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ABSTRACT: A common finding in the literature is that systematic post-announcement drifts in security returns are associated with the sign or magnitude of unexpected earnings changes. This paper examines proposed explanations for these drifts. The paper also documents that the systematic drifts in security returns are found for only a subset of earnings expectations models. For a class of expectations models based on the time series of reported quarterly earnings, variables coding (1) the sign and magnitude of the earnings forecast error and (2) firm size independently explain 81 percent and 61 percent, respectively, of the variation in post-announcement drifts. The joint explanatory power of (1) and (2) is 85 percent, indicating that the effect of these two variables is highly collinear. The drifts are a persistent phenomenon over the 1974 to 1981 period with no evidence of being concentrated in a specific subperiod. The properties of expectations models based on the time series of earnings are contrasted with earnings expectations models based on security returns. The latter exhibit no evidence of systematic post-announcement drift behavior. The expectations models based on security returns have the appealing property that the assignment of firms to unexpected earnings change portfolios better approximates the independence-over-time assumption. This property means that these models are less vulnerable to the "proxy effect" criticism that has been made of results previously reported in the literature. The results in this paper are based on a sample of over 56,000 observations covering the 1974 to 1981 time period.

1. INTRODUCTION

THE literature on market efficiency anomalies is both large in size and broad-based in terms of the topic areas covered.[1] One frequently cited anomaly relates to the behavior of security returns subsequent to earnings announcements by firms. Many studies have reported evidence that the sign and magnitude of security returns in the *post*-earnings announcement period are positively correlated with the sign and magnitude of the unexpected component of the earnings release. This finding is consistent with the speed of adjustment to information contained in earnings releases being gradual rather than instantaneous. Section 2 of this paper discusses the existing literature and competing explanations proposed for the

[1] Foster [1984] classifies evidence viewed as anomalous with respect to market efficiency into four cate-

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post-announcement security return behavior. The research design facilitates the probing of at least four explanations—the misspecified asset pricing model explanation, the use of hindsight information explanation, the time-period explanation, and the information market explanation. Details of sample selection, expectations models, and residual estimation/significance testing appear in Sections 3, 4, and 5, respectively. Results examining the post-announcement drifts in security returns and explanations for those drifts are presented in Sections 6 and 7. These results are based on a sample of over 56,000 observations covering the 1974 to 1981 period. Summary comments on the findings and unresolved issues are made in Section 8.

The results reported in this paper are of interest in several areas. One area is the numerous information content studies on interim and annual earnings announcements, dividend announcements, acquisition and divestiture announcements, etc. These studies typically assume market efficiency and focus on short time periods surrounding the chosen announcement to measure its information content. A similar assumption appears in the many studies on the capital market effect of FASB and SEC accounting regulations. Results discussed in Section 2 are inconsistent with this market efficiency assumption and thus raise the possibility that some inferences drawn in prior information content and accounting regulation studies are incorrect. The results are also of interest to the investment community. Studies which conclude that systematic post-announcement drifts in security returns imply market inefficiencies have stressed this rationale for the research; e.g., Latane, Jones and Rieke [1974, p. 130] conclude that their results "evidence the potential value of quarterly data in selecting investment alternatives." The Value Line security ranking system includes a "quarterly earnings momentum" factor and an "earnings surprise" factor to exploit the post-announcement security return results reported in the literature.[2] The results in this paper provide insight into some of the factors that may explain the security return differences Eisenstadt [1980] reports for stocks differentially coded in the Value Line ranking system.

The most important result reported in this paper is that systematic post-announcement drifts in security returns are found for only a subset of the earnings expectations models examined. For two expectations models based on the past quarterly earnings series, post-announcement drifts are found over the 1974 to 1981 period. However, for two expectations models based on the security return series, post-announcement drifts are not found. The latter expectations models have the appealing property that they are less vulnerable to the "proxy effect" criticism that has been made of results previously reported in the literature.

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gories: (a) evidence on the speed of adjustment of prices to information releases, (b) evidence on price adjustments associated with releases by information intermediaries, (c) evidence on pricing anomalies assuming complete and perfect markets, and (d) evidence relating to the behavior of the aggregate market over time.

[2] Eisenstadt [1980, pp. 3, 4] describes these two factors as follows:

- "*Quarterly Earnings Momentum* . . . . each stock's quarterly earnings change from the same quarter in the preceding year is graded as to whether the change is above average, average, or below. . . .
- *An Earnings Surprise Factor* . . . . takes into account the deviation between an analyst's earnings estimate for a particular quarter and the actual earnings report. Studies have indicated that where earnings surprises occur, sharp price movements tend to follow in the direction of the surprise."

2. Overview of Existing Literature

2.1 *Research Results Reported in Literature*

Research that documents post-earnings announcement drifts in security returns has been published in many studies. Two review papers—Ball [1978] and Joy and Jones [1979]—summarize at least eight studies reporting post-announcement drifts for unexpected good news or unexpected bad news observations. Several studies published subsequent to these review papers, using more refined methods and larger samples, have also reported similar results—e.g., Latane and Jones [1979], Bidwell and Riddle [1981], and Rendleman, Jones and Latane [1982]. The last cited study examined quarterly earnings announcements over the 1971–1980 period. Using a standardized unexpected earnings (SUE) measure, each observation was placed into one of ten SUE categories (category 1 = most negative . . . category 10 = most positive). Summary results from Table 4 of this study are:

Standardized Unexpected Earnings Category	*Cumulative Average Residual [Days −20 to −1]*	*Average Residual [Day 0]*	*Cumulative Average Residual [Days 1 to 90]*	*Average Beta*
1 (Most Negative)	−8.7	−1.4	−4.0	1.02
2	−7.3	−1.0	−3.2	1.00
3	−5.6	−0.7	−3.3	0.97
4	−3.6	−0.2	−1.8	1.00
5	−1.1	0.1	−0.8	1.03
6	1.2	0.3	0.5	1.03
7	2.8	0.6	1.2	1.01
8	3.9	0.8	1.6	1.02
9	6.9	1.3	3.4	1.02
10 (Most Positive)	8.0	1.3	4.3	1.02

The authors concluded that their "results are remarkably consistent in suggesting that the market does not assimilate unexpectedly favorable or unfavorable quarterly earnings information by the day of earnings announcement" (p. 283).

A smaller set of studies has reported evidence of less significant or insignificant systematic drift behavior. Watts [1978] examined a sample of 73 firms over the 1962 to 1968 period and reported that "abnormal returns" were found in "the 1962–1965 period but not in the 1965–1968 period" (p. 148). Moreover, he argued that the "inefficiency [in the 1962–1965 period] is not substantial. Only those who can avoid some of the direct transaction costs can make abnormal returns after quarterly earnings announcements" (p. 146). Reinganum [1981] examined 566 firms over the 1975–1977 period and reported that " 'abnormal' returns cannot be earned over the period studied by constructing portfolios on the basis of firms' standardized unexpected earnings" (p. 24).

2.2 *Competing Explanations for Systematic Drifts*

The set of explanations offered for the post-earnings announcement anomalies reported in many studies can be classified into (a) capital market inefficiency explanations, and (b) noncapital market inefficiency explanations.

A. *Capital Market Inefficiency Explanations.* The most frequently referenced explanation for the reported systematic drifts is market inefficiency. For instance, Brown [1978, p. 27] concludes his study thus:

> The most important results of this study are the findings relative to market efficiency. The excess returns from purchasing the qualifying securities at the time of publication of the EPS number substantially exceed transaction costs. The adjustment process, rather than being instantaneous, is lengthy (about 45 market days). Thus, with respect to this particular sample of securities, the market exhibited inefficiencies.

In a review of much of this literature, Joy and Jones [1979, p. 51] conclude "that, at least with respect to quarterly earnings announcements there have been marked inefficiencies."

The notion of market efficiency implicit in the anomalies literature appears to preclude a trading strategy yielding "abnormal returns" if it is based only on publicly available information. Following Fama [1976], let ϕ_t^A be the information set available to the capital market at time t and ϕ_t^M be the information set used by the market at time t in setting equilibrium prices. If the capital market is efficient with respect to ϕ_t^A, then equilibrium prices will be set "as if"

$$\phi_t^A = \phi_t^M . \qquad (1)$$

Tests of (1) typically have used the two-parameter model of Sharpe [1964] to give content to what is an "abnormal return":

$$E(\tilde{R}_{it}) = R_{ft} + \beta_i(E(\tilde{R}_{Mt}) - R_{ft}), \qquad (2)$$

where

R_{it} = return on ith security in period t,
R_{Mt} = return on the market portfolio in period t,
R_{ft} = return on a riskless asset in period t, and
β_{it} = the relative (systematic) risk of firm i in period t.

Market efficiency implies that:

$$f(\tilde{R}_{it}|\beta_{it}, E(\tilde{R}_{Mt}), R_{ft}, \phi_t^A) = f(\tilde{R}_{it}|\beta_{it}, E(\tilde{R}_{Mt}), R_{ft}, \phi_t^M), \qquad (3)$$

where $f(\quad)$ is a distribution function. Let

$$\tilde{u}_{i,t} = [\tilde{R}_{it}|\phi_t^M] - [E(\tilde{R}_{it})|\beta_{it}, \tilde{R}_{Mt}, R_{ft}, \phi_t^A]. \qquad (4)$$

Assume zero information processing costs for data in ϕ_t^A and unbiased estimates of β_{it}, $\tilde{R}_{Mt}$ and R_{ft}. An implication of (1) and (2) is that $\tilde{u}_{i,t}$ in (4) should not behave in a systematic way that is related to an information cue that is already in ϕ_t^A.

Direct empirical tests of the above market efficiency notion do not appear possible; the left-hand side of (3) is an unobservable. Empirical tests concentrate on the descriptive validity of implications of the market efficiency notion. Assumptions typically made in these tests include:

(i) that the two-parameter asset pricing model in (2)—CAPM—is descriptively valid,
(ii) that unbiased estimates of $E(\tilde{R}_{it})$, β_{it}, $E(\tilde{R}_{Mt})$ and R_{ft} are used in the test,
(iii) that the specific information cue is part of ϕ_t^A, and
(iv) that the processing costs of using the information are zero.

Note that if one or more of these assumptions does not hold, conclusions drawn about market inefficiencies can be premature.

B. *Non-Capital Market Inefficiency Explanations.* This section outlines non-market inefficiency explanations for the systematic post-announcement drifts.

(i) *CAPM—An Inadequate Model of Asset Pricing.* This explanation asserts that some model other than the two-parameter model is descriptively valid. Ball [1978] summarizes the argument thus:

> The hypothesis is that: (i) the two-parameter model, when applied to a portfolio of common stocks, misspecifies the process generating securities' yields in equilibrium; and (ii) earnings and dividend variables proxy for the underlying determinants of equilibrium yields. The implication is that the estimated post-announcement excess returns result from earnings and dividends proxying for omitted variables or other misspecification effects (p. 111).

Using a multi-factor model approach, Sharpe [1982] presents results that "call into question naive applications in which expected returns are assumed to be related only to estimates of future betas based on past patterns of returns" (p. 18). Factors reported to be significant by Sharpe include the alpha and beta from a market model regression of R_{it} against R_{Mt}, β_{it}, dividend yield, firm size, and a bond beta from a regression of R_{it} against a long-term government bond index. Several other papers also report results consistent with firm size being (or proxying for) an omitted variable in the CAPM—see Banz [1981], Reinganum [1981] and Keim [1983]. This paper examines the ability of the firm size variable to explain the post-earnings announcement drifts in security returns.

In addition to examining firm size as an omitted variable, the paper analyzes the "proxy" argument of Ball [1978], i.e., that the variables used to classify firms into earnings change categories proxy for variables omitted in the CAPM but priced by the capital market. Proxy effects are more likely with earnings expectations models that exhibit period by period dependencies in their classification of firms to earnings change categories. To illustrate, suppose a study examined the earnings releases of one large firm and one small firm over 20 quarters and ranked the two firms each quarter into a high and low earnings category. Pooling the 40 observations, 20 observations will be in the high earnings category and 20 will be in the low earnings category. Inferences about the market reaction to the two earnings classifications will be most reliable if the classification on earnings is independent of firm size. Under independence, both earnings categories would include approximately ten large-firm and ten small-firm observations randomly drawn from the 20 quarters. If, however, the earnings-change classification perfectly proxies for the firm-size classification, the high/low earnings category each would include all observations of the one firm-size category. In this context, the experiment cannot discriminate between firm size or earnings classification being the causal variable in a capital market reaction study. Section 4 of this paper reports data on period by period dependencies in the assignment of firms to earnings change categories for each of the expectations models used in the research.

(ii) *Biased Estimates of Parameters of Adopted Asset Pricing Model.* To illustrate this explanation, assume the CAPM is a descriptively valid model. To employ the CAPM in empirical research, estimates of β_{it}, R_{ft} and R_{Mt} are required. Let $\tilde{u}^T_{i,t}$ be the "true" abnormal return and $\tilde{u}^E_{i,t}$ be the "estimated" abnormal return. This explanation posits that

$$E(\tilde{u}^T_{i,t}|\phi^M_t)=E(\tilde{u}^T_{i,t}|\phi^A_t)=0 \qquad (5)$$

in the post-announcement period, but that $\tilde{u}^E_{i,t}$ behaves in a systematic way due to estimation errors in β_{it}, R_{ft} or R_{Mt}. Given that many prior studies report positive $\tilde{u}^E_{i,t}$ for positive unexpected earnings changes and negative $\tilde{u}^E_{i,t}$ for negative unexpected earnings changes, the precise form that the estimation error would have to take would depend on the sign of the unexpected earnings change and the sign of $(\tilde{R}_{Mt}-R_{ft})$.[3]

Rendleman, Jones and Latane [1982] examine the importance of relative risk adjustments and conclude that "the typical SUE (standardized unexpected earnings) portfolio has a beta of approximately 1.0, and that risk adjustment procedures are not the critical issue here. One must look elsewhere for an explanation of these results" (p. 287). In Sections 6 and 7 of this paper abnormal returns are estimated via a companion portfolio technique that controls for beta (and other) differences across portfolios with different market capitalization characteristics.

iii) *Use of Hindsight Information in the Experiment.* One assumption made when testing market efficiency with respect to a specific information item is that the information is available to the market at the time it is used to classify securities differentially. In several studies, information appears to have been assumed available before it is publicly released; e.g., Jones and Litzenberger [1970] assume all interim releases to be available to the market within two months subsequent to the end of the fiscal quarter. This assumption is correct for many but not all firms—see Foster [1981, Table 2]. The effect of this violation of a "predictive experiment" design is to include as part of the post-announcement returns the announcement month effect of those firms releasing their interim report after the two-month post-fiscal year-end period. Typically this will result in the post-announcement returns for positive (negative) earnings change groups being overstated (understated). The research in this paper uses actual earnings announcement dates (as reported by Standard and Poor's) in an attempt to avoid this problem.

Another example of the use of hindsight information is in the Watts [1978] study. The 1962 to 1968 period first was used to choose the "best" time-series model to employ in the research. Then the same 1962 to 1968 period was used to examine the post-announcement drifts associated with the unexpected earnings increase and decrease classifications from the "best" time-series model. The research in this paper employs time-series models that are estimated using only data available at the time the earnings increase/decrease classifications are made.

A third example of the use of hindsight information is the classification of firms into portfolios based on information not available at the time a trading strategy is implemented. For example, a trading strategy based on the rank of each firm's earnings change is not implementable until the last firm in the sample has announced its earnings. A related problem is when observations are placed into portfolios each quarter and the mean aggregate results based on the mean of the individual quarter's (mean) results; this implicitly "assumes that the trader knows the distribution of standardized forecast errors at the time of the first earnings announcement in each calendar quarter" [Holthausen, 1983, p. 41]. Holthausen notes that the trading strategies in Watts [1978] and Rendleman, Jones and Latane [1982] suffer from this experimental defect. He reports that use of a ranking scheme based on publicly released information results in "the association between post earnings

[3] To illustrate, consider markets in which $(\tilde{R}_{Mt}-R_{ft})<0$. To explain the results in Rendleman, Jones and Latane [1982] would require β_{it} to be over-estimated for firms with positive SUE, but under-estimated for firms with negative SUE. In contrast, in markets in which $(\tilde{R}_{Mt}-R_{ft})>0$, β_{it} would have to be under-estimated for firms with positive SUE but over-estimated for firms with negative SUE.

announcement abnormal performance and the size of forecast errors [being] much weaker than those reported by Rendleman, Jones and Latane [1982]" (p. 56). The research in this paper uses cut-off points based on a ranking of the *previous* quarter's earnings forecast errors to assign firms into one of ten forecast error portfolios, and all observations in a given portfolio are weighted equally.[4]

A fourth example of the use of hindsight information is the survivorship bias encountered when the Compustat data base is employed. For instance, the 1982 Compustat quarterly tape includes the most recent 40 quarters of data for firms surviving in 1982. Firms that were publicly listed in 1973 but were delisted prior to 1982 are excluded from the 1982 tape. The effect of these exclusions is difficult to predict; e.g., the exclusion of bankrupt firms may impart an upward bias to the sample security returns whereas the exclusion of acquired firms may have the opposite effect. In the initial stage of this research project, a sample of 79 companies publicly listed in 1962 was selected. Earnings announcement dates for these firms over the 1963 to 1977 period were hand-collected. Of the 79 companies available in 1962, 55 were surviving in 1978. Results for the sample of 79 companies vis-a-vis the sample of 55 surviving companies were very similar, e.g., a policy of investing long in firms with actual earnings $>1.6*$ expected earnings and short in firms with actual earnings $<.6*$ expected earnings yielded a six-month post-announcement CAR of 2.02 percent for the 55 survived-firm sample vis-a-vis 2.10 percent for the 79-firm sample. The conclusion drawn was that survivorship was not an important explanation for the systematic post-announcement CAR drifts.[5] Subsequent to the collection of data for the above noted 79 companies, we became aware that the Compustat quarterly tape includes earnings announcement dates as well as reported earnings data. The results reported in this paper are for the 1982 Compustat sample. This sample choice is based both on (a) the above noted results on the minimal effect of survivorship bias and (b) the sizeable increase in sample size available with the Compustat tape.

(iv) *Time-Period Phenomenon*. This explanation has two variants. The first variant hypothesizes that the underlying process is one for which

$$E(\tilde{u}_{i,t}|\phi_t^A)=0 \tag{6}$$

but that the time period examined is one in which the realizations of $\tilde{u}_{i,t}$ appear inconsistent with (6); this possibility exists especially when short time periods are examined. Beaver and Landsman [1981] illustrate how a process consistent with (6) holding over the 46-year period from 1932 to 1977 can show apparent systematic drifts in $\tilde{u}_{it}$ for (say) two- or three-year subperiods.

The second variant of this explanation is that in an early subperiod examined,

$$E(\tilde{u}_{i,t}|\phi_t^A)\neq 0, \tag{7}$$

but that in a later subperiod learning occurs such that (6) holds. Watts [1978, p. 146] puts forward this argument in a study examining the 1962 to 1968 period:

> The observation of abnormal returns in the 1962–1965 period but not in the 1965–1968 period raises several possibilities. One is that the 1962–1965 abnormal returns are observed by chance. . . . [Another possibility is] that the

[4] We are indebted to an anonymous reviewer of this paper and R. Holthausen for pointing out this class of experimental problems.

[5] Survivorship was also reported not to be an important factor in drawing inferences about the time series properties of reported earnings—see Ball and Watts [1979].

market was inefficient in the 1962–1965 period but learned over time. Discrimination among these alternative explanations requires estimation of abnormal returns outside the 1962–1968 period.

Results reported in Sections 6 and 7 of this paper are for the first quarter of 1974 to the fourth quarter of 1981 period. Results will be presented for all 32 quarters pooled as well as a breakdown of results on a subperiod basis. This relatively long time period was chosen to address better both variants of the time period explanation for the systematic post-announcement drifts in security returns.

(v) *Capital Market Efficient but Anomalies due to Attributes of Other Markets.* This explanation posits that the market for information could explain the pattern of post-announcement drifts—see Gonedes [1976]. The explanation has been offered only in a very general way, with no specific reference to earnings announcement-based anomalies. *A priori*, the costs of processing information about the magnitude of unexpected earnings changes appear minimal. Moreover, there are no obvious barriers to the entry of individual market participants employing the ranking procedures used in this and prior papers.

One variant of the information market explanation posits a link between the size of a company and the efficiency with which that stock is priced. For instance, the following comment was made in a brochure circulated by Equity Research Associates [undated], an investment company that focuses on so-called "junior companies":

> The larger and more visible a company, the more "perfect" its market is likely to be—"perfect" meaning that most of the likely factors affecting the price of its securities are presumably known to the market. Conversely, the smaller a company is, the less visible it is to the investing public and the more "imperfect" the market price for its shares is likely to be.

As applied to the post-earnings announcement drift anomaly, this argument would imply larger systematic drifts for smaller firms than for larger firms. In Section 7 of this paper, results are presented for different size partitions to probe this argument.

3. Sample Selection

The 1982 Compustat tape, covering 2,454 companies, was the initial data base examined. The first screen, requiring each company to have at least ten consecutive earnings observations, reduced the sample to 2,213 companies. The second screen required each company to have data on the CRSP daily tape. This further reduced the sample to 2,053 companies. Early versions of the quarterly Compustat tape were then used to build for each company (if available) a quarterly earnings file covering the second quarter of 1970 to the fourth quarter of the 1981 period.

The cumulative abnormal return (CAR) results reported in this paper cover the 1974 to 1981 period. The pre-1974 period is used in estimating univariate time-series models. In any one quarter, fewer than the maximum of 2,053 companies are available. Some observations are lost due to the Compustat tape not having a complete set of earnings announcement dates for each company. Other observations are lost for firms which were not publicly listed over the entire 1974–1981 period. The minimum number of observations in any one quarter is 1,495 while the maximum number is 1,978.

4. Models Used to Estimate Unexpected Earnings

Results will be presented for four

models of estimating unexpected earnings. Models 1 and 2 use quarterly earnings forecasts from the following univariate time-series model:

$$E(Q_{i,t}) = Q_{i,t-4} + \phi_i(Q_{i,t-1} - Q_{i,t-5}) + \delta_i \quad (8)$$

where $Q_{i,t}$ = quarterly earnings of the ith firm in period t. The ϕ_i and δ_i parameters are estimated using the most recent twenty quarters of data.[6]

Model 1

$$\mathrm{FE}_i^1 = \frac{Q_{i,t} - E(Q_{i,t})}{|Q_{i,t}|} \quad (9)$$

Model 2

$$\mathrm{FE}_i^2 = \frac{Q_{i,t} - E(Q_{i,t})}{\sigma[Q_{i,t} - E(Q_{i,t})]} \quad (10)$$

where FE_i = forecast error for firm i. Model 1 uses the absolute value of the series as the deflator while Model 2 uses the standard deviation of the forecast error.[7] The following time-series model was also examined in this research with no substantive change in the results reported in this paper for Models 1 and 2 using (8):

$$E(Q_{i,t}) = Q_{i,t-4} + \delta_i. \quad (11)$$

Foster [1977] also found that using a market association criterion, there was little difference between the results of (8) and (11).

Models 3 and 4 use security returns as the basis for estimating unexpected earnings. Model 3 focuses on the short-run market reaction to the earnings announcement:

Model 3

$$\mathrm{FE}_i^3 = \frac{\sum_{t=-1}^{0} \tilde{u}_{i,t}}{\sigma(\tilde{u}_{i,t})} \quad (12)$$

where

$\sum_{t=-1}^{0} \tilde{u}_{i,t}$ = the cumulative two-day abnormal return in the day preceding and the day of the earnings announcement, and

$\sigma(\tilde{u}_{i,t})$ = the standard deviation of $\tilde{u}_{i,t}$ in the 250-trading-day period prior to the $[-1, 0]$ event time period being examined.

Model 4 focuses on a longer time frame to capture an anticipation period when some of the information embedded in the earnings release is impounded in security prices:

Model 4

$$\mathrm{FE}_i^4 = \frac{\left(\sum_{t=-60}^{0} \tilde{u}_{i,t}\right)/61}{\sigma(\tilde{u}_{i,t})} \quad (13)$$

where

$\sum_{t=-60}^{0} \tilde{u}_{i,t}$ = the cumulative abnormal return in the 61-trading-day period up to and including the day of the earnings announcement, and

$\sigma(\tilde{u}_{i,t})$ = the standard deviation of $\tilde{u}_{i,t}$ in the 250-trading-day period prior to the $[-60, 0]$ event time period being examined.

Details of abnormal return estimation are provided in the next section of this paper. One motivation for using Models 3 and 4 is prior research documenting the broad information set impounded in security

[6] For the first five quarters of the 1974–1981 period, 15, 16, 17, 18, and 19 observations, respectively, are used to estimate ϕ_i and δ_i. The remaining 27 quarters use the most recent 20 quarters of data to estimate ϕ_i and δ_i. See Foster [1977] for further description of this model.

[7] Only forecast errors observed prior to the quarter examined are used to estimate the standard deviation of the forecast error. The maximum number of observations used to compute the standard deviation is 20.

TABLE 1

UNCONDITIONAL AND CONDITIONAL RELATIVE FREQUENCIES FOR MEMBERSHIP OF FORECAST ERROR PORTFOLIOS[a]

Forecast Error Portfolio	$\phi(\mathrm{FEP}_t)$	$\phi(\mathrm{FEP}_t \mid \mathrm{FEP}_{t-1})$	$\phi(\mathrm{FEP}_t \mid \mathrm{FEP}_{t-2})$	$\phi(\mathrm{FEP}_t \mid \mathrm{FEP}_{t-3})$	$\phi(\mathrm{FEP}_t \mid \mathrm{FEP}_{t-4})$
A. Model 1[b]					
1	.101	.334	.245	.202	.109
2	.101	.192	.159	.134	.099
3	.100	.171	.146	.126	.099
4	.101	.189	.162	.140	.134
5	.096	.193	.171	.159	.166
6	.099	.197	.173	.163	.165
7	.100	.189	.152	.141	.132
8	.100	.192	.151	.124	.106
9	.101	.228	.166	.151	.101
10	.101	.372	.297	.266	.166
B. Model 2[c]					
1	.101	.270	.197	.149	.075
2	.098	.176	.143	.130	.096
3	.101	.147	.134	.115	.111
4	.102	.172	.153	.143	.151
5	.100	.155	.133	.130	.141
6	.098	.135	.114	.110	.114
7	.098	.133	.112	.101	.102
8	.099	.146	.124	.116	.098
9	.101	.186	.151	.129	.122
10	.103	.322	.248	.220	.197
C. Model 3[d]					
1	.100	.116	.106	.108	.116
2	.099	.102	.096	.099	.109
3	.100	.096	.097	.100	.105
4	.102	.099	.093	.106	.111
5	.099	.099	.097	.106	.100
6	.100	.105	.100	.103	.106
7	.101	.101	.105	.095	.105
8	.098	.106	.101	.103	.101
9	.099	.104	.106	.111	.106
10	.101	.114	.105	.109	.112
D. Model 4[e]					
1	.102	.156	.136	.163	.150
2	.097	.111	.104	.105	.104
3	.100	.101	.110	.101	.103
4	.098	.107	.100	.104	.103
5	.101	.099	.104	.099	.105
6	.102	.106	.102	.101	.102
7	.099	.107	.101	.108	.097
8	.098	.102	.101	.096	.099
9	.100	.109	.093	.100	.112
10	.103	.161	.116	.126	.118

[a] Forecast error portfolios 1 and 10 are formed using lowest and highest forecast error decile cut-offs, respectively.

[b] Model 1 forecast error $=(Q_{i,t}-E(Q_{i,t}))/\mathrm{Abs}\,(Q_{i,t})$ where $E(Q_{i,t})=Q_{i,t-4}+\phi_i(Q_{i,t-1}-Q_{i,t-5})+\delta_i$.

[c] Model 2 forecast error $=(Q_{i,t}-E(Q_{i,t}))/\sigma(Q_{i,t}-E(Q_{i,t}))$ where $E(Q_{i,t})$ as in Model 1.

[d] Model 3 forecast error $=\sum_t \tilde{u}_{i,t}/\sigma(\tilde{u}_{i,t})$ where $\tilde{u}_{i,t}=\tilde{R}_{i,t}-\tilde{R}_{p,t}$; $t=-1$ to 0; $\tilde{R}_{p,t}$ = equally weighted mean daily return on the firm size decile that firm i falls into in the quarter examined; $\sigma(\tilde{u}_{i,t})$ = standard deviation of the residual return estimated over 250 trading days prior to the $[-1, 0]$ period.

[e] Model 4 forecast error $=((\sum_t \tilde{u}_{i,t})/61)/\sigma(\tilde{u}_{i,t})$ where $\tilde{u}_{i,t}=\tilde{R}_{i,t}-\tilde{R}_{p,t}$; $t=-60$ to 0; $\tilde{R}_{p,t}$ as in Model 3; $\sigma(\tilde{u}_{i,t})$ = standard deviation estimated over 250 trading days prior to the $[-60, 0]$ period.

prices—see Beaver, Lambert and Morse [1980] for the use of security price when forecasting earnings, Foster [1981] for the use of security price in identifying information transfers associated with earnings releases, and Patell and Wolfson [1982] for the use of security price in classifying earnings releases into "good news" and "bad news" categories.

The portfolio formation technique will be explained using FE_i^1. For each quarter from the fourth quarter of 1973 to the third quarter of 1981, all observations were ranked using the FE_i^1 for that quarter. Then the deciles of the distribution for each quarter were determined. These deciles were used as the cut-offs for assigning firms into one of ten forecast error portfolios in the quarter subsequent to that in which the cut-off points were determined. The same procedure independently was used with FE_i^2, FE_i^3 and FE_i^4.

Table 1 presents the unconditional and conditional relative frequencies of a firm being in portfolio j in quarter t:

$\phi(FEP_{j,t})$ = unconditional relative frequency of a firm being in forecast error portfolio j (FEP_j) in period t, and

$\phi(FEP_{j,t}|FEP_{j,t-n})$ = relative frequency of a firm being in FEP_j in period t, conditional upon being in FEP_j in period $t-n$.

If there is independence in period-by-period classification of firms to a specific FEP,

$$\phi(FEP_{j,t})=\phi(FEP_{j,t}|FEP_{j,t-1}) = \ldots =\phi(FEP_{j,t}|FEP_{j,t-n}). \quad (14)$$

The two models that violate the independence assumption most are Models 1 and 2. For instance, using Model 2 the unconditional relative frequency of being in the most negative (positive) unexpected earnings portfolio is .101 (.103). However, conditional upon the firm being in $FEP_1^2(FEP_{10}^2)$ in period $t-1$, the probability of it also being in $FEP_1^2(FEP_{10}^2)$ in period t increases to .270 (.322). Results using Models 1 and 2 are more exposed than Models 3 and 4 to the "proxy bias" described in Section 2.2B(i) of this paper. Models 1 and 2 are similar to those used in prior studies reporting systematic drifts in security returns.

Table 2 presents the median values of FE_i^1, FE_i^2, FE_i^3 and FE_i^4 for observations in each of the ten forecast error portfolios of each model. The Spearman rank correlations between the median values of each model are:

Model Used To Form Portfolios	*Spearman Rank Correlation Between*					
	FE_i^1 *and* FE_i^2	FE_i^1 *and* FE_i^3	FE_i^1 *and* FE_i^4	FE_i^2 *and* FE_i^3	FE_i^2 *and* FE_i^4	FE_i^3 *and* FE_i^4
Model 1	.96	.93	.96	.99	1.00	.99
Model 2	1.00	1.00	1.00	1.00	1.00	1.00
Model 3	1.00	.99	.99	.99	.99	1.00
Model 4	1.00	1.00	1.00	1.00	1.00	1.00

The above correlations are all significant at the .01 level. They are consistent with each of the four models capturing related phenomena.

5. Security Return Estimation and Significance Testing

Abnormal returns reported in Section 6 of this paper are computed as:

$$\tilde{u}_{i,t} = \tilde{R}_{i,t} - \tilde{R}_{p,t} \qquad (15)$$

where

$\tilde{R}_{i,t}$ = return on security i in day t, and
$\tilde{R}_{p,t}$ = equally weighted mean return on the NYSE firm size decile that firm i is a member of in the quarter examined.

This companion portfolio approach assumes that all firms in a firm size decile are homogeneous but allows for heterogeneity across firm size deciles. Adopting the capital asset pricing model perspective of (2), it allows for relative risk differences across firm size deciles but assumes homogeneity within firm size deciles. One benefit of (15) is that it controls for the firm size effects in security returns noted in Banz [1981], Reinganum [1981], Sharpe [1982] and Keim [1983]. This benefit is especially important in Section 7 where the effect of firm size on the magnitude of the post-earnings announcement drifts in security returns is examined—see the Appendix of this paper for further discussion.

The firm size deciles used in (15) are constructed by ranking all firms on the NYSE at the start of each year and then computing the mean daily returns of each decile for the next 12 months. Table 3 presents the average daily return and relative risk estimates of the ten firm size deciles over the 1973–1981 period. The firm size effect on security returns reported previously in the literature is apparent over the 1973–1981 period; e.g., the mean return for the smallest decile is more than five times the mean

TABLE 2

MEDIAN VALUES OF ALTERNATIVE ERROR METRICS FOR FORECAST ERROR PORTFOLIOS[a]

Forecast Error Portfolio	*Median*[b] FE_i^1	*Median*[b] FE_i^2	*Median*[b] FE_i^3	*Median*[b] FE_i^4
Model 1				
1	−2.335	−1.445	−0.388	−0.038
2	−0.600	−0.994	−0.319	−0.032
3	−0.165	−0.458	−0.249	−0.022
4	−0.011	−0.028	−0.146	−0.014
5	0.066	0.353	−0.023	−0.005
6	0.126	0.784	0.069	0.006
7	0.192	1.108	0.163	0.010
8	0.286	1.355	0.216	0.020
9	0.459	1.399	0.264	0.025
10	1.233	1.158	0.152	0.019
Model 2				
1	−1.093	−2.244	−0.437	−0.045
2	−0.496	−0.907	−0.301	−0.031
3	−0.191	−0.363	−0.194	−0.020
4	−0.012	−0.030	−0.165	−0.008
5	0.084	0.200	−0.026	−0.003
6	0.157	0.467	0.040	0.003
7	0.206	0.775	0.110	0.009
8	0.243	1.182	0.184	0.014
9	0.282	1.803	0.245	0.022
10	0.343	3.151	0.318	0.030
Model 3				
1	−0.039	−0.098	−2.412	−0.041
2	0.038	0.097	−1.385	−0.022
3	0.071	0.208	−0.884	−0.013
4	0.080	0.254	−0.503	−0.009
5	0.079	0.235	−0.174	−0.007
6	0.095	0.310	0.120	−0.002
7	0.112	0.415	0.472	0.002
8	0.124	0.456	0.904	0.005
9	0.141	0.534	1.505	0.014
10	0.204	0.817	2.829	0.038
Model 4				
1	−0.027	−0.081	−0.504	−0.165
2	0.003	0.010	−0.316	−0.099
3	0.047	0.123	−0.203	−0.065
4	0.070	0.196	−0.079	−0.038
5	0.095	0.309	−0.044	−0.015
6	0.105	0.337	0.005	0.008
7	0.121	0.402	0.073	0.033
8	0.132	0.490	0.115	0.061
9	0.158	0.634	0.262	0.099
10	0.189	0.793	0.406	0.174

[a] Forecast error portfolios and models are noted in Table 1.
[b] The median of the sorted distribution of forecast errors based on portfolio membership as per the model in the far left column.

return of the largest decile. The relative risks of the ten deciles range from 1.11 to .92 using OLS and 1.16 to 0.83 using Scholes-Williams [1977] estimation techniques.

TABLE 3

NYSE FIRM SIZE DECILES: 1973–1981

Firm Size Decile	*Average Daily Security Return*	*Average O.L.S. Beta*[a]	*Average Scholes-Williams [1977] Beta*[a]
0–.1 (Smallest)	0.111%	1.11	1.16
.1–.2	0.084%	1.10	1.10
.2–.3	0.070%	1.07	1.06
.3–.4	0.063%	1.02	1.01
.4–.5	0.061%	1.00	0.98
.5–.6	0.053%	0.97	0.94
.6–.7	0.048%	0.96	0.93
.7–.8	0.046%	0.93	0.90
.8–.9	0.038%	0.92	0.88
.9–1.00 (Largest)	0.021%	0.92	0.83

[a] The beta is based on a separate regression using daily data for each year. The annual betas are averaged over the nine-year period.

Statistical significance of cumulative abnormal return (CAR) results is assessed by comparing the observed CAR with the empirical distribution of CAR's for the sample of firms. The empirical distribution is generated as follows:

1. Randomly select 8,000 firm/quarter combinations over the 1974 to 1981 period (out of a maximum of 65,696—2,053 firms × 32 quarters).
2. Select those observations satisfying the announcement date/security return availability requirements and compute the CAR for that sample over the time period in question. (This is equivalent to randomly assigning an observation to a specific earnings forecast error portfolio.) The typical sample size in Step 2 approximates that of each of the ten portfolios examined in Section 6.
3. Repeat Steps 1 and 2 1,000 times and then rank the sample CAR's from lowest to highest to obtain the empirical distribution of CAR's for the sample.

This significance test has several appealing properties vis-a-vis the use of the more conventional *t* tests or standardized *t* tests; e.g., it does *not* assume normality, it does *not* assume constant variance across securities or over time, and it does *not* assume cross-sectional independence in the residuals.[8]

In Section 7, firms are classified into one of five firm size quintiles each quarter and CAR results are presented for each quintile. Significance tests presented in Section 7 for the separate firm size quintiles are based on an empirical distribution generated over 200 independent trials for the specific firm size quintile being examined.

6. CAR RESULTS FOR ALL OBSERVATIONS

CAR results are presented in Table 4 for three time periods:

$[-1, 0]$ = CAR for the trading day preceding and the trading day of the earnings announcement,

$[-60, 0]$ = CAR from 61 trading days up to and including the day of the earnings announcement, and

$[+1, +60]$ = CAR for the 60-trading-day period subsequent to the earnings announcement date.

All four models used to estimate unexpected earnings show a consistent pattern

[8] The assistance of E. Noreen in devising this significance test is gratefully acknowledged. L. Marais of The University of Chicago is conducting related research in this area.

TABLE 4

CUMULATIVE AVERAGE RESIDUALS FOR FORECAST ERROR PORTFOLIOS: ALL OBSERVATIONS POOLED[a]

Forecast Error Portfolio	Days [−1, 0]				Days [−60, 0]				Days [+1, +60]			
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 1*	*Model 2*	*Model 3*	*Model 4*
1	−1.36*	−1.34*	−6.54*	−1.38*	−5.57*	−5.94*	−5.39*	−21.50*	−3.02*	−3.08*	0.04	0.17
2	−0.94*	−0.88*	−3.70*	−0.86*	−4.01*	−3.95*	−2.65*	−14.48*	−2.59*	−2.73*	0.40	0.47
3	−0.50*	−0.49*	−2.44*	−0.56*	−2.29*	−2.37*	−1.04*	−10.19*	−1.58*	−1.78*	0.06	0.42
4	−0.25*	−0.25*	−1.36*	−0.24*	−1.19*	−0.32*	−0.54*	−6.33*	−1.34*	−0.92*	−0.06	0.16
5	0.04	0.19	−0.50*	0.06	−0.18*	0.93	−0.25*	−2.55*	−0.48*	0.22	0.00	0.39
6	0.28	0.44*	0.34*	0.28	0.96*	1.51*	0.92*	1.41*	0.55*	0.79*	0.14	−0.02
7	0.54*	0.73*	1.24*	0.52*	1.71*	2.38*	1.12*	5.52*	1.31*	1.32*	−0.02	0.07
8	0.90*	0.81*	2.38*	0.80*	3.41*	2.75*	1.99*	9.99*	2.46*	1.70*	0.03	−0.13
9	1.40*	1.03*	3.91*	1.18*	5.35*	3.78*	3.10*	15.20*	3.22*	2.21*	0.13	0.12
10	1.44*	1.26*	8.16*	1.65*	5.83*	4.83*	6.50*	26.73*	2.93*	3.23*	0.11	−0.37

Significance Testing.
For Portfolio 1–5, * Indicates CAR < 1st Percentile of Sample Distribution of $R_i - R_p$.
For Portfolio 6–10, * Indicates CAR > 99th Percentile of Sample Distribution of $R_i - R_p$.

[a] Forecast error portfolios and models are noted in Table 1. Residuals are calculated as $\tilde{u}_{i,t} = \tilde{R}_{i,t} - \tilde{R}_{p,t}$ where $\tilde{R}_{p,t}$ = equally weighted mean daily return on the firm size decile that firm i falls into the quarter examined.

FIGURE 1

BEHAVIOR OF CAR'S OVER [−60, +60] TRADING DAY PERIOD USING $R_i - R_p$

PANEL A: MODEL 1

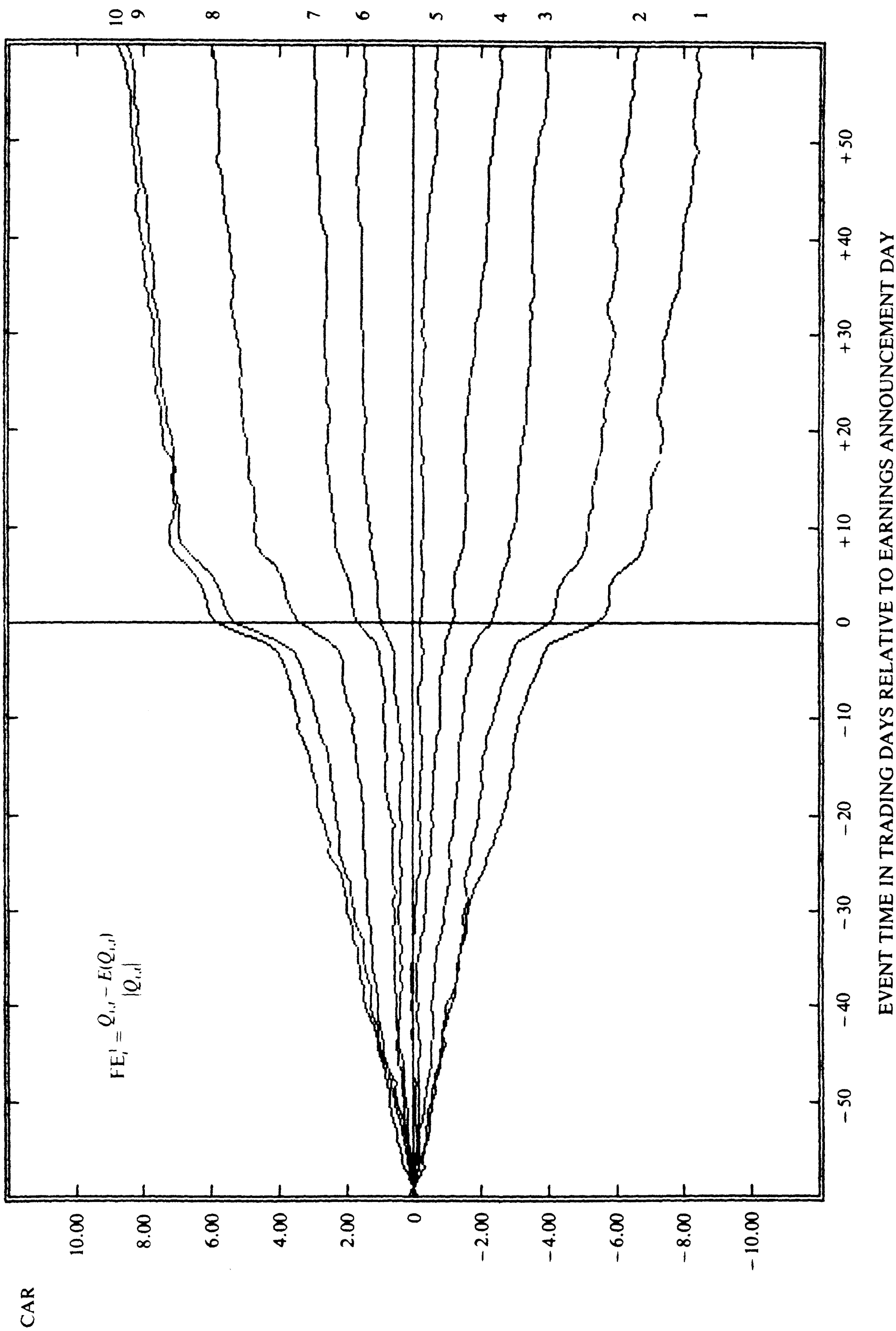


FIGURE 1—(*Continued*)

PANEL B: MODEL 2

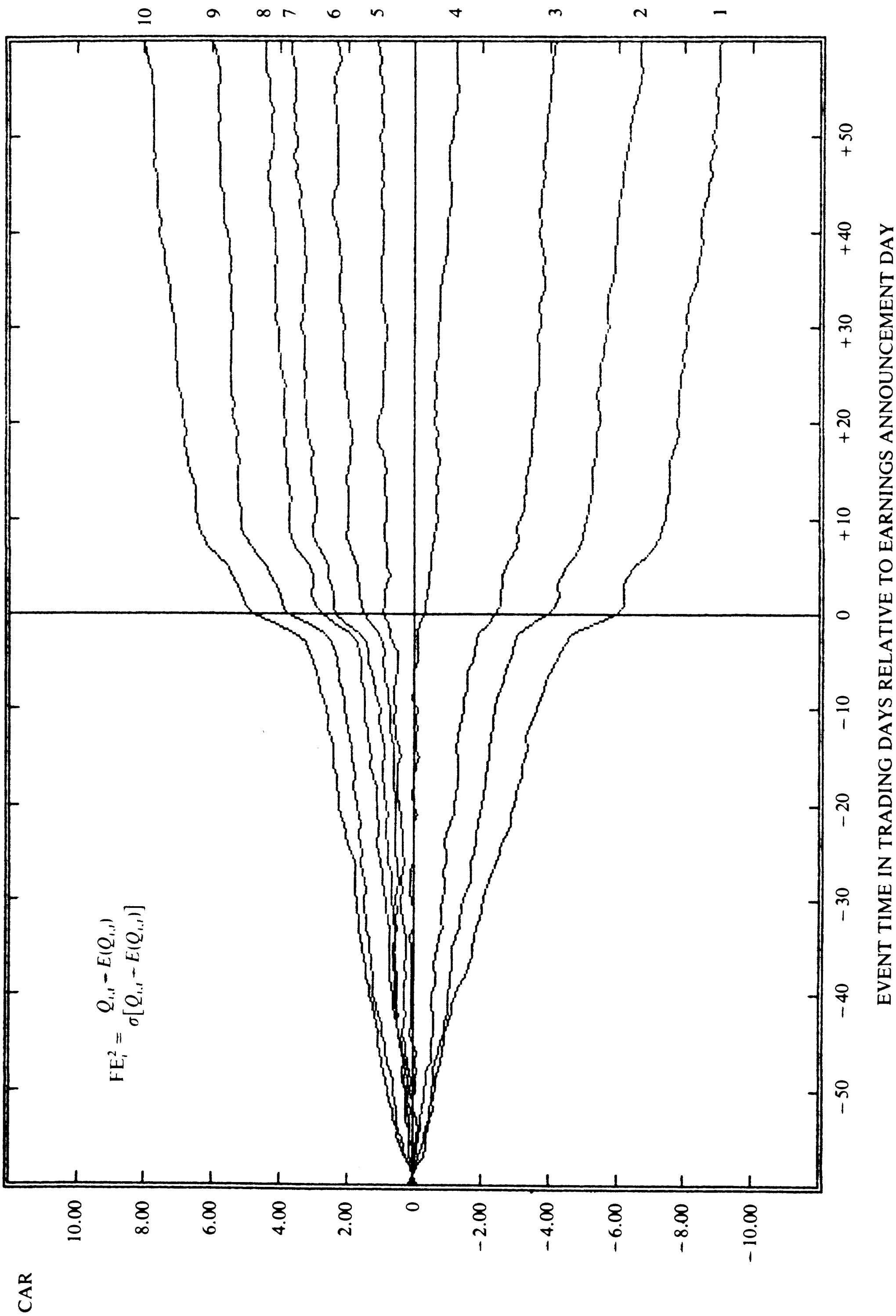


FIGURE 1—(*Continued*)

PANEL C: MODEL 3

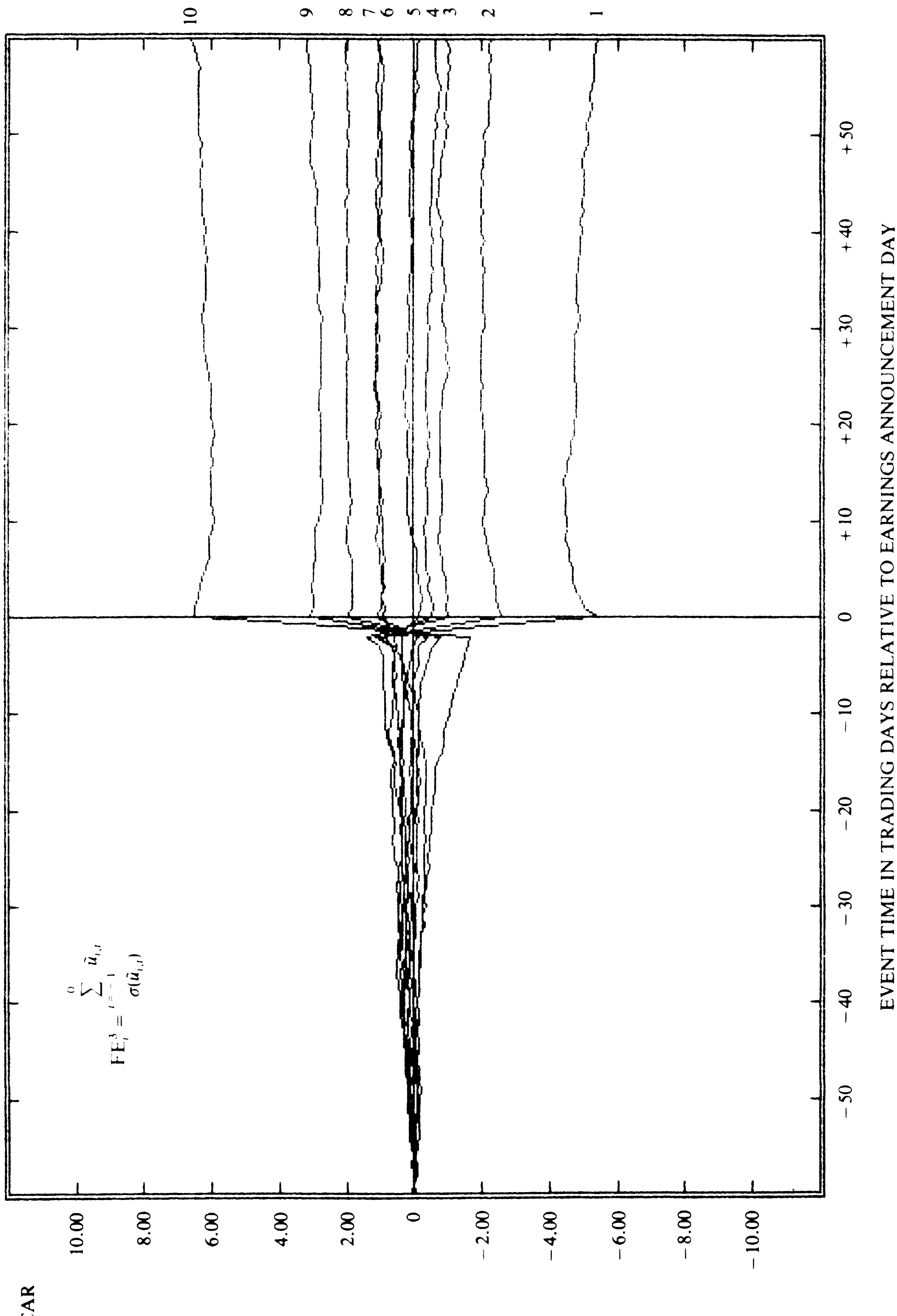
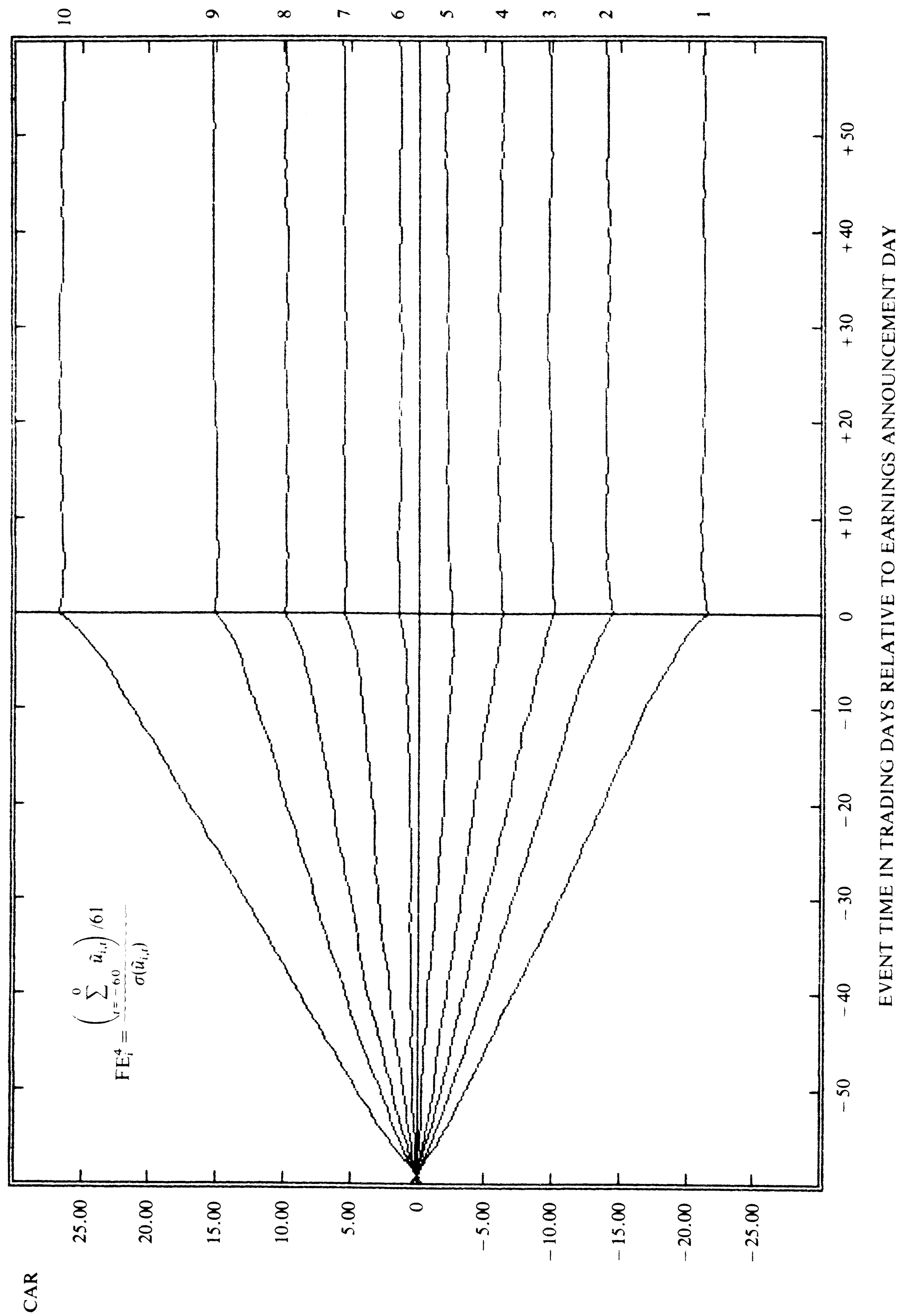


FIGURE 1—(*Continued*)

PANEL D: MODEL 4



for $[-1, 0]$, i.e., the sign and magnitude of the earnings forecast error is significantly associated with the sign and magnitude of the CAR for $[-1, 0]$.[9]

The $[-60, 0]$ and $[+1, +60]$ time-periods focus on a longer time frame. Panels A, B, C, and D of Figure 1 present the CAR's of the ten forecast error portfolios for Models 1, 2, 3, and 4, respectively. Models 1 and 2 exhibit both pre-announcement and post-announcement drifts in the CAR which are associated with the sign and magnitude of the earnings forecast error. The post-announcement drift is the anomaly highlighted previously in the literature. For instance, the results in Panel B of Figure 1 and Table 4 for Model 2 imply that an investor could use a publicly available earnings release on day 1 to form one portfolio that has a -3.08 percent abnormal return (observations with ten percent most negative earnings forecast error) and another portfolio with an abnormal return of $+3.23$ percent (ten percent most positive earnings forecast error). Based on the empirical sampling distribution, these abnormal returns are significantly different from zero at, at least, the .01 level. Indeed, in none of the 1,000 trials used to compute the empirical sampling distribution were CAR's of -3.08 percent or $+3.23$ percent encountered for the $[+1, +60]$ period. These results suggest that the hindsight biases found in prior studies (see Section 2B(iii) of this paper) do not explain the post-announcement systematic drifts in security returns reported in those studies.

Models 3 and 4 present a different pattern of results, with little evidence that portfolios with negative (positive) CAR's in $[-1, 0]$ or $[-60, 0]$, respectively, have negative (positive) CAR's in the subsequent $[+1, +60]$ time period—see Panels C and D of Figure 1. Using the empirical sampling distribution, not one of ten portfolios for either Model 3 or Model 4 is significantly different from zero at the .01 level. Thus, the post-announcement drifts reported in the literature are observed for Models 1 and 2 but not for Models 3 and 4.[10]

The results in Table 4 are pooled over 32 quarters from the first quarter of 1974 (7401) to the last quarter of 1981 (8104). Table 5 presents results for $[+1, +60]$ for three sub-periods: 7401 to 7602 (10 quarters), 7603 to 7804 (10 quarters) and 7901 to 8104 (12 quarters). Table 5 reports the number of quarters in each sub-period for which the CAR in $[+1, +60]$ was negative. The previously noted association between the sign and magnitude of the forecast error and the CAR in $[+1, +60]$ is found in each sub-period in Table 5 for Models 1 and 2 but not for Models 3 and 4. To further probe the time-period explanation for the models reporting post-announcement drifts in security returns, Figure 2 presents a histogram of the CAR's of Model 2 for $[+1, +60]$ for each of the 32 quarters for the most extreme bad news portfolio (FEP_1) and the most extreme good news portfolio (FEP_{10}). (A similar pattern is observed for Model 1.) No discernible sub-period behavior is observed for either FEP_1 or FEP_{10}, with no evidence that the magnitude of the post-announcement drifts decreased over the 1974 to 1981 period. Based on the results in Table 5 and Figure 2, the time period explanation (see Section 2B(iv) of this paper) does not have support for being the source of the post-announcement drifts in security returns.

[9] This result for FEP_i^3 is by construction; firms were placed into the FEP_i^3 portfolios based on their security return behavior in $[-1, 0]$.

[10] The results for Model 3 are consistent with those reported in Arbel and Jaggi [1982]. The results for Model 4 are consistent with those reported in Beaver and Landsman [1981]. While both these papers adopted an event-time format, neither used actual earnings announcement dates in determining day 0 (month 0) in their experiments.

TABLE 5

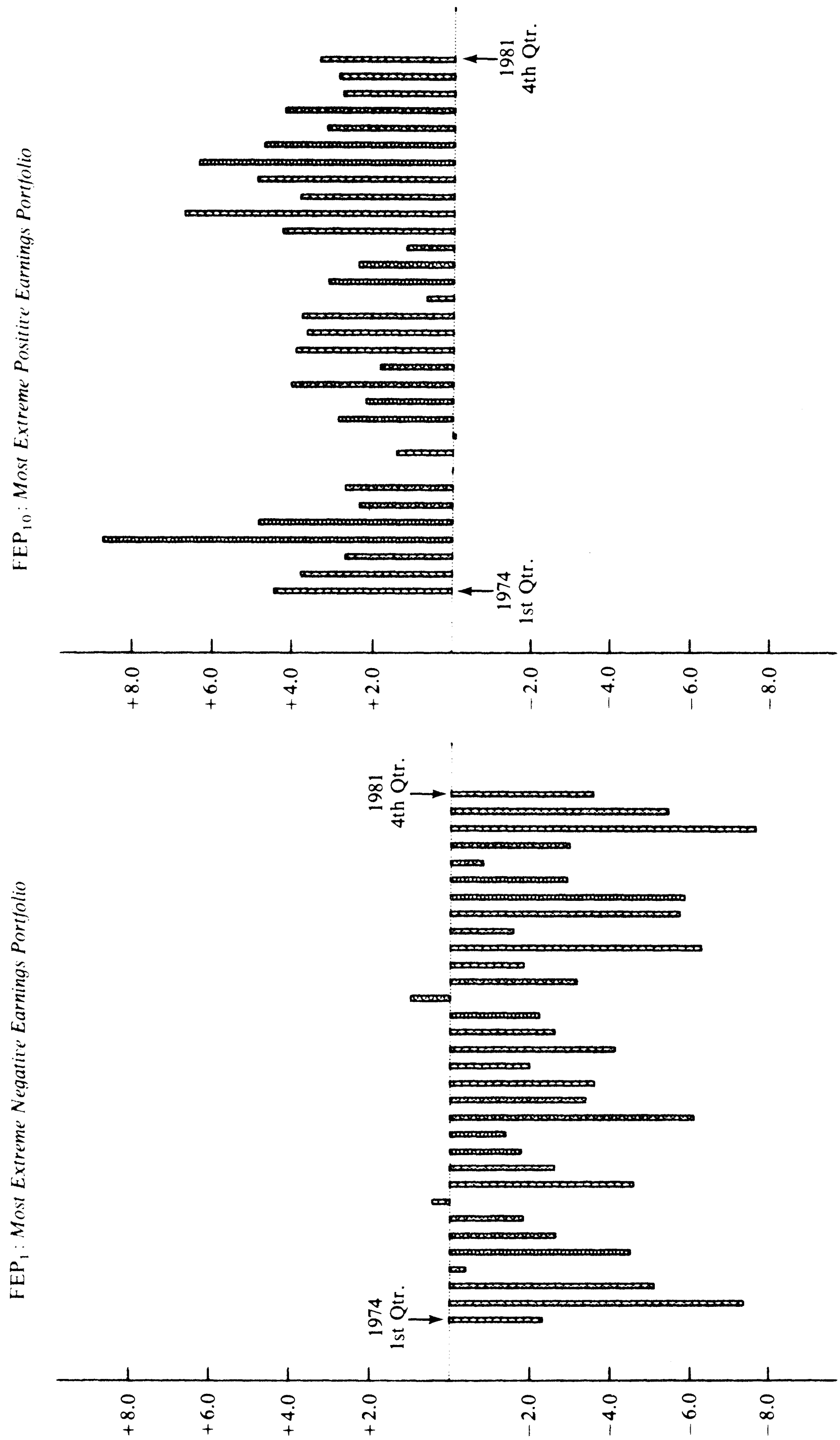
TIME PERIOD ANALYSIS OF CAR'S OF FORECAST ERROR PORTFOLIOS[a] IN [+1, +60] EVENT TIME: FREQUENCY WITH WHICH QUARTERLY CAR NEGATIVE IN THREE NON-OVERLAPPING SUB-PERIODS

Forecast Error Portfolio	*Model 1*			*Model 2*			*Model 3*			*Model 4*		
	7401–7602 10 Qtrs	7603–7804 10 Qtrs	7901–8104 12 Qtrs	7401–7602 10 Qtrs	7603–7804 10 Qtrs	7901–8104 12 Qtrs	7401–7602 10 Qtrs	7603–7804 10 Qtrs	7901–8104 12 Qtrs	7401–7602 10 Qtrs	7603–7804 10 Qtrs	7901–8104 12 Qtrs
1	8	9	11	9	9	12	3	6	7	3	7	6
2	8	9	12	9	9	11	4	2	8	2	5	7
3	8	10	12	8	7	11	4	0	6	3	2	5
4	8	9	10	7	5	10	5	3	7	5	0	8
5	8	4	8	6	6	5	6	4	4	6	1	7
6	4	3	2	4	1	5	7	4	6	6	3	6
7	6	1	2	2	0	2	8	8	6	4	4	7
8	1	1	0	4	1	0	7	6	6	7	5	8
9	1	0	0	2	1	0	5	4	6	7	5	3
10	3	0	4	1	0	0	5	5	6	7	5	5

[a] Forecast error portfolios and models are noted in Table 1.

FIGURE 2

QUARTER BY QUARTER CAR'S FOR [+1, +60] PERIOD USING MODEL 2:
1974 FIRST QUARTER TO 1981 FOURTH QUARTER



7. CAR Results for Firm Size Partitions

This section examines the ability of a firm size variable to explain the sign and magnitude of the post-announcement drifts. Each observation underlying Tables 4 and 5 was placed into one of five NYSE firm size quintiles based on the firm's market capitalization at the start of the year of each earnings announcement examined: I = smallest firm to .20 market capitalization decile, II = .20 decile to .40 decile, . . . V = .80 decile to largest firm.

Table 6 presents results of each firm size quintile for Model 2 and Model 4. The inferences drawn from this table for the post-announcement drifts for Model 2(4) also apply to Model 1(3). Focusing on the [+1, +60] trading-day period, there are significant post-announcement drifts (at the .01 level) across all five firm size quintiles for Model 2. The empirical distribution for each firm size quintile is based on 200 independent trials (see Section 5). The smallest firm size quintile has the most number (nine) of earnings forecast error portfolios with significant post-announcement drifts at the .01 level—the observed CAR in Table 6 for portfolios 1 (−3.34), 2 (−4.10), and 3 (−1.98) are less than the lowest on any of the 200 independent trials; the observed CAR for portfolios 6 (1.82), 7 (2.34), 8 (3.60), 9 (3.51), and 10 (5.00) exceed the highest on any of the 200 independent trials for this firm size quintile. The largest firm quintile has five of the ten forecast error portfolios exhibiting significant post-announcement drifts—the observed CAR for all five (1, 2, 3, 9, and 10) are on more extreme points of the distribution than observed on any of the 200 independent trials for this firm size quintile. The results for Model 4 over the [+1, +60] period are in marked contrast to those reported for Model 2. Not one of the ten portfolios in any of the five size quintiles has significant post-announcement drifts using Model 4.

Using the data in Table 6, the following regression was run to probe the relative importance of the earnings forecast error variable and the firm size variable in explaining the sign and magnitude of CAR_j:

$$\tilde{CAR}_j = \hat{\alpha} + \hat{\beta}_1 \cdot \tilde{FEP}_j + \hat{\beta}_2 \cdot FSQ_j + \tilde{e}_j \tag{16}$$

where

CAR_j = the CAR of the jth portfolio,

FEP_j = a coding from 1 to 10 of the earnings forecast error of portfolio j, and

FSQ_j = a coding of the firm size quintile of portfolio j. For FEP_1 to FEP_5, the firm size quintiles (I–V) are each coded I(10), II(9), III(8), IV(7) and V(6). For FEP_6 to FEP_{10}, the firm size quintiles were each coded I(1), II(2), III(3), IV(4) and V(5). This coding is designed to test the hypothesis that the magnitudes of the drifts are a function of firm size, but that their sign is a function of whether the earnings are coded as "bad news" (portfolios 1–5) or "good news" (portfolios 6–10).

Results for Models 1 to 4 are presented in Table 7. Consider Model 2; the results across all three time periods in Table 7 are consistent. For instance, in the [+1, +60] period, 81 percent of the variation in CAR_j is explained by a coding of the earnings forecast error portfolio—the positive coefficient on β_1 implies the more positive (negative) the magnitude of the earnings change, the more positive (negative) the magnitude of CAR_j in [+1, +60]. The firm size quintile variable explains 66 percent of the variation in CAR_j. The negative β_2

TABLE 6

CUMULATIVE AVERAGE RESIDUALS FOR FORECAST ERROR PORTFOLIOS:[a] BREAKDOWN INTO NYSE POPULATION FIRM SIZE QUINTILES[b]

Forecast Error Portfolio	Days [−1, 0]					Days [−60, 0]					Days [+1, +60]				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Model 2															
1	−1.83*	−1.49*	−1.04*	−0.71*	−0.81*	−7.26*	−7.29*	−5.44*	−5.07*	−3.43*	−3.34*	−4.12*	−2.56*	−2.91*	−1.87*
2	−1.07*	−1.29*	−0.54*	−0.41*	−0.71*	−4.83*	−5.25*	−2.92*	−2.91*	−2.20*	−4.10*	−2.32*	−1.44*	−1.90*	−1.40*
3	−0.50*	−0.67*	−0.44*	−0.51*	−0.26*	−3.26*	−1.95*	−2.58*	−2.31*	−1.05*	−1.98*	−1.58	−1.88*	−1.50	−1.52*
4	−0.09*	−0.43*	−0.43*	−0.34*	−0.31*	−0.50	−0.51	−0.21	−0.12	−0.16	−0.97*	−1.42	−0.93	−1.13	0.23
5	0.38	0.11	−0.01	0.01	0.05	1.98	0.79	0.42	−0.07	−0.38	1.45	−1.21	−0.14	−0.91	−0.63
6	0.81*	0.26	0.26	−0.02	0.20	2.60*	1.57	1.59*	0.22	0.74	1.82*	0.60	0.50	−0.51	−0.27
7	1.36*	0.68*	0.45*	0.26	0.19	4.14*	2.25*	1.39	1.41*	0.99	2.34*	1.60*	1.06	−0.35	0.79
8	1.41*	0.89*	0.63*	0.45*	0.36*	4.29*	3.92*	1.81*	1.55*	2.10*	3.60*	1.35*	1.41	1.11*	0.02
9	1.91*	1.00*	0.82*	0.65*	0.41*	6.50*	4.87*	3.39*	2.28*	2.13*	3.51*	2.88*	1.89*	1.16*	1.25*
10	2.58*	1.42*	1.06*	0.86*	0.50*	9.38*	6.35*	4.50*	3.74*	1.96*	5.00*	4.86*	2.83*	2.52*	1.73*
Model 4															
1	−1.97*	−1.74*	−1.21*	−0.87*	−0.88*	−28.68*	−24.43*	−20.75*	−19.10*	−16.66*	−0.40	−1.42	0.77	0.37	1.41
2	−1.23*	−1.10*	−0.66*	−0.50*	−0.32*	−19.71*	−15.18*	−13.66*	−11.72*	−9.57*	1.03	−0.59	0.19	0.36	0.63
3	−0.87*	−0.38*	−0.41*	−0.29*	−0.34*	−13.97*	−10.68*	−9.04*	−7.82*	−6.47*	0.53	0.83	0.46	0.17	−0.18
4	−0.40*	−0.22	0.00	−0.21*	−0.04	−8.87*	−6.32*	−5.55*	−4.74*	−3.80*	0.52	−0.92	0.62	−0.13	0.10
5	0.12	0.00	−0.11	0.20	−0.04	−3.62*	−2.37*	−2.04*	−1.84*	−1.43*	1.12	0.64	−0.24	−0.64	−0.37
6	0.53	0.35	0.12	0.00	−0.10	2.01*	1.56	1.38	1.10	0.88	0.70	−0.33	−0.92	−0.42	−0.54
7	0.81*	0.32	0.56*	0.14	0.29	7.99*	5.59*	4.80*	4.12*	3.31*	0.51	−0.15	0.93	−0.81	−0.85
8	1.38*	0.62*	0.69*	0.29	0.24	14.92*	10.04*	8.54*	7.52*	6.14*	−0.22	−0.11	0.35	−0.35	−0.18
9	2.01*	0.95*	0.89*	0.79*	0.43*	22.57*	15.61*	13.63*	12.29*	9.49*	−0.19	0.87	0.59	−0.17	−0.03
10	2.72*	1.36*	1.19*	1.39*	0.99*	40.07*	28.36*	25.62*	22.00*	18.08*	−1.14	0.02	−0.48	0.05	0.09

Significance Testing
For Portfolios 1–5, * Indicates CAR < 1st Percentile of Sample Distribution of $R_i - R_p$ for Firm Size Quintile.
For Portfolios 6–10, * Indicates CAR > 99th Percentile of Sample Distribution of $R_i - R_p$ for Firm Size Quintile.

[a] Forecast error portfolios and models are noted in Table 1. Residuals are calculated as $\tilde{u}_{i,t} = R_{i,t} - R_{p,t}$.

[b] Firm size quintiles I and V comprise the smallest and largest firms, respectively.

TABLE 7

REGRESSION STATISTICS FOR CAR_j AS DEPENDENT VARIABLE AND FEP_j AND FSQ_j AS INDEPENDENT VARIABLES[a]

	α	$t\cdot(\alpha)$	β_1	$t(\beta_1)$	β_2	$t(\beta_2)$	$ADJ\ R^2$
A. *Model 1*[b]							
[−1, 0]	−1.38	−17.23	0.27	20.96	—	—	.899
	1.37	9.13	—	—	−0.23	−9.49	.645
	−0.81	−4.28	0.23	12.53	−0.06	−3.28	.916
[−60, 0]	−6.30	−24.69	1.21	29.50	—	—	.947
	5.71	8.15	—	—	−0.97	−8.60	.598
	−5.14	−8.01	1.12	18.33	−0.12	−1.97	.950
[+1, +60]	−3.57	−14.22	0.65	16.20	—	—	.842
	3.31	9.46	—	—	−0.60	−10.56	.693
	−1.31	−2.39	0.48	9.11	−0.23	−4.44	.886
B. *Model 2*[b]							
[−1, 0]	−1.33	−10.82	0.26	13.32	—	—	.783
	1.47	9.65	—	—	−0.24	−9.98	.668
	−0.32	−1.15	0.18	6.94	−0.10	−3.92	.833
[−60, 0]	−5.71	−12.82	1.11	15.43	—	—	.829
	5.65	8.46	—	—	−0.96	−8.90	.615
	−3.01	−2.78	0.90	8.67	−0.28	−2.70	.849
[+1, +60]	−3.62	−12.65	0.67	14.48	—	—	.810
	3.38	8.85	—	—	−0.60	−9.83	.661
	−1.37	−2.08	0.49	7.82	−0.23	−3.70	.850
C. *Model 3*[b]							
[−1, 0]	−6.52	−15.29	1.21	17.57	—	—	.863
	5.50	7.20	—	—	−0.98	−7.95	.559
	−5.07	−4.65	1.09	10.50	−0.15	−1.44	.866
[−60, 0]	−4.90	−13.90	0.96	16.87	—		.853
	4.46	6.93	—	—	−0.74	−7.17	.507
	−4.46	−4.86	0.92	10.54	−0.04	−0.51	.850
[+1, +60]	0.08	0.58	−0.01	−0.22	—	—	.000
	0.04	0.28	—	—	0.01	0.12	.000
	0.11	0.29	−0.01	−0.20	−0.01	−0.08	.000
D. *Model 4*[b]							
[−1, 0]	−1.41	−11.73	0.28	14.28	—	—	.805
	1.45	8.63	—	—	−0.24	−8.99	.620
	−0.64	−2.21	0.22	7.82	−0.08	−2.89	.831
[−60, 0]	−25.32	−18.97	4.68	21.74	—	—	.906
	21.59	7.94	—	—	−3.85	−8.80	.609
	−18.22	−5.51	4.12	13.06	−0.73	−2.33	.914
[+1, +60]	0.30	1.60	−0.05	−1.55	—	—	.028
	−0.17	−0.87	—	—	−0.04	1.23	.010
	0.26	0.52	−0.04	−0.93	0.01	0.10	.008

[a] Regression equation $\tilde{CAR}_j = \hat{\alpha} + \hat{\beta}_1 \cdot \tilde{FEP}_j + \hat{\beta}_2 \cdot \tilde{FSQ}_j + \tilde{e}_j$, where FEP_j = forecast error portfolio, FSQ = firm size quintile (see text for coding).

[b] Models are noted in Table 1.

coefficient on FSQ_j implies that the smaller the firm size, the larger the absolute magnitude of CAR_j in the [+1, +60] period, with portfolios 1–5 having negative drifts and portfolios 6–10 having positive drifts. The FEP_j and FSQ_j effects are collinear. Focusing still on the [+1, +60] period for Model 2, the explanatory power of the two variables in a multiple regression is 85 percent; the incremental power of adding the FSQ_j variable to a regression already including the FEP_j variable is only four percent.

Consider the results in Table 7 for Models 3 and 4 over the [+1, +60] period. Neither the FEP_j nor FSQ_j variables have any significant ability to explain CAR_j differences across the 50 portfolios used in each regression. The consistent result that emerges is that for both the pooled sample and the firm size quintiles, Models 3 and 4 do not provide any evidence of significant post-earnings announcement drifts in security returns.

8. Summary

The most important result in this paper is that the systematic post-announcement drifts in security returns reported in the literature are found for only a subset of earnings expectations models. Portfolios based on two price-based earnings expectations models exhibit no systematic post-announcement drifts in the [+1, +60] trading day period. The price-based expectations models have the appealing property that the assignment of firms to unexpected earnings change portfolios better approximates the independence-over-time assumption than do models used previously. This property means that the abnormal returns reported for each earnings change portfolio are less likely to capture firm-specific variables priced by the capital market but not incorporated into abnormal return estimation.

Another important set of results in this paper relates to the class of earnings expectations models reporting systematic drifts in security returns in the [+1, +60] period. These drifts persist throughout the entire 1974 to 1981 period and thus a sub-time-period explanation for their existence appears unlikely. Approximately 80 percent of the variation in cumulative abnormal returns of the ten earnings change portfolios in the [+1, +60] time period can be explained by a coding of the sign and magnitude of the unexpected earnings change of each portfolio. The more positive (negative) the unexpected earnings change, the more positive (negative) the post-announcement abnormal returns. A coding based on firm size explained approximately 65 percent of the variation in the portfolio cumulative abnormal returns in the [+1, +60] time period. The smaller the firm size, the larger the post-announcement cumulative abnormal return, with positive (negative) earnings change portfolios having positive (negative) cumulative abnormal returns. Although the smallest quintile of firms examined in this paper had the greatest number of portfolios with significant abnormal returns in the [+1, +60] period, the two most extreme positive unexpected earnings portfolios and the two most extreme negative unexpected earnings portfolios had significant post-announcement drifts across all five firm size quintiles examined. The earnings magnitude effect and the firm size effect were collinear; together, they explained 85 percent of the variation across portfolios in their post-announcement security return behavior.

The results in this paper raise a major

unresolved issue: Why do systematic post-announcement drifts appear with Models 1 and 2 but not with Models 3 and 4? One possible avenue of research is to use univariate or multivariate time-series models based on the past earnings series that are better specified using a conventional time-series criterion—e.g., the Box-Jenkins Q statistic. Another avenue of research is to examine the characteristics of the observations Models 1 and 2 assign to different portfolios in an attempt to gain more insight into the proxy effect explanation for the systematic drifts. A third avenue is to focus on that subset of observations that make marked transitions over time in their membership of forecast error portfolios, e.g., to examine if observations that are in portfolio 1 in period t and portfolio 10 in $t+1$ exhibit the patterns reported for Models 1 and 10 for the forecast error portfolios that they are members of in that period. A fourth avenue is to examine how the earnings concept implicit in security price differs from the earnings concept implicit in a single quarter's (or year's) reported accounting earnings. This research involves issues such as the forecast time horizon used to price securities and the models used to forecast earnings over the (presumably) multi-year time horizon. Such research could facilitate understanding how earnings forecast error models based on quarterly or annual accounting data may classify securities differently than does the capital market when it revalues security prices at the time of earnings announcements.

APPENDIX

ABNORMAL RETURN ESTIMATION

Rendleman, Jones and Latane [1982], in one of the most extensive studies on post-earnings announcement drifts in security returns, estimated abnormal returns using (17) in Section 5 of their paper:

$$\tilde{u}_{i,t} = \tilde{R}_{i,t} - \tilde{R}_{M,t} \qquad (17)$$

where

$R_{i,t}$ = return on security i in day t and
$R_{M,t}$ = equally weighted return on CRSP daily file (NYSE and ASE firms) in day t.

Table 8 presents results for the pooled sample previously reported in Table 4 of this paper when (17) is used to estimate abnormal returns.[11] Use of (17) does not change any of the inferences drawn previously in this paper as regards the pooled sample population.

However, when observations are placed into firm size quintiles, use of (17) will cause the earnings association results to be confounded with the effect that firm size (or related variables) has on security returns—see Banz [1981], Reinganum [1981], Sharpe [1982] and Keim [1983]. To illustrate, Table 9 presents results for earnings forecast Model 2 when (17) is used to estimate abnormal returns. Note, for instance, that in both the $[-60,0]$ and $[+1,+60]$ periods, firm size quintile V (.80 market capitalization decile to largest firm) has negative CAR's across all ten forecast error portfolios. Portfolio 10 (the ten percent with the most favorable unexpected increase in earnings using Model 2) has a CAR of -1.98 percent in $[-60,0]$ and -0.78 percent in $[+1,+60]$. This result arises from the firm

[11] For Models 3 and 4 in Table 8, (17) was used to estimate both the FE_i variable and the CAR. There was no change in the inferences drawn when (15) was used to estimate the CAR.

TABLE 8

CUMULATIVE AVERAGE RESIDUALS FOR FORECAST ERROR PORTFOLIOS:[a] ALL OBSERVATIONS POOLED WITH $R_i - R_m$ USED TO COMPUTE CAR

Forecast Error Portfolio	Days [−1, 0]				Days [−60, 0]				Days [+1, +60]			
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 1*	*Model 2*	*Model 3*	*Model 4*
1	−1.35*	−1.36*	−6.52*	−1.23*	−5.22*	−6.75*	−6.28*	−22.44*	−2.69*	−3.46*	−0.90*	−1.04*
2	−0.95*	−0.90*	−3.66*	−0.87*	−4.47*	−4.64*	−3.75*	−15.88*	−2.72*	−3.06*	−0.07	−0.76*
3	−0.52*	−0.52*	−2.48*	−0.64*	−3.52*	−2.98*	−1.67*	−11.94*	−2.31*	−2.08*	−0.20	0.08
4	−0.30*	−0.25*	−1.39*	−0.36*	−2.59*	−0.64	−1.30*	−8.27*	−2.16*	−1.00*	−0.56	0.11
5	−0.01*	0.18	−0.55*	0.00	−1.88*	0.57	−0.75	−4.28*	−1.51*	0.21	0.03	0.04
6	0.23	0.43*	0.27*	0.17	−0.76	0.95*	0.27*	−0.01	−0.42	0.69*	0.08	0.22
7	0.51*	0.71*	1.17*	0.43*	0.36*	1.53*	0.18*	4.56*	0.58*	0.87*	−0.52	0.37*
8	0.88*	0.79*	2.34*	0.80*	2.50*	1.60*	1.14*	9.67*	2.10*	1.01*	−0.24	−0.35
9	1.40*	1.00*	3.91*	1.18*	5.28*	2.75*	2.46*	15.67*	3.08*	1.59*	−0.46	−0.14
10	1.48*	1.20*	8.27*	1.75*	6.72*	3.38*	5.91*	28.72*	3.78*	2.32*	−0.33	−1.09

Significance Testing
For Portfolio 1–5, * Indicates CAR < 1st Percentile of Sample Distribution of $R_i - R_m$.
For Portfolio 6–10, * Indicates CAR > 99th Percentile of Sample Distribution of $R_i - R_m$.

[a] Forecast error portfolios and Models 1 and 2 are noted in Table 1. Models 3 and 4 are the same except $\tilde{u}_{i,t} = \tilde{R}_{i,t} - \tilde{R}_{M,t}$ where $\tilde{R}_{M,t}$ = equally weighted market index.

TABLE 9

CUMULATIVE AVERAGE RESIDUALS FOR FORECAST ERROR PORTFOLIOS[a] OF MODEL 2 WITH $R_i - R_m$ USED TO COMPUTE CAR: BREAKDOWN INTO NYSE POPULATION FIRM SIZE QUINTILES[b]

Forecast Error Portfolio	*Days [−1, 0]*					*Days [−60, 0]*					*Days [+1, +60]*				
	I	*II*	*III*	*IV*	*V*	*I*	*II*	*III*	*IV*	*V*	*I*	*II*	*III*	*IV*	*V*
1	−1.78*	−1.49*	−1.08*	−0.81*	−0.94*	−5.51*	−7.92*	−6.83*	−7.46*	−8.06*	−2.10*	−4.74*	−3.85*	−4.37*	−4.62*
2	−1.03*	−1.32*	−0.56*	−0.48*	−0.85*	−3.11*	−5.93*	−4.30*	−5.57*	−6.66*	−2.85*	−2.95*	−2.41*	−3.28*	−4.27*
3	−0.45*	−0.71*	−0.50*	−0.60*	−0.38*	−1.47*	−2.60*	−4.05*	−4.74*	−5.40*	−0.88*	−2.12*	−2.89*	−2.88*	−4.64*
4	−0.03*	−0.44*	−0.47*	−0.41*	−0.39*	1.24	−1.20	−1.82	−2.39	−4.40	0.29*	−1.88	−1.90*	−2.81*	−2.34
5	0.43	0.10	−0.05	−0.06	−0.04	3.53	0.08	−0.86	−2.48	−4.60*	3.06	−1.84	−1.14	−2.53*	−3.32*
6	0.88*	0.25	0.22	−0.07	0.10	4.22*	0.78*	0.06	−2.24	−3.77	3.25*	0.11	−0.39	−1.93	−2.66
7	1.41*	0.68*	0.42*	0.20	0.07	5.85*	1.60*	−0.12	−0.99*	−3.44	3.69*	1.02*	0.21	−1.75	−1.77
8	1.44*	0.89*	0.58*	0.42*	0.25*	5.94*	3.27*	0.37*	−1.12	−2.39*	4.69*	0.78*	0.42	−0.26*	−2.43
9	1.95*	0.97*	0.78*	0.59*	0.32*	8.17*	4.06*	1.84*	−0.28*	−1.73*	4.88*	2.53*	0.93*	−0.06*	−1.41
10	2.62*	1.37*	1.01*	0.78*	0.39*	10.98*	5.58*	2.91*	1.13*	−1.98*	6.36*	4.26*	1.63*	1.16*	−0.78*

Significance Testing
For Portfolios 1–5, * Indicates CAR < 1st Percentile of Sample Distribution of $R_i - R_m$ for Firm Size Quintile.
For Portfolios 6–10, * Indicates CAR > 99th Percentile of Sample Distribution of $R_i - R_m$ for Firm Size Quintile.

[a] Forecast error portfolios and Models 1 and 2 are noted in Table 1. Models 3 and 4 are the same except $\tilde{u}_{i,t} = \tilde{R}_{i,t} - \tilde{R}_{M,t}$ where $\tilde{R}_{m,t}$ = equally weighted market index.

[b] Firm size quintiles I and V comprise the smallest and largest firms, respectively.

size effect on security returns being stronger in magnitude than the earnings forecast error effect for that portfolio. Note, however, that the significance test employed in this paper will take account of the firm size effect in generating the empirical distribution.[12]

ALTERNATIVE CUMULATION APPROACHES

The cumulative abnormal return (CAR) measures reported in this paper are calculated as:

$$\text{CAR} = \frac{1}{n}\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{u}_{i,t} \tag{18}$$

Roll [1983] discusses three alternative approaches and notes differences in their underlying assumptions:

AR (Arithmetic)

$$= \left(\left[\frac{1}{N\cdot\tau}\sum_{i}\sum_{t}R_{it}\right]^{\tau} - 1\right)\times 100 \tag{19}$$

BH (Buy and Hold)

$$= \left(\frac{1}{N}\sum_{i}\left[\prod_{t}R_{it}\right] - 1\right)\times 100 \tag{20}$$

RB (Rebalanced)

$$= \left(\prod_{i}\left[\frac{1}{N}\sum_{i}R_{it}\right] - 1\right)\times 100 \tag{21}$$

where $R_{i,t} = 1 + \tilde{u}_{i,t}$.

A subset of the results was run using these three cumulation approaches with no change in the inferences previously drawn in this paper. For instance, results for forecast error portfolios 1 to 10 for Model 2 over the [+1, +60] period using (15) are:

Cumulation Approach	*Forecast Error Portfolio*									
	1	2	3	4	5	6	7	8	9	10
CAR	−3.08*	−2.73*	−1.78*	−0.92*	0.22	0.79*	1.32*	1.70*	2.21*	3.23*
AR	−3.00*	−2.63*	−1.75*	−0.91*	0.19	0.79*	1.27*	1.67*	2.22*	3.18*
BH	−4.71*	−4.10*	−3.32*	−2.50*	−1.49	−0.53*	0.16*	0.78*	1.37*	2.42*
RB	−3.00*	−2.63*	−1.75*	−0.91*	0.19	0.78*	1.27*	1.67*	2.22*	3.18*

For portfolios 1 to 5, * indicates that the CAR (AR, BH or RB) is less than the first percentile of the empirical distribution. For portfolios 6 to 10, * indicates the CAR (AR, BH, or RB) is greater than the 99th percentile of the empirical distribution. The empirical distributions are calculated over 1,000 trials. Separate distributions were generated for the CAR, AR, BH and RB cumulation approaches. Note that all four approaches indicate the same forecast error portfolios as having significant post-announcement drifts in security returns.

[12] Abnormal returns were also calculated using the market model, with α and β estimated using the 600 trading days prior to the [−60] trading day. Separate simulations were run to generate the empirical distribution of the CAR for each event time period examined. Portfolios 1 to 5 and 8 to 10 of Model 1 and 1 to 4 and 6 to 10 of Model 2 reported evidence of statistically significant abnormal returns in the [+1, +60] period. No portfolios for Model 3 or Model 4 had significant abnormal returns in the [+1, +60] period. Full results are available from the authors.

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