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Author(s): Werner F. M. De Bondt and Richard Thaler
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WERNER F. M. De BONDT and RICHARD THALER*

ABSTRACT

Research in experimental psychology suggests that, in violation of Bayes' rule, most people tend to "overreact" to unexpected and dramatic news events. This study of market efficiency investigates whether such behavior affects stock prices. The empirical evidence, based on CRSP monthly return data, is consistent with the overreaction hypothesis. Substantial weak form market inefficiencies are discovered. The results also shed new light on the January returns earned by prior "winners" and "losers." Portfolios of losers experience exceptionally large January returns as late as five years after portfolio formation.

As ECONOMISTS INTERESTED IN both market behavior and the psychology of individual decision making, we have been struck by the similarity of two sets of empirical findings. Both classes of behavior can be characterized as displaying *overreaction.* This study was undertaken to investigate the possibility that these phenomena are related by more than just appearance. We begin by describing briefly the individual and market behavior that piqued our interest.

The term overreaction carries with it an implicit comparison to some degree of reaction that is considered to be appropriate. What is an appropriate reaction? One class of tasks which have a well-established norm are probability revision problems for which Bayes' rule prescribes the correct reaction to new information. It has now been well-established that Bayes' rule is not an apt characterization of how individuals actually respond to new data (Kahneman et al. [14]). In revising their beliefs, individuals tend to overweight recent information and underweight prior (or base rate) data. People seem to make 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 [14, p. 416]). This rule-of-thumb, an instance of what Kahneman and Tversky call the representativeness heuristic, violates the basic statistical principal that the extremeness of predictions must be moderated by considerations of predictability. Grether [12] has replicated this finding under incentive compatible conditions. There is also considerable evidence that the actual expectations of professional security analysts and economic forecasters display the same overreaction bias (for a review, see De Bondt [7]).

One of the earliest observations about overreaction in markets was made by J. M. Keynes:"... day-to-day fluctuations in the profits of existing investments,

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which are obviously of an ephemeral and nonsignificant character, tend to have an altogether excessive, and even an absurd, influence on the market" [17, pp. 153–154]. About the same time, Williams noted in this *Theory of Investment Value* that "prices have been based too much on current earning power and too little on long-term dividend paying power" [28, p. 19]. More recently, Arrow has concluded that the work of Kahneman and Tversky "typifies very precisely the exessive reaction to current information which seems to characterize all the securities and futures markets" [1, p. 5]. Two specific examples of the research to which Arrow was referring are the excess volatility of security prices and the so-called price earnings ratio anomaly.

The excess volatility issue has been investigated most thoroughly by Shiller [27]. Shiller interprets the Miller-Modigliani view of stock prices as a constraint on the likelihood function of a price-dividend sample. Shiller concludes that, at least over the last century, dividends simply do not vary enough to rationally justify observed aggregate price movements. Combining the results with Kleidon's [18] findings that stock price movements are strongly correlated with the following year's earnings changes suggests a clear pattern of overreaction. In spite of the observed trendiness of dividends, investors seem to attach disproportionate importance to short-run economic developments.[1]

The price earnings ratio (P/E) anomaly refers to the observation that stocks with extremely low P/E ratios (i.e., lowest decile) earn larger risk-adjusted returns than high P/E stocks (Basu [3]). Most financial economists seem to regard the anomaly as a statistical artifact. Explanations are usually based on alleged misspecification of the capital asset pricing model (CAPM). Ball [2] emphasizes the effects of omitted risk factors. The P/E ratio is presumed to be a proxy for some omitted factor which, if included in the "correct" equilibrium valuation model, would eliminate the anomaly. Of course, unless these omitted factors can be identified, the hypothesis is untestable. Reinganum [21] has claimed that the small firm effect subsumes the P/E effect and that both are related to the same set of missing (and again unknown) factors. However, Basu [4] found a significant P/E effect after controlling for firm size, and earlier Graham [11] even found an effect within the thirty Dow Jones Industrials, hardly a group of small firms!

An alternative behavioral explanation for the anomaly based on investor overreaction is what Basu called the "price-ratio" hypothesis (e.g., Dreman [8]). Companies with very low P/E's are thought to be temporarily "undervalued" because investors become excessively pessimistic after a series of bad earnings reports or other bad news. Once future earnings turn out to be better than the unreasonably gloomy forecasts, the price adjusts. Similarly, the equity of companies with very high P/E's is thought to be "overvalued," before (predictably) falling in price.

While the overreaction hypothesis has considerable a priori appeal, the obvious question to ask is: How does the anomaly survive the process of arbitrage? There

[1] Of course, the variability of stock prices may also reflect changes in real interest rates. If so, the price movements of other assets—such as land or housing—should match those of stocks. However, this is not actually observed. A third hypothesis, advocated by Marsh and Merton [19], is that Shiller's findings are a result of his misspecification of the dividend process.

is really a more general question here. What are the equilibria conditions for markets in which some agents are not rational in the sense that they fail to revise their expectations according to Bayes' rule? Russell and Thaler [24] address this issue. They conclude that the existence of some rational agents is not sufficient to guarantee a rational expectations equilibrium in an economy with some of what they call quasi-rational agents. (The related question of market equilibria with agents having heterogeneous expectations is investigated by Jarrow [13].) While we are highly sensitive to these issues, we do not have the space to address them here. Instead, we will concentrate on an empirical test of the overreaction hypothesis.

If stock prices systematically overshoot, then their reversal should be predictable from past return data alone, with no use of any accounting data such as earnings. Specifically, two hypotheses are suggested: (1) Extreme movements in stock prices will be followed by subsequent price movements in the opposite direction. (2) The more extreme the initial price movement, the greater will be the subsequent adjustment. Both hypotheses imply a violation of weak-form market efficiency.

To repeat, our goal is to test whether the overreaction hypothesis is *predictive*. In other words, whether it does more for us than merely to explain, ex post, the P/E effect or Shiller's results on asset price dispersion. The overreaction effect deserves attention because it represents a behavioral principle that may apply in many other contexts. For example, investor overreaction possibly explains Shiller's earlier [26] findings that when long-term interest rates are high relative to short rates, they tend to move down later on. Ohlson and Penman [20] have further suggested that the increased volatility of security returns following stock splits may also be linked to overreaction. The present empirical tests are to our knowledge the first attempt to use a behavioral principle to predict a new market anomaly.

The remainder of the paper is organized as follows. The next section describes the actual empirical tests we have performed. Section II describes the results. Consistent with the overreaction hypothesis, evidence of weak-form market inefficiency is found. We discuss the implications for other empirical work on asset pricing anomalies. The paper ends with a brief summary of conclusions.

I. The Overreaction Hypothesis: Empirical Tests

The empirical testing procedures are a variant on a design originally proposed by Beaver and Landsman [5] in a different context. Typically, tests of semistrong form market efficiency start, at time $t = 0$, with the formation of portfolios on the basis of some event that affects all stocks in the portfolio, say, an earnings announcement. One then goes on to investigate whether later on ($t > 0$) the estimated residual portfolio return $\hat{u}_{pt}$—measured relative to the single-period CAPM—equals zero. Statistically significant departures from zero are interpreted as evidence consistent with semistrong form market inefficiency, even though the results may also be due to misspecification of the CAPM, misestimation of the relevant alphas and/or betas, or simply market inefficiency of the weak form.

In contrast, the tests in this study assess the extent to which systematic nonzero residual return behavior in the period after portfolio formation ($t > 0$) is associated with systematic residual returns in the preformation months ($t < 0$). We will focus on stocks that have experienced either extreme capital gains or extreme losses over periods up to five years. In other words, "winner" (W) and "loser" portfolios (L) are formed *conditional upon past excess returns*, rather than some firm-generated informational variable such as earnings.

Following Fama [9], the previous arguments can be formalized by writing the efficient market's condition,

$$E(\tilde{R}_{jt} - E_m(\tilde{R}_{jt} \mid F^m_{t-1}) \mid F_{t-1}) = E(\tilde{u}_{jt} \mid F_{t-1}) = 0$$

where F_{t-1} represents the complete set of information at time $t - 1$, $\tilde{R}_{jt}$ is the return on security j at t, and $E_m(\tilde{R}_{jt} \mid F^m_{t-1})$ is the expectation of $\tilde{R}_{jt}$, assessed by the market on the basis of the information set F^m_{t-1}. The efficient market hypothesis implies that $E(\tilde{u}_{Wt} \mid F_{t-1}) = E(\tilde{u}_{Lt} \mid F_{t-1}) = 0$. As explained in the introduction, the overreaction hypothesis, on the other hand, suggests that $E(\tilde{u}_{Wt} \mid F_{t-1}) < 0$ and $E(\tilde{u}_{Lt} \mid F_{t-1}) > 0$.

In order to estimate the relevant residuals, an equilibrium model must be specified. A common procedure is to estimate the parameters of the market model (see e.g., Beaver and Landsman [5]). What will happen if the equilibrium model is misspecified? As long as the variation in $E_m(\tilde{R}_{jt} \mid F^m_{t-1})$ is small relative to the movements in $\tilde{u}_{jt}$, the exact specification of the equilibrium model makes little difference to tests of the efficient market hypothesis. For, even if we knew the "correct" model of $E_m(\tilde{R}_{jt} \mid F^m_{t-1})$, it would explain only small part of the variation in $\tilde{R}_{jt}$.[2]

Since this study investigates the return behavior of specific portfolios over extended periods of time (indeed, as long as a decade), it cannot be merely *assumed* that model misspecification leaves the conclusions about market efficiency unchanged. Therefore, the empirical analysis is based on three types of return residuals: market-adjusted excess returns; market model residuals; and excess returns that are measured relative to the Sharpe-Lintner version of the CAPM. However, since all three methods are single-index models that follow from the CAPM, misspecification problems may still confound the results. De Bondt [7] formally derives the econometric biases in the estimated market-adjusted and market model residuals if the "true" model is multifactor, e.g., $\tilde{R}_{jt} = A_j + B_j\tilde{R}_{mt} + C_j\tilde{X}_t + \tilde{e}_{jt}$. As a final precaution, he also characterizes the securities in the extreme portfolios in terms of a number of financial variables. If there were a persistent tendency for the portfolios to differ on dimensions that may proxy for "risk," then, again, we cannot be sure whether the empirical results support market efficiency or market overreaction.

It turns out that, whichever of the three types of residuals are used, the results

[2] Presumably, this same reasoning underlies the common practice of measuring abnormal security price performance by way of easily calculable mean-adjusted excess returns [where, by assumption, $E(\tilde{R}_j)$ equals a constant K_j], market-adjusted excess returns (where, by assumption, $\alpha_j = 0$ and $\beta_j = 1$ for all j), rather than more complicated market model residuals, let along residuals relative to some multifactor model.

of the empirical analysis are similar and that the choice does not affect our main conclusions. Therefore, we will only report the results based on market-adjusted excess returns. The residuals are estimated as $\hat{u}_{jt} = R_{jt} - R_{mt}$. There is no risk adjustment except for movements of the market as a whole and the adjustment is identical for all stocks. Since, for any period t, the same (constant) market return R_{mt} is subtracted from all R_{jt}'s, the results are interpretable in terms of raw (dollar) returns. As shown in De Bondt [7], the use of market-adjusted excess returns has the further advantage that it is likely to bias the research design *against* the overreaction hypothesis.[3] Finally, De Bondt shows that winner and loser portfolios, formed on the basis of market-adjusted excess returns, do not systematically differ with respect to either market value of equity, dividend yield or financial leverage.

We will now describe the basic research design used to form the winner and loser portfolios and the statistical test procedures that determine which of the two competing hypotheses receives more support from the data.

A. Test Procedures: Details

Monthly return data for New York Stock Exchange (NYSE) common stocks, as compiled by the Center for Research in Security Prices (CRSP) of the University of Chicago, are used for the period between January 1926 and December 1982. An equally weighted arithmetic average rate of return on all CRSP listed securities serves as the market index.

1. For every stock j on the tape with at least 85 months of return data (months 1 through 85), without any missing values in between, and starting in January 1930 (month 49), the next 72 monthly residual returns u_{jt} (months 49 through 120) are estimated. If some or all of the raw return data beyond month 85 are missing, the residual returns are calculated up to that point. The procedure is repeated 16 times starting in January 1930, January 1933, . . . , up to January 1975. As time goes on and new securities appear on the tape, more and more stocks qualify for this step.
2. For every stock j, starting in December 1932 (month 84; the "portfolio formation date") ($t = 0$), we compute the cumulative excess returns $CU_j = \sum_{t=-35}^{t=0} u_{jt}$ for the prior 36 months (the "portfolio formation" period, months 49 through 84). The step is repeated 16 times for all nonoverlapping three-year periods between January 1930 and December 1977. On each of the 16 relevant portfolio formation dates (December 1932, December 1935, . . . , December 1977), the CU_j's are ranked from low to high and portfolios are formed. Firms in the top 35 stocks (or the top 50 stocks, or the top decile) are assigned to the winner portfolio W; firms in the bottom 35 stocks (or the bottom 50 stocks, or the bottom decile) to the loser portfolio L. Thus, the portfolios are formed conditional upon excess return behavior prior to $t = 0$, the portfolio formation date.
3. For both portfolios in each of 16 nonoverlapping three-year periods ($n =$

[3] We will come back to this bias in Section II.

$1, \ldots, N$; $N = 16$), starting in January 1933 (month 85, the "starting month") and up to December 1980, we now compute the cumulative average residual returns of all securities in the portfolio, for the next 36 months (the "test period," months 85 through 120), i.e., from $t = 1$ through $t = 36$. We find $CAR_{W,n,t}$ and $CAR_{L,n,t}$. If a security's return is missing in a month subsequent to portfolio formation, then, from that moment on, the stock is permanently dropped from the portfolio and the CAR is an average of the available residual returns. Thus, whenever a stock drops out, the calculations involve an implicit rebalancing.[4]

4. Using the CAR's from all 16 test periods, *average* CAR's are calculated for both portfolios and each month between $t = 1$ and $t = 36$. They are denoted $ACAR_{W,t}$ and $ACAR_{L,t}$. The overreaction hypothesis predicts that, for $t > 0$, $ACAR_{W,t} < 0$ and $ACAR_{L,t} > 0$, so that, by implication, $[ACAR_{L,t} - ACAR_{W,t}] > 0$. In order to assess whether, at any time t, there is indeed a statistically significant difference in investment performance, we need a pooled estimate of the population variance in CAR_t,

$$S_t^2 = [\textstyle\sum_{n=1}^{N}(CAR_{W,n,t} - ACAR_{W,t})^2 + \sum_{n=1}^{N}(CAR_{L,n,t} - ACAR_{L,t})^2]/2(N-1).$$

With two samples of equal size N, the variance of the difference of sample means equals $2S_t^2/N$ and the t-statistic is therefore

$$T_t = [ACAR_{L,t} - ACAR_{W,t}]/\sqrt{2S_t^2/N}.$$

Relevant t-statistics can be found for each of the 36 postformation months but they do not represent independent evidence.

5. In order to judge whether, for any month t, the average residual return makes a contribution to either $ACAR_{W,t}$ or $ACAR_{L,t}$, we can test whether it is significantly different from zero. The sample standard deviation of the winner portfolio is equal to

$$s_t = \sqrt{\textstyle\sum_{n=1}^{N}(AR_{W,n,t} - AR_{W,t})^2/N-1}.$$

Since $s_t/\sqrt{N}$ represents the sample estimate of the standard error of $AR_{W,t}$, the t-statistic equals

$$T_t = AR_{W,t}/(s_t/\sqrt{N}).$$

Similar procedures apply for the residuals of the loser portfolio.

B. Discussion

Several aspects of the research design deserve some further comment. The choice of the data base, the CRSP Monthly Return File, is in part justified by

[4] Since this study concentrates on companies that experience extraordinary returns, either positive or negative, there may be some concern that their attrition rate sufficiently deviates from the "normal" rate so as to cause a survivorship bias. However, this concern is unjustified. When a security is delisted, suspended or halted, CRSP determines whether or not it is possible to trade at the last listed price. If no trade is possible, CRSP tries to find a subsequent quote and uses it to compute a return for the last period. If no such quote is available because the stockholders receive nothing for their shares, the return is entered as minus one. If trading continues, the last return ends with the last listed price.

our concern to avoid certain measurement problems that have received much attention in the literature. Most of the problems arise with the use of daily data, both with respect to the risk and return variables. They include, among others, the "bid-ask" effect and the consequences of infrequent trading.

The requirement that 85 subsequent returns are available before any firm is allowed in the sample biases the selection towards large, established firms. But, if the effect under study can be shown to apply to them, the results are, if anything, more interesting. In particular, it counters the predictable critique that the overreaction effect may be mostly a small-firm phenomenon. For the experiment described in Section A, between 347 and 1,089 NYSE stocks participate in the various replications.

The decision to study the CAR's for a period of 36 months after the portfolio formation date reflects a compromise between statistical and economic considerations, namely, an adequate number of independent replications versus a time period long enough to study issues relevant to asset pricing theory. In addition, the three-year period is also of interest in light of Benjamin Graham's contention that "the interval required for a substantial underevaluation to correct itself averages approximately 1½ to 2½ years" [10, p. 37). However, for selected experiments, the portfolio formation (and testing) periods are one, two, and five years long. Clearly, the number of independent replications varies inversely with the length of the formation period.

Finally, the choice of December as the "portfolio formation month" (and, therefore, of January as the "starting month") is essentially arbitrary. In order to check whether the choice affects the results, some of the empirical tests use May as the portfolio formation month.

II. The Overreaction Hypothesis: Empirical Results

A. Main Findings

The results of the tests developed in Section I are found in Figure 1. They are consistent with the overreaction hypothesis. Over the last half-century, loser portfolios of 35 stocks outperform the market by, on average, 19.6%, thirty-six months after portfolio formation. Winner portfolios, on the other hand, earn about 5.0% less than the market, so that the difference in cumulative average residual between the extreme portfolios, $[ACAR_{L,36} - ACAR_{W,36}]$ equals 24.6% (t-statistic: 2.20). Figure 1 shows the movement of the ACAR's as we progress through the test period.

The findings have other notable aspects. First, the overreaction effect is asymmetric; it is much larger for losers than for winners. Secondly, consistent with previous work on the turn-of-the-year effect and seasonality, most of the excess returns are realized in January. In months $t = 1$, $t = 13$, and $t = 25$, the loser portfolio earns excess returns of, respectively, 8.1% (t-statistic: 3.21), 5.6% (3.07), and 4.0% (2.76). Finally, in surprising agreement with Benjamin Graham's claim, the overreaction phenomenon mostly occurs during the second and third year of the test period. Twelve months into the test period, the difference in performance between the extreme portfolios is a mere 5.4% (t-statistic: 0.77).

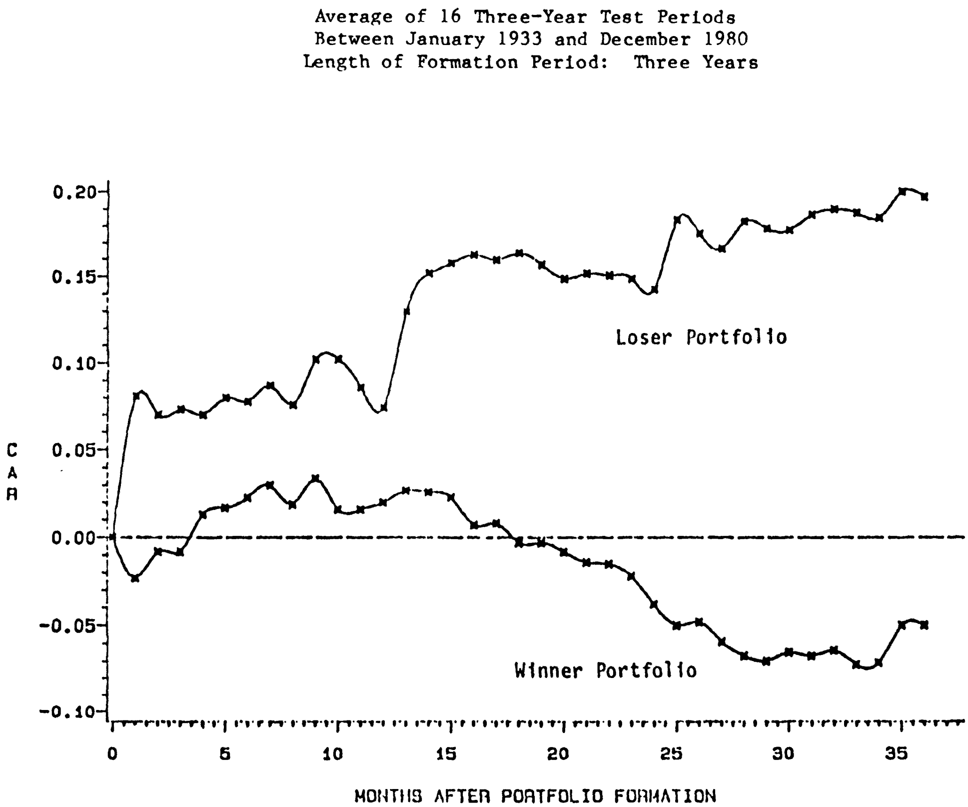

Figure 1. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1–36 months into the test period)

While not reported here, the results using market model and Sharpe-Lintner residuals are similar. They are also insensitive to the choice of December as the month of portfolio formation (see De Bondt [7]).

The overreaction hypothesis predicts that, as we focus on stocks that go through more (or less) extreme return experiences (during the formation period), the subsequent price reversals will be more (or less) pronounced. An easy way to generate more (less) extreme observations is to lengthen (shorten) the portfolio formation period; alternatively, for any given formation period (say, two years), we may compare the test period performance of less versus more extreme portfolios, e.g., decile portfolios (which contain an average 82 stocks) versus portfolios of 35 stocks. Table I confirms the prediction of the overreaction hypothesis. As the cumulative average residuals (during the formation period) for various sets of winner and loser portfolios grow larger, so do the subsequent price reversals, measured by $[ACAR_{L,t} - ACAR_{W,t}]$ and the accompanying t-statistics. For a formation period as short as one year, no reversal is observed at all.

Table I and Figure 2 further indicate that the overreaction phenomenon is qualitatively different from the January effect and, more generally, from season-

Table I

Differences in Cumulative Average (Market-Adjusted) Residual Returns Between the Winner and Loser Portfolios at the End of the Formation Period, and 1, 12, 13, 18, 24, 25, 36, and 60 Months into the Test Period

Portfolio Selection Procedures: Length of the Formation Period and No. of Independent Replications	Average No. of Stocks	CAR at the End of the Formation Period: Winner Portfolio	CAR at the End of the Formation Period: Loser Portfolio	Difference in CAR (t-Statistics), Months After Portfolio Formation: 1	12	13	18	24	25	36	60
10 five-year periods	50	1.463	−1.194	0.070 (3.13)	0.156 (2.04)	0.248 (3.14)	0.256 (3.17)	0.196 (2.15)	0.228 (2.40)	0.230 (2.07)	0.319 (3.28)
16 three-year periods	35	1.375	−1.064	0.105 (3.29)	0.054 (0.77)	0.103 (1.18)	0.167 (1.51)	0.181 (1.71)	0.234 (2.19)	0.246 (2.20)	NA*
24 two-year periods[a]	35	1.130	−0.857	0.062 (2.91)	−0.006 (−0.16)	0.074 (1.53)	0.136 (2.02)	0.101 (1.41)	NA	NA	NA
25 two-year periods[b]	35	1.119	−0.866	0.089 (3.98)	0.011 (0.19)	0.092 (1.48)	0.107 (1.47)	0.115 (1.55)	NA	NA	NA
24 two-year periods[a] (deciles)	82	0.875	−0.711	0.051 (3.13)	0.006 (0.19)	0.066 (1.71)	0.105 (1.99)	0.083 (1.49)	NA	NA	NA
25 two-year periods[b] (deciles)	82	0.868	−0.714	0.068 (3.86)	0.008 (0.19)	0.071 (1.46)	0.078 (1.41)	0.072 (1.29)	NA	NA	NA
49 one-year periods	35	0.774	−0.585	0.042 (2.45)	−0.076 (−2.32)	−0.006 (−0.15)	0.007 (0.14)	−0.005 (−0.09)	NA	NA	NA

[a] The formation month for these portfolios is the month of December in all uneven years between 1933 and 1979.
[b] The formation month for these portfolios is the month of December in all even years between 1932 and 1980.
* NA, not applicable.

ality in stock prices. Throughout the test period, the difference in ACAR for the experiment with a three-year formation period (the upper curve) exceeds the same statistic for the experiments based on two- and one-year formation periods (middle and lower curves). But all three experiments are clearly affected by the same underlying seasonal pattern.

In Section I, it was mentioned that the use of market-adjusted excess returns is likely to bias the research design against the overreaction hypothesis. The bias can be seen by comparing the CAPM-betas of the extreme portfolios. For all the experiments listed in Table I, the average betas of the securities in the winner portfolios are significantly larger than the betas of the loser portfolios.[5] For example, for the three-year experiment illustrated in Figure 1, the relevant numbers are respectively, 1.369 and 1.026 (t-statistic on the difference: 3.09). Thus, the loser portfolios not only outperform the winner portfolios; if the CAPM is correct, they are also significantly less risky. From a different viewpoint, therefore, the results in Table I are likely to *underestimate* both the true magnitude and statistical significance of the overreaction effect. The problem is particularly severe with respect to the winner portfolio. Rather than 1.369, the residual return calculations assume the CAPM-beta of that portfolio to equal

[5] The CAPM-betas are found by estimating the market model over a period of 60 months prior to portfolio formation.

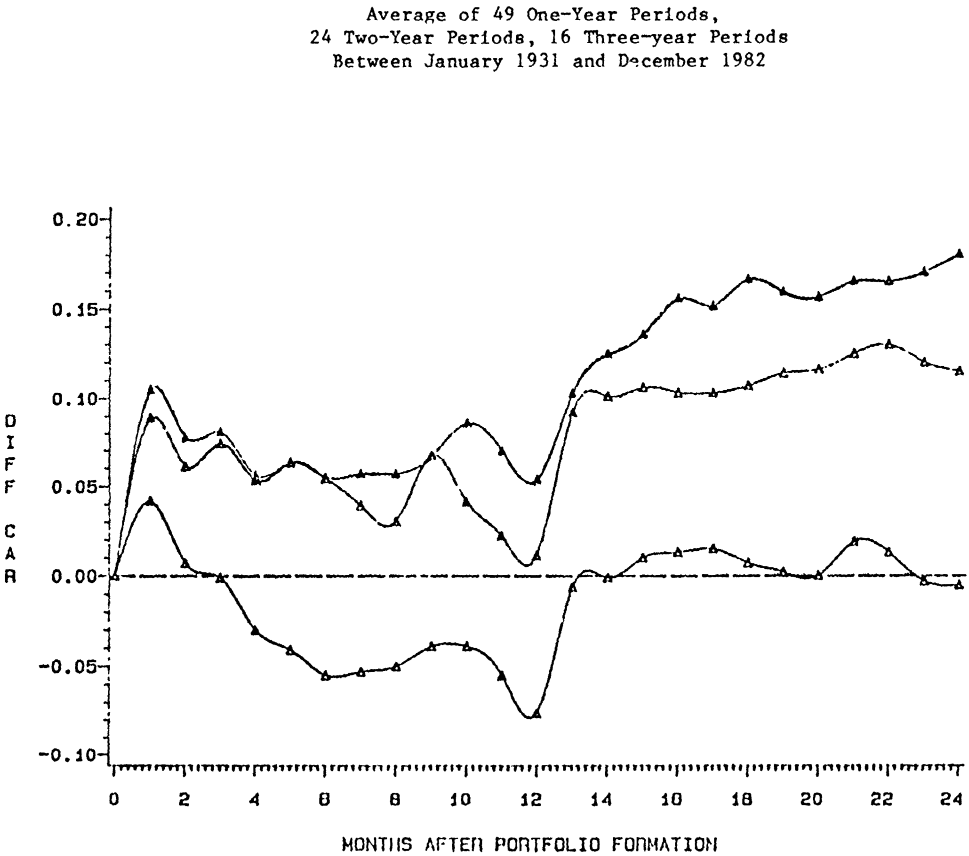

Figure 2. Differences in Cumulative Average Residual Between Winner and Loser Portfolios of 35 Stocks (formed over the previous one, two, or three years; 1–24 months into the test period)

1.00 only. This systematic bias may be responsible for the earlier observed asymmetry in the return behavior of the extreme portfolios.

To reiterate, the previous findings are broadly consistent with the predictions of the overreaction hypothesis. However, several aspects of the results remain without adequate explanation. Most importantly, the extraordinarily large positive excess returns earned by the loser portfolio in January.

One method that allows us to further accentuate the strength of the January effect is to increase the number of replications. Figure 3 shows the ACAR's for an experiment with a five-year-long test period. Every December between 1932 and 1977, winner and loser portfolios are formed on the basis of residual return behavior over the previous five years. Clearly, the successive 46 yearly selections are not independent. Therefore, no statistical tests are performed. The results in Figure 3 have some of the properties of a "trading rule." They represent the average (cumulative) excess return (before transaction costs) that an investor, aware of the overreaction phenomenon, could expect to earn following any

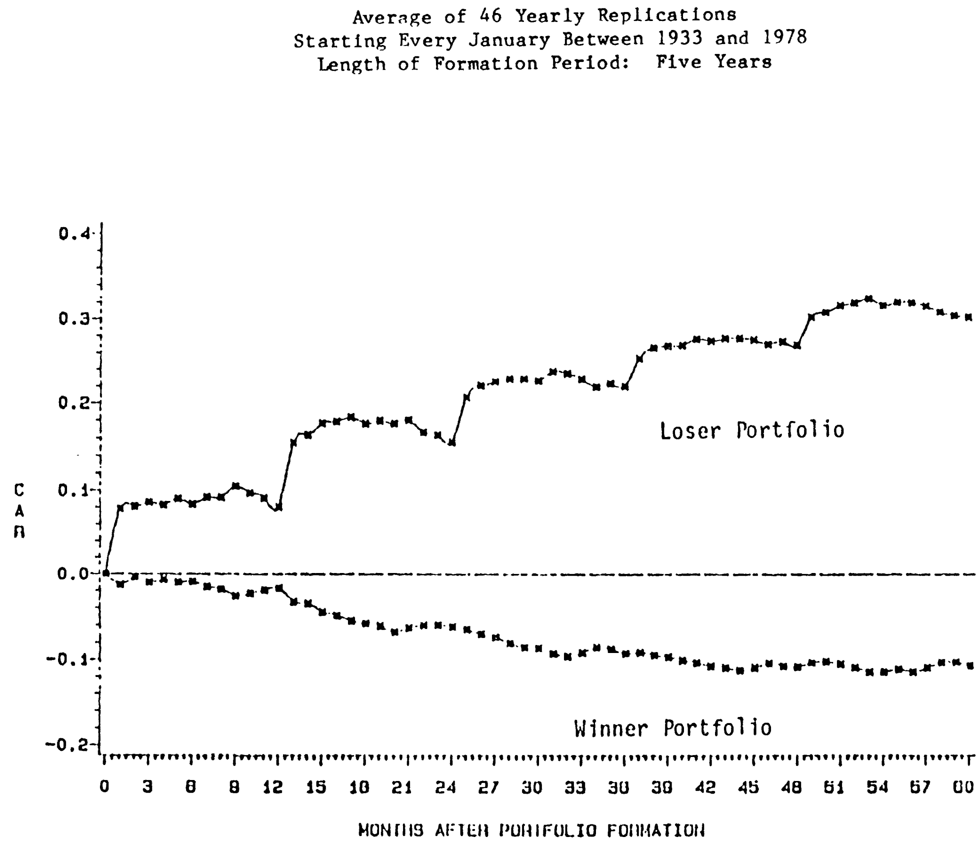

Figure 3. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1–60 months into the test period)

December in which he chose to try the strategy. The effect of multiplying the number of replications is to remove part of the random noise.

The outstanding feature of Figure 3 is, once again, the January returns on the loser portfolio. The effect is observed as late as five Januaries after portfolio formation! Careful examination of Figure 3 also reveals a tendency, on the part of the loser portfolio, to decline in value (relative to the market) between October and December. This observation is in agreement with the naive version of the tax-loss selling hypothesis as explained by, e.g., Schwert [25]. The winner portfolio, on the other hand, gains value at the end of the year and loses some in January (for more details, see De Bondt [7]).

B. Implications for Other Empirical Work

The results of this study have interesting implications for previous work on the small firm effect, the January effect and the dividend yield and P/E effects. Blume and Stambaugh [6], Keim [16], and Reinganum [21] have studied the interaction between the small firm and January effects. Their findings largely redefine the small firm effect as a "losing firm" effect around the turn-of-the-year.[6] Our own results lend further credence to this view. Persistently, losers earn exceptionally large January returns while winners do not. However, the companies in the extreme portfolios do not systematically differ with respect to market capitalization.

The January phenomenon is usually explained by tax-loss selling (see, e.g., Roll [23]). Our own findings raise new questions with respect to this hypothesis. First, if in early January selling pressure disappears and prices "rebound" to equilibrium levels, why does the loser portfolio—even while it outperforms the market—"rebound" once again in the second January of the test period? And again, in the third and fourth Januaries? Secondly, if prices "rebound" in January, why is that effect so much larger in magnitude than the selling pressure that "caused" it during the final months of the previous year? Possible answers to these questions include the argument that investors may wait for years before realizing losses, and the observed seasonality of the market as a whole.

With respect to the P/E effect, our results support the price-ratio hypothesis discussed in the introduction, i.e., high P/E stocks are "overvalued" whereas low P/E stocks are "undervalued." However, this argument implies that the P/E effect is also, for the most part, a January phenomenon. At present, there is no evidence to support that claim, except for the persistent positive relationship between dividend yield (a variable that is correlated with the P/E ratio) and January excess returns (Keim [15]).

III. Conclusions

Research in experimental psychology has suggested that, in violation of Bayes' rule, most people "overreact" to unexpected and dramatic news events. The question then arises whether such behavior matters at the market level.

Consistent with the predictions of the overreaction hypothesis, portfolios of prior "losers" are found to outperform prior "winners." Thirty-six months after portfolio formation, the losing stocks have earned about 25% more than the winners, even though the latter are significantly more risky.

Several aspects of the results remain without adequate explanation; most importantly, the large positive excess returns earned by the loser portfolio every January. Much to our surprise, the effect is observed as late as five years after portfolio formation.

[6] Even after purging the data of tax-loss selling effects, Reinganum [22] finds a (considerably smaller) January seasonal effect related to company size. This result may be due to his particular definition of the tax-loss selling measure. The measure is related to the securities' relative price movements over the last *six months* prior to portfolio formation only. Thus, if many investors choose to wait longer than six months before realizing losses, the portfolio of small firms may still contain many "losers."

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