Articles

Is the Stock Market Efficient?

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A stock market is said to be efficient if it accurately reflects all relevant information in determining security prices. Critics have asserted that share prices are far too volatile to be explained by changes in objective economic events—the October 1987 crash being a case in point. Although the evidence is not unambiguous, reports of the death of the efficient market hypothesis appear premature.

THE EFFICIENT MARKET HYPOTHESIS (EMH) HAS BEEN AN article of faith for most financial economists and is even accepted in part by a significant number of market practitioners. It states that the stock market is remarkably efficient in adjusting to, and reflecting in a rational way, all relevant information concerning individual stocks and the economy as a whole. According to the hypothesis, the market adjusts so quickly to the receipt of new information that no techniques of selecting a portfolio of stocks can consistently outperform a strategy of simply buying and holding a diversified group of securities such as those that make up the popular market indices or that may have been randomly selected. Indeed, a blindfolded chimpanzee throwing darts at the stock pages of *The Wall Street Journal* could, according to EMH, select a portfolio that performs as well as one carefully chosen by the experts.

Early in October 1987, the most popular stock market index in the United States, the Dow Jones average of 30 major industrial corporations, sold at approximately the 2600 level. After 19 October, a day in which the Dow Jones industrial average fell by more than 500 points on unprecedented trading volume, the market traded under the 1800 level—a drop of approximately one-third within a single month. To many observers, such an event stretches the credibility of EMH beyond the breaking point. Did the stock market really accurately reflect all relevant information about individual stocks and the economy when it sold at 2600 early in October? Had fundamental information about the economic prospects of U.S. corporations changed that much in the following 2 weeks to justify a drop in share valuations of almost one-third? In one view (*1*), stock prices show far "too much variability" to be explained by EMH and one must look to behavioral considerations and to crowd psychology to understand the fluctuations of the stock market (*2*).

The Meaning of Efficiency

A stock market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information set if security prices would be unaffected by revealing that information to all participants. Efficiency with respect to an information set also implies that it is impossible to make economic profits by trading on the basis of this information.

It has been customary to distinguish three levels of market efficiency by considering three different types of information sets.

1) The weak form of EMH asserts that prices fully reflect all information contained in the historical sequence of prices. Thus, investors cannot devise an investment strategy to yield abnormal profits on the basis of an analysis of past price patterns (a technique known as technical analysis). By abnormal profits, I mean portfolio profits over and above those attainable by buying and holding a diversified portfolio of stocks with similar risk such as those that make up the Standard & Poor's (S&P) 500 stock index. It is this form of efficiency that is associated with the term "random walk hypothesis."

2) The semistrong form of EMH asserts that current stock prices reflect not only historical price information but also all publicly available information relevant to the market as a whole or to any individual company's securities. If markets are efficient in this sense, then an analysis of balance sheets, income statements, announcements of dividend changes or stock splits, or any other public information about individual companies (the technique of fundamental analysis) will not yield abnormal economic profits.

3) The strong form of EMH asserts that all information that is known by any market participant is fully reflected in market prices. Hence, not even those with privileged information can make use of it to secure superior investment results.

Weak Form Market Efficiency

If markets are efficient, the (technical) analysis of past price patterns to predict the future will be useless because any information from such an analysis will already have been included in current market prices. Suppose market participants were confident that the price of any security would double next week. The price would not gradually approach its new equilibrium value. Indeed, unless the price adjusted immediately, a profitable arbitrage opportunity would exist and could be expected to be exploited immediately in an efficient market. Samuelson (*3*) and Mandelbrot (*4*) have proved that if the flow of information is unimpeded and if there are no transactions costs, then tomorrow's price change in speculative markets will reflect only tomorrow's "news" and will be independent of the price change today. But news by definition is unpredictable, and thus the resulting price changes must also be unpredictable and random.

The term random walk is usually used loosely in the finance

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literature to characterize a price series in which all subsequent price changes represent random departures from previous prices. Thus, changes in price will be unrelated to past price changes. More formally, the random walk model states that investment returns are serially independent and that their probability distributions are constant through time. It is believed that the term was first used in an exchange of correspondence appearing in *Nature* in 1905 (*5*). The subject of the correspondence was the optimal search procedure for finding a drunk who had been left in the middle of a field. The answer was quite complex, but the place to start was simply where the drunk had been placed. That point is an unbiased estimate of the drunk's future position since he will presumably stagger along in an unpredictable and random fashion.

The earliest empirical work on the random walk hypothesis was performed by Bachelier (*6*). He concluded that commodities prices followed a random walk, although he did not use that term. Corroborating evidence from other time series was provided by Working (*7*) and from U.S. stock prices by Cowles and Jones (*8*) and Kendall (*9*). These studies generally found that the serial correlation between successive price changes was essentially zero. Roberts (*10*) found that a time series generated from a sequence of random numbers had the same appearance as a time series of U.S. stock prices. Osborne (*11*) concluded that stock price movements were similar to the random Brownian motion of physical particles and that the logarithms of price changes were independent of each other.

Other empirical work has used alternative techniques and data sets and has searched for more complicated patterns in the sequence of prices in speculative markets. Granger and Morgenstern (*12*) used the technique of spectral analysis but were unable to find any dependably repeatable patterns in stock price movements. Fama (*13*) not only looked at serial correlation coefficients (which were close to zero) but also corroborated his investigation by examining a series of lagged prices and by performing a number of nonparametric "runs" tests. He also examined a variety of filter techniques—trading techniques where buy (sell) signals are generated by some upward (downward) price movements from recent troughs (peaks)—and found they could not produce abnormal profits. Other investigations have done computer simulations of more complicated techniques of technical analysis of stock price patterns and found that profitable trading strategies could not be used on the basis of these techniques. Solnik (*14*) measured serial correlation coefficients for daily, weekly, and monthly price changes in nine countries and concluded that profitable investment strategies could not be formulated on the basis of the extremely small dependencies found.

Although most of the earliest studies of the stock market supported a general finding of randomness, more recent work indicates that the random walk model does not strictly hold. Nevertheless, it is less clear that violations exist of the weak form of EMH, which states only that unexploited trading opportunities should not persist in any efficient market.

Recent findings inconsistent with the pure random walk model involve the tendency for price changes measured over short periods of time to persist. For example, Lo and MacKinlay (*15*) noted that over a 23-year period, from the early 1960s to the mid-1980s, stock returns for weekly and monthly holding periods showed positive serial correlation. However, this rejection of the random walk model is due largely to the behavior of stocks of small companies, which are less frequently traded than larger capitalization stocks. In part, such serial correlation may be induced by new information about the market being factored into large capitalization stocks first and then into the smaller stocks. In any event, their findings do not necessarily imply any inefficiencies in formation of the stock price.

Fama and French (*16*) and Poterba and Summers (*17*) noted that while stock returns over short horizons such as a week or a month may be positively correlated, stock returns over longer horizons, such as a year or more, display negative serial correlation. Thus, a contrarian investment strategy, that is, buying those stocks that have had relatively poor recent performance, might be expected to outperform a strategy of buying stocks that recently produced superior returns (*18*). However, subperiod results cast some doubt on the robustness of this finding. Indeed, both studies (*16, 17*) show that correlations in periods after 1940 are much lower than for earlier periods. Moreover, such mean reversion as exists in stock market returns does not necessarily imply the existence of slowly decaying "price fads" that cause stock prices to deviate from justifiable values for substantial periods of time, as has been conjectured by Poterba and Summers (*17*). Time varying required rates of return would also be consistent with such findings. In any event, it is not clear that risk-adjusted returns after transactions costs can be earned from using simple contrarian investment strategies.

Another apparently predictable relation concerns longer run holding period returns from stocks and initial divided yields (*19*). For example, 25% of the variances of 2- to 4-year holding period returns can, in certain periods, be explained by a regression of returns on dividend-price ratios. Such a finding is consistent with an efficient market view of security price determination. Stock prices are low (high) relative to dividends when discount rates and thus required returns are high (low). Such a result also is consistent with the findings of mean reversion. An economic shock that raises discount rates will be associated with opposite shocks to stock prices, which lower realized returns. But the price decline raises both the dividend yield and the future rate of return. If one assumes that the cumulative price effects from expected return shocks are roughly zero, time variation of expected returns can give rise to mean-reverting components of market prices.

A few additional predictable patterns have been found in stock price series. For example, there is evidence of a January effect, where stock returns are abnormally higher during the first few days of January (especially for small firms) (*20*). A so-called "weekend effect" has also been documented, in which average returns to stocks are negative from the close of trading on Friday to the close of trading on Monday (*21*). Seasonals have also been discovered in several international markets (*22*). But pervasive departures from randomness are generally small, and an investor who pays transaction costs cannot formulate an investment strategy that is profitable on the basis of these anomalies. Thus, although the random walk hypothesis is not strictly upheld, the departures from randomness that have occurred do not appear large enough to leave unexploited investment opportunities.

Of course, it is always possible that dependable risk-adjusted arbitrage opportunities existed even after properly accounting for transactions costs. But there is a compelling logical reason to doubt that systematic arbitrage opportunities will persist in markets dominated by profit-maximizing traders. Suppose a trading scheme was discovered that could dependably produce excess risk-adjusted profits. For example, if there were a "Christmas rally" with the stock market dependably rising between Christmas and New Year's, traders would attempt to take advantage of the rally by buying on the last trading day before Christmas and selling just before New Year's. But soon it would be necessary to buy 2 days before Christmas to catch the rally and sell 2 days before New Year's to anticipate the late December selling of the other arbitrageurs. Carried to its extreme, attempts to "beat the gun" will eventually result in all the buying being done long before Christmas and all the selling occurring during the week after Christmas so that the Christmas rally would no longer exist. This is why I am skeptical of putting too much weight on the anomalies that have been reported.

Table 1. Pension funds outperformed by S&P 500 stock index.

Time period	Return on equities: median pension fund (%)	Return on S&P 500 (%)	Accounts outperformed by S&P 500 (%)
From 1982 to 1987	14.9	16.5	74
From 1967 to 1987	8.3	9.3	72

Most have yet to be shown to provide true risk-adjusted arbitrage opportunities. Even if such a consistent opportunity could be discovered, it is unlikely to persist. Any dependable trading opportunity that can be discovered is bound to self-destruct. For this reason, financial economists generally subscribe to the weak form of EMH.

Semi-Strong Form Efficiency

The weak form of EMH has found general acceptance in the financial community, where technical analysis has never been held in high repute. The stronger assertion that all publicly available information has already been figured into current market prices has proved far more controversial among investment professionals, who practice fundamental analysis of publicly available information as a widely accepted mode of security analysis. In general, however, the empirical evidence suggests that public information is so rapidly integrated into current market prices that fundamental analysis is not likely to be fruitful.

Various tests have been performed to ascertain the speed of adjustment of market prices to new information. Fama *et al.* (*23*) looked at the effect of stock splits on equity prices. Although splits themselves provide no economic benefit, splits are usually accompanied or followed by dividend increases that do convey information to the market concerning management's confidence about the future progress of the enterprise. Thus, while splits usually result in higher market valuations, the market appears to adjust to such announcements fully and immediately. Substantial returns can be earned before the split announcement, but there is no evidence of abnormal returns after the public announcement. Similarly, merger announcements can raise market prices substantially, especially when premiums are being paid to the shareholders of the acquired firm, but it appears that the market adjusts fully to the public announcements. Dodd (*24*) found no evidence of abnormal price changes after the public release of merger information. Patell and Wolfson (*25*) examined the intraday speed of adjustment to earnings and dividend announcements. They noted that the stock market assimilates publicly available information "very quickly." The largest portion of the price response occurs in the first 5 to 15 minutes after the disclosure.

Although most studies support the semi-strong version of EMH, some do not. Ball (*26*) found that stock price reactions to earnings announcements are not complete. Abnormal risk-adjusted returns are systematically nonzero in the period after the announcement. Rendleman *et al.* (*27*) also found a relation between unexpected quarterly earnings and excess returns for common shares after the announcement date. Roll (*28*) stated that orange juice futures prices did not always fully reflect all available information because of exchange-imposed maximum daily price moves. Apart from this constraint, however, prices did reflect all known information. Moreover, the other anomalies noted have not been shown to occur consistently over time, and when they have occurred, they have usually been so small that only a professional broker-dealer could have earned economic profits. Thus, it remains to be seen how robust these anomalies are, given the vast body of evidence supporting the semi-strong EMH. The evidence in favor of the market's rapid adjustment to new information is sufficiently pervasive that it is now a generally, if not universally, accepted tenet of financial econometric research.

Strong Form of EMH

Stock splits, dividend increases, and merger announcements can have substantial effects on share prices. Consequently, insiders who trade on such information can profit before the announcement is made (*29*). Although such trading is illegal, the fact that the market often at least partially anticipates the announcements suggests that it is possible to profit on the basis of privileged information. Thus, the strongest form of EMH is clearly refuted. Nevertheless, there is considerable evidence that the market comes reasonably close to strong-form efficiency.

Several studies have been performed on the records of professional investment managers. In general, they show that randomly selected portfolios or unmanaged indices do as well or better than professionally managed portfolios after expenses. Cowles (*30*) examined the records of selected financial services and professional investors. He failed to find any evidence of performance superior to that which could be achieved by investing in the market as a whole. Friend *et al.* (*31*) concluded that the performance of the average mutual fund was insignificantly different from the performance of an unmanaged portfolio with similar asset composition. Jensen (*32*) measured the risk-adjusted performance of mutual funds and found that although the funds tended to earn gross positive abnormal returns, any relative advantage of the professional managers was lost in management fees. The EMH would not rule out small gross abnormal returns as an incentive to acquire information. Other studies (*33, 34*) have shown that a sensible market equilibrium should leave some incentive for analysis. Those who acquire costly information would have superior gross returns but only average net returns. The overwhelming evidence on the performance of professional investors is that net returns are only average or below average. For example, during the 20 years preceding 1987, more than 70% of the equity portfolios of professional pension fund managers were outperformed by the unmanaged S&P 500 stock index (Table 1). Moreover, there seems to be little consistency to whatever exceptional performance one finds. It appears that a professional manager who has achieved exceptional performance in one period is just as likely to underperform the market in the next period. Superior investment managers may exist, but they are extremely rare.

Some Further Anomalies

In general, the empirical evidence in favor of EMH is extremely strong. Probably no other hypothesis in either economics or finance has been more extensively tested. Thus, it is not surprising that along with general support for EMH there has been additional evidence of anomalies, inconsistent with the hypothesis in its strongest forms. Basu (*35, 36*) found that stocks with low price-earnings (P/E) ratios have higher average risk-adjusted returns than stocks with high P/E's. Banz (*37*) concluded that substantial abnormal (risk-adjusted) long-run rates of return could be earned by investing in portfolios of smaller firms. Transactions costs are higher for smaller firms, but this factor does not seem to explain the size effect. This size effect appears to persist in varying degrees over time and is related to the evidence regarding higher returns for stocks with low P/E multiples. Of course, these findings of abnormal

returns are always joint tests of market efficiency and the particular form of the asset pricing model involved. Thus, it is impossible to distinguish if the abnormal returns are truly the result of inefficiencies or result instead because of inadequacies of the capital asset pricing model used to measure risk. The higher returns for smaller companies may simply be the requisite reward owed to investors for assuming greater risk of disappointment in the investment returns they expect, just as larger returns are achieved over the long run from investing in relatively volatile long-term bonds than from more predictable short-term Treasury bills.

French and Roll (*38*) examined the key presumption of EMH that market moves are precipitated by the receipt of new information. If the major cause of market movements is the receipt of news, then market prices should not fluctuate more when the market is open than when it is closed. In fact, asset prices are much more volatile during exchange trading hours. For example, the variance of prices from the open to the close of trading on an average day is more than six times as large as the price variances from Friday's close to Monday's opening even though the weekend is eleven times longer. One possible explanation for this phenomenon is that new public information (for example, new economic data, merger announcements, judicial decisions, and new contracts) is most likely to arrive during normal business hours. Alternatively, the greater price volatility during periods when the market is open could be caused by the provision of private information (that is, the predictions of market gurus or the recommendation of fundamental security analysts), which typically gets incorporated into market prices when the exchange is open. Security analysts are more likely to work at this time, and the benefits of producing such information are larger when the information can be acted on quickly and conveniently.

In order to distinguish between these two explanations, French and Roll (*38*) examined the volatility of prices around regular business days when the exchanges were closed. During the second half of 1968, the major stock exchanges were closed on Wednesdays because of a paperwork backlog. Public information could be expected to be generated without interruption on those days, while the flow of private information would be sharply reduced. Thus, one should expect the volatility of prices from Tuesday's close to Thursday's opening to be considerably larger than the variability of prices from Tuesday's close to Wednesday's opening if new public information is the major cause of stock price changes. On the other hand, if the production of private information is an important cause of stock price change, then the Tuesday to Thursday volatility will be far less when the exchange is closed on Wednesday than it is when Wednesday is a normal trading day. It turned out that the 2-day volatility numbers were quite small. They were only a little larger than the 1-day numbers, suggesting that the generation of private information is a principal cause of price variances in the market.

The point is that the market makes its own news. Just as the discovery of an important new source of petroleum can affect the price of an oil stock, so can the publication of a bullish report on the stock from a major brokerage firm. Although this is not necessarily inconsistent with markets being efficient, it does open the possibility of additional influences on the market besides the receipt of the new public information. Surely the sentiment of the professional investment community is not irrelevant.

Roll (*39*) has also shown that even with hindsight, the ability to explain stock price changes is relatively modest. Less than 40% of the volatility in stock prices is explained by news events concerning the economy, industry developments, and specific news about the individual companies. It appears that security valuations and their changes over time are complex and that private information and the sentiments of professional and other investors can play an important role in the valuation process.

The Theory of Stock Valuation

The complexity of the stock valuation process can best be captured by referring to the standard "rational" model of share pricing. The purchaser of a common stock buys a future stream of dividends. The price of the stock can be expressed as the present (discounted) value of the future stream. (The discounting process recognizes that a dollar next year is not as valuable as a dollar today.) If the growth rate (g) of the current dividend (D_0) remains constant, we can express a stock's price today (P_0) as

$$P_0 = \frac{D_0 (1 + g)}{(1 + r)} + \frac{D_0 (1 + g)^2}{(1 + r)^2} + \ldots + \frac{D_0 (1 + g)^N}{(1 + r)^N} \quad (1)$$

where r is the appropriate discount rate used to adjust future magnitudes to present values. If the number of periods N is allowed to go to infinity, the expression simplifies to

$$P_0 = \frac{D_0 (1 + g)}{r - g}, g < r \quad (2)$$

This standardized model of share valuation can be altered to accommodate any pattern of forecasted growth. Although the current price of a stock (P_0) is affected by the current dividend (D_0), the major variables influencing share valuation, future growth, and the appropriate discount rate are unknown.

Future growth rates, one of the most important variables in the valuation equation, are unknown and hard to forecast. As Little (*40*) showed in an article entitled "Higgledy Piggledy Growth," calculated historical growth rates for a firm are essentially uncorrelated with the growth achieved in any future period. The firms that grew most quickly during the decade of the 1970s were no more likely to grow quickly in the 1980s than were those firms with below average past growth rates. Cragg and I (*41*) have also shown that the careful growth estimates of security analysts, although more closely related to share prices than past growth extrapolations, are not much more accurate in forecasting the future. Moreover, the appropriate discount rate at which the future stream of dividends should be discounted is far from self-evident. For example, one knows the rate of return on a long-term (zero coupon) government bond, free of default risk. But risk premiums in the equity market appear to vary considerably over time, and their changes can have a large effect on the appropriate prices of common stocks (*42*).

In this view of the matter, behavioral considerations can enter the picture in two ways: (i) In explaning how market participants form and change their expectations about the future growth of cash flows, and (ii) in showing how the market determines the appropriate premium to be added to the riskless rate of interest in discounting those streams to present value.

Rational Versus Behavioral Considerations

The importance of risk premium can be illustrated in the following way. As was mentioned above, behaviorists such as Shiller (*1*) have suggested that stock prices move too much to be plausibly explained by changes in fundamentals such as the prospects for earnings and dividends. The variation in aggregate stock market prices is much too large to be justified by the variation in subsequent dividend payments. Shiller would say, therefore, that stock prices were rather obviously overpriced in the mid-1960s when earnings multiples rose to almost unprecedented levels and, similarly, were very much underpriced in the late 1970s when multiples dropped to extraordinarily low levels. He believes, therefore, that unless one takes a more or less psychological view of price determination, as

opposed to a rational one, pricing in the stock market is inexplicable (*43*).

An alternative assumption is that there were good reasons to think that investors should rationally have changed their risk perceptions from the mid-1960s to the late 1970s. In the mid-1960s, price increases were running at less than 1% per year—inflation was essentially unnoticeable and exchange rates were relatively stable. The economics profession believed that a new era of stability was upon us. Economists at that time used to claim that even small recessions could be "fine tuned" away. Financial markets reflected the anticipated stability in economic activity, and risk premiums were small.

No one would have imagined in the 1960s that the economy could experience double-digit unemployment or double-digit inflation, let alone that both could appear simultaneously. Clearly, we learned that economic conditions are far less stable than previously imagined, and investors in the 1970s quite rationally demanded higher risk premiums. Inflation was no longer characterized as a benign phenomenon as it was often described in the 1960s. When prices rise by 10%, all prices do not rise by the same amount. Rather, relative prices (including the relation between input and output prices) are far more variable at higher levels of inflation. Furthermore, the higher the rate of inflation, the more variable and unpredictable inflation is from year to year. This instability of real output and inflation, and the accompanying greater volatility of interest rates and exchange rates, increased uncertainty throughout the economy. Consequently, equity securities (which really should be called equity insecurities) were more rationally considered riskier investments that deserved higher risk premiums.

The way the market adjusts to provide a higher risk compensation for investors is through a fall in prices relative to earnings and dividends to provide larger returns in the future. According to this view, there were rational reasons to expect a substantial change in stock market valuations from the 1960s to the 1970s.

The Market Crash of October 1987

Can an event such as the October 1987 market crash be explained by rational considerations, or does such a rapid and significant change in market valuations prove the dominance of psychological rather than logical factors in understanding the stock market? It is impossible to rule out the existence of behavioral or psychological influences on stock market pricing. Nevertheless, several logical considerations could explain a sharp change in market valuations during the first weeks of October 1987.

First, there was a substantial increase in interest rates over the late summer and early fall. Yields on long-term Treasury bonds increased from about 9 to 10½% just before the crash. In addition, a number of events created significantly increased risk perceptions in the market. In early October, Congress threatened to impose a "merger tax" that would have made merger activity prohibitively expensive and could well have ended the merger boom. The stocks that went down the most in the week preceding 19 October were the stocks of companies that were the subject of takeover attempts. The risk that merger activity might be curtailed increased risks throughout the stock market by weakening the discipline over corporate management that potential takeovers provide. Also, James Baker, then Secretary of the Treasury, had threatened in October to encourage a further fall in the price of the dollar, increasing risks for all foreign investors and thereby frightening domestic investors as well. A numerical illustration shows how sensitive share prices can be as a result of rational responses to small changes in interest rates and risk perceptions.

The formula of rational present value pricing of common stocks, as shown in Eq. 2, can be rewritten as follows

$$r = \frac{D_0\,(1 + g)}{P} + g \tag{3}$$

where P is the stock price. Suppose initially that the "riskless" rate of interest on government bonds is 9% and that the required additional risk premium for equity investors is 2%. In this case r, the appropriate rate of return for equity holders (or, equivalently, the proper discount rate), will be 11% (0.09 + 0.02 = 0.11). If a typical stock's expected growth rate, g, is 6% and if the next period's dividend $[D_0\,(1 + g)]$ is \$5, one can solve for the appropriate price of the stock, obtaining

$$0.11 = \frac{\$5}{P} + 0.06,\ P = \$100 \tag{4}$$

Now assume that government bond yields rise from 9 to 10½%, with no increase in expected inflation (*44*), and that risk perceptions increase so that stock market investors now demand a premium of 2½ percentage points instead of 2 points. The appropriate discount rate, r, rises then from 11 to 13% (0.105 + 0.025), and the price of the stock falls from \$100 to \$71.43

$$0.13 = \frac{\$5}{P} + 0.06,\ P = \$71.43 \tag{5}$$

No irrationality is required for share prices to suffer dramatic declines with the type of changes in interest rates and risk perceptions that occurred in October 1987. Of course, even very small changes in anticipated growth would have magnified these declines in warranted share valuations. This is not to say that purely psychological factors were irrelevant in explaining the sharp correction of market prices. But it would be a mistake to dismiss the significant change in the external environment, which can provide a rational explanation of the need for a significant decline in the appropriate values for common stocks.

Conclusions

Market valuations rest on both logical and psychological factors. The theory of valuation depends on the projection of a long-term stream of dividends whose growth rate is extraordinarily difficult to estimate. Moreover, the appropriate risk premiums for common equities are changeable and far from obvious either to investors or economists. Thus, there is room for the hopes, fears, and favorite fashions of market participants to play a role in the valuation process. Indeed, history provides examples of markets in which psychology seemed to dominate the pricing process, as in the tulip bulb mania in 16th-century Holland (*45*). Thus, I harbor some doubts that the current tableau of market prices always represents the best estimates available of appropriate discounted value.

Nevertheless, one has to be impressed with the substantial volume of evidence suggesting that stock prices display a remarkable degree of efficiency. Information contained in past prices is included in current market prices, and any publicly available fundamental information is rapidly assimilated into market prices. Prices adjust so well to reflect all important information that a randomly selected and passively managed portfolio of stocks performs as well or better than those selected by the experts. If some degree of mispricing exists, it does not persist for long and it is usually only recognizable after it occurs. "True value will always out" in the stock market.

To be sure, there are scattered instances of inefficiencies in the stock market. I argued in 1980 (*46*) that investment company shares—so-called closed-end funds (even those holding essentially

"market" portfolios)—were inefficiently priced over many years so that they would provide investors abnormal returns over and above those involved in buying and holding directly the well-diversified portfolios owned by the funds.

But this last illustration, rather than convincing me of substantial areas of market inefficiency, actually drives me to the opposite conclusion. If there is truly some area of pricing inefficiency that can be discovered by the market and dependably exploited, then profit-maximizing traders and investors will eventually, through their purchases and sales, bring market prices in line so as to eliminate the possibility of extraordinary return. In time, investors recognized that closed-end funds at discounts represented extraordinary value, and the discounts on these funds were largely eliminated except for those explainable by tax considerations and management fees (*47*).

So we are again driven back to the position of EMH. Pricing irregularities may well exist and even persist for periods of time, and markets can at times be influenced by fads and fashions. Eventually, however, any excesses in market valuations will be corrected. Undoubtedly, with the passage of time and with the increasing sophistication of our databases and empirical techniques, we will document further departures from efficiency and understand their causes more fully. But I suspect that the end result will not be an abandonment of the belief of many in the profession that the stock market is remarkably efficient in its use of information.

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42. For example, B. Friedman and K. Kuttner, "Time varying risk perceptions and the pricing of risky assets" (Working paper 2694, National Bureau of Economic Research, Cambridge, MA, 1988).
43. R. Shiller's original work [*Am. Econ. Rev.* **71**, 421 (1981)] rejecting the concept of market efficiency has been criticized on a technical level by T. Marsh and R. Merton [*J. Bus.* **60**, 1 (1987)] and A. Kleidon [*J. Pol. Econ.* **94**, 953 (1986)]. They concluded that Shiller's findings that stock prices are "too volatile" were a result of his incorrect specification of the dividend process rather than a result of market inefficiency.
44. It is important to assume that real interest rates (adjusted for inflation) rose during the period. If nominal rates rose only because inflationary expectations increased, then expected growth rates should also rise and the stock price would not decline. Surveys of expectations at the time suggest that real interest rates did increase—inflation expectations were roughly constant.
45. The tulip bulb craze is considered the prime example of a speculative bubble. Even in this case, however, researchers such as P. Garber ["Tulipmania" (Working paper, Brown University, Providence, RI, June 1988)] have questioned the conventional wisdom that the episode was an obvious bubble.
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