STOCK PRICE REVERSALS AND OVERREACTION TO NEWS EVENTS: A SURVEY OF THEORY AND EVIDENCE

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ABSTRACT: Stock price reversals may be due to short-term overreactions to news, waves of unjustified optimism or pessimism about future earnings, fear and normatively "excessive" risk premia, or other causes. This paper reviews [1] the psychological literature on Bayesian decision-making and intuitive prediction; [2] the arguments that overreaction by individuals is likely to matter at the market level; [3] the evidence on short-term and long-term price reversals. The research findings are compared with the predictions of standard theories of asset pricing and market efficiency.

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1. INTRODUCTION

Over recent years, our understanding of stock valuation has been greatly influenced by three related developments: [i] the continuing failure of standard frameworks such as the Capital Asset Pricing Model (CAPM), the Consumption Capital Asset Pricing Model, or the Arbitrage Pricing Theory to account for actual stock price movements in a way that is credible and non-tautological; [ii] the emergence of a large "anomaly" literature; and [iii] the re-opening of the "efficient markets debate" with the work on excess volatility, the apparent predictability of two-to-five year returns, and short-term stock price reversals.

All three empirical developments have created a new urgency for the finance profession to come up with better theories of asset valuation. Of course, with respect to standard valuation models, it may reasonably be argued that "market efficiency imposes few restrictions on the behavior of expected returns" (Fama and French [1986, p. 2]) and that, as a consequence, time-varying risk premia may still account for the evidence. Also, the rational agent perfect-market model may be salvaged by introducing information costs and other institutional complexities (Merton [1986]). However, it appears that the more innovative work in the area now focuses on the implications for asset pricing of the presence of non-rational behavioral "noise" traders (see e.g., Campbell and Kyle [1986], Shefrin and Statman [1986], and DeLong, Shleifer, Summers and Waldman [1987]).

The purpose of this paper is to review and re-evaluate the theoretical basis and the empirical evidence relating to a simple behavioral model first suggested by myself and Thaler [1985]. There it is argued that stock prices behave as if the representative agent systematically "overreacts" to new information, particularly as it relates to earnings. The empirical work uses the magnitudes of initial price run-ups or price declines, adjusted for risk, as proxy variables to measure "excessive" market optimism or pessimism. Consistent with overreaction bias and the profitability of contrarian investment strategies, De Bondt and Thaler report predictable long-term stock price reversals for prior (extreme) stock market "winners" and "losers." While investor overreaction easily agrees with our intuition, the cognitive psychological micro-foundations of the theory largely consist of experimental work by Kahneman and Tversky on heuristics and biases, intuitive prediction, and Bayesian updating.

The paper starts in section 2 with a brief review of the psychological evidence on overreaction bias in intuitive judgment. Section 3 discusses the economic question as to whether we should expect overreaction behavior by individual investors to affect prices in financial markets. Section 4 reviews the empirical evidence relating to stock price reversals, both short-term and long-term. Because of space limitations, I do not attempt to summarize either the empirical asset pricing anomaly literature or the work on speculative bubbles and volatility tests (see Keim [1986], Reinganum [1987], Camerer [1987] and West [1987] for useful reviews). Section 5 concludes the paper with a discussion of the implications of price reversals and overreaction for modern finance.

2. DO INDIVIDUAL INVESTORS OVERREACT?

According to the overreaction hypothesis, asset prices overrespond to new information. Obviously, the hypothesis stands or falls with the evidence on the relative sophistication of man as an intuitive statistician.[1] In view of the enormity of the literature on intuitive judgmental processes and heuristics and biases, I focus here on recent research that I think to be most relevant to business and financial decision-making. For more general surveys, I refer the reader to Nisbett and Ross [1980], Hogarth [1981], Kahneman, Slovic and Tversky [1982] and Bazerman [1986]. A broad discussion of the relevance of aggregate psychological variables to financial markets appears in Adler and Adler [1984] and Schachter, Hood, Andreassen and Gerin [1986]. An even broader discussion of the relevance of psychology to economics is found in Hogarth and Reder [1987].

Much of the psychological research on intuitive prediction has produced quite discouraging results. For example, simple regression models, which capture a subject's weighting policy for major predictor variables and which apply it consistently, lead to better predictions than the subject himself. This "bootstrapping" phenomenon, which applies to experts as well as amateurs, builds on the fact that any misconception that the subject has is less detrimental to performance than his inconsistency in applying the decision rule (Dawes [1979]). Contrary to the intuition of most economists, outcome feedback does not necessarily enhance prediction accuracy (see e.g., Brehmer and Kuylenstierna [1978]). The reason is that feedback often induces

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[1]In this section, I interpret overreaction strictly in the sense of De Bondt and Thaler [1985, 1987], i.e., "overreaction-to-earnings" and systematic bias in investors' expectations of future cash flows. However, overreaction behavior and non-rational subsequent price reversals may also occur, [1], if investors are vulnerable to fashions-and-fads or market momentum unrelated to earnings, or [2], if investors violate the axioms underlying expected utility theory in ways that make their decisions (as in prospect theory) overly sensitive to low probability events, in effect requiring normatively "excessive" risk premia. See section 4.C.

response inconsistency. Neither does it appear that prediction accuracy always improves with experience, incentives, or the amount of available information. Subjects with "expertise" are less likely than amateurs to admit to (or perhaps to understand) their use of heuristics (Northcraft and Neale [1987]). Experts further tend to falsely believe that they can beat decision rules which are known to yield the correct decision in a large proportion of cases. In addition, highly motivated subjects easily grow impatient. They find it difficult to tolerate errors without resorting to a strategy shift (Arkes, Dawes and Christensen [1987]). Finally, the primary effect of extra information is often to make the subjects feel more confident, without clearly improving the quality of their judgment (Oskamp [1965]).

Experiments conducted by Kahneman and Tversky, Grether [1980] and others demonstrate that man can hardly be viewed as a Bayesian decision-maker (for a long list of references, see Kahneman, Slovic and Tversky [1982]). It appears that, contrary to Bayes' Rule, when revising beliefs, subjects systematically overweight singular information about the specific case at hand and underweight distributional or base-rate information. People take, so-to-speak, an "internal" approach to intuitive prediction. Their acquaintance with the problem, their emotional involvement, the immediate availability in memory of numerous vivid details -- all these factors lead people to generate predictions according to a simple matching rule: "the predicted value is selected so that the standing of the case in the distribution of outcomes matches its standing in the distribution of impressions" (Kahneman and Tversky [1982], p. 416). This rule-of-thumb, an instance of the "representativeness" heuristic, violates a basic statistical principle, namely, that the extremeness of predictions must be moderated by considerations of predictability.

Consistent with representativeness and a tendency to ignore base rate information, people have little appreciation of the statistical principle summarized in the "law of large numbers." The willingness of the layperson to make strong inferences based on small amounts of data leads Tversky and Kahneman [1971] to argue that people act as if the law of large numbers also applies to small numbers. Gilovich, Vallone and Tversky [1985] illustrate how common misconceptions of the laws of chance, explained by representativeness, underlie "the hot hand" fallacy in basketball.

In the context of accounting and finance, some of the most detailed work on intuitive prediction and time series extrapolation has been done by Eggleton [1976, 1982] (see Slovic [1972] and Hogarth [1975] for a review of older studies). He reports how subjects "impute a lawfulness to random series" ([1982], p. 90). Again, the "compulsive structuring" of random walk data is attributed to the representativeness heuristic. In a similar vein, Andreassen and Kraus [1987] and Andreassen [forthcoming] show how the "salience of change" influences investors' tendency to discover trends in stock prices. Depending on whether subjects focus on price levels or on changes in levels, their predictions are regressive or extrapolative.

In a different set of experiments, Andreassen [1986, 1987] also suggests that subjects' beliefs as to whether security price changes will persist or regress to previous levels may depend on whether causal attributions are provided to explain recent changes. If such attributions are provided, then any tendency to make regressive predictions (as, e.g., in the case of the gambler's fallacy) is diminished and subjects become more likely to project recent changes into the future. Andreassen argues that the news media provide causal attributions and that we can expect the news accounts to be selective. For example, to present a coherent explanation of a market rise, newspeople are prone to report good news: searching for those stories from the many available that support a rise, and ignoring those that do not. Thus, the argument goes, the media may encourage trading by leading investors to extrapolate recent events into the future.

Further time-series experiments conducted by Schmalensee [1976] reveal undue optimistic bias and overconfidence. Unrealistic optimism about future life events is also reported by Weinstein [1980]. People rate their own chances to be above average for positive events (e.g., the chances that the value of their home doubles in five years) and below average for negative events. The bias increases with the perceived controllability of the outcome (see also Langer [1975]). Both motivational and cognitive factors are to blame. Consistent with representativeness, Weinstein emphasizes people's tendency to focus on their own circumstances and their failure to adopt the perspective of others.

It may be thought that, in view of the fallibility of human judgment, people would exhibit appropriate caution concerning their judgmental abilities. However, many studies show this is false. Subjects are prone to experience confidence in highly fallible judgments, a phenomenon that Einhorn and Hogarth [1978] refer to as the "illusion of validity." The contradiction between the problem solver's self-confidence and his poor performance raises new questions with respect to the link between learning and experience.

Numerous factors restrict our ability to learn and I will only mention a few. It is well-known that prior expectations of relationships can lead to faulty observation and inference, or "illusory correlation" (Chapman and Chapman [1967]). Because of hindsight bias, outcomes often fail to surprise people as much as they should (Fischoff [1975]). People also tend to attribute success to skill and failure to chance.

In decision problems involving both skill and chance, e.g., the selection of securities for superior short-term performance, they feel inappropriately confident and the task structure induces an "illusion of control" (Langer [1975]). Finally, there are "outcome irrelevant learning structures" which reinforce poor heuristic decision rules with positive outcome-feedback. As a consequence, the validity of the rules is not questioned (Einhorn [1980]).

3. SHOULD WE EXPECT FINANCIAL MARKETS TO OVERREACT?

If we accept the notion that many investors have a propensity to overweigh dramatic, unanticipated news events, then the theoretical question arises whether, as financial economists, we should worry about it. Even though economic analysis is frequently applied in non-market settings (see e.g., Becker [1976]), finance consists for the most part of the theory of (perfect) financial markets. Grether [1980] raises a familiar point when he states that, perhaps, "the repetitive nature of market interactions, together with the reinforcement provided by the profit system .. render single observations on individual behavior irrelevant" or "..a relatively few individuals sensitive to arbitrage may make markets work as predicted.." ([1980], p. 555).[2]

One way to rephrase the issue is to ask for the minimal set of restrictions on heterogeneous beliefs and information sets that, even in frictionless markets, remains necessary to allow for the existence of rational, arbitrage-free equilibrium prices. The analysis of Jarrow [1983] indicates that two conditions are necessary. First, in an economy where a generic asset z is identified by an exogenous cash flow z(w) which depends on the state of the world w, all investors must always be in agreement on the value implications of any conceivable state. That is, while they may have different viewpoints on the likelihood of a particular event, they agree on z: $\Omega \rightarrow R$. Secondly, all investors must agree on relevant zero-probability events.

Since Bayesian and non-Bayesian investors are thought to form different opinions on the basis of the same substantive information, overreaction models consider economies where these minimal requirements are not met. However, as pointed out by Russell and Thaler [1985], rational prices may still prevail if it is

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[2]Camerer [1987] addresses the issue of whether bias in probability judgment matters in experimental markets. His experimental design is based on procedures laid out by Grether [1980]. Camerer finds that prices and asset holding patterns tend toward Bayesian predictions, even though there is evidence of bias caused by (exact) "representativeness." He rejects a number of competing hypotheses, including overreaction.

assumed that [1], at some future time, the true mapping is revealed to all, i.e., both rational and non-rational investors, and [2], that, in the meantime, only rational investors go short. But, clearly, neither of these assumptions applies in any obvious way to the stock market.

Institutional factors -- such as short-sales constraints, capital gains taxes and transaction costs -- are likely to change the situation for the worse, rather than for the better. In a world with non-trivial trading costs and heteogeneous beliefs, every individual not only chooses the size of his holdings in each asset, but also in which assets to invest. Equilibrium involves the simultaneous determination of asset prices and the identity of the investors trading in each asset (Mayshar [1983]). Some agents never reveal their private information via trade, except by abstaining. As a consequence, market prices cannot reflect it. In general, prices depend in a complex manner on the structure of trading costs and beliefs across investors. Full information efficient prices, however, ought to be independent of the distribution of private information among investors. Under specific circumstances, it may even happen that only the information held by "marginal" investors matters. Miller [1977] presents a model in which the traders who are most optimistic about a company's prospects determine its market value. In other words, stocks appear to be systematically "overpriced."

As argued before, a pure arbitrage opportunity simply does not exist unless it is certain that share prices will eventually revert to their "fundamental" underlying value. However, apart from institutional impediments, there are further economic reasons to doubt that rational arbitrageurs prevail in markets and thereby guarantee full information efficiency.

First, as investors with superior forecasting ability or inside information purchase (sell) undervalued (overvalued) stock, they assume increasing amounts of diversifiable risk, since their portfolios become more and more unbalanced.

Second, as was pointed out by Keynes long ago, it may be rational strategy for traders with superior competence to ride on the trend rather than to go against it. Harrison and Kreps [1978] present a model where, in the presence of short-sales restrictions, some investors rationally bid up the price of a stock in anticipation of the opportunity for selling it at a higher price than they themselves think it is worth. It then follows that, if a self-fulfilling equilibrium is to be found, the price must exceed what any investor is willing to pay for the asset if obliged to hold it forever. DeLong, Shleifer, Summers and Waldman [1987] present a simple overlapping generations model with two assets (a riskless asset and a risky asset) and with two types of two-period lived investors: sophisticated traders and noise traders. Both types of agents maximize expected utility but noise traders misperceive the price of the risky asset in the second period. It turns out that noise traders (i) affect prices so that they become more volatile than can be justified on the basis of the underlying fundamentals; (ii) earn higher returns than rational investors; and (iii) create additional risk and, thereby, higher expected returns. The reason for (iii) is that sophisticated investors dislike bearing the risk that noise traders may be irrationally pessimistic in the future.

Third, it is well-known that the market may rationally launch itself onto a speculative bubble with prices being driven by an arbitrary self-confirming element in expectations (see e.g., Tirole [1982] or Cass and Shell [1983]). But there is nothing that rational arbitrage can do to prevent such bubbles. In fact, there is no choice-theoretic rationale for singling out equilibrium price paths that do not suffer from this "extrinsic" uncertainty.

Of course, irrespective of any arbitrage argument, we may still hope that the non-rational investors will somehow "learn" over time. This is essentially a psychological, not an economic, argument and it is contradicted by the evidence reviewed in Section 2. Its importance is further tempered by the observation that -- since the market is composed of successive generations of participants -- there is a continual in-flow of "inexperienced" and out-flow of "experienced" traders.

A final non-arbitrage rationale for efficient markets is a Darwinian weeding-out process by which, over time, wealth is gradually redistributed from investors with poor forecasting ability to those with superior information or competence. Figlewski [1978, 1982] shows, however, that neither in the short nor in the long run does such a process lead to full information efficiency.

I conclude that there are few if any convincing theoretical reasons to expect that either the competitive process or rational arbitrage can correct market prices for the persistent overreaction of non-Bayesian investors to dramatic news events.

4. DOES THE STOCK MARKET OVERREACT?

Evidently, the "overreaction hypothesis" does not represent an entirely new idea. In *The General Theory*, Keynes argued that "day-to-day fluctuations in the profits of existing investments, which are obviously of an ephemeral and non-significant character, tend to have an altogether excessive, and even an absurd, influence on the market" ([1936], pp. 153-154). Williams notes in his *Theory of Investment Value* that "prices have been based too much on current earning power, too little on long-run dividend paying power" ([1938], p.19). Similar arguments may also be found in, e.g., Taussig [1921], Macaulay [1938] and Graham and Dodd [1951].

More recent empirical findings with respect to the price-earnings ratio (P/E) anomaly also suggest stock market overreaction. It appears that stocks with comparatively low P/E-ratios -- or, equivalently, high earnings yields (E/Ps) -- earn larger CAPM risk-adjusted returns than high P/E stocks.[3] The so-called "price-ratio hypothesis" motivates the work of Basu [1977]. Companies with high (low) P/Es are thought to be temporarily overvalued (undervalued) because the market gets inappropriately optimistic (pessimistic) about current or future earnings. Eventually, however, actual earnings growth differs predictably from the growth rate impounded in the price. Price corrections and the P/E anomaly follow inevitably. Also consistent with the hypothesis, earnings yields affect the association between annual income numbers and share prices (Basu [1978]). During the twelve months that lead up to the announcement date, unanticipated increases (decreases) in earnings cause larger positive (negative) residual returns to securities with low (high) P/Es that to securities with high (low) P/Es.

Alternatively, the P/E-effect may follow from misspecification of the CAPM (Reinganum [1981]). Ball [1978] emphasizes possibly omitted risk factors. If price-earnings ratios are correlated with the omitted variables, then their tendency to proxy for these variables permits P/Es to "explain" differences in securities' rates of return which are not predicted by the simple CAPM. In particular, Reinganum [1981] claims that the small firm effect (for a review, see Schwert [1983]) subsumes the P/E-anomaly and that both are related to the same set of missing factors. However, papers by Basu [1983] and Cook and Rozeff [1984] show a significant P/E-effect even after controlling for firm size. Both effects appear to have strong January components.

If stock prices systematically overshoot, then, (i), their reversal should be predictable from past return data alone. Also, (ii), the more prices are initially out of line, the stronger they should bounce back later on. The moving force is not so much rational learning, or rational arbitrage, as it is extreme expectations later refuted by economic reality. Finally, (iii), the shorter the duration of the initial price move-

[3]A related phenomenon is the "dividend-yield" effect. Fama and French [1987] study nominal and real returns on equal- and value-weighted portfolios of all NYSE stocks between 1927 and 1986. Dividend yields often explain more than 25 percent of the variances of 2- to 4-year returns.

ment, the stronger the subsequent price response (per unit of time). Brown and Harlow [1988] refer to (i), (ii) and (iii) as, respectively, the "directional", the "magnitude," and the "intensity" effects. All three hypotheses imply return forecastability and specific violations of weak form market efficiency. The directional and magnitude effects follow from any divergence between market and fundamental values that is eliminated beyond some limit. The intensity effect bears on the economic importance of rational risk arbitrage. If these forces are at work, then non-rational price movements that are concentrated in time -- presumably, in immediate response to specific news events -- should, on average, "be corrected sooner and more fully."

Prior to 1985, there were, at best, only a few hints in the empirical finance literature that foreshadowed the price reversals that have been documented since. In spite of a large body of research on excess return volatility, the possible logical link between the violation of variance bounds tests, stock price reversals, and overreaction was left unexplored (see, however, Campbell and Shiller [1987]). Shiller's [1984] survey article is an exception. Among other evidence (including, e.g., the P/E-effect), Shiller presents regression tests, based on annual data, showing that aggregate real stock prices appear to overreact to real dividends and to real earnings. He also argues -- as does Summers [1986] -- that standard random walk and "event study" tests of market efficiency have little power against "fashions and fads"-type alternative hypotheses.

Simulation evidence presented by Poterba and Summers [1987] indicates that recent variance ratio, regression, and likelihood ratio tests checking for transitory components in stock prices (e.g., Fama and French [1988], French and Roll [1986], Lo and McKinlay [1987], Poterba and Summers [1987]) also have limited power, even with data spanning a sixty-year period. Papers that specifically address overreaction have often dealt with this issue by focusing, for selected stocks, on brief episodes of extreme price gains or losses that, presumably, are associated with the release of firm-specific information. Thus, relatively "calm" periods -- during which any given company's share price tends to move in ways that are suggested by standard valuation models -- are not considered and do not dilute the power of the tests. In addition, the use of residual returns controls for market-wide news and underlying risk factors.

Most tests are based on variants of the following procedure: (1) find (residual and/or cumulative residual) returns for every individual stock in a given population over an initial "formation" period; (2) rank the stocks by the (cumulative residual) return earned over the formation period and form portfolios of winners and losers; (3)

test for average (cumulative residual) return differences between the winner and loser portfolios during a "test period" that follows upon the formation period.

Stock price reversals have been observed over varying time periods ranging between one day to two-to-five year returns. Below, I review the empirical literature classifying papers somewhat arbitrarily as documenting either short-term or long-term price reversals. In order to avoid lengthy reviews of the exact methods used in each study, I only report results that appear robust to obvious manipulations in the testing procedures.

A. Short-Term Price Reversals

Dyl and Maxfield [1987] select at random 200 trading days between January 1974 and January 1984. Each day, they choose the three NYSE or AMEX stocks with the largest percentage price gain (on average, 16.3 percent) or loss (on average, -12.2 percent). On average, over the next 10 trading days, prior winners (losers) earn CAPM risk-adjusted excess returns of -1.8 (3.6) percent.

Brown, Harlow and Tinic [1988] consider all one-day (market model) residual returns above 2.5 or below -2.5 percent for the 200 largest firms in the S&P 500 index. The sample period runs between July 1963 and December 1985 and, in total, there are 4,806 positive and 4,319 negative events. On average, over the next 10 trading days, prior winners earn (insignificant) CAPM risk-adjusted excess returns of 3 basis points (t-statistic: 0.18); prior losers earn about 37 basis points (t-statistic: 7.63).

Bremer and Sweeney [1988] study all Fortune 500 and S&P 500 companies with one-day returns below -10.0 (-7.5; -15.0) or above 10.0 percent. For the period between July 1962 and December 1986, there are 1,305 price declines of this magnitude and 3,218 increases. Five trading days after the price "jump," the cumulative average excess return (CAER) for losers -- with excess returns, for each individual stock, computed relative to the average return of the stock over the sample period -- equals an extraordinary 3.95 (2.84; 6.18) percent. On the other hand, for winners, CAER is (statistically) significant but (economically) irrelevant at minus 4/10 of one basis point (t-statistic: -9.82).

Concerned with stock return volatility during trading and non-trading hours, French and Roll [1986] test, among other hypotheses, whether the process of trading introduces noise into stock returns, as if "investors overreact to each other's trades"

(p. 6).[4] French and Roll's first test is based on daily autocorrelations in returns for all NYSE and AMEX stocks between January 1963 and December 1982. If pricing errors are corrected over time, negative autocorrelations are expected. Secondly, French and Roll compare daily return variances with variances for longer holding periods. If daily returns are affected by noise trading, the longer holding period variance should be less than the cumulated daily variances within the period (i.e., the "implied variance"). The findings are generally consistent with the "noise trading hypothesis." For at least 10 trading days, small but significantly negative autocorrelations in returns persist. After six months, the average actual-to-implied variance ratio for all stocks in the population (for the smallest quintile) equals 0.88 (0.73). These results imply that, on average, between 4 to 12 percent (5 to 27 percent) of the daily return variance is caused by mispricing.

The previous studies -- all based on daily return data -- are vulnerable to the critique that, even in efficient markets, thin trading and price movements between the bid and asked prices may give the appearance of negative serial correlation in returns. Howe [1986] therefore examines the weekly return patterns of NYSE and AMEX stocks that rise or fall more than 50 percent within one week. For the period between 1963 and 1981, the good news and bad news samples comprise, respectively, 385 and 131 observations. During the ten weeks that follow the initial price change, prior winners underperform the market by 13 percent. Prior losers outperform the market by 13.8 percent. Most of the reversal occurs early on. For example, one week after the portfolios are formed, the winners (losers) lag (lead) the market by 7.7 (10.2) percent.

Lehmann [1988] also works with weekly returns. He studies the profitability of a return reversal strategy which finances its purchases of short-term losers (the stocks that underperformed the market over the previous week) by selling winners short (the stocks that outperformed the market). Lehmann's research does not focus on extreme performers. For the 1962-1986 period, almost all securities listed on the NYSE and AMEX are considered. However, the dollar amount invested in each

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[4]Ohlson and Penman [1985] are also concerned with return volatility. They find a perplexingly robust average increase of about 30 percent in the return standard deviation of NYSE and AMEX stocks following the ex-dates of stock splits. It appears to these authors that "the concept of an informationally efficient market .. is obviously inconsistent with an essentially "arbitrary" increase in return variances" ([1985], p. 264). Forced to look for "folklore explanations," Ohlson and Penman suggest that "..overreaction to information is more likely to occur for relatively low-priced (per share) stocks.." ([1985], p. 265).

security is proportional to its (absolute) weekly excess return, i.e., extreme performers carry more weight in the arbitrage portfolio. Typically, there are more than 2,000 round trip transactions per week, generating weekly volume of about three dollars per dollar long in the portfolio.

The strategy is extraordinarily successful. Net of 10 basis points one-way costs per dollar transacted, portfolios which are long $100 million of losers and short $100 million of winners earn average six-month profits of $38.77 million, with about 2/3 of the profit generated by the losers. The winners have negative returns only in the week subsequent to portfolio formation. However, since their returns are strongly negatively correlated with the returns on the losers, the profits of the arbitrage portfolio are positive for about nine out of every ten weeks. Consistent with the magnitude effect, the winners and losers that gained or lost the most experience the largest reversals.

For various periods starting in May of 1973, Rosenberg and Rudd [1982] and Rosenberg, Reid and Lanstein [1985] report on a one-month "specific return reversal" strategy purchasing an equal-weighted portfolio of stocks whose previous month's specific returns (found relative to a multifactor model) were negative and selling short a portfolio whose previous month's specific returns were positive. Between January 1981 and October 1984, the strategy earns on average 136 basis points per month, with most of it coming from prior losers. The exclusion of stocks with (extreme) prior monthly residual returns below -10 or above +10 percent reduces the profit to 105 basis points.

Jegadeesh [1987] presents regression evidence for NYSE stocks indicating that, between 1945 and 1980, Sharpe-Lintner residual returns for any given month are negatively related to raw returns for the previous month and, reflecting seasonality, positively related to returns for the same month one, two and three years earlier. When decile portfolios are formed on the basis of "one-month-ahead" forecasts of excess returns, the average difference between the risk-adjusted excess returns on the extreme portfolios is about 2.5 percent per month (6.0 percent in January). Adding a size-variable -- measured as the natural logarithm of the market value of equity at the end of the previous month -- to the equation leaves the results largely unchanged. For January excess returns, the size-coefficient is significantly negative; otherwise, it is insignificant.

Brown and Harlow [forthcoming] study the returns of securities with an initial abnormal performance adding up to between 20 (-20) and 65 (-65) percent over periods that range between one to six months. They consider all stocks trading on the NYSE between January 1946 and December 1983. For "negative events," the evidence is consistent with the directional, magnitude and intensity effects. For example, in the first month (month +1) following a 60 to 65 percent price drop, the average price rebound is 6.2 percent. It is only 48 basis points for an initial fall between 20 and 25 percent. Also, for the combined samples of all negative events (i.e., excess returns between -20 and -65 percent) that occurred within one month, the average residual for the following month is 2.7 percent. But, for the same range of negative excess returns, the average rebound is 56 basis points if the initial drop occurred over a six-month period.

For "positive events," the test period excess returns are negative in month +1. However, in agreement with the asymmetry reported by other studies, the price correlation is smaller (in absolute terms) than for losers. It further appears that the magnitude of the price drop is not significantly related either to the amount of the initial rise or to the length of the period over which it occurred. Brown and Harlow document a second asymmetry, relating to the long-term price response to positive and negative events. There is, on average, a further 56 (31) percent price decline between months +2 and +36 of the test period for "prior losers" that already fell between 60 and 65 percent in value over one (six) month(s). This observation, suggesting inertia (rather than overreaction), does not apply to winners.[5]

B. Long-Term Price Reversals

De Bondt and Thaler [1985] study the relative test period performance of (35 stock, 50 stock or decile portfolios) of "long-term" winners and losers. They use monthly return data for NYSE stocks between December 1925 and December 1982. Initial performance is measured over formation periods ranging between one and five years. Typically, the formation periods start in January and end in December. Even though there are always significant differences in the January excess returns of the extreme portfolios, the price reversals become much more pronounced as the formation period lengthens beyond two years. In that case, an "arbitrage" strategy

[5]Further evidence of inertia or underreaction to news events is suggested, among other studies, by the work of Rendleman, Jones and Latane [1982]. After controlling for CAPM-risk, roughly half of the adjustment of stock returns to unexpected quarterly earnings occurs over a 90-day period after earnings are announced. Lo and MacKinlay [1987] and Poterba and Summers [1987] also report positive serial correlation in stock returns over short intervals. Positive autocorrelation is consistent with stock prices slowly gravitating towards their underlying intrinsic values, as well as with "inertia."

that buys losers by selling winners short earns average annual returns ranging between 5 and 8 percent, with most the returns occurring in (the successive months of) January.[6] Vermaelen and Verstringe [1986] and Dark and Kato [1986] both use De Bondt and Thaler's [1985] empirical methods to document overreaction on the Belgian and Japanese stock markets, respectively. For the period between 1964 and 1980, Dark and Kato find that the three-year returns for decile portfolios of extreme prior losers exceed the comparable returns of extreme prior winners by, on average, 69.7 percent (t-statistic: 4.6).

In the U.S. market, Fama and French [1988] also observe long-horizon price reversals which they interpret as being consistent with temporary disparities between market prices and fundamental values, as well as with time-varying equilibrium expected returns. Fama and French test whether (the natural logarithm) of stock price $P(t)$, $p(t) = \ln P(t)$, moves through time as if the permanent change from each news shock is less than one. For example, let $p(t) = q(t) + z(t)$, where the "permanent" component $q(t)$ follows a random walk process with drift μ, $q(t) = q(t-1) + \mu + u(t)$, and where the "temporary" component $z(t)$ follows an AR(1) process, $z(t) = \phi z(t-1) + e(t)$. Also, let $b(T)$ be the slope of a regression of $r(t,t+T)$ on $r(t-T,t)$, where $r(t,t+T)$ equals $[\ln P(t+T) - \ln P(t)]$. In that case, if changes in the random walk and the stationary component are uncorrelated, $b(T)$ measures the proportion of the variance of T-period returns that is explained by the mean reversion of the decaying price component $z(t)$. If prices do not have a random walk component, then, for large T, $b(T)$ tends toward -1/2. If prices move as hypothesized, then, for large T, the variance of the random walk component eventually dominates. As a result, $b(T)$ is

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[6]Chan [1987], Jones [1987] and Zarowin [1988] computationally replicate De Bondt and Thaler's [1985] results for three-year formation periods. Chan [1987], De Bondt [1985], De Bondt and Thaler [1987], Fama and French [1986], Jones [1987], and Zarowin [1988] check the findings' robustness. All studies use virtually identical empirical methods. Even though the debate is not closed as yet, it appears that [1] the results do not greatly change depending on whether the residual returns are defined as size-adjusted excess returns, market-adjusted excess returns, market model residuals, or Sharpe-Lintner residuals; [2] the results do not depend on the different methods that can be used to estimates CAPM-betas (see, however, Chan [1987]); [3] the results do not depend on whether December or any other month is the last month of the formation period; [4] the excess returns earned by the extreme portfolios are not explained by unusual attrition (say, because of merger or bankruptcy) during the test period; [5] the extreme portfolios do not contain unusually small firms; [6] the extreme portfolios do not systematically differ through time in terms of average dividend yield, size, or financial leverage.

negative but close to zero for small T, close to -1/2 for intermediate T, and negative but close to zero for large T.

Fama and French study monthly returns between 1926 and 1985 for two market indices, 17 industry portfolios, and decile portfolios of NYSE-listed companies ranked on the basis of market value of equity. The regression slopes are significantly negative when T varies between 3- and 5 years; the slopes suggest that between 25 to 45 percent of the variation in returns over a 3- to 5 year horizon is predictable. However, the stationary component is largely captured by one common factor: the return process of small companies' stocks. Fama and French also find little evidence of firm-specific stationary components, an observation which is "heartening for proponents of parsimonious equilibrium pricing models" ([1987], p. 19).

Poterba and Summers [1987] confirm Fama and French's findings. They apply variance ratio tests to the 82 firms on the CRSP monthly return files that have no missing data between 1926 and 1985, to market returns for the U.S. over the 1871-1985 period, and to market indices for 17 other countries over the 1957-1986 period. Poterba and Summers consistently find evidence that stock returns are positively autocorrelated over short horizons (see also Lo and MacKinlay [1987]) and negatively autocorrelated over long horizons. The results suggest that transitory components in stock prices account for more than half of the variance in monthly returns.

C. Explaining Price Reversals: Where Are We?

Fama and French [1988] and Poterba and Summers [1987] do not explicitly discuss the extent to which their findings are influenced by the unusual behavior of the stock market in January. However, the price reversals of extreme winners and losers largely occur in that month and they continue as late as five Januaries after portfolio formation (De Bondt and Thaler [1987]; Fama and French [1986]). The most obvious interpretation of the January seasonal for losers is that it reflects the size-anomaly. But losers are not unusually small firms (De Bondt and Thaler [1987]) and there is a January winner-loser effect, even after experimental control is exercised over firm size (Fama and French [1986]; Zarowin [1987]). One possible reason for the January seasonal involves tax-motivated portfolio rebalancing behavior. Numerous empirical papers suggest short-term tax-loss selling pressure for losers (see, e.g., Reinganum [1983]) and a capital gains tax "lock-in" effect for winners.[7] While rational tax trading predicts a relation between January returns and short-term losses (but no link with long-term losses), Chan [1986], Jones [1987] and De Bondt and Thaler [1987] all observe how the January reversals are driven in large part by prior long-term performance (see also Branch and Chang [1987]). These findings are consistent with overreaction but they may also follow from (non-rational) tax-loss selling explained by investor reluctance to realize losses (Shefrin and Statman [1985]).

The price reversals and the winner-loser effect are often interpreted as evidence of rationally time-varying expected returns. Factor risk premia may contain a January seasonal (Rogalski and Tinic [1985]) and/or they may vary with certain business cycle variables (see, e.g., Keim and Stambaugh [1986]). Also, the relevant factor loadings could be changing, e.g., when stock prices decline, debt-equity ratios increase, leading to an increase in CAPM-betas (Vermaelen and Verstringe [1986]; Chan [1987]).[8]

While these arguments have a solid theoretical basis and are hard to refute empirically, I doubt their economic significance with respect to most of the studies reviewed above. In particular, the changing-risk argument seems totally incapable of explaining price reversals that occur within a few days or weeks unless the "risk premia" are redefined to reflect flimsy return perceptions and (rationally) unjustified hope and fear. For example, on the assumption that the market risk premium equals 10 percent per year, Bremer and Sweeney [1988] calculate that, on the first day after a negative "jump" in excess of 10 percent, the CAPM-beta of the average loser company would have to suddenly rise to about 50! With respect to long term

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[7]Ritter [1988] offers an interesting new twist on the tax-loss selling hypothesis, which he calls the "parking-the-proceeds" effect. It appears that the buy/sell ratio for individual investors is below normal in late December and above normal in early January. The phenomenon most clearly occurs following bear markets. Thus, the difference in January performance between small and large companies may not only reflect a "rebound" from December selling pressure (Reinganum [1983]) but also buying pressure that results from delayed portfolio rebalancing behavior by individual investors (who are known, in the aggregate, to prefer low-capitalization stocks).

In addition, price pressures resulting from "window dressing" and portfolio rebalancing behavior by institutional investors -- who, as suggested by Haugen and Lakonishok [1987], may turn contrarian in early January -- could be responsible for the January effect. But, at this time, there is no empirical evidence either to support or to reject that view.

[8]Brown, Harlow and Tinic [1988] present a third line of reasoning. They argue that for rational risk-averse utility-maximizing investors the conditional certainty equivalent value of a stock will always be less than the corresponding conditional expected value. As a consequence, the initial price reaction to uncertain information will, on average, be insufficient. This view -- called the Uncertain Information Hypothesis -- leads to predictions that are observationally equivalent to overreaction to "bad" news and underreaction to "good" news.

price reversals and the test period performance of on "arbitrage" portfolio that buys losers by selling winners short, Chan [1987] admits that the excess returns cannot be explained by the CAPM unless there is positive correlation between the market risk premium and time-varying betas (say, because both are responding to common state variables). However, as explained in De Bondt and Thaler [1987], the dependence of the arbitrage portfolio beta on market movements makes it difficult to interpret that measure as a risk-index.[9] Finally, Poterba and Summers [1987] directly investigate what variability (standard deviation) of expected returns is necessary to account for the observed mean reversion in prices. The estimates are very large relative to the mean of ex post returns; they imply that ex ante returns must frequently exceed 20 percent.

Even though much energy has been spent to distinguish long-term price reversals from mere compensation for risk, tax-induced turn-of-the-year effects, and the size anomaly, relatively little has happened in the way of further testing its original cognitive bias interpretation.[10] The "overreaction to earnings" hypothesis starts from the claim that there are temporary mean-reverting components in company earnings (see, e.g., Brooks and Buckmaster [1976]), particularly with respect to extreme winner and loser portfolios. Such mean-reversion -- which, like the price reversals, is the strongest for losers -- is documented by De Bondt and Thaler [1987] and Zarowin [1987]. But investors either perceive all earnings changes to be permanent or, worse, they detect "trends." Either way, as the original expectations (too optimistic for prior winners; too pessimistic for prior losers) get disappointed, stock prices adjust and move towards their underlying "fundamental values." Thus, mean

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[9]The arbitrage portfolio has a CAPM-beta of .395 in bull markets and -.323 in bear markets. In January, the bull (bear) market beta is .748 (-.848). Therefore, the arbitrage portfolio is profitable no matter which direction the market takes. If the market is up, the loser portfolio moves more strongly with it than the winner portfolio does, and the arbitrage portfolio earns excess profits on the long side. If the market is down, the arbitrage portfolio earns profits on the short side. These findings further suggest that losers are initially "undervalued" and winners "overvalued."

[10]If deviations between market price and intrinsic value get corrected over time, negative serial correlation in returns follows inescapably. Any fashion or fad will do. However, price reversals may still be consistent with rational time-varying risk premia. Therefore, the arguments against the efficient market hypothesis stand to gain the most from specific "speculative fad models" that explain the observed mean-reversion in terms of variables which do not relate to "fundamentals" and which ought to be irrelevant -- such as earnings forecast errors. "Overreaction to earnings" may be thought of as precisely one such model.

reversion in stock prices and the associated profitability of contrarian strategies may reflect no more than mean reversion in earnings which the representative investor fails to recognize.

Klein and Rosenfeld [1987] attempt to explain the P/E-anomaly from this perspective. For the period between 1977 and 1984, they analyze financial analysts' earnings predictions on IBES, a data base marketed by Lynch, Jones & Ryan in New York. The quality of analysts' predictions deserves our attention because it represents a natural upper bound on the quality of the earnings-per-share (EPS) forecasts of less sophisticated agents.[11] Klein and Rosenfeld observe that analysts, on average, underestimate the actual EPS of the firms with the lowest dollar level of expected earnings. Using the same data base, Dowen and Bauman [1987] find that, on average, the forecasts for stocks with high P/E-ratios are too large relative to stocks with low P/E ratios. However, neither study succeeds in accounting for the P/E-anomaly.[12]

Zarowin [1987] tests the overreaction-to-earnings hypothesis directly by forming portfolios on the basis of a company-specific "earnings performance measure" (EPM) that is defined as the change in earnings from one year to the next divided by the standard deviation of the company's earnings changes over the previous five years. Between 1971 and 1981, the yearly samples contain 551 to 788 firms (listed both on the Annual Industrial COMPUSTAT and the monthly CRSP return tapes). Zarowin finds that, over the next three years, the 20 percent of the companies with the lowest EPM outperform the top quintile by, on average, 16.6 percent (t-statistic:

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[11]The debate about the quality of analysts' EPS forecasts remains largely unresolved (see the survey by Givoly and Lakonishok [1984]), particularly as it relates to stocks that we may reasonably believe to be subject to fashions and fads. While there is evidence of bias, analysts' predictions, on average, seem to beat naive time-series extrapolations. However, this comparison is skewed in favor of the analysts since they benefit from larger amounts of (and more timely) information than is captured by time-series models.

[12]De Bondt and Thaler [forthcoming] also use IBES expectations data to test whether, for extreme winners (losers), 8-, 13- and 21-month EPS forecasts are on the average revised downwards (upwards) as time elapses. Their preliminary findings go against overreaction bias for EPS forecasts over 1- and 2-year horizons. However, in the spirit of a well-known Wall Street aphorism -- that the market at times not only discounts the future but also the hereafter -- expectations of long-term EPS growth may be more relevant.

2.9), with the largest part, 13.4 percent, occurring in January.[13] Further evidence on overreaction-to-earnings is provided by Ou and Penman [1987]. For the period between 1973 and 1983, these authors draw numerous accounting data items for the Annual COMPUSTAT files in attempts to measure, for about 1,600 companies per year, "future earning power" and to predict the probability of an EPS-increase in the subsequent year (p). Every year, portfolios are formed and stocks are assigned either to a "long" position (if $p > .60$) or to a "short" position (if $p < .40$). Two years later, the average return difference on the positions is a highly significant 14.53 percent (9.08 percent when size-adjusted returns are used). Interestingly, Ou and Penman find that the stocks with large (small) p have typically experienced substantial price decreases (increases) over the previous five years. Also, in the last year before portfolio formation, these companies report very substantial declines (rises) in earnings-per-share relative to other firms. Ou and Penman conclude that "financial statements capture fundamentals that are not reflected in prices" (p. 34). In addition, extreme values of p may be interpreted as "identifying cases where stock prices have previously moved away from fundamentals as well as subsequent reversion to fundamentals" (p. 19).

Apart from non-rational earnings expectations and normatively "excessive" risk premia, a third socio-psychological interpretation of the price reversals involves investors overreacting to each other's trades rather than to news per se (see Black [1986] and French and Roll [1986]). Shiller and Pound [1987] and Shiller [1987] conduct broad-based surveys of institutional investors, wealthy individual investors and stockbrokers in order to study their investment strategies and reaction to news events. On the basis of nearly 1000 responses, Shiller [1987] is unable to identify specific news breaks that led to the October 19 stock market crash. He is sympathetic to the view that the stock market "may have a life of its own to some extent, unrelated to economic fundamentals" (p. 22). Overall, however, we have little evidence directly related to the trading process that allows us to judge, at this time, the relevance of socio-psychological explanations of overreaction.

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[13]When Zarowin controls for firm size by comparing the test period returns of earnings-based winners and losers with roughly the same market value of equity, the results become much weaker. However, this result is to be expected if, say, for small firms, both "winners" and "losers" (in Zarowin's definition, based on one-year earnings changes) are "long-term" losers in the sense of De Bondt and Thaler [1985], i.e., based on long-term return performance.

5. CONCLUSION

This paper summarizes theoretical and empirical work suggestive of overreaction in stock prices. The empirical evidence is "anomalous" relative to standard valuation models and notions of market efficiency but it is broadly consistent with predictions made by theories of intuitive judgment formulated by psychologists. Yet, many puzzles remain. These puzzles include the extreme seasonality of "price corrections" and their asymmetry in response to "good" or "bad" news events. Overreaction behavior may be driven either by normatively "excessive" risk premia, non-rational expectations of future cash flows (i.e., fashions and fads), or investors overreacting to each other's trades. At this time, the empirical findings do not allow us to clearly distinguish between these hypotheses. Neither do they allow us to reject the view that mean-reversion in asset prices reflects, at least in part, rationally time-varying risk premia. Since, in any event, none of these interpretations are mutually exclusive, the old saw "that much work remains to be done" clearly applies.

Nevertheless, the research that is summarized above already has profound implications for finance. For example, it can no longer be assumed (as it is in event studies) that the reaction of market prices to important news breaks is instantaneous and unbiased. It would be interesting to compare the observed changes in market value with independent estimates of the "correct" change (for a rare attempt -- and results consistent with overreaction -- see Jarrell and Peltzman [1986]).

On a more basic level, our task is to invent better theories of stock valuation. If economic fundamentals cannot account for the volatility of asset prices (Cutler, Poterba and Summers [1987]), what does? It is important that we model how the consensus opinion of market participants evolves through time. The results on overreaction may be helpful in this regard. In many ways, the field of finance is in a state similar to its position at the birth of the efficient market hypothesis. In his classic review article on efficient markets, Fama comments on that period as follows [1970, p. 389],

> ...research on security prices did not begin with the development of a theory of price formation...Rather...faced with the evidence [that speculative prices could be well approximated by a random walk], economists felt compelled to offer some rationalization...there existed a large body of empirical results in search of a rigorous theory...

In this paper, I have suggested that, in the search for better theories of asset valuation, the introduction of findings of behavioral science represents a reasonable (and an empirically promising) modeling strategy. Apart from the fact that numerous empirical anomalies plague the standard models, this is also sensible because there is so much doubt about the descriptive validity for individual behavior of the assumptions underlying these theories (such as expected utility maximization, risk aversion, or Bayesian updating). Yet, in the economics and finance literature, it often seems as if there are no modeling alternatives. For example, with respect to the assumption of rational expectations, Barro and Fisher ([1976], p. 163) argue,

> ...The ... assumption may be excessively strong...but it is a more persuasive starting point than the alternative of using a rule of thumb for expectations formation that is independent of the stochastic properties of the time path of the variable about which expectations are formed. A fundamental difficulty with theories of expectations that are not based on the predictions of the relevant economic model ... is that they require a theory of systematic mistakes..

As described in section 2, the groundwork for a behavioral theory of systematic expectation bias -- or other deviations from "rationality," narrowly defined -- presently exists. Furthermore, it is unlikely that a class of "fully rational" traders can remove such bias at the market level. A willingness to assume more than mere consistency in behavior -- in short, a "richer" behavioral model -- may therefore be useful in tackling such little understood phenomena as the week-end effect, the turn-of-the-year effect, etc. In his review paper on the small firm effect, Schwert argues that ([1983], p. 10, my emphasis):

> ...to successfully explain the "size effect," new theory must be developed that is consistent with rational maximizing behavior on the part of *all* actors in the model..

I believe instead that a promising topic for future theoretical and empirical work is to characterize the "quasi"-equilibria that prevail in markets where a substantial number of economic agents are less than fully rational.

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