedom to pursue these inquiries wherever they might lead him and the negative freedom from interference and censorship regardless of his findings. Otherwise, original research worthy of the time, effort, and resources expended could not have been initiated, kept on course, completed, or brought to light. The freedom of inquiry, as valuable as it is rare, is the sine qua non of serious scholarship and useful enduring knowledge.