

Answering Financial Anomalies: Sentiment-Based Stock Pricing

Edward R. Lawrence, George McCabe and Arun J. Prakash

The efficient market hypothesis (EMH) assumes that investors are rational and value securities rationally. A rational investor would value a security by its net present value; the price of a stock in this framework is based on the discounted cash flow or the present value model. Although the EMH-based model is partially successful in computing fundamental stock prices, other anomalies such as high trading volume, high volatility, and stock market bubbles remain unexplained. These models assume rational investors who are utility maximizers. But some investors behave irrationally or against the predictions, and in the aggregate they become irrelevant. In this paper, we relax the assumption of investor rationality, and attempt to explain high volatility, high trading volume, and stock market bubbles by incorporating investor sentiment into the already existing asset pricing model.

keywords: investor sentiments, stock pricing, financial anomalies, behavioral finance

Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science.

-Thomas Kuhn

Introduction

Prior to 1950, researchers believed that the use of technical or fundamental approaches could “beat the market.” During the 1950s and 1960s, studies began to contradict this view, however, and researchers found that stock price changes (not stock prices) follow a random walk. They also discovered that stock prices react to new information almost immediately, not gradually as had been believed.

Samuelson [1965] and Mandelbrot [1966] were among the first to show that returns can be unpredictable in competitive markets with rational risk-neutral investors. Fama [1970] defined an efficient market as one in which security prices always fully reflect available information; and thus was born the efficient market hypothesis (EMH), which became the foundation of modern financial theory. The EMH came to enjoy such strong support that academicians like Malkiel [1973] argued that “a chimpanzee throwing darts at the

Wall Street Journal can select a portfolio that performs as well as those managed by the experts.” Fama [1970] wrote that “support of the efficient market models is extensive, and contradictory evidence is sparse.” Jensen [1978] asserted that “there is no other proposition in economics which has more solid empirical evidence supporting it than the efficient market hypothesis.”

According to Thaler [1999], modern finance theory is based on the assumption that the “representative agent” in the economy is rational in two ways: She makes decisions according to the axioms of expected utility theory, and she makes unbiased forecasts about the future. Traditional models hold that some investors may make suboptimal decisions, but they will not have an effect as long as the marginal investor is rational.

The foundations of EMH rest on three basic arguments: 1) Investors are assumed to be rational and hence they value securities rationally, 2) to the extent that some investors are not rational, their trades are random and hence cancel each other out, ultimately having no affect on prices, and 3) if investors are irrational, they will be met in the market by rational arbitrageurs who will eliminate any influence they have on the market.

The first few years of EMH were very good, because academicians did find that EMH satisfied many security pricing anomalies. During the 1980s, however, several academicians started challenging it, beginning with Shiller’s [1981] work on stock market volatility, where he showed that stock market prices are far more volatile than EMH could justify. The October 1987 stock market crash raised further concerns about EMH. If the market did accurately reflect all publicly available information, academicians wondered, how could the crash have happened?

Edward R. Lawrence Florida International University, Miami.
George McCabe University of Nebraska, Lincoln.

Arun J. Prakash Florida International University, Miami.

The corresponding author is Edward R Lawrence, RB 205A, Department of Finance, College of Business Administration, Florida International University, Miami FL 33199, Tel: (305)3480082. Email: elawrenc@fiu.edu

De Bondt and Thaler [1985] formed portfolios of best- and worst-performing stocks and found that extreme losers have extremely high post-formation returns, while winners showed relatively poor performance. Some studies have shown underreaction, where security prices underreact to news like earnings announcements (Bernard [1992], Jegadeesh and Titman [1993], Chan, Jegadeesh, and Lakonishok [1996], Rouwenhorst [1997]). Others have found evidence of overreaction, and show that over longer horizons of, say, three to five years, security prices overreact to consistent patterns of news pointing in the same direction (Fama and French [1988], Poterba and Summers [1988], Cutler, Poterba, and Summers [1991], Campbell and Shiller [1988a], Pontiff and Schall [1998], Kothari and Shanken [1997], Lo and MacKinlay [1999]).

Such results defy the pure randomness of the stock markets, which throws the weak-form EMH into question. Some academics uncovered stock market patterns that question the semi-strong EMH, too. Fama and French [1988] and Campbell and Shiller [1988b] find that a significant portion of the variance of future stock market returns can be predicted by the dividend yields of the market index.

Campbell and Shiller [2001] find that stocks with low price/earnings and/or price/book multiples produce above-average returns over time. Other researchers have shown how stock splits, dividend increases, insider buying, inclusion in the S&P 500 index, and merger announcements can all dramatically affect stock prices, thereby disproving the strongest-form EMH. In his book, *A Random Walk Down Wall Street*, even Malkiel [1996] himself admitted that “while the reports of the death of the efficient-market theory are vastly exaggerated, there do seem to be some techniques of stock selection that may tilt the odds of success in favor of the individual investor.”

The EMH has also been questioned on theoretical grounds. The first assumption of rationality is challenged by Black [1986], who maintains that many investors trade on noise rather than information. And much of the EMH is based on the assumption of effective and riskless arbitrage in the case of irrational investors. According to the tenets of behavioral finance, real-world arbitrage is risky and hence limited. It cannot help pinpoint stock and bond price levels because these broad categories of securities don't have substitute portfolios. Hence if they are mispriced, there is no riskless hedge for the arbitrageur.

Many of the findings that disprove the EMH have been challenged on the grounds of data snooping, trading costs, sample selection biases, and improper risk adjustments. But the attacks on EMH have been increasing, and a growing number of academicians have become skeptical of its validity.

Behavioral finance has emerged as a new theory with an alternative view of financial markets. It does not expect financial markets to be efficient and systematic, and it allows that significant deviations can persist for long periods of times. Behavioral finance rests on the foundation of two arguments, limited arbitrage and investor sentiment (the theory of how investors form their beliefs and valuations).

In the field of finance, there is a growing acceptance that cognitive biases may influence asset prices. Neal and Wheatley [1998] examine the power of three measures of investor sentiment to predict returns: 1) the level of discount on closed-end funds, 2) the ratio of odd-lot sales to purchases, and 3) net mutual fund redemptions. Using data from 1933 to 1993, they find that fund discounts and net redemptions predict the size premium, the difference between small- and large-firm returns. They find little indication that the odd-lot ratio can predict returns.

Fisher and Statman [2003] find that increases in the consumer confidence index are accompanied by statistically significant increases in the bullishness of individual investors. They find a statistically significant relationship between consumer confidence and subsequent S&P 500, Nasdaq, and small-cap stock returns.

As Thaler [1999] notes, traditional financial models based on EMH have improved capabilities of explaining stock returns, but they are unable to explain anomalies such as “high trading volume,” “abnormally high volatility,” and “the formation and bursting of bubbles.” In this study, we attempt to provide answers to these anomalies by relaxing the assumption of rational investor as marginal investor. As pointed out by Thaler [1999], “It may be equilibrium (although not a “rational equilibrium”) as long as the Wall Street experts are not the marginal investors in these stocks. If Internet stocks are primarily owned by individual investors, Wall Street pessimism will not drive the price down because the supply of short sellers will then be too limited.”

We modify the existing asset pricing model (the dividend discount method) by including investor sentiment. This enables us to satisfactorily explain the anomalies of high trading volume, high volatility, and the formation and bursting of bubbles.

The second section provides the details of the traditional models to compute fundamental stock prices. In the third section, we lay out how we incorporate investor sentiment into the dividend discount model, and then provide answers to some of the existing anomalies. The final section concludes.

EMH-Based Rational Pricing Model

Some academicians view rationality as the cornerstone of economics and finance. When investors are

assumed to be rational, they are also assumed to value securities rationally, by net present value. In this framework, the price of a stock is based on the discounted cash flow model or the present value model. These models relate a stock's price to its expected future cash flows (dividends), discounted to the present using a constant or time-varying discount rate.

The cash flow of a common stock consists of an infinite stream of dividends. Hence, we express the present value of a common stock as:

$$PV = \sum_{t=0}^{\infty} \frac{DIV_t}{(1+r)^t} \quad (1)$$

If the dividends are expected to grow forever at a constant rate “g,” the current price of a stock can be written as:

$$P_0 = \frac{DIV_1}{r-g} \quad \text{for all } r > g \quad (2)$$

where r is the investor's expected return.

This formula is also known as the constant growth model, or the Gordon model, after Gordon and Shapiro [1956]. The formula assumes a constant dividend growth rate and a constant discount rate. Such an assumption is acceptable for mature low-risk firms, but not for firms that anticipate high near-term growth.

For firms with growth rates greater than r , we can modify the formula by assuming that the firm's growth rate will eventually settle down at somewhere less than the discount rate at time T (presumably equal to the growth rate of the economy). We also assume there is a linear decrease in the growth rate of the firm over time. By discounting each future dividend by the discount rate until we reach the constant growth rate, and by then adding the discounted constant growth value of the stock, we can calculate the present value of the stock as follows:¹

$$P_0 = \frac{DIV_1}{1+r} + \dots + \frac{DIV_{T-1}}{(1+r)^{T-1}} + \frac{DIV_T}{(1+r)^T * (r-g)} \quad (3)$$

DIV_1 to DIV_{T-1} are the dividends for years 1 to year $(T-1)$, where $r > g$ and $DIV_{T+1} = DIV_T \times (1+g)$.

The fundamental price of a stock is based solely on company-specific information, i.e., future cash flows as anticipated by the company, its growth rate, and the discount rate (which depends on the riskiness of the company). According to EMH, this fundamental price is where the shares should trade. It has a specific value and is the same for all investors. For any firm i , the investors' expected return $E(r_i)$ is calculated using

CAPM, as per the following equation:

$$E(r_i) = r_f + \beta E(r_m - r_f) \quad (4)$$

Whenever the risk-free rate r_f is known, we usually compute the expected market risk premium $E(r_m - r_f)$ by taking the average of the difference between the market return and the risk-free rate over several months. Taking the beta of the stock from any financial source (such as ValueLine), and plugging it into Equation 4 allows us to compute the stock's expected rate of return.

The data on the growth rate for stocks can also be taken from analyst forecasts such as ValueLine. We can then calculate the fundamental price of the stock using Equation (3). For higher-growth stocks, we can assume that their growth rate will approximately equal the growth rate of the economy over ten years (120 months)². ValueLine's forecasts are usually short term, for, say, the next three years. Thus for any forecasts beyond that, analysts usually rely on their own forecasts, or on other resources.

This is the simplest way to compute the price of any stock. The formula can easily be modified by using the time-varying discount rate and the time-varying growth rate. In most option pricing models, the price of a stock is computed by assuming it follows a random process (Hull and White [1987], Wiggins [1987], Ball and Roma [1994]). Our model focuses on future dividends, the growth rate, and the discount rate³.

EMH states that the future cash flow, the growth rate, and the discount rate adjust to new information about the market and the firm, and that the price of the stock will adjust accordingly. The arrival of new information onto the market, however, is random; hence stock price changes must be random as well.

Campbell, Lo, and MacKinlay [1997] find that empirical studies conducted on the above models show large discrepancies between the observed stock price and the price predicted by these models. Campbell and Shiller [1987], West [1988], and others have explored the expected present value model and have found that stock prices appear to grow exponentially over time.

Campbell and Shiller [1988a, 1988b] use a log-linear approach, which enables them to calculate asset price behavior under any model of expected returns, rather than just using the model with constant expected return. Even with all these modifications, however, the short-term predictability of stocks remains poor. And the observed anomalies of “high trading volume,” “abnormally high volatility,” and “the formation and bursting of bubbles” remain unexplained.

Sentiment-Based Stock Pricing: Answering Financial Anomalies

Shleifer [2000] proposed a model based on investor sentiment that is consistent with the evidence of

over- and underreaction. His model gives the price of a stock at any time t by:

$$P_t = \frac{N_t}{\delta} + y_t(p_1 - p_2 q_t) \quad (5)$$

where the first term N_t/δ is the price if the investor uses a true random walk process to forecast earnings. The second term gives the deviation of price from this fundamental value⁴.

Other studies have also found that models based on investor behavior generate both under- and overreaction. In Daniel, Hirshleifer, and Subrahmanyam's [1998] model, noise traders are overconfident and suffer from biased self-attribution in evaluating their own performance. Hong and Stein [1999] consider a market where different classes of investors pay attention to different information: Some look only at fundamental news; others look only at price trends.

The goal of our study is similar to the above-mentioned studies, but our approach is new. We incorporate investor sentiment into stock pricing by modifying the components of the already existing dividend discount model. We hypothesize that stock price is governed not just by company fundamentals, but by investor sentiment. In contrast to the simple Gordon and Shapiro [1956] model, we assume that investor sentiment affects both the expected growth rate and the expected discount rate. Investor sentiment here is considered as individual beliefs about the future performance of the firm. Investors may obtain feedback from the overall macroeconomic conditions of the market, as well as from the advice of experts and market analysts. But ultimately the beliefs are their own. They are subjective, and vary from person to person depending on level of investor risk averseness, as well as on individual wealth, educational background, age, gender, and culture.

As an example, consider an investor who is hopeful about the strong future performance of a firm. He will perceive it to be less risky than an investor who believes it is a sure failure. Hence the former will require less risk premium than the latter (if the latter invests in it at all!). The CAPM can now be modified to incorporate investor sentiment as follows:

$$E(r_i^s) = r_f + \beta^s E(r_m - r_f) \quad (6)$$

This equation contains a modified beta, now a function of beta and investor sentiment. If sentiment is high, the firm will be perceived as less risky and the value of modified beta will be lower, thus reducing expected return (and vice versa).

Similarly, a person who believes in the strong future performance of a firm will expect a higher growth rate than the person who believes the firm is a sure failure. The growth rate for the firm is hence modified from

g (the growth rate from the previous section) to g^s , where g^s is a function of growth rate g and investor sentiment.

For a firm where investor expected return is greater than the growth rate and constant growth, the modified equation for the stock price is⁵:

$$P_0 = \frac{DIV_1}{r^s - g^s} \quad (7)$$

For an investor with high sentiment for a firm's future performance, the expected discount rate r^s will be low, while the expected growth rate g^s will be higher, thus making the value of the stock higher (as perceived by the investor). Similarly, the perceived value of the stock will be low for a person with low sentiments for a firm's future prospects. When the market price is higher than what the low-sentiment investor perceives it should be, she will sell the stock. When it is lower than what the high-sentiment investor perceives it should be, she will purchase it.

Consider an open outcry market like the NYSE. The seller agent yells out, say, 100 shares to sell at \$X, and only lowers the asking price when no buyer agent is willing to buy. Similarly, the buyer agent yells out to buy, say, 100 shares at \$Y, and only raises the price when there are no sellers. So buyer agents raise their bid prices, and seller agents lower their ask prices, until the sale price equals the price buyer agents will pay. This is the point at which equilibrium is reached.

If there are large numbers of investors who perceive the value of the stock to be higher than the current market price, they will be ready to purchase at the ask price of the seller. At a particular price, the sellers are those with low sentiments for the firm (their perceived value is lower than or equal to the market price), while the buyers are those with high sentiments for the firm (their perceived value is higher than the market price).

But the market is made up of literally millions of investors, and they may all have different sentiment levels. We can consider that the low-sentiment (high-sentiment) individuals make trading at low (high) prices possible. When they are eliminated after selling (buying) their shares, the stock price rises (falls). Hence investor sentiment differences make trading at diverse price levels possible, causing *stock prices to potentially be highly volatile*.

The sentiment level of an individual is dynamic, perpetually changing. Investors may update their sentiments over time depending on macroeconomic conditions, firm-specific conditions, expert and analyst views, or even on false information or on genuine insider information. This means that investors who have sold (bought) stock can later purchase (sell) it at a higher (lower) price.

This can lead to *high volumes of trading* at each price level, which may cause the market price to be way

above or below the EMH-based fundamental price of the stock. Investors may go long, or they may go short. When the number of high-sentiment investors is greater than the number of low-sentiment investors, there will be more demand to purchase the stock than there may be people who are selling it. This is the catalyst for price escalation, i.e., when economics leads to price increases (demand is greater than supply).

At each price level, however, the perceived value for some investor is attained. This investor either purchases the stock at or below her perceived value, but if she is unable to purchase the stock until this price level is reached (because of a shortage of sellers), she will drop out of the market.

We can compare this situation to the *formation of a positive bubble*, which keeps enlarging depending on the level of investor sentiment and the number of investors with high sentiments. Thus a bubble can be said to occur when the equilibrium price based on sentiment-based supply and demand is considerably above the equilibrium price based on EMH. Clearly, bubbles can breach as sentiment falls, and prices will fall to the EMH price or below if most investors have a very low level of sentiment for the firm.

Because of the dynamic nature of sentiment levels, at each moment some investors become purchasers, while others become sellers. If the stock price continues to rise, the number of high-sentiment investors

will decrease, and at some point there will be more low-sentiment than high-sentiment investors. The result is a regime shift, with more sellers in the market than buyers. But increased supply and reduced demand lead to a price decrease, and the direction of price changes can reverse.

Note that when the market is trending upward, it moves in small steps by eliminating investors at each price level. But when it trends downward, the price decreases tend to be dramatic. Because the demand for high-sentiment investors is already met, there are no buyers left who perceive a bargain. But some investors are desperate to sell (even at lower prices) because of liquidity demand, to make profits (if they purchased the stock at lower prices), or to minimize their losses (if they purchased the stock at its peak). We can compare this condition to the *bursting of a bubble*, which is a time for buyers (because supply is greater than demand)!

In this reverse journey of stock prices, some investors who were not able to purchase previously (because of availability) are now able to. These investors typically have a somewhat high level of sentiment for the firm. And as long as low-sentiment investors outnumber high-sentiment investors, the price decline continues. The stock may even attain a price lower than the EMH price if there are a very high number of low-sentiment investors.

FIGURE 1

In the following figures we plot the month end stock price for the Dow Jones companies for 244 months (February 1984 to December 2004). The stock price increases in steps whereas it falls sharply for all the DJ companies indicating the formation and bursting of bubble. (Continued)

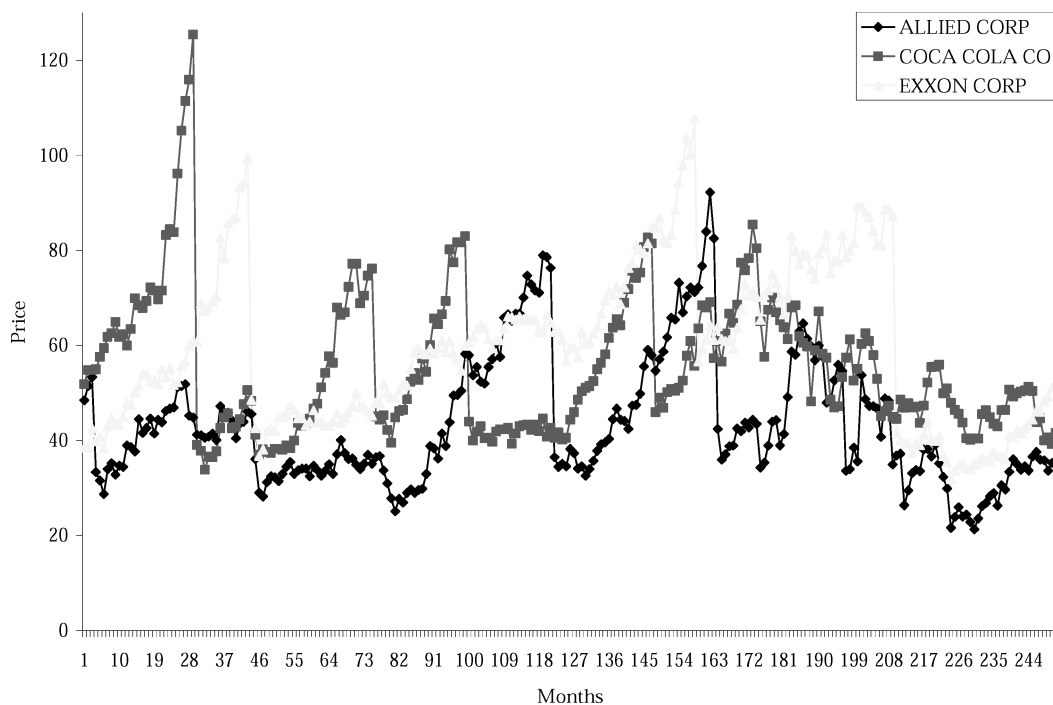
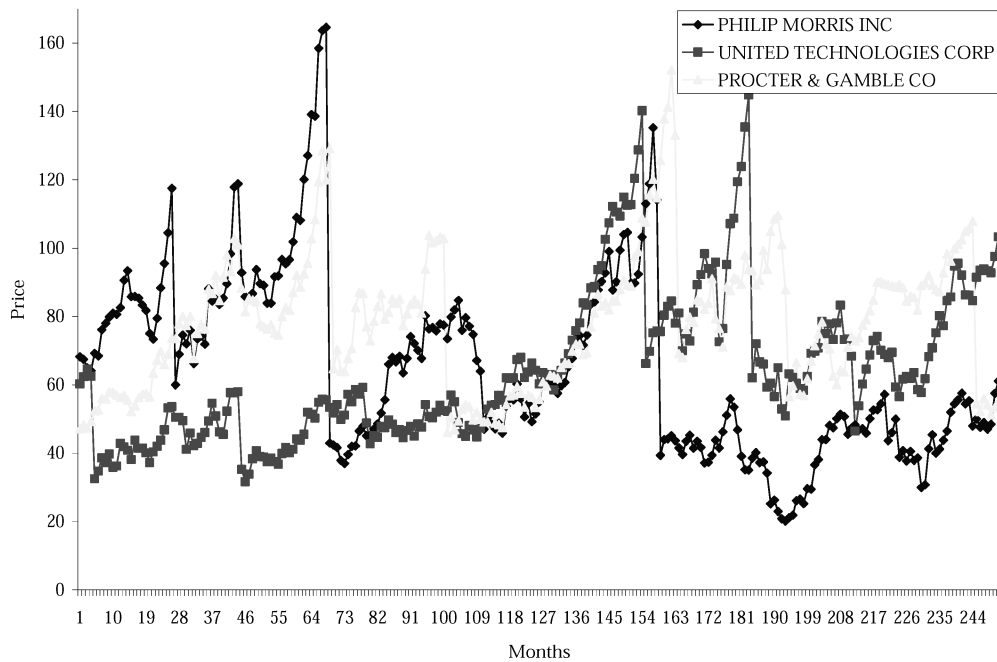
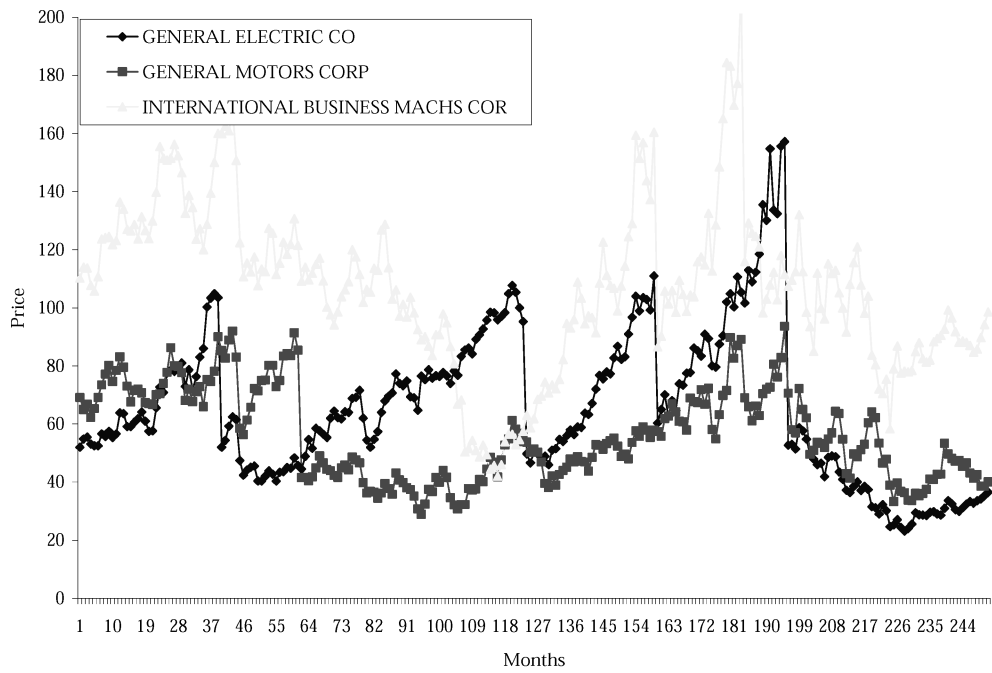


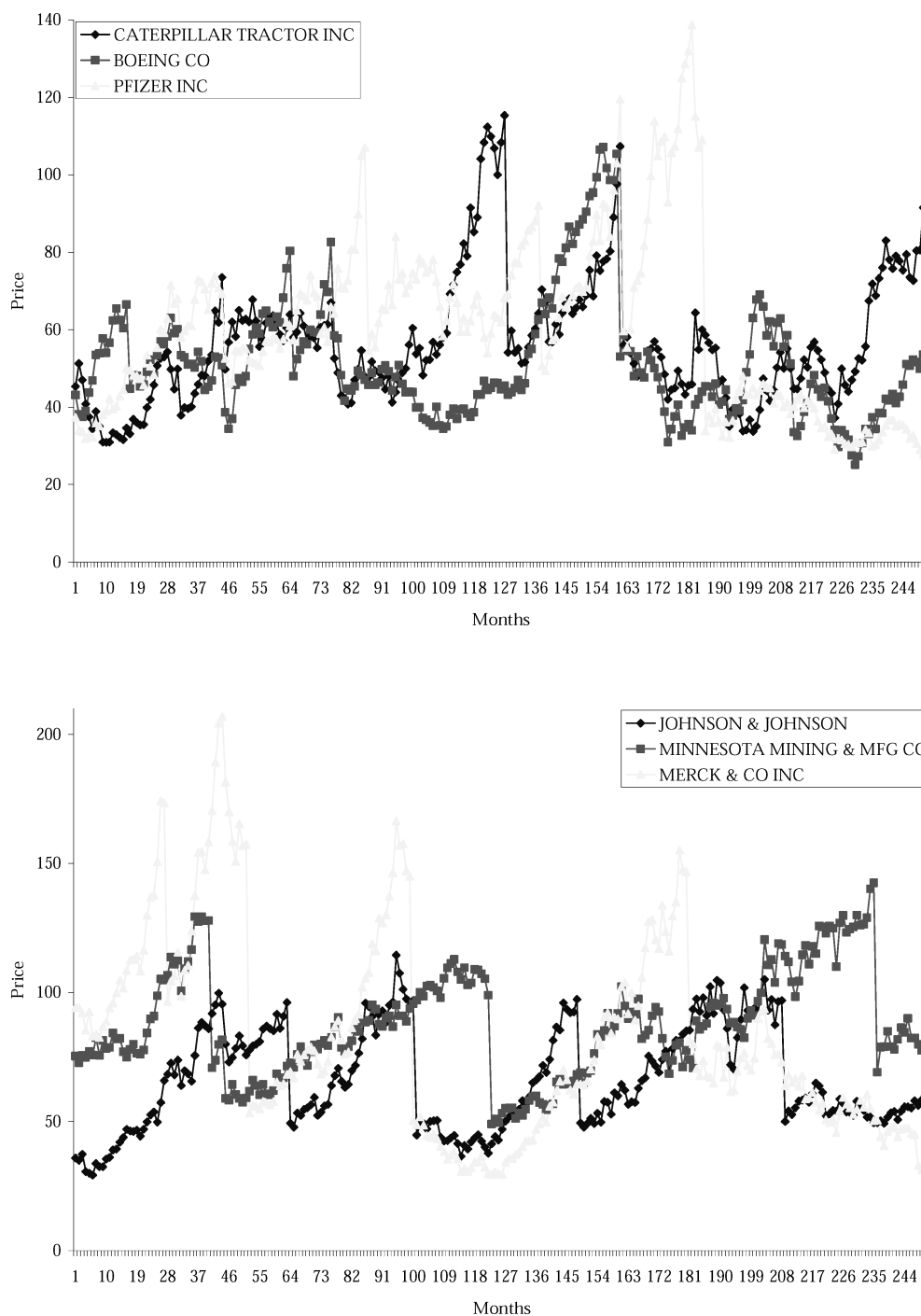
FIGURE 1
(Continued).

Under these conditions, sellers must sell at lower than EMH prices. At this level, large institutional buyers, bankers, and those with knowledge of the fundamental price of the stock start buying, while other individual investors (or those without knowledge of the EMH price of the stock) are the sellers. The stock will decline until a balance is reached between the high-sentiment and the low-sentiment investors.

With some favorable information about the firm, the number of high-sentiment investors may increase again, and the stock may start trending upward again. Alternatively, any unfavorable news about the firm may lead to an increase in the number of low-sentiment investors, leading to a downward trend.

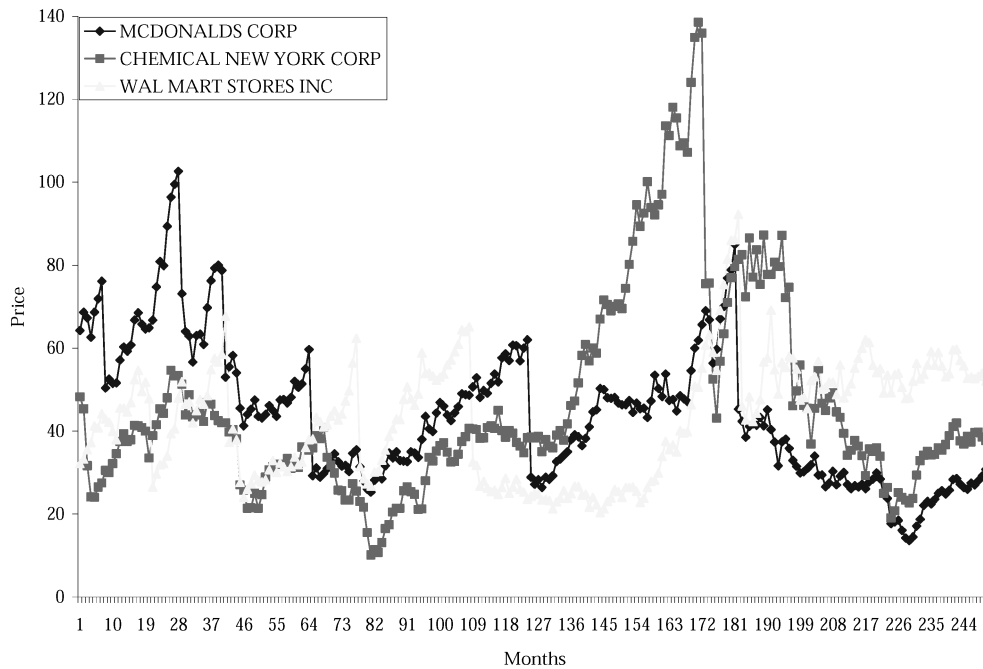
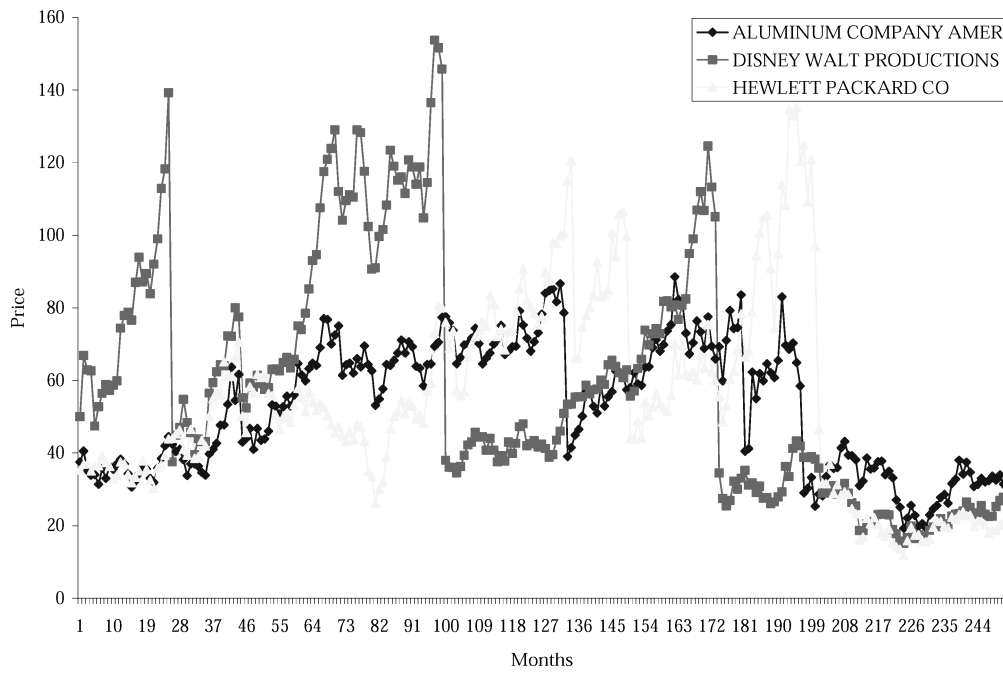
According to White [1990], a common explanation for most stock market crashes is the bursting of a

FIGURE 1
(Continued).



speculative bubble. Blanchard and Watson [1982], Triole [1982], and Hong and Stein [1999] proposed that stock markets are affected by price bubbles when the fundamental value of a stock is difficult to predict even when investors are behaving rationally. In this study, sentiment-based pricing takes a different approach in explaining these stock market crashes.

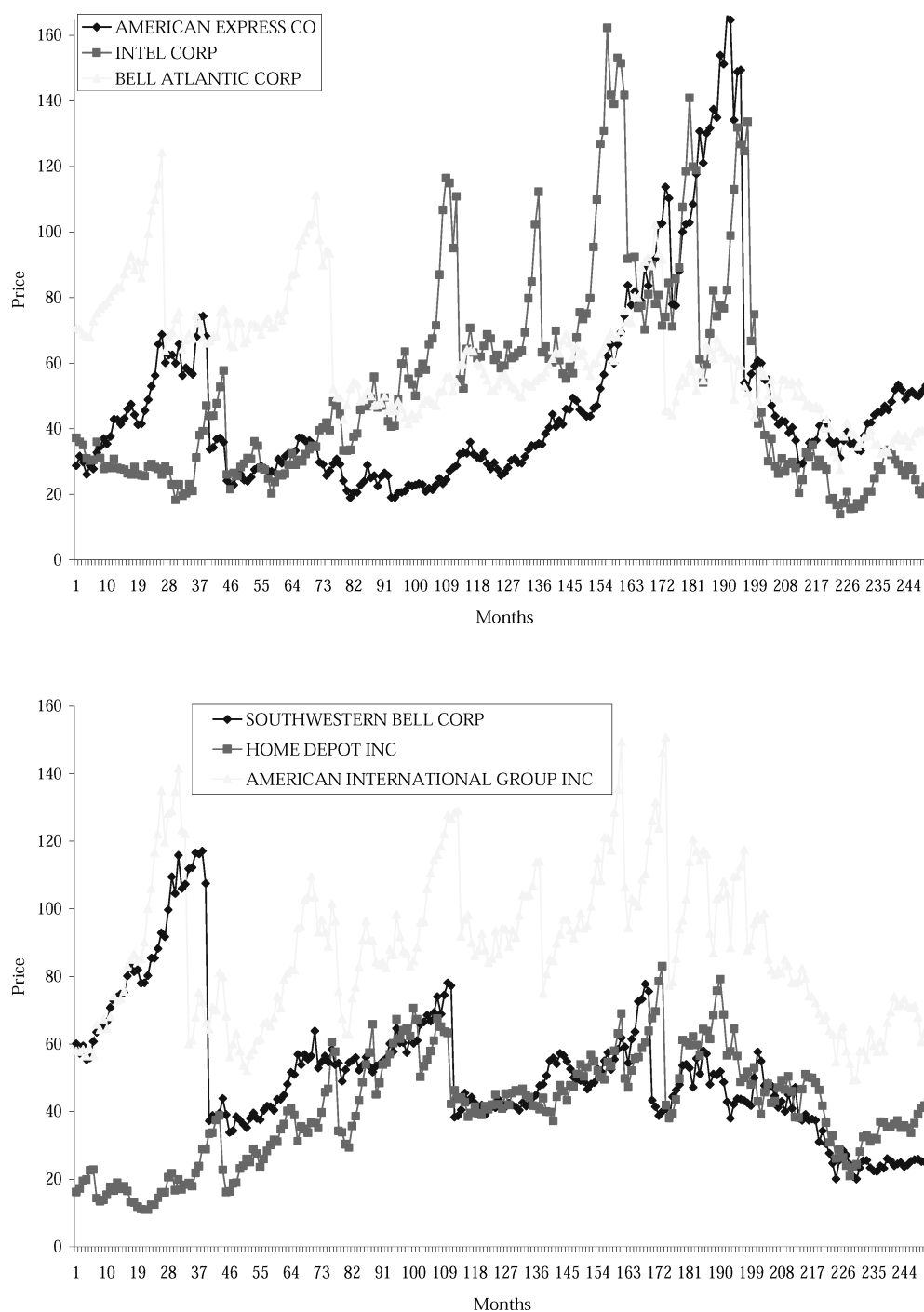
To provide a check for our hypothesis that stock increases proceed slowly, while stock decreases move much more quickly, Figure 1 shows month-end prices for twenty-seven Dow Jones (DJ) index companies⁶ from 1984 to 2004. The data come from CRSP. Figure 1 shows stepwise increases in the stock price of all DJ companies, which can be compared to the formation

FIGURE 1
(Continued).

of a bubble. For all DJ companies, the stock price falls sharply and can be compared to the bursting of a bubble.

When a large number of stocks are trending upward, we refer to the market as a bull market, or we could say there are a large number of high-sentiment investors for a large number of firms. This may occur because of a boom period in the economy.

Alternatively, the stock prices of a large number of firms may crash together, causing a bear market, when low-sentiment investors outnumber high-sentiment investors. Under these bear conditions, stock prices should be either below or close to their EMH-based fundamentals. If the bear market is attributable to economic conditions, when the economy improves, investor sentiments should improve and the cycle

FIGURE 1
(Continued).

of upward-trending prices should begin again. If a company-specific event is to blame, the stock price will hover around or below its EMH-based fundamental (there are no buyers and no sellers; only liquidity trading takes place). Unless there is some good news, the stock prices may remain low and trading volume will also be low. If some major event such as September 11 occurs, investors may lower their sentiments so

dramatically that the perceived value of stocks will fall far below their actual market prices. This is what can lead to a dramatic increase in selling, and result in a market crash.

The above discussion establishes our theory about the price behavior of stocks and explains the reasons for high trading volumes, high stock price volatility, and the formation and bursting of bubbles. In the absence of

data on individual investor sentiment levels, however, computing the exact stock price and volume remains a challenge.

Conclusions

In this paper, we relax the assumption of investor rationality and modify the already existing asset pricing model (the dividend discount method) by including investor sentiment. Thus we can satisfactorily explain anomalies like high trading volume, high price volatility, and the formation and bursting of bubbles.

The field of behavioral finance is still fairly young, but it has offered an intriguing new paradigm, a new set of explanations for empirical irregularities, and a new set of predictions. Most of the extant studies have attempted to explain the anomalies of EMH on theoretical grounds because investor sentiment is so difficult to measure and the assumed proxies are at best approximate. For future research, it would be interesting to compute stock prices based more precisely on investor sentiment and compare them with actual market prices.

Notes

1. We assume the dividends have extremely high growth g_s , where $g_s > r$ until time T . Afterward, we assume dividends grow at a constant rate g_n , where $g_n < r$. The current price of the high-growth stock is then:

$$P_0 = \frac{DIV_1}{(r - g_s)} \left[1 - \left[\frac{1 + g_s}{(1 + r)} \right]^T \right] + \frac{DIV_1(1 + g_s)^{T-1}(1 + g_n)}{(1 + r)^T * (r - g_n)}$$

2. See Sharpe [1978, p. 315] for a fuller description of this method.
3. Future dividends are computed from the current dividends and the growth rate. The discount rate is computed using CAPM. The growth rate is computed from the company-specific information (usually a multiple of ROE and the plowback ratio).
4. For details about the formula and a description of each term, see Shleifer [2000, pp. 134–143].
5. For a firm with abnormally high growth, Equation (3) can be modified accordingly.
6. The remaining three companies were added much later to the Dow Jones Index.

References

- Ball, Clifford A., and Antonio Roma. "Stochastic Volatility Option Pricing." *Journal of Financial and Quantitative Analysis*, 29, (1994) pp. 589–607.
- Bernard, V. "Stock Price Reactions to Earnings Announcements." In R. Thaler, ed., *Advances in Behavioral Finance*. New York: Russell Sage Foundation, 1992.
- Black, Fischer. "Noise." *Journal of Finance*, 41, (1986), pp. 529–543.
- Blanchard, O.J., and M.W. Watson. "Bubbles, Rational Expectations and Financial Markets." In Paul Wachtel, ed., *Crisis in Economic and Financial Structure*. Lanham, MD: Lexington Books, 1982.
- Campbell, J.Y., A.W. Lo, and A.C. MacKinlay. *The Econometrics of Financial Markets*. Princeton, NJ: Princeton University Press, 1997.
- Campbell, J., and R.J. Shiller. "Cointegration and Tests of Present Value Models." *Journal of Political Economy*, 95, (1987), pp. 1062–1087.
- Campbell, J., and R.J. Shiller. "Stock Price Earnings and Expected Dividends." *Journal of Finance*, 43, (1988), pp. 661–676.
- Campbell, J., and R.J. Shiller. "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors." *Review of Financial Studies*, 1, (1988), pp. 195–227.
- Campbell, J., and R.J. Shiller. "Valuation Ratios and the Long-Run Stock Market Outlook: An Update." NBER Working Paper 8221, 2001.
- Chan, L., N. Jegadeesh, and J. Lakonishok. "Momentum Strategies." *Journal of Finance*, 51, (1996), pp. 1681–1713.
- Cutler, D., J. Poterba, and L. Summers. "Speculative Dynamics." *Review of Economic Studies*, 58, (1991), pp. 529–546.
- Daniel, K., D. Hirshleifer, and A. Subrahmanyam. "Investor Psychology and Security Market Under- and Overreactions." *Journal of Finance*, 53, (1998), pp. 1839–1885.
- De Bondt, W.F.M., and R.H. Thaler. "Does the Stock Market Overreact?" *Journal of Finance*, 40, (1985), pp. 793–808.
- Fama, E. "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance*, 25, (1970), pp. 383–417.
- Fama, E., and K. French. "Dividend Yields and Expected Stock Returns." *Journal of Financial Economics*, 22, (1988), pp. 3–25.
- Fisher, Kenneth L., and Meir Statman. "Consumer Confidence and Stock Returns." *Journal of Portfolio Management*, Fall, (2003), pp. 115–127.
- Gordon, M.J., and E. Shapiro. "Capital Equipment Analysis: The Required Rate of Profit." *Management Science*, 3, (1956), pp. 102–110.
- Hong, H., and J.C. Stein. "Differences of Opinion: Rationality Arbitrage and Market Crashes." Working paper, Stanford University, 1999.
- Hull, John, and Alan White. "The Pricing of Options on Assets with Stochastic Volatilities." *Journal of Finance*, 42, (1987), pp. 281–300.
- Jegadeesh, N., and S. Titman. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *Journal of Finance*, 48, (1993), pp. 65–91.
- Jensen, Michael. "Some Anomalous Evidence Regarding Market Efficiency." *Journal of Financial Economics*, 6, (1978), pp. 95–101.
- Kothari, S., and J. Shanken. "Book-to-Market, Dividend Yield and Expected Market Returns: A Time Series Analysis." *Journal of Financial Economics*, 46, (1997), pp. 169–203.
- Lo, Andrew W., and A. Craig MacKinlay. *A Non-Random Walk Down Wall Street*. Princeton: Princeton University Press, 1999.
- Malkiel, Burton. *A Random Walk Down Wall Street*, 6th ed. New York: W.W. Norton, 1996.
- Mandelbrot, B. "Forecasts of Future Prices, Unbiased Markets and 'Martingale' Models." *Journal of Business*, 39, (1966), pp. 242–255.
- Neal, Robert, and Simon M. Wheatley. "Do Measures of Investor Sentiments Predict Returns?" *Journal of Financial and Quantitative Analysis*, December, (1998), pp. 523–547.
- Pontiff, J., and J. Schall. "Book-to-Market Ratios as Predictors of Market Returns." *Journal of Financial Economics*, 49, (1998), pp. 141–160.

- Poterba, J., and L. Summers. "Mean Reversion in Stock Returns: Evidence and Implications." *Journal of Financial Economics*, 22, (1988), pp. 27–59.
- Rouwenhorst, G. "International Momentum Strategies." *Journal of Finance*, 53, (1997), pp. 267–284.
- Samuelson, P. "Proof that Properly Anticipated Prices Fluctuate Randomly." *Industrial Management Review*, 6, (1965), pp. 41–49.
- Sharpe, William F. *Investments*. Englewood Cliffs, NJ: Prentice-Hall, 1978.
- Shiller, Robert J. "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review*, 71, (1981), pp. 421–436.
- Shleifer, Andrei. *Inefficient Markets: An Introduction to Behavioral Finance*. Oxford, UK: Oxford University Press, 2000.
- Thaler, Richard H. "The End of Behavioral Finance." Association for Investment Management and Research, November, pp. 12–17, 1999.
- Triole, J. "On the Possibility of Speculation under Rational Expectations." *Econometrica*, 50, (1982), pp. 1163–1181.
- West, K. "Dividend Innovations and Stock Price Volatility." *Econometrica*, 56, (1988), pp. 37–61.
- White, E.N. "The Stock Market Boom and the Crash of 1929 Revisited." *Journal of Economic Perspectives*, 4, 2, (1990), pp. 67–83.
- Wiggins, James B. "Option Values under Stochastic Volatility." *Journal of Financial Economics*, 19, (1987), pp. 351–372.

Copyright of Journal of Behavioral Finance is the property of Lawrence Erlbaum Associates and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.