Disentangling the Dividend Information in Splits: A Decomposition Using Conditional Event-Study Methods

Subhankar Nayak
Georgia Institute of Technology

Nagpurnanand R. Prabhala
University of Maryland

While folklore in finance holds that split valuation effects are due to dividend increases associated with splits, little is known about magnitudes of dividend and nondividend components of split announcement effects. We find that splits and dividends are indeed informational substitutes, a notion we characterize more precisely, but a significant portion of split valuation effects, 46% according to our estimates, *cannot* be attributed to dividend information in splits. Our techniques extend the literature on conditional event-study methods and we illustrate their practical value in testing hypotheses and analyzing data not amenable to analysis by standard procedures.

Stock splits have long puzzled researchers in finance. A split merely increases the number of shares outstanding by subdividing the existing number of shares into a greater number of units. Thus it is a purely cosmetic change that does not affect a firm's cash flow, investments, or capital structure. Standard textbook analysis [e.g., Brealey and Myers (1991, p. 302–303)] suggests that such changes should have no effect on firm value. Yet much literature since the seminal article by Fama et al. (1969)—henceforth FFJR—documents that splits are associated with positive valuation effects. For instance, our data reveal that more than 70% of splits between 1985 and 1994 are associated with positive stock price reactions, and the average announcement effect for all splits announced in this period is a substantial 2.1%.

Many hypotheses have been proposed to explain positive split valuation effects. The explanations fall into two broad categories. One school of thought attributes split valuation effects mainly to an implied promise of higher dividends. For instance, FFJR write "Unusually high returns on splitting

We are grateful to Mike Fishman (the editor) and two anonymous referees for very extensive and helpful comments. We also thank Yakov Amihud, Mark Grinblatt, Robert Higgins, Roger Ibbotson, Nikunj Kapadia, Kai Li, Ron Masulis, Manju Puri, K. Geert Rouwenhorst, Rex Thompson, G. Visvanathan, P. V. Viswanath, Luigi Zingales, and seminar participants at the European Finance Association, Financial Management Association, Western Finance Association, Carnegie Mellon University, and Yale University, and participants at the conference "A Tribute to Larry Fisher" held at Rutgers University. We retain sole responsibility for any errors that remain. Address all correspondence to N. R. Prabhala, Robert H. Smith School of Business, University of Maryland, College Park, MD 20742, or e-mail: nprabhal@rhsmith.umd.edu.

The Review of Financial Studies Winter 2001 Vol. 14, No. 4, pp. 1083–1116

shares in the months immediately preceding a split reflect the market's anticipation of substantial increases in dividends" and "when the information effects of dividend changes are taken into account, the apparent price effects of the split will vanish." A different school of thought holds that splits affect firm value for reasons other than dividend increases. For example, Lakonishok and Lev (1987) suggest that splits return stock prices to an "optimal" trading range. Grinblatt, Masulis, and Titman (1984) suggest that splits draw increased "attention" to a stock, which triggers positive revaluation of the splitting stock. Lamoureux and Poon (1987) argue that the increase in idiosyncratic volatility of a stock after a split increases the tax-option value and hence the price of a stock. Most recently, Muscarella and Vetsuypens (1996), who analyze ADR solo splits, suggest that improved liquidity explains positive split valuation effects. Dividend and nondividend reasons for split valuation effects are, however, not mutually exclusive. Split announcement effects could be due to both associated dividend increases, as well as, nondividend factors such as a return to an optimal trading range or increased attention to a stock. Little progress has been made, however, on disentangling the relative importance of dividend and nondividend factors in explaining split announcement effects.

In this article we explore the role of splits and near-term cash dividends in explaining split valuation effects along two lines. The first part of our analysis compares splits by non-dividend-paying firms with those by dividend-paying firms. In an extensive study, Grinblatt, Masulis, and Titman (1984)—henceforth GMT—document that split announcement effects are higher if the splitting firm is not dividend paying. Why should the dividend paying status of the firm condition how markets respond to its splits? The issue remains an unresolved puzzle. The relation between a firm's dividend status and its split announcement effects certainly suggests there is an informational link between the two announcements, but its precise nature still remains to be characterized since the stylized facts were documented in GMT.

We examine whether the differences between dividend payer and non-dividend payer split announcement effects arise because splits and dividends are partial informational substitutes for each other. Dividend payers have, in effect, established a mechanism (dividends) by which they can convey information about future cash flows to shareholders. If split announcements are conditioned, at least partly, on similar information, some of the information in splits is subsumed by that in dividends. If so, splits by firms paying dividends should be less informative announcements, and should elicit a less intense stock price response. We develop econometric methods that allow us to formally test such a hypothesis, while simultaneously controlling for systematic differences in firm-specific characteristics and split expectations that may also explain the differences in announcement effects. We find that splits and dividends are indeed partial informational substitutes for each other, and empirically characterize the nature of this informational relation between splits and dividends. Our results provide one explanation for the differences in announcement effects first noted by GMT.

Our second tests focus on splits by dividend-paying firms alone. Several articles (e.g., FFJR and GMT) suggest that when a dividend-paying firm announces a split, it is also more likely to announce a dividend increase. Thus existing literature argues that announcement effects associated with splits are at least partly due to impending dividend increases by the splitting firm. What part of split announcement effects is due to the implied dividend information? Is it just 5%? Alternatively, does the dividend component account for the vast majority, say 95%, of split announcement effects? We propose empirical techniques that provide some first estimates of such a decomposition, while exploiting a rarely used sample of *joint* split-dividend announcements. The results suggest that a significant component of split announcement effects—about 46% according to our estimates—is caused by information orthogonal to dividend information implied in splits. Thus, for dividend-paying firms, splits and dividends appear to be informational substitutes, but only partially so.

Our empirical analysis is also of interest from a methodologic perspective for two reasons. First, we provide an analysis of a vast, yet essentially unused sample of *joint* split-dividend announcements. About 80% of splits by dividend-paying firms are announced with a contemporaneous dividend announcement. However, most empirical work thus far has concentrated on the sample of splits *not* announced with a dividend. The principal difficulty in using the joint announcement sample is that in such samples, it is difficult to extract the portion of the announcement effect attributable to the split alone. Hence existing work focuses mostly on "pure" split announcements *not* accompanied with a concurrent dividend announcement. However, even the "pure" split sample is bedeviled by the joint announcement problem. When a split is announced, financial markets can make some inference about the related dividend, even when the dividend is not formally announced together with the split. Such inferences will contaminate announcement effects associated with stand-alone "pure" splits as well. Thus focusing on stand-alone split announcements will not necessarily solve the joint announcement problem. A different approach is to use the joint announcement data instead of discarding it, and admit, explicitly model, and control for the dividend information that contaminates split announcements. Our article takes a first step in this direction.

Our empirical application is also of methodological interest because it extends the literature on *conditional* event-study methods [see Thompson (1985), Acharya (1988), Eckbo, Maksimovic, and Williams (1990), Prabhala (1997)]. We illustrate the potential value of such techniques in testing hypotheses and analyzing data otherwise not amenable to analysis by standard event-study methods. For instance, conditional methods shed light on the vast sample of joint split-dividend announcements considered relatively intractable in previous work.

We proceed as follows. Section 1 briefly develops the main hypotheses and discusses the methodology used in the article. Section 2 describes the data and the firm-specific variables used in our study. Section 3 presents the empirical results. Section 4 concludes.

1. Hypotheses and Methodology

We examine the relation between splits and dividends primarily through two sets of tests. One set of tests compares splits by dividend-paying firms with those by non-dividend-paying firms, and a second set of tests focuses on simultaneous split-dividend announcements by dividend-paying firms. In this section we develop the hypotheses examined by each set of tests and describe the methodology used for testing these hypotheses.

1.1 Dividend-paying firms versus non-dividend-paying firms

The comparison between dividend-paying and non-dividend-paying firms is motivated by results documented in Grinblatt, Masulis, and Titman (1984). In perhaps the most detailed analysis of splits since FFJR, the article finds, among other things, that split announcement effects are higher when the splitting firm is non-dividend paying. This relation has not yet been explained since GMT first published their findings.

We propose and test two hypotheses to explain differences in split announcement effects between dividend-paying (*D*) firms and non-dividend-paying (*ND*) firms. One possibility is that *ND* firms differ systematically from *D* firms. *ND* firms are likely to be younger and more volatile compared to *D* firms, which tend to be older, stable firms in more mature businesses. Thus *ND* firms might be less likely, a priori, to announce a split. If so, markets will be more surprised when *ND* firms announce splits, and this could cause split announcement effects to be higher for *ND* firms. We call this the "differential expectations" hypothesis.

A second possibility is that splits and dividends are informational substitutes for each other. Firms with established dividend payment programs have effectively set up one mechanism for communicating their cash flow information to shareholders. If the decision to split is also conditioned (at least partly) on future cash flow—equivalently, on being able to raise dividends in the future—the information in splits is partly subsumed by that in the stream of dividend payments being made by firms. In this case, a unit of the unexpected information in a split should be less informative and should elicit a less intense stock price response for a *D* firm than for a *ND* firm. We term this the "informational substitute" hypothesis.

Both the differential expectations and informational substitute hypotheses are consistent with the positive difference between split announcement effects of *ND* and *D* firms. In addition, the two hypotheses are not mutually exclusive, and it is quite possible that both contribute toward explaining the difference in split announcement effects between the two types of firms. Therefore, simply comparing announcement effects of D and ND firms does not allow one to distinguish between the hypotheses, or at least assess whether both hypotheses contribute toward explaining split announcement effects. A different approach is needed. We propose one such method that relies on analyzing the *conditional* announcement effects associated with splits.

We start by specifying a statistical model for firms' decisions to announce a split. Suppose that firm i announces a split if a variable SPL_i is positive, where SPL_i may be interpreted as the net benefit from announcing a split. Part of SPL_i is publicly known, based on a vector of variables X_{si} in the preannouncement information set. For example, firms with high nominal stock prices, or firms with a recent run-up in stock prices are more likely to announce a split, so X_{si} potentially includes these variables. The rest of the information motivating a split, say ψ_{si}, is not known to the market, and represents firm i's private information. Thus we have

$$SPL_i = \theta_s X_{si} + \psi_{si}, \tag{1}$$

and firm i announces a split if

$$SPL_i = \theta_s X_{si} + \psi_{si} > 0, \tag{2}$$

where $E\ (\psi_{si})$, the preannouncement expectation of the private information ψ_{si}, is zero without loss of generality.[1]

The announcement of a split reveals something about the announcing firm's private information ψ_{si} to the market—specifically, that $\theta_s X_{si} + \psi_{si} > 0 \Rightarrow \psi_{si} > -\theta_s X_{si}$. Based on this fact, markets can form revised expectations about the splitting firm's private information ψ_{si}. The revised expectation of ψ_{si}, conditional on the occurrence of the split, constitutes the information revealed by the split. If splits have positive valuation effects, we should find that split announcement effects are positively related to the information revealed in the split. Thus β_s should be positive in the regression

$$E(AR_i \mid S) = \gamma_s + \beta_s E(\psi_{si} \mid \theta_s X_{si} + \psi_{si} > 0), \tag{3}$$

where AR_i denotes the announcement effect associated with a split S announced by firm i. Equation (3) gives the *conditional* announcement effect associated with a split, given the vector of characteristics X_{si} associated with the splitting firm. We use uppercase S to denote the split decision, while the lowercase s denotes variables and parameters used in modeling splits.

We can test both the differential expectations and informational substitute hypotheses using Equation (3). The differential expectations hypothesis may

[1] The expectations model could, in principle, differ across D and ND firms, due to (i) differences in decision rules (for instance, ND firms may be less likely to initiate splits than D firms for comparable price run-ups); (ii) differences in observable characteristics; or (iii) unobserved differences between the two types of firms. We allow for these possibilities by allowing the specification coefficients θ_s to differ for D and ND firms.

be tested by examining whether the expression $\theta_s X_s$ is greater for *D* firms than for *ND* firms. Splits are more likely to occur when $\theta_s X_s$ is high. Hence a finding that $\theta_s X_s$ is greater for *D* firms would imply that splits are more likely for these firms, consistent with the differential expectations hypothesis. In addition, we can test the informational substitute hypothesis by comparing the value of β_s for dividend payers ($\beta_{s,d}$) with that for non-dividend payers ($\beta_{s,nd}$). If the informational substitute hypothesis is correct, we should find that $\beta_{s,d} < \beta_{s,nd}$, that is, the information in a split elicits a stronger response for an *ND* firm than for a *D* firm.

It is, of course, possible that neither the differential expectations hypothesis nor the information substitute hypothesis explains differences between *D* and *ND* split announcement effects. We can test for this possibility too in Equation (3) by comparing magnitudes of intercepts γ_s for type *D* and type *ND* firms. If neither hypothesis is the right explanation, the difference in the intercepts, $\gamma_{s,nd} - \gamma_{s,d}$, should be positive and statistically significant. That is, the difference in intercepts should capture most of the difference in split announcement effects between *D* and *ND* firms.

1.2 Simultaneous split-dividend announcements

Our next tests focus on splits announced by dividend-paying firms alone. Two issues arise in this analysis, one relating to interpretation and another relating to methodology.

It is well known that splits by dividend-paying firms result in positive announcement effects [e.g., FFJR, GMT, and McNichols and Dravid (1990)]. However, splitting firms also tend to announce near-term dividend increases around the split date. What part of the split announcement effects are due to the increased likelihood of dividend increases, and what part is due to other nondividend factors such as increased "attention" to the stock or a more "optimal" price for the stock? Our work sheds light on this question.

A second issue in analyzing splits by dividend-paying firms is one of methodology. About 80% of such splits are announced jointly with a contemporaneous dividend announcement, and an important question is how one should empirically deal with the joint announcement problem. The problem with using joint announcement samples is that, in such samples, the valuation effect of the split is clouded by that of the accompanying dividend. It is difficult to extract the effect of the split alone from the joint announcement effect. Hence the approach in previous work has been to focus on "pure" splits that are not formally accompanied by a dividend announcement. However, even when a firm announces a stand-alone split, markets can draw inferences about any dividend changes implied by the split. Such inferences will certainly condition the stock price reaction to a split announcement, even when no dividend announcement formally accompanies the split. Thus, regardless of whether a split is formally announced together with a dividend or not, announcement effects on the split date will be clouded by the market's inferences about dividend implications of splits. Focusing on pure split announcements alone does not necessarily eliminate the joint announcement problem.

In this article we take a different approach to the joint announcement problem. Instead of discarding the joint announcement sample, we attempt to statistically model the dividend information in a joint split-dividend announcement and control for this component in explaining the resulting announcement effects. This approach allows us to exploit the joint announcement sample instead of discarding it, and enables us to disentangle the dividend and non-dividend portions of split announcement effects.

The empirical specification is developed as follows. We model firms as choosing whether to split or not, and also choosing an accompanying dividend decision. We assume that firm i's split decision is governed, as in Section 1.1, by Equation (2). On the other hand, firm i's dividend decision is assumed to be governed by a latent variable DIV_i. As before, suppose that markets form expectations about DIV_i, based on a set of variables X_{di}. Thus we can express DIV_i as

$$DIV_i = \theta_d X_{di} + \psi_{di}, \tag{4}$$

where $\theta_d X_{di}$ is the part of DIV_i known ex ante to the market and ψ_{di} denotes the part of DIV_i that is privately known to firm i but not to the market. We set $E\ (\psi_{di})$ to zero without loss of generality.

We model the firm as choosing a dividend decision $C \in \{I, U, D\}$, where I, U, and D denote the decision to increase, leave unchanged, or decrease dividends, respectively, based on the latent variable DIV_i. We specify this decision process as an ordered probit model:

$$\begin{aligned} I &\Leftrightarrow DIV_i > \mu_I \\ U &\Leftrightarrow \mu_D \leq DIV_i \leq \mu_I \\ D &\Leftrightarrow DIV_i < \mu_D. \end{aligned} \tag{5}$$

According to Equation (5), firm i increases dividends if the underlying information DIV_i is good enough, and cuts dividends if there is bad information, that is, DIV_i is low. For interim values of DIV_i, it chooses not to change dividends.

The announcement of a dividend decision $C \in \{D, U, I\}$ reveals something about firm i's private information ψ_{di}, and causes markets to revise expectations about ψ_{di}. The revised expectations of ψ_{di}, conditional on firm i's choice C, constitute the information revealed to the markets by firm i's dividend announcement. Equation (2) for the split decision and Equation (5) for the accompanying dividend decision suggest that the announcement effect for a firm announcing a split S and an accompanying dividend announcement C may be written as

$$E(AR_{sdi} \mid C, S) = \gamma_{sd} + \beta_d E(\psi_{di} \mid C, S) + \beta_s E(\psi_{si} \mid C, S). \tag{6}$$

The conditional expectations in Equation (6) must be solved to obtain the regressors in the right-hand side and then estimate the specification. We return to this issue shortly.

Equation (6) is our basic model to exploit and analyze the joint split-dividend announcement sample. In Equation (6), a positive and significant value of β_s would indicate that splits have information content even after controlling for information in accompanying dividends. Thus split valuation effects cannot be attributed solely to dividend-related information implied by splits. Equation (6) can be extended to test other hypotheses also. For instance, to test whether split announcement effects reflect any information about *future* dividends, we estimate the incremental probability of future dividends implied by splits and include the related information variable in Equation (6). If β_s shrinks and becomes insignificant upon inclusion of the future dividend variable, we can conclude that split valuation effects are primarily due to information about future dividend changes implied by a split; otherwise, split valuation effects cannot be attributed to information about future dividend changes either.

1.2.1 A finer decomposition of split announcement effects. The preceding analysis simply tells us whether splits have incremental information relative to dividends, but say little about the relative magnitude of the dividend and nondividend information implied in splits. For instance, is only 5% of split announcement effects due to dividend information, or is 95% due to dividends? Additional structure is needed to get at this central question.

To begin, we note that from Equations (1) and (2), the information revealed in splits is ψ_{si} while the dividend information, from Equation (4), is ψ_{di}. If some of the information in splits reflects that in dividends, ψ_{si} and ψ_{di} should be correlated. Accordingly, we decompose the split information ψ_{si} into its dividend and nondividend components and write

$$\psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}, \tag{7}$$

where $\rho_{sd}\psi_{di}$ is the dividend information implied in ψ_{si}, and $\psi_{s-d,i}$ denotes the portion of ψ_{si} that is orthogonal to dividends, that is, the "pure" split information. Our objective is to extract the portion of split announcement effects attributable to this pure split component.

When a split is announced, markets respond to the two components that comprise ψ_{si}—the "pure" split information $\psi_{s-d,i}$, and the implied dividend information ψ_{di}. Suppose that the announcement effect related to each of these two parts is $AR_{s-d,i}$ and AR_{di}, respectively. The total announcement effect AR_{si} is the sum of these two parts and may be written as

$$\begin{aligned} E(AR_{si} \mid \psi_{si}) &= E(AR_{s-d,i}) + E(AR_{di}) \\ &= \alpha_{s-d} E(\psi_{s-d,i} \mid \psi_{si}) + \alpha_d E(\psi_{di} \mid \psi_{si}). \end{aligned} \tag{8}$$

The expectations of each of the components, conditional on split information ψ_{si}, gives the relative magnitudes of the "pure" split and dividend-related components of split valuation effects. Thus we write the total announcement effect, given the split information $\psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}$, as

$$\begin{aligned} E(AR_{si} \mid \psi_{si}) &= \alpha_{s-d} E(\psi_{s-d,i} \mid \psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}) \\ &\quad + \alpha_d E(\psi_{di} \mid \psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}). \end{aligned} \tag{9}$$

We can solve for the conditional expectations in the right-hand side of Equation (9) given a distribution for the latent variables $\psi_{s-d,i}$ and ψ_{di}. Assuming that $\psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}$ and ψ_{di} are standard normal, a standard assumption for estimating a bivariate probit specification in the limited dependent variable literature that we draw from, we get

$$E(AR_{si} \mid \psi_{si}) = (1 - \rho_{sd}^2)\alpha_{s-d}\psi_{si} + \rho_{sd}\alpha_d\psi_{si}. \tag{10}$$

The right-hand side of Equation (10) consists of two parts. The first part gives the "pure" split effect, while the second gives the dividend-related component of split valuation effects.

The intuition underlying Equation (10) is sensible. The equation says that the dividend information in splits is more important when the values of ρ_{sd} and α_d are high and when the value of α_{s-d} is low. This makes sense. The parameter ρ_{sd} is positively related to the dividend component of the total split information ψ_{si}, viz., $\rho_{sd}\psi_{si}$, while it is negatively related to the "pure split" component of ψ_{si}, viz., $\psi_{s-d,i}$, because the variance of $\psi_{s-d,i}$ equals $1 - \rho_{sd}^2$. Thus the greater the value of ρ_{sd}, the greater is the dividend component of ψ_{si} ($\rho_{sd}\psi_{si}$), but the lesser is its pure split component ($\psi_{s-d,i}$). Hence, as $\rho_{sd} \to 1$, the nondividend component of split announcement effects, $(1 - \rho_{sd}^2)\,\alpha_{s-d}\psi_{si} \to 0$, while as $\rho_{sd} \to 0$, the dividend component, $\rho_{sd}\alpha_d\psi_{si} \to 0$. A high α_d implies that each unit of dividend information has greater effect on stock prices, so a greater portion of split valuation effects are due to implied dividend information. Finally, a low α_{s-d} implies that each unit of the pure *split* information matters less to stock prices, so the dividend component matters more, relatively, to split valuation effects. It is useful to note, in particular, that the correlation between the split and dividend latent variables, that is, ρ_{sd}, is *not* sufficient to infer their relative importance in explaining stock price reactions. We must also consider the α's for splits and dividends, that is, how the information in each announcement affects firm value.

1.2.2 Estimation. To obtain a decomposition of split announcement effects, Equation (10) indicates that we need estimates of α_{s-d}, α_d, and ρ_{sd}. We consider how these parameters may be recovered from a sample of firms that make simultaneous split-dividend announcements.

Firm i's private information when it announces a split decision S and a dividend decision C is the vector (ψ_{di}, ψ_{si}). Given that $\psi_{si} = \rho_{sd}\psi_{di} + \psi_{s-d,i}$, the revelation of (ψ_{di}, ψ_{si}) should result in an announcement effect of

$$\begin{aligned} AR_{sdi} &= \alpha_d \psi_{di} + \alpha_{s-d}\psi_{s-d,i} \\ &= (\alpha_d - \rho_{sd}\alpha_{s-d})\psi_{di} + \alpha_{s-d}\psi_{si}. \end{aligned}$$

Thus a firm making a dividend announcement $C \in (D, U, I)$ and a split decision S experiences a joint announcement effect of

$$E(AR_{sdi} \mid C, S) = (\alpha_d - \rho_{sd}\alpha_{s-d})E(\psi_{di} \mid C, S) + \alpha_{s-d}E(\psi_{si} \mid C, S). \quad (11)$$

Comparing Equation (11) and (6), we find that Equation (11) simply restates Equation (6), but provides an interpretation of the regression coefficients β_s and β_d in Equation (6) in terms of α. Thus, given estimates of β in Equation (6), we can recover estimates of α, parameters of central interest to us.

The above discussion suggests a procedure to obtain the α's. First, we estimate a bivariate probit model for firms' split and dividend decisions. This yields estimates of parameters θ_s, θ_d, and ρ_{sd}. Using these, we compute the expectations in the right-hand side of Equation (6). Note that these expectations are not the usual univariate inverse Mills ratios seen in standard selection models used in previous conditional event-study specifications. The standard expectations are of the form $E(z \mid z > (\leq)\mu)$, where z is normally distributed. The conditional expectations required in Equation (11) condition on *two* decisions—splits and dividends—rather than one decision considered in the standard models. We require to compute expressions of the form $E(z_1 \mid z_1 > (\leq)\mu_1, z_2 > (\leq)\mu_2)$. The appendix provides the necessary derivations for the bivariate inverse Mills ratios. With these expressions in hand, the regressors on the right-hand side of Equation (6) can be computed. Ordinary least-squares estimates of the regression of joint announcement effects AR_{sdi} on $E(\psi_{di} \mid C, S)$ and $E(\psi_{si} \mid C, S)$ gives us estimates of β_D and β_S. Standard errors of these estimates require adjustment along the lines of Heckman (1979) since the regressors in Equation (6) are estimated ("generated") variables. Finally, comparing Equation (6) and (11), we get $\alpha_{s-d} = \beta_s$ and $\alpha_d - \rho_{sd}\alpha_{s-d} = \beta_d$, equivalently, $\alpha_d = \beta_d + \rho_{sd}\alpha_{s-d}$.

2. Data

Our dataset is constructed from the University of Chicago's Center for Research in Security Prices (CRSP) daily master tapes. We identify splits (coded

"5523" in the CRSP tapes) between 1985 and 1994, and this constitutes our primary splitting sample. We also replicate our analysis for splits announced between 1975 and 1984. We obtain qualitatively similar results for the 1975–1984 period. While our primary focus is on results from the 1985–1994 period, we also present and discuss several of the 1975–1984 results in Section 3.

2.1 Classification of firms

We classify all firms announcing splits into two categories: "non-dividend paying" (*ND*) and "dividend paying" (*D*). A firm is classified as *ND* if it made no dividend announcement on the split date or in the year prior to the split; all other firms are classified as *D* firms. *D* firms are then classified into two categories: ones that made a simultaneous dividend announcement with the split and others that did not. For this classification, we define a "simultaneous" announcement as a split accompanied by a dividend announcement in a 10-day window surrounding the split. Of interest, virtually all splits (97%) in this subsample are announced within a day of the related dividend announcement. In both cases, we collect data on one- and four-quarter back dividends preceding the split (the "prior" dividends) and the one- and four-quarter ahead dividends after the split (the "subsequent" dividends).

In addition to the sample of splitting firms, we also collect two samples of nonsplitting firms. One sample includes all nondividend payers that did not split in a given year and had valid price data during the year. Another sample consists of all dividend payers that did not announce a split and had valid price data during a year. We sample the universe of nonsplitters rather than matching samples based on sorts along prespecified dimensions (such as firm size). Presorting firms and picking subsamples according to such characteristics biases split probabilities, and does so in potentially different ways across *D* and *ND* firms. Problems with such "choice-based" stratified sampling methods are discussed in Manski and McFadden (1981). Palepu (1986) provides a practical illustration of the resulting biases in the context of predicting takeover targets.

Choice-based sampling is typically employed when sampling costs render it infeasible to proceed otherwise. For instance, sampling consumers in studies of transportation mode choice may be biased toward users of public transportation, given the lower costs of collecting data on these users. In such samples, Manski and McFadden (1981) show that the standard probit estimator is inconsistent and biased because the sample distribution of subjects with any given characteristic does not equal the population distribution of subjects with the characteristic. If a choice-based sample must be used, consistent estimation requires weighting to reflect differences in the sample and population distributions. The actual estimation procedure depends on what is known about the true and sample probability distributions along dimensions of the various exogenous characteristics. The alternative to choice-based sampling is, of course, to use the entire population and employ standard maximum likelihood methods. This is certainly preferred in a context such as ours where the cost of sampling the universe of nonsplitters is trivial.

2.2 Computation of unconditional announcement effects

For each announcement (split or dividend or both) we compute the announcement effects as the cumulative excess of the actual stock return over the benchmark "expected return" over the three-day window surrounding (and including) the announcement date. Expected returns were computed via one of two techniques, viz., the market model and the size portfolio model. While the market model is a popular choice in event studies for reasons elucidated in Brown and Warner (1985), the results reported in this study are based on the size portfolio model, in terms of which we compute announcement effects as

$$AR_i = \sum_{t=T-1}^{T+1} R_{i,t} - R_{s,i,t},$$

where $R_{i,t}$ is the return of security i on date t, $R_{s,i,t}$ is the date t return on the equally weighted index of the size decile s to which firm i belongs at the beginning of the calendar year containing t, and T is the date on which firm i announces the event in question.

We prefer the size portfolio model to the market model because of an ex post conditioning issue of the sort discussed in Brown, Goetzmann, and Ross (1995): splits are conditioned on the existence of large stock price run-ups in the preceding year. Procedures such as those based on the market model, which estimate expected returns based on the splitting firm's recent history will therefore overstate expected returns and understate announcement effects.

2.3 Firm-specific characteristics

Our empirical tests require us to specify a set of variables X_{si} that determine the market's expectations about forthcoming splits and another set of variables X_{di} that determine dividend expectations. For this purpose we obtain the following characteristics from the CRSP tapes for each firm in our samples:

- *PR_PRICE*: price of the firm's stock five trading days before the split.
- *TAR_PRICE*: target price of the firm's stock after the split, that is, *PR_PRICE* divided by the split factor.
- *SIZE*: the natural logarithm of the market value of the firm's equity five trading days prior to the split.
- *VOLUME*: trading volume, computed as the ratio of the average number of shares traded in the month prior to the split to the total number of outstanding shares five trading days before the split.
- *VOLATL*: stock return volatility, computed as the standard deviation of stock returns over the six months prior to the split.

- *RUNUP*: the ratio of the price of the firm's stock five trading days prior to the split to the price one year before the split.
- *PR1DUMMY*: this takes the value −1, 0, or +1 depending on whether the previous quarter's dividend was decreased, unchanged, or increased, respectively.
- *PR4DUMMY*: this takes the value −1, 0, or +1, depending on whether the one-year back dividend was decreased, unchanged, or increased, respectively.

Firm characteristics for nonsplitters paying dividends are obtained as of a quarterly dividend date, randomly chosen from among four such quarterly dividends paid during the year. For non-dividend-paying firms, all firm-specific data are obtained as on June 30 of the relevant year.

3. Empirical Results

Section 3.1 presents an initial exploration of descriptive statistics and announcement effects for our sample. Section 3.2 examines why split announcement effects of dividend-paying and non-dividend-paying firms differ. Section 3.3 analyzes joint dividend-split announcements made by dividend-paying firms. Section 3.4 examines alternative specifications and results from the 1975–1984 period.

3.1 Splitter characteristics and valuation effects: initial exploration

Table 1 reports the number of splits and split announcement effects for dividend-paying and non-dividend-paying firms over the 1985–1994 period.[2] A total of 1,597 splits were announced in this period, the vast majority of which (1,222 splits) were by dividend-paying (*D*) firms. *D* firms experience lower unconditional split announcement effects for all years except 1993, where both *D* and *ND* firms experience similar announcement effects. One explanation for why *D* firms have lower split announcement effects is that *D* firms are more likely to split—there are three times as many *D* splits as *ND* splits. This conclusion is, however, only tentative, because we need to consider the total number of *D* and *ND* firms, as well as differences in characteristics of the two types of firms. We defer more definite conclusions on split probabilities to a more formal analysis in Section 3.2.

Table 2 describes several cross-sectional features of dividend-paying and non-dividend-paying splitters for the 1985–1994 period as a whole and for two five-year subperiods, 1985–1989 and 1990–1994. *D* firms announcing splits are larger and have consistently higher presplit and target prices than

[2] Patterns in the number of announcements, announcement effects, firm characteristics, and statistics for simultaneous and nonsimultaneous split-dividend announcements are quite similar to those in the 1975–1984 period [and to other split studies such as Grinblatt, Masulis, and Titman (1984)]. We do not report these descriptive statistics for the 1975–1984 period.

Table 1
Split announcement effects: dividend-payers and non-dividend payers

	Dividend payers		Non-dividend payers		All firms	
Year	Number	Average AR	Number	Average AR	Number	Average AR
1985	152	2.24	44	2.82	196	2.37
		(0.25)		(1.03)		(0.54)
1986	221	2.23	46	2.56	267	2.29
		(0.26)		(0.61)		(0.35)
1987	184	1.91	39	4.24	223	2.32
		(0.29)		(0.96)		(0.48)
1988	70	1.58	21	2.13	91	1.71
		(0.42)		(0.70)		(0.50)
1989	118	1.30	37	4.15	155	1.98
		(0.31)		(0.95)		(0.54)
1990	55	1.05	31	2.46	86	1.56
		(0.35)		(1.01)		(0.67)
1991	84	1.75	30	3.13	114	2.11
		(0.35)		(1.36)		(0.76)
1992	134	1.57	39	3.68	173	2.05
		(0.37)		(1.23)		(0.67)
1993	118	1.94	49	1.91	167	1.93
		(0.41)		(1.12)		(0.70)
1994	86	1.77	39	2.66	125	2.05
		(0.38)		(0.69)		(0.50)
1985–1994	1222	1.84	375	2.98	1597	2.11
		(0.11)		(0.32)		(0.18)

Table 1 reports the year-wise breakup of the number of splits and average split announcement effects (AR) for splits between 1985 and 1994, classified by whether the splitter is dividend paying or non-dividend paying. AR is computed as $AR_i = \sum_{t=T-1}^{T+1} R_{i,t} - R_{s,i,t}$, where $R_{i,t}$ denotes the date t stock return of splitting firm i, $R_{s,i,t}$ is the date t return of the equally weighted index of size decile s to which firm i belongs and T is the split announcement date. Numbers in parentheses denote standard errors.

ND firms announcing splits. The average share trading volume of both types of firms is similar during 1985–1989, but trading volume for *ND* firms dramatically increases thereafter. Dividend-paying firms have significantly lower presplit run-ups. This suggests that dividend payers are likely to split earlier following a stock price appreciation. Not surprisingly, *ND* firms were more volatile than *D* firms throughout the 1985–1994 period. For the entire sample period, the average of each characteristic of splitting firms was significantly different from that of nonsplitting firms (t-statistics for significance tests of the differences exceed 8.0).

Table 3 focuses on dividend-paying splitters and reports unconditional split announcement effects classified by whether there is a simultaneous dividend or not, and by the nature of the preceding and accompanying dividend.[3] Only 20% of splits are *not* announced together with dividends. In this non-contemporaneous sample, splits preceded by a dividend increase have an average announcement effect of only 0.72%, whereas those preceded by unchanged dividends elicit more than double the response (1.91%). This

[3] A dividend is classified as a change only when the total payout changes after a split. For instance, a dividend payment nominally cut from 50 cents/share to 25 cents/share following a 2-for-1 split is an unchanged dividend.

Table 2
Cross-sectional characteristics of splitters

Year	Number of observations	Firm characteristics						
		PR_PRICE	*TAR_PRICE*	*SPFAC*	*RUNUP*	*SIZE*	*VOLUME*	*VOLATL*
Panel A: Dividend-paying firms								
1985–1994	1222	50.96	27.24	0.8312	1.367	13.61	2.586	2.409
		(0.77)	(0.33)	(0.01)	(0.01)	(0.05)	(0.06)	(0.03)
1985–1989	745	50.54	27.17	0.8190	1.365	13.39	2.597	2.412
		(1.00)	(0.44)	(0.02)	(0.01)	(0.06)	(0.08)	(0.03)
1990–1994	477	51.61	27.36	0.8503	1.369	13.96	2.570	2.403
		(1.20)	(0.49)	(0.02)	(0.02)	(0.07)	(0.10)	(0.04)
Panel B: Non-dividend-paying firms								
1985–1994	375	32.03	18.13	0.7200	1.730	12.23	3.543	3.619
		(1.05)	(0.47)	(0.02)	(0.06)	(0.08)	(0.18)	(0.08)
1985–1989	187	29.20	16.72	0.6985	1.605	11.84	2.724	3.505
		(1.40)	(0.59)	(0.03)	(0.05)	(0.09)	(0.17)	(0.11)
1990–1994	188	34.84	19.53	0.7414	1.855	12.62	4.357	3.731
		(1.53)	(0.71)	(0.04)	(0.12)	(0.12)	(0.30)	(0.12)

Table 2 reports sample averages of six characteristics of firms that announced a split between 1985 and 1994. *PR_PRICE* is the level of stock price on trading date [−5], where day [0] denotes the split date; *TAR_PRICE* equals *PR_PRICE* divided by the split factor *SPFAC*, which denotes the increase in the number of shares postsplit divided by the total number of shares prior to the split; *RUNUP* is the buy-and-hold return from trading days [−250] through [−5]; $SIZE$ is the natural logarithm of the market value of equity (in $ mm) on day [−5]; and *VOLATL* is the standard deviation of stock returns over the six months prior to the event date. Panel A reports data for splitters that paid at least one quarterly cash dividend in the calendar year prior to the split, and panel B reports data for splitters that did not pay a cash dividend in the year prior to the split. In each case we report data for the full period of 1985–1994 and for two five-year subperiods from 1985 to 1989 and 1990 to 1994. Numbers in parentheses denote standard errors.

Table 3
Dividend payer split valuation effects by nature of accompanying dividend

Nature of dividend	Number	Average AR	Percent positive
No simultaneous dividend			
Prior dividend unchanged	198	1.908	71.21
		(0.28)	
Prior dividend increased	76	0.718	63.16
		(0.28)	
Simultaneous dividend unchanged			
Prior dividend unchanged	260	2.388	76.54
		(0.25)	
Prior dividend increased	89	1.454	65.17
		(0.37)	
Simultaneous dividend increased			
Prior dividend unchanged	555	1.659	69.73
		(0.14)	
Prior dividend increased	15	1.697	73.33
		(0.49)	

Table 3 reports the number of announcements, average announcement effects (*AR*), and the percentage of announcement effects that are positive for splits announced by dividend-paying firms between 1985 and 1994. The data are classified by the nature of the dividend accompanying and preceding the split. Announcement effects are computed as $AR_i = \sum_{t=T-1}^{T+1} R_{i,t} - R_{s,i,t}$, where $R_{i,t}$ denotes the date t stock return of splitting firm i, $R_{s,i,t}$ is the date t return of the equally weighted index of size decile s to which firm i belongs, and T is the split announcement date. Numbers in parentheses denote standard errors.

evidence suggests that similar information might condition both dividend increases and splits. Common determinants, such as increases in earnings and stock prices, may underlie both dividend increases and splits so that splits tend to be more anticipated in circumstances that have led to recent dividend increases. We formally verify the existence of such common factors through a bivariate probit analysis in Section 3.3.

The vast majority of splits by D firms (about 80%) are announced together with dividends. Here the dividend accompanying a split is either unchanged (38% of the time) or increased (62% of the time). In the contemporaneous sample in which the current dividend is unchanged, splits preceded by dividend increases have lower announcement effects (1.45%) versus splits preceded by unchanged dividends, where the split announcement effect is 2.39%. As in the previous paragraph, the evidence might indicate that common factors underlie dividend increases and splits, so splits preceded by increased dividends may have been more anticipated. When a simultaneous dividend is an increase, however, split announcement effects are similar regardless of the nature of the preceding dividend. This may suggest that dividend increases in successive quarters are unlikely (we verify that this is empirically true). Hence a dividend increase in quarter t following a previous increase in quarter $t-1$ results in a stronger stock-price reaction to the dividend increase (AR_{di}). On the other hand, dividend increases are associated with lower subsequent split valuation effects ($AR_{s-d,i}$), as discussed previously. This might explain why total split-dividend increase announcement effects ($AR_d + AR_{s-d,i}$) do not vary depending on the nature of the preceding dividend.

The above discussion suggests two points. First, both the average split announcement effects and the cross-sectional characteristics of ND splitters differ from those of D splitters. Second, split announcement effects vary according to the nature of related dividend announcements. This suggests, although only informally, that there exists common information underlying splits and dividends. Section 3.3 formally examines whether such a relation exists and characterizes its nature more precisely.

3.2 Dividend-paying versus non-dividend-paying firms

Why do non-dividend-paying firms experience greater split announcement effects than dividend-paying firms? Is it because splits are less likely events for non-dividend-paying firms (the differential expectations hypothesis) or because splits are more informative for non-dividend-paying firms (the informational substitute hypothesis)?

Following the discussion in Section 1.1, we begin by specifying a model for market expectations of forthcoming splits, based on variables in the market's information set prior to a split. Empirically our model for SPL_i, the latent variable governing a split decision, is

$$SPL_i = \theta_{s0} + \theta_{s1} * PR\_PRICE_i + \theta_{s2} * SIZE_i + \theta_{s3} * VOLUME_i + \theta_{s4} * RUNUP_i + \psi_{si}. \tag{12}$$

We include the variable *PR_PRICE* as firms with high share prices are more likely to announce splits, if splits are indeed intended to return stock prices to a more "optimal" trading range. We include size as a control variable, since price and size are positively correlated. Firms with an unusual increase in stock prices are more likely to split; hence the variable *RUNUP* in Equation (12). We include trading volume as a control variable because Copeland (1979) suggests that splits are associated with changes in trading volume.

Under the parametric assumption that ψ_{si} is standard normal, the firm's split decision is a standard probit model. Panel A of Table 4 reports the probit estimates. The first column of results reports probit estimates for the pooled

Table 4
Conditional split valuation effects: 1985–1994

Model	1. All firms	2. *D* firms	3. *ND* firms
Panel A: Probit model for splits[a]			
Dependent variable: *SPLCODE*			
Independent variables:			
Constant	−1.97 (−19.05)	−2.51 (−15.32)	−2.81 (−14.65)
PR_PRICE	0.02 (32.40)	0.02 (22.48)	0.02 (15.47)
SIZE	−0.02 (−1.94)	−0.05 (−4.37)	0.05 (2.90)
RUNUP	0.06 (7.93)	1.13 (22.67)	0.04 (4.57)
VOLUME	0.02 (4.19)	−0.01 (−1.00)	0.02 (3.35)
χ^2 (d.f.)	1713.9 (4)	1486.1 (4)	440.35 (4)
Panel B: Second-pass regression[b]			
Dependent variable: *AR*			
Independent variables:			
Constant	−0.66 (−1.43)	1.13 (2.70)	−1.16 (−0.78)
λ_s	1.69 (5.69)	0.49 (1.77)	2.15 (2.66)

[a] Panel A reports probit estimates of firms' split decisions for stock splits announced between 1985 and 1994. The dependent variable *SPLCODE* is 1 if the firm announced a split during the calendar year and zero otherwise. Independent variables include *PR_PRICE*, the level of stock price on date [−5], where day [0] denotes the split or dividend event date; *SIZE*, the natural logarithm of the market value of equity (in $ mm) on day [−5]; *RUNUP*, the buy-and-hold return from days [−250] through [−5]; and *VOLUME*, ratio of the average volume of the stock traded in the month before the event date to the total outstanding shares.

[b] Panel B reports estimates of the regression

$$AR = \gamma_s + \beta_s * \lambda_s,$$

for splits announced by dividend-paying and non-dividend-paying firms. The dependent variable (*AR*) is the split announcement effect, computed for each announcement as $AR_{sd} = \sum_{t=T-1}^{T+1} R_t - R_{st}$, where T is the announcement date, R_t is the date t stock return of the announcing firm, and R_{st} is the date t return on the equally weighted index of size decile s to which the firm belongs. The independent variable (λ_s) is the unexpected information revealed by the split and is computed as inverse mills ratio based on parameters estimated from the panel A probit model. Numbers in parentheses denote t-statistics.

sample of both dividend-paying and non-dividend-paying firms. The coefficient for *PR_PRICE* is positive and significant: firms with higher stock prices are more likely to announce splits. The coefficient for firm size is negative, and this sign remains in all specifications that include both firm size and *PR_PRICE*, though size has a positive coefficient on a univariate basis (results not reported here). Thus, conditional on price, small firms are more likely to split, as in McNichols and Dravid (1990). The coefficient for *VOLUME* is positive, which suggests that firms with higher trading volumes are more likely to announce splits. The coefficient for *RUNUP* is positive: firms whose stocks have experienced large run-ups are more likely to split their stocks. We do not market adjust the variable *RUNUP*, since split decisions are likely to be based on the total price run-up of a stock, and not just the run-up in excess of the equilibrium expected return. Equivalently, when the market goes up, one should see more splits, and when the market retreats, fewer splits should be announced. Our data are consistent with such an interpretation, since relatively fewer splits were announced in the aftermath of the 1987 crash (see Table 1).

The probit model notably does not control for presplit earnings changes. To account for these, we obtain quarterly earnings data for our sample from the COMPUSTAT database. We discard about a quarter of our sample in this analysis due to nonavailability of earnings data from COMPUSTAT. We compute the change in preevent earnings as $\Delta e = e[0] - e[-4]$, where e[0] denotes the most recent quarterly earnings announcement up to and including the split date. We normalize the earnings change by one-year back market value rather than the presplit market value (to avoid conditioning on presplit price run-ups), so that $\Delta e/MV = \frac{e_0 - e_{-4}}{MV}$, where MV denotes the four-quarter back market value of equity. It is well known that earnings changes tend to be skewed and have outliers [e.g., Collins and Kothari (1989)], especially their note 11, so we analyze the median earnings changes. The median $\Delta e/MV$ for splitters is 0.4%, while it is 0.1% for nonsplitters, and the difference is significant at 1% (Wilcoxon $z = 7.97$). Splitters experience higher earnings growth compared to nonsplitters.

We reach similar conclusions when earnings changes are included in the probit model. Here $\Delta e/MV$ is reliably positively related to split probabilities on a stand-alone basis (coefficient = 0.02, t-statistic = 3.93), but only when 1% trimmed for outliers.[4] However, in multivariate probits (Equation (12)) that include prior period returns, earnings change is insignificant (coefficient = 0.004, $t = 0.90$). We experimented with alternative definitions of earnings changes, including the lagged change in earnings ($e[-1]-e[-5]$)

[4] If the data are not trimmed of such outliers, earnings change is not significant even on a stand-alone basis and earnings effects would be straightaway ruled out. A 1% trimming rule used here, which in our sample ends up excluding data with $|\Delta e/MV| \geq 70\%$, picks up a positive relation between earnings changes and splits. Trimming is a relatively standard practice in the accounting literature [see Section 4 in Collins and Kothari (1989), especially note 11].

and changes in operating income before depreciation (the "EBITDA" ratio) as defined in the long-term operating performance literature. The results are invariant to the metric used. Earnings changes—trimmed of outliers—are significant on a stand-alone basis but are never significant in multivariate specifications. We exclude this variable from further analysis.

The specification estimated in column 1 assumes that the same expectation model underlies splits by both *D* and *ND* firms. This assumption may be incorrect. For instance, Table 2 suggests that *ND* firms have greater presplit run-ups. Thus *ND* firms seem less likely to split than *D* firms for comparable price run-ups, which implies that $(\theta_{s4})_{ND}$ should exceed $(\theta_{s4})_{D}$. Moreover, it is not necessary to impose the requirement of equal coefficients for *D* and *ND* firms, a constraint implied in the pooled probit discussed above. Accordingly, the last two columns in Table 4 report separate probit estimates for *D* and *ND* firms.

Comparing the *D* and *ND* probit equations, we find that the coefficient for *PR_PRICE* is about the same for both *D* and *ND* firms. However, the coefficients for firm size and volume differ across the two samples. Among dividend payers, small firms are more likely to split, while among non-dividend payers, large firms are more likely to split. Higher volumes are associated with splits only for *ND* firms, so the positive split-volume relation noted in the pooled sample seems to be driven by non-dividend payers only. Positive run-ups are associated with splits for both *D* and *ND* firms, but the coefficient for *ND* firms is much lower. This indicates that *ND* firms are less likely to split than *D* firms given equal presplit run-ups. Finally, the difference in expectations of splits between dividend-paying and non-dividend-paying firms, $E(\theta_s X_s)_D - E(\theta_s X_s)_{ND}$ is 0.57, and is significant at well above 1% (t-statistic = 51). Splits are indeed less likely for non-dividend-paying firms than for dividend-paying firms.

To test the informational substitute hypothesis, we estimate the second-pass regression of Equation (3) for both *ND* and *D* firms. Under the assumption that ψ_{si} is standard normal, we can write Equation (3) as

$$E(AR_i \mid S) = \gamma_s + \beta_s \lambda_s(\theta_s' X_{si}), \tag{13}$$

where $\lambda_s(\cdot)$ denotes the inverse mills ratio for split announcement S [see, e.g., Greene (1993, p. 685)], consistently estimated by using the probit estimates from Equation (12) for the parameter θ_s. Equation (13) is estimated by ordinary least squares with standard errors adjusted along the lines of Heckman (1979). Panel B of Table 4 reports the estimates. Slope coefficient β_s is higher and significantly different for *ND* firms relative to *D* firms—in fact, $\beta_{s,nd} \approx 4\beta_{s,d}$. The results are consistent with the informational substitute hypothesis. As argued earlier, dividend payers have established a second mechanism by which to convey some of the common information underlying splits and dividends. For the same amount of surprise in splits, dividend payers should experience weaker stock price response to splits compared to non-dividend-paying firms. Our empirical evidence is consistent with this proposition.

Our results on *D* and *ND* β's may also be interpreted as additional evidence that the initiation of a dividend is an economically distinct event relative to a dividend increase. If dividends initiated by *ND* firms are close substitutes for increases announced by *D* firms, the second-pass regression coefficient β_s should be similar for *D* and *ND* firms, while we find that $\beta_{s,nd} > \beta_{s,d}$. Our findings are consistent with empirical evidence on price effects of initiations compared to dividend increases [e.g., Asquith and Mullins (1983)] and with postinitiation evidence documented in Venkatesh (1989), who finds structural changes in firms after initiations. Venkatesh argues that initiations reflect the maturing of firms' business. He documents that idiosyncratic risk is lower and future earnings changes become more predictable following a dividend initiation, which is consistent with a change in a firm's life-cycle stage driving dividend initiations. Finally, Asquith, Healy, and Palepu (1989) report additional evidence that initiations and increases are not informational substitutes in the context of stock splits. They find that *ND* splits are unlikely to be accompanied by initiations, while our evidence suggests that *D* splits are accompanied by dividend increases.

Finally, the panel B estimates reveal that the intercept term γ_s for *ND* firms is lower than that for *D* firms and is not statistically significant. This result suggests that information unrelated to what is modeled here does not explain why split announcement effects are *greater* for *ND* firms. Rather a combination of the differential expectations and informational substitute hypotheses are primarily responsible for the differences in split announcement effects between *D* and *ND* firms.

3.3 Simultaneous dividend-split announcements

In this section we examine splits announced by dividend-paying firms alone, to assess the relative importance of dividends and splits in explaining split announcement effects.

As discussed in Section 1.2, conditional techniques require us to specify a model for market expectations of both splits and dividends. We model splits as the probit model of Equation (12), while the dividend decision is assumed to depend on a latent variable DIV_i. We specify DIV_i as

$$\begin{aligned} DIV_i = {} & \theta_{d0} + \theta_{d1} * PR\_PRICE_i + \theta_{d2} * SIZE_i + \theta_{d3} * RUNUP_i \\ & + \theta_{d4} * PR1DUMMY_i + \theta_{d5} * PR4DUMMY_i \\ & + \theta_{d6} * VOLATL_i + \psi_{di}. \end{aligned} \tag{14}$$

Firms announcing a split do not announce dividend decreases or omissions. Hence we replace the ordered probit model, in which firms either increase, decrease, or do not change dividends, by a probit model in which dividends are either increased or left unchanged, to specify firms' potential dividend choices on an announcement date.[5]

The variables included in Equation (14) deserve some comment, as there exists little previous evidence on the cross-sectional structure of dividend expectations. We include the variables *PR_PRICE* and *SIZE* as proxies for firm risk, as previous work [e.g., Eades (1982)] shows that riskier firms are less likely to raise dividends. We include the volatility of returns, *VOLATL*, for much the same reason. Firms with large price run-ups are likely to announce dividend increases, while those with large price declines are likely to decrease dividends, since dividends lag prices in adjusting to new information. Hence we include the variable *RUNUP* in our dividend specification. The variable *PR*1*DUMMY* is included because firms that have announced dividend increases in the previous quarter seem unlikely to announce another dividend increase this quarter. We also include a dummy for the four-quarter back dividend announcements, *PR*4*DUMMY*, to account for seasonality in dividend increase patterns. Firms that increase a dividend in a quarter tend to increase dividends four quarters ahead.

Panel A of Table 5 presents estimates of a bivariate probit specification for firms' split-dividend decisions. The sign and significance of the bivariate probit split decision coefficients are broadly similar to those reported in Table 4. The dividend probit results present evidence that dividend increases are indeed partially predictable. We find that large firms, firms with higher stock price levels, high preannouncement run-ups, and firms that have announced an increase four quarters back or those that have *not* announced a dividend increase in the previous quarter are more likely to announce dividend increases. Our estimate of ρ_{SD} is 0.63 and is significant at greater than 1%, indicating that split and dividend information are positively correlated.

To test the information substitute hypothesis, we estimate the second-pass regression of Equation (6) on the joint announcement sample. Under the assumption of normality, Equation (6) can be written as

$$E(AR_{sdi} \mid S, C) = \gamma_{sd} + \beta_s \lambda_s(\theta_s' X_{si}) + \beta_d \lambda_d(\theta_d' X_{di}), \tag{15}$$

where $\lambda_s(\cdot)$ and $\lambda_d(\cdot)$ denote the bivariate inverse mills ratios for the split and dividend announcements, respectively. These are computed using the probit estimates of θ_s and θ_d obtained in the bivariate probit estimates of Equation (12) and (14), respectively.

Panel B in Table 5 reports estimates of Equation (15). Univariate regression estimates of both β_d and β_s are positive and statistically significant, suggesting that both dividends and splits, in isolation, have positive *conditional* valuation effects. In particular, surprises estimated off the dividend expectations

[5] While splitting firms never decreased dividends in our sample, dividend decreases do occur in our control sample of nonsplitters. Rather than discarding such decreases, we estimated an ordered probit rather than a standard probit model. The results are qualitatively similar under both approaches.

Table 5
Conditional split-dividend announcement effects: 1985–1994

Panel A: Bivariate probit[a]			
Dependent variables:	*SPLCODE*	*DIVDUMMY*	
Independent variables:			
Constant	−2.70 (−14.82)	−2.29 (−13.44)	
PR_PRICE	0.02 (25.48)	0.01 (7.17)	
SIZE	−0.04 (−2.85)	0.03 (2.46)	
RUNUP	1.10 (30.23)	0.48 (10.33)	
VOLUME	−0.01 (−1.40)		
VOLATL		−0.07 (−4.19)	
PR1DUMMY		−0.57 (−13.44)	
PR4DUMMY		1.17 (40.20)	
χ^2 (d.f.)	1097 (4)	619 (6)	
ρ_{sd}	0.63(33.60)		
Panel B: Second-pass regression[b]			
Dependent variable: AR_{sd}			
Independent variables:			
Constant	0.28 (8.26)	0.28 (8.23)	0.28 (8.28)
λ_s	0.93 (13.53)		0.79 (10.93)
λ_d		0.60 (10.05)	0.38 (6.16)

[a]Panel A estimates a bivariate probit model for joint split-dividend announcements made from 1985 to 1994. Dependent variables are 0/1 dummies for splits (*SPLCODE*) and dividend increases (*DIVDUMMY*). Independent variables include *PR_PRICE*, the stock price on day [−5], where day [0] is the event date; *SIZE*, the natural logarithm of the market value of equity (in $ mm) on day [−5]; *RUNUP*, the buy-and-hold return from [−250] through [−5]; *VOLUME*, the volume of the stock traded in month [−1] divided by shares outstanding; *VOLATL*, the standard deviation of stock returns over six months before the event date; and *PR1DUMMY* and *PR1DUMMY*, indicator variables that are 1, 0, or −1 if the one-quarter back (*PR1DUMMY*) or four-quarters back (*PR4DUMMY*) dividend was increased, unchanged, or decreased, respectively.

[b]Panel B reports the estimates of the regression

$$AR_{sd} = \gamma_{sd} + \beta_s * \lambda_s + \beta_d * \lambda_d.$$

The dependent variable, AR_{sd}, is the joint split-dividend announcement effect, estimated as $AR_{sd} = \sum_{t=T-1}^{T+1} R_t - R_{st}$, where T is the announcement date, R_t is the date t stock return of the announcing firm and R_{st} is the date t return on the equally weighted index of size decile s to which the firm belongs. Independent variables, λ_s and λ_d, denote the unexpected information revealed by the split and dividend announcements, respectively, the inverse mills ratios based on parameters estimated from the panel A bivariate probit model. Numbers in parentheses denote t-statistics.

model of Equation (14) are significantly related to announcement effects. This suggests that the popular “naive” model for dividend expectations is misspecified. Both the split and dividend multiple-regression coefficients are lower than their univariate counterparts (β_s by 18% and β_d by 37%), which suggests that splits and dividends are informational substitutes. However, both β_s and β_d remain significant in the multivariate specification. Thus neither announcement subsumes the other in explaining the joint split-dividend announcement effect.

What part of split valuation effects are due to implied dividend information? Equation (10) shows that the fraction of split valuation effects due to dividend information is $\alpha_d \rho_{sd}$, while the portion unrelated to dividends is $(1-\rho_{sd}^2)\alpha_{s-d}$. Following Section 1.2.2, we have $\alpha_{s-d} = \beta_s$ and $\alpha_d = \beta_d + \rho_{sd}\alpha_{s-d}$. The estimates in Table 5 give $\beta_s = 0.79$, $\beta_d = 0.38$, and $\rho_{sd} = 0.63$. Using these estimates, we get $\alpha_{s-d} = 0.79$ and $\alpha_d = 0.88$, which in turn imply that $\alpha_d \rho_{sd} = 0.55$ and $(1-\rho_{sd}^2)\alpha_{s-d} = 0.48$. This implies that the portion of split valuation effects that is *unrelated* to dividends is $\frac{0.48}{0.55+0.48} \approx 46\%$ (asymptotic standard error$=2.46\%$), while 54% of split valuation effects simply reflect the dividend information implied in splits. Thus dividend and nondividend components each account for roughly half of split valuation effects.

3.4 Additional specifications and robustness

3.4.1 Results from 1975 to 1984. The samples in Sections 3.2 and 3.3 cover splits announced between 1985 and 1994. We also replicate the analysis for a sample drawn from an earlier 10-year period from 1975 to 1984 to reassess the differential expectations and informational substitute hypotheses for a different time period. This analysis also allows us to track the evolution in conditional split and dividend announcement effects and reexamine the relative proportions of nondividend and dividend components of split announcement effects over a different period. Tables 6 and 7 present the results, replicating the contents of Tables 4 and 5 for the 1975–1984 sample. As before, we first examine the conditional announcements for *D* and *ND* firms and then turn to simultaneous split-dividend announcements.

Table 6
Conditional split valuation effects: 1975–1984

Model	1. All firms	2. *D* firms	3. *ND* firms
Panel A: Probit model for splits[a]			
Dependent variable: *SPLCODE*			
Independent variables:			
Constant	−1.62 (−13.46)	−1.23 (−7.75)	−2.61 (−10.89)
PR_PRICE	0.03 (33.65)	0.03 (28.00)	0.03 (14.60)
SIZE	−0.10 (−9.42)	−0.16 (−11.82)	−0.01 (−0.28)
RUNUP	0.46 (20.11)	0.79 (21.68)	0.25 (7.61)
VOLUME	0.02 (2.06)	0.01 (0.74)	0.04 (3.49)
χ^2 (d.f.)	2541.5 (4)	2018.4 (4)	611.98 (4)
Panel B: Second-pass regression[b]			
Dependent variable: *AR*			
Independent variables:			
Constant	−0.18 (−0.44)	0.82 (1.88)	−0.24 (−0.25)
λ_s	2.34 (8.21)	1.64 (5.04)	2.66 (4.48)

[a]Panel A reports probit estimates of firms' split decisions for stock splits announced between 1975 and 1984. The dependent variable *SPLCODE* is 1 if the firm announced a split during the calendar year and zero otherwise. Independent variables include *PR_PRICE*, the level of stock price on date [−5], where day [0] denotes the split or dividend event date; *SIZE*, the natural logarithm of the market value of equity (in $ mm) on day [−5]; *RUNUP*, the buy-and-hold return from days [−250] through [−5]; and *VOLUME*, ratio of the average volume of the stock traded in the month before the event date to the total outstanding shares.

[b]Panel B reports estimates of the regression

$$AR = \gamma_s + \beta_s * \lambda_s$$

for splits announced by dividend-paying and non-dividend-paying firms. The dependent variable (*AR*) is the split announcement effect, computed for each announcement as $AR_{sd} = \sum_{t=T-1}^{T+1} R_t - R_{st}$, where T is the announcement date, R_t is the date t stock return of the announcing firm and R_{st} is the date t return on the equally weighted index of size decile s to which the firm belongs. The independent variable (λ_s) is the unexpected information revealed by the split and is computed as inverse mills ratio based on parameters estimated from the panel A probit model. Numbers in parentheses denote t-statistics.

Table 7
Conditional split-dividend announcement effects: 1975–1984

Panel A: Bivariate probit[a]

Dependent variables:	*SPLCODE*	*DIVDUMMY*	
Independent variables:			
Constant	−1.29 (−7.62)	−1.66 (−13.15)	
PR_PRICE	0.03 (24.76)	0.01 (10.91)	
SIZE	−0.16 (−10.78)	0.02 (2.01)	
RUNUP	0.77 (19.53)	0.37 (11.66)	
VOLUME	0.01 (0.70)		
VOLATL		−0.03 (−2.11)	
PR1DUMMY		−0.61 (−15.58)	
PR4DUMMY		1.06 (32.06)	
χ^2 (d.f.)	1512 (4)	842 (6)	
ρ_{sd}	0.69 (40.86)		
Panel B: Second-pass regression[b]			
Dependent variable: AR_{sd}			
Independent variables:			
Constant	0.54 (15.96)	0.52 (15.29)	0.53 (15.95)
λ_s	1.60 (19.54)		1.25 (14.76)
λ_d		1.06 (20.60)	0.74 (14.20)

[a]Panel A estimates a bivariate probit model for joint split-dividend announcements made from 1975 to 1984. Dependent variables are 0/1 dummies for splits (*SPLCODE*) and dividend increases (*DIVDUMMY*). Independent variables include *PR_PRICE*, the stock price on day [−5], where day [0] is the event date; *SIZE*, the natural logarithm of the market value of equity (in $ mm) on day [−5]; *RUNUP*, the buy-and-hold return from [−250] through [−5]; *VOLUME*, the volume of the stock traded in month [−1] divided by shares outstanding; *VOLATL*, the standard deviation of stock returns over six months before the event date; and *PR1DUMMY* and *PR4DUMMY*, indicator variables that are 1, 0, or −1 if the one-quarter back (*PR1DUMMY*) or four-quarters back (*PR4DUMMY*) dividend was increased, unchanged, or decreased, respectively.

[b]Panel B reports the estimates of the regression

$$AR_{sd} = \gamma_{sd} + \beta_s * \lambda_s + \beta_d * \lambda_d.$$

The dependent variable, AR_{sd}, is the joint split-dividend announcement effect, estimated as $AR_{sd} = \sum_{t=T-1}^{T+1} R_t - R_{st}$, where T is the announcement date, R_t is the date t stock return of the announcing firm and R_{st} is the date t return on the equally weighted index of size decile s to which the firm belongs. Independent variables, λ_s and λ_d, denote the unexpected information revealed by the split and dividend announcements, respectively, the inverse mills ratios based on parameters estimated from the panel A bivariate probit model. Numbers in parentheses denote t-statistics.

Panel A of Table 6 reports estimates of split probit models for both *D* and *ND* firms. The similarities and differences between *D* and *ND* probit estimates roughly parallel those in the 1985-1994 sample (panel A of Table 4). For instance, the coefficient for *PR_PRICE* is positive, significant, and has similar magnitudes for both *D* and *ND* firms, as in the 1985–1994 sample. The coefficient for volume is significant only in the *ND* sample, and that for size is significantly negative only for the *D* sample. Size, however, does not explain split decisions for *ND* firms. The coefficient for *RUNUP* is lower for *ND* firms than for *D* firms, as in the 1985–1994 sample. The difference in dividend expectations $E(\theta_s X_s)_D - E(\theta_s X_s)_{ND}$ equals 0.51 and is significant at 1% (t-statistic = 41), consistent with the differential expectations hypothesis. These results are largely similar to those for the 1985–1994 sample.

Panel B of Table 6 reports estimates of second-pass regressions relating announcement effects to the information revealed in splits. The second-pass coefficient β_s for *ND* firms (2.66) is higher and significantly different from β_s for *D* firms (1.64) as in the 1984–1994 sample. The most striking feature of the data, however, is the structural change in β_s over time. For both *D* and *ND* firms, $\beta_{s,1975-1984} > \beta_{s,1985-1994}$. The *conditional* split announcement effects for both types of firms have declined over time, more strikingly for *D* firms (1.64 in 1975–1984 versus 0.49 in 1985–1994) than for *ND* firms (2.66 in 1975–1984 versus 2.14 in 1985–1994). Thus similar amounts of surprise in splits appear to elicit a weaker stock market response in the more recent 1985–1994 period than in the 1975–1984 period. Similar structural changes also appear in the simultaneous split-dividend announcement effect sample, which we discuss next.

Table 7 reports estimates of the bivariate probit specification (panel A) and conditional announcement effects (panel B) for the 1975–1984 period. With regard to the bivariate probit estimates, all significant cross-sectional coefficients have similar sign and significance in both the 1975–1984 and 1985–1994 samples. In addition, the correlation coefficient between split and dividend is similar, 0.69 for the 1975–1984 period versus 0.63 for the 1985–1994 period. With regard to the second-pass regression of announcement effects on the split/dividend inverse mills ratios, there is again evidence of structural change over the two periods. The coefficient for the dividend information is 0.74 in 1975–1984, while it is about 50% lower at 0.38 for the 1985–1994 period. This provides some of the first evidence that the informational content of dividends has declined over time. The split information coefficient also drops by about one-third from 1.25 to 0.79. Again, the data suggest that the *conditional* announcement effects have declined over time: equivalent amounts of surprise result in lower announcement effects in the more recent periods, possibly because of better availability of information to investors. We leave for future work a more detailed investigation of the structural changes noted here.

Finally, the estimates in Table 7 imply that for the 1975–1984 period, $\rho_{sd}\alpha_d = 1.11$ and $(1-\rho_{sd}^2)\alpha_{s-d} = 0.65$, so that the portion of conditional split valuation effects unrelated to implied dividend information is $\frac{0.65}{1.10+0.65} \approx 37\%$ (asymptotic standard error $= 1.57\%$), while 63% of conditional split valuation effects reflect the dividend information implied in splits. These numbers are comparable to those for the 1985–1994 period, though the *nondividend* component of split valuation effects has increased somewhat from 37% in 1975–1984 to 46% in the later 1985–1994 period.

3.4.2 Magnitudes of splits and dividends. The specifications of Section 3.3 have focused only on the split and dividend change events, ignoring the actual *magnitudes* of the split and the accompanying dividend change. As a diagnostic, we add to Equation (15) additional variables capturing the magnitudes of the split and dividend changes, to assess the robustness of our conclusions. To assess the effect of the size of dividend changes and splits, we need to compute the unexpected size of each announcement given the nature of the dividend decision $C \in (D, U, I)$ and the split decision S. We then include the unexpected sizes as regressors that potentially explain split-dividend announcement effects.

To compute the unexpected magnitude of the split factor $SPFAC_i$ announced by firm i, we subtract from $SPFAC_i$ its expectation. This eliminates the portion of $SPFAC_i$ that is predictable given the information already available to the market. To this end we regress $SPFAC_i$ on variables X_{si} that are in the market's preevent information set. To obtain the incremental information in the split size over and above just the *fact* that a split was announced (or not announced), we also include the inverse mills ratio $\lambda_S(.)$ in Equation (15) as an auxiliary regressor to explain the firm's choice of a split size. The coefficient for this term will, of course, be zero if the last relation is immaterial. Thus we estimate the regression

$$SPFAC_i = \pi_{s0} + \pi_s' X_{si} + \pi_{imr,s} \lambda_s(\theta' X_{si}) + usf_i. \tag{16}$$

Residuals from Equation (16), viz., usf_i, capture the unexpected information in the magnitude of the split factor. Similarly we regress the magnitude of the dividend change ($DIVCHG_i$) announced by firm i on the variables X_{di} and the inverse mills ratio $\lambda_d(\theta_d' X_{di})$. That is, we estimate

$$DIVCHG_i = \pi_{d0} + \pi_d' X_{di} + \pi_{imr,d} \lambda_d(\theta' X_{di}) + udiv_i, \tag{17}$$

and the residuals from this equation, $udiv_i$, estimate the unexpected information in the size of a dividend change. Following existing literature [e.g., Denis, Denis and Sarin (1994)], we define $DIVCHG_i$ as the change in the dollars per share paid as dividends, normalized by the preannouncement share price.

We reestimate Equation (15), but now with the residuals usf_i and $udiv_i$ from Equations (16) and (17), respectively, added as extra explanatory variables. That is, we estimate

$$E(AR_i \mid S, D) = \gamma_{sd} + \beta_s \lambda_s(\theta_s' X_{si}) + \beta_d \lambda_d(\theta_d' X_{di}) + \beta_{usf} usf_i + \beta_{udiv} udiv_i. \tag{18}$$

Table 8 reports estimates of Equation (18). The unexpected split size (usf) and the unexpected dividend change ($udiv$) do explain split-dividend announcement effects, both in the univariate and the multivariate specifications (see Table 8). However, even after controlling for both usf and $udiv$, the magnitude and significance of β_s and β_d remain essentially unchanged. Similar results obtain for the 1975–1984 period, for which estimates of Equation (18) yield $\beta_{usf} = 0.80$ and $\beta_{udiv} = 0.33$ (both significant at 1%), while β_s and β_d are 1.21 and 0.73, very similar to estimates in Table 7.[6]

[6] We also analyze earnings releases that occur around split or dividend dates. The requirement of COMPUSTAT data and a quarterly earnings report date shrinks the sample by about a third. We find that about a quarter of the

Table 8
Information in magnitudes of split factors and dividend changes

Dependent variable: AR_{sd}

	Independent variables				
Model	Constant	λ_s	λ_d	usf	$udiv$
1	0.28			0.69	
	(8.20)			(2.79)	
2	0.28				0.43
	(8.22)				(8.13)
3	0.34	0.81	0.38	0.85	0.49
	(10.09)	(12.21)	(5.81)	(3.47)	(9.28)

Table 8 reports estimates of the regression

$$AR_{sd} = \gamma_{sd} + \beta_s * \lambda_s + \beta_d * \lambda_d + \beta_{usf} * usf + \beta_{udiv} * udiv,$$

for joint split-dividend announcements made between 1985 and 1994. The dependent variable, AR_{sd}, is the split-dividend announcement effect, computed as $AR_{sd} = \sum_{t=T-1}^{T+1} R_t - R_{st}$, where R_t denotes the date t stock return of the announcing firm, R_{st} is the date t return of the equally weighted index of size decile s to which the firm belongs and T is the split-dividend announcement date. The independent variables are

- λ_s and λ_d, the inverse mills ratios associated with splits and dividends, respectively, computed on the basis of the probit models estimated in Table 5.
- usf and $udiv$ denote the unexpected information in the magnitude of the split factor and size of dividend change, respectively.

The variable usf is computed as the residual from the regression of *SPFAC* on *PR_PRICE*, *SIZE*, *VOLUME*, *RUNUP*, and λ_s, while $udiv$ is the residual from the regression of *DIVCHG* on *PR_PRICE*, *SIZE*, *RUNUP*, *VOLATL*, *P1DUMMY*, *P4DUMMY*, and λ_d, and the λ's are inverse mills ratios based on a bivariate probit model for firms' choices of splits and dividends. The bivariate probit estimates and the definitions of the independent variables are provided in Table 5.

3.4.3 The role of future dividends. The specifications in Section 3.3 do not control for the possibility that information about *future* dividends explains some part of joint split-dividend announcements. To examine this possibility, we examine if splits have any power to predict future dividend announcements. If so, we can examine whether the future dividend implications of splits explain joint split-dividend announcement effects.

Table 9 gives some preliminary evidence on the ability of splits to predict four-quarter ahead dividend changes. We classify the sample of all dividend-paying splitting firms into three categories: firms that increased the accompanying dividend, ones that did not change the dividend and ones that cut the contemporaneous dividend. Within each category we estimate the proportion of firms that announced increased, decreased, or unchanged dividends four quarters after the split. We also report in panel B analogous estimates of future dividend change probabilities for the control sample of dividend-paying firms that did not announce a split.

sample has coincident earnings releases in a two-day window surrounding the event. We estimate a measure of earnings surprises from COMPUSTAT data, $e[0]-e[-4]$ (we also used $e[0]-e[-4]-(e[-1]-e[-5])$), normalized by market value [Collins and Kothari (1989)]. Earnings surprises have positive coefficients (0.05 with t-statistic = 2.72) but have no material impact on any other regression estimates.

Table 9
Future dividend changes

	Nature of future dividend			
Nature of current dividend	Increased	Unchanged	Decreased	All
Panel A: Splitting firms				
All firms	300 (0.3282)	614 (0.6718)	0 (0.0000)	914
Simultaneous dividend increased	252 (0.4516)	306 (0.5484)	0 (0.0000)	558
Simultaneous dividend unchanged	48 (0.1348)	308 (0.8652)	0 (0.0000)	356
Simultaneous dividend decreased	0 (0.0000)	0 (0.0000)	0 (0.0000)	0
Panel B: Nonsplitting firms				
All firms	1063 (0.1103)	8343 (0.8655)	233 (0.0242)	9639
Simultaneous dividend increased	572 (0.5009)	542 (0.4746)	28 (0.0245)	1142
Simultaneous dividend unchanged	461 (0.0557)	7647 (0.9024)	167 (0.0202)	8275
Simultaneous dividend decreased	30 (0.1351)	154 (0.6937)	38 (0.1712)	222

Table 9 reports the number of firms that increased, left unchanged, or decreased the four-quarters ahead dividend, classified by the nature of current dividend. Panel A reports the results for the sample of splits announced between 1985 and 1994 where a dividend announcement accompanied the split. Panel B reports the results for dividend-paying firms that did not announce a split, and the dividend event is a randomly chosen from the four quarterly dividends paid during a calendar year. Numbers in parentheses denote the fraction of firms that increase, leave unchanged, or decrease the four-quarters ahead dividend within each category of firms classified by the nature of current dividend.

The data in Table 9 suggest that splits do contain some information about future dividends. Not conditioning on the nature of the dividend announcement accompanying a split, splitters are certainly more likely to increase one-year ahead dividends, as about 33% (300/914) of all splitters increase one-year ahead dividends, while only 11% (1063/9639) of nonsplitters increase one-year ahead dividends (see row 1 in both panel A and panel B). However, once one controls for the nature of the accompanying dividend announcement, splitters are not more likely to announce future dividend increases compared to nonsplitters. This result is best seen by comparing the frequencies of dividend increases for splitters making a given type of dividend change announcement (panel A) with nonsplitters making the same type of dividend announcement (panel B).[7]

The above results suggest that splits have no role in explaining future dividend changes beyond the information contained in a contemporaneous dividend. However, before discarding this possibility altogether, consider the

[7] Our evidence complements that in Asquith, Healy, and Palepu (1989), who analyze dividend initiations by non-dividend-paying firms. We focus on changes in future dividends in already-existing dividend programs of dividend payers rather than initiation of new dividends by hitherto non-dividend-paying firms. Asquith, Healy, and Palepu document that the probability of dividend initiations by non-dividend-paying firms is not higher following a split.

evidence concerning dividend decreases. Table 9 shows that splitting firms never announce a one-year ahead dividend decrease, while dividend cuts, while rare (frequency of 2.32%), still occur in the nonsplitting sample. Similar results (not reported here) obtain when we consider one-quarter ahead dividend announcements rather than four-quarter (one-year) ahead dividend announcements. This suggests that splits may have some power to predict future dividend information. We examine this possibility statistically by estimating an ordered probit specification to predict future dividend changes:

$$\begin{aligned} D_{+4,i} &= I \Leftrightarrow \theta'_{d4} X_{d4,i} + \psi_{d4} > \mu \\ D_{+4,i} &= U \Leftrightarrow \mu_I \geq \theta'_{d4} X_{d4,i} \geq 0 \\ D_{+4,i} &= D \Leftrightarrow \theta'_{d4} X_{d4,i} < 0, \end{aligned} \tag{19}$$

where $D_{+4,i} AR\{D, U, I\}$ denotes firm i's four-quarter ahead dividend announcement (decreased, unchanged, or increased dividends) and $X_{d4,i}$ is a set of explanatory variables. We include three sets of variables in the ordered probit equation. First, we include a dummy variable *SPLCODE* that takes the value one or zero depending on whether a split is announced or not. The coefficient for *SPLCODE* determines whether splits have information about future dividends. Second, we include the variable *SIM_DUMMY*, which takes the value -1, 0, or $+1$, depending on whether the current dividend was a decrease, unchanged, or an increase. This variable controls for the information about the future dividend contained in the current dividend announcement. Finally, following the evidence in Table 9, we include in $X_{d4,i}$ all the variables used to explain current dividend announcements [as in Equation (14)], and a dummy variable for the previous quarter dividend. Table 10 reports estimates of the ordered probit specification.

From the first column in Table 10, we see that the split alone has some power to predict future dividends. A splitting firm, as expected, is more likely to announce a dividend increase (and less likely to announce a dividend cut) four quarters from the split date. In the second column specification, where the simultaneous dividend dummy is added as a regressor, we find that the coefficient for splits decreases dramatically. Evidently most of the explanatory power of splits is subsumed by that of the accompanying dividend. Finally, the coefficient for splits tails off almost completely in the third column specification in Table 10, when other variables are added to estimate the ordered probit specification. The split coefficient is small and no longer significant in the third column. Thus it appears that splits have *no* incremental power to predict future dividend changes once we control for both the contemporaneous dividend and other variables in the market's information set. Future dividend payment patterns of splitters appear to be driven by cross-sectional characteristics of splitters; the split itself says little about future dividends.

Table 10
Ordered probit model for future dividend announcements

Dependent variable: Four-quarter ahead dividend

Independent variables:			
Constant	2.04 (67.63)	1.98 (65.71)	1.25 (7.82)
SPLCODE	0.80 (16.71)	0.11 (2.07)	0.005 (0.08)
SIMDUMMY		1.44 (41.11)	1.13 (29.07)
PR1DUMMY			0.62 (19.20)
PR_PRICE			0.004 (4.26)
SIZE			0.03 (2.92)
RUNUP			0.19 (3.53)
VOLATL			−0.01 (−0.85)
μ	3.27 (95.87)	3.51 (102.94)	3.61 (100.19)
χ^2 (d.f.)	295 (2)	1519 (3)	1620 (8)

Table 10 reports estimates of an ordered probit model that predicts the nature of the four-quarter (one year) ahead dividend announcement following current dividend announcement made between 1985 and 1994. The dependent variable is DIV_{+4} which equals +1, 0, or −1 if the four-quarter ahead dividend is increased (I), unchanged (U), or decreased (D). This decision is modeled as an ordered probit model in which firms announce I if $L > \mu$, U if $0 \leq L \leq \mu$, and D if $L < 0$, respectively, where μ is an estimated parameter. We specify the underlying latent variable L as

$$L = \theta_{d4,0} + \theta_{d4,1} SPLCODE + \theta_{d4,2} SIMDUMMY + \theta_{d4,3} PR1DUMMY + \theta_{d4,4} PR\_PRICE$$
$$+ \theta_{d4,5} SIZE + \theta_{d4,6} RUNUP + \theta_{d4,7} VOLATL + \psi_{d4},$$

where *SPLCODE* is an indicator variable that takes a value of 1 if firm i announced a split and zero otherwise; *SIMDUMMY (PR1DUMMY)* equals +1, 0, or −1 if the current (last quarter) dividend is increased, unchanged, or decreased, respectively; *PR_PRICE* is the firm's stock price on date [−5], where day [0] denotes the split or dividend event date; *SIZE* is the natural logarithm of the market value of equity (in \$ mm) on day [−5]; *RUNUP*, the buy-and-hold return from days [−250] through [−5]; *VOLATL* is the standard deviation of stock returns over the six months prior to the event date; and ψ_{d4} denotes the announcing firm's private information. Numbers in parentheses denote t-statistics.

In results not reported here, we replicated the analysis for one-quarter ahead dividends and obtain similar results. In addition, we also compute the incremental unexpected information about future dividends conveyed by a split and examine whether this variable explains split-dividend announcement effects. Not surprisingly, it does not. If the split itself explains little about future dividend changes, the unexpected information about future dividends implied by a split can hardly be expected to explain split-dividend announcement effects.

4. Conclusion

Positive split announcement effects have long posed an interesting empirical puzzle to researchers in finance. In particular, a long-standing question in the splits literature has been whether split announcement effects can be attributed to dividends, and if so, what part of the announcement effects reflect the dividend information implied in splits. We develop and implement econometric methods to obtain some first estimates of such a decomposition. Our results suggest that 46% of split valuation effects are not caused by dividend information implied by splits. We leave a more precise characterization of such nondividend factors and their relative importance for future research.

Perhaps as important, the article also makes a methodological point concerning sample selection in event studies. In selecting samples for analysis in event studies, researchers often encounter events that are accompanied by simultaneous "contaminating" announcements. For instance, dividend announcements contaminate more than 80% of splits announced by dividend-paying firms. How should one handle such contamination? A frequently used approach is to simply discard all joint announcements and concentrate instead on "clean" samples free of contemporaneous contaminating announcements. However, such a procedure has significant drawbacks. First, purging data of joint announcements cuts the sample size used in empirical work. Moreover, this procedure does not necessarily eliminate biases due to contamination. In fact, if the contaminating event were likely, even its *absence* would surprise markets and cause a confounding stock price reaction. On the other hand, conditional event study techniques allow one to exploit the information in the joint samples instead of discarding such data by explicitly controlling for contaminating announcements within a simple, easy-to-implement econometric framework, as demonstrated here.

Appendix: Derivation of Expressions for Bivariate Probit Conditional Expectations

We have two variables z_1 and z_2 satisfying a bivariate probit distribution with correlation coefficient ρ. The density function can be expressed as

$$f(z_1, z_2, \rho) = \frac{1}{2\pi\sqrt{1-\rho^2}} e^{\frac{-(z_1^2+z_2^2-2\rho z_1 z_2)}{2(1-\rho^2)}}.$$

We require to compute expressions of the form $E(z_1 \,|\, z_1 > (\leq)\mu_1, z_2 > (\leq)\mu_2)$. From the theory of conditional distributions, we have that

$$E(z_1 \,|\, z_1 > (\leq)\mu_1, z_2 > (\leq)\mu_2) = \frac{E_f(z_1, C)}{P(z_1 > (\leq)\mu_1, z_2 > (\leq)\mu_2)},$$

where $E_f(\cdot)$ denotes the expectation taken with respect to the joint density function given above, and C denotes the boundary conditions, that is, $C \equiv (z_1 > (\leq)\mu_1, z_2 > (\leq)\mu_2)$.

We also have the following results for the joint probabilities:

$$\begin{aligned}
P(z_1 > \mu_1, z_2 > \mu_2) &= 1 - \Phi(\mu_1) - \Phi(\mu_2) + \Phi_2(\mu_1, \mu_2, \rho) \\
P(z_1 > \mu_1, z_2 < \mu_2) &= \Phi(\mu_2) - \Phi_2(\mu_1, \mu_2, \rho) \\
P(z_1 < \mu_1, z_2 > \mu_2) &= \Phi(\mu_1) - \Phi_2(\mu_1, \mu_2, \rho) \\
P(z_1 < \mu_1, z_2 < \mu_2) &= \Phi_2(\mu_1, \mu_2, \rho),
\end{aligned}$$

where $\Phi(.)$ and $\Phi_2(.)$ denote the univariate and bivariate standard normal distribution functions, respectively, and $\phi(.)$ denotes the univariate standard normal density function:

$$
\begin{aligned}
E_f(z_1, C \equiv z_1 > \mu_1, z_2 > \mu_2) &= \int_{\mu_1}^{\infty}\int_{\mu_2}^{\infty} \frac{z_1}{2\pi\sqrt{1-\rho^2}} e^{\frac{-(z_1^2+z_2^2-2\rho z_1 z_2)}{2(1-\rho^2)}} dz_1 dz_2 \\
&= \int_{\mu_1}^{\infty}\int_{\mu_2}^{\infty} \frac{z_1}{2\pi\sqrt{1-\rho^2}} e^{\frac{-((z_2-\rho z_1)^2+z_1^2(1-\rho^2))}{2(1-\rho^2)}} dz_1 dz_2 \\
&= \int_{\mu_1}^{\infty}\int_{\mu_2}^{\infty} \frac{z_1}{2\pi\sqrt{1-\rho^2}} e^{-\frac{1}{2}\left(\frac{z_2-\rho z_1}{\sqrt{1-\rho^2}}\right)^2} e^{-\frac{1}{2}z_1^2} dz_1 dz_2
\end{aligned}
$$

We make the substitution $z = \frac{z_2-\rho z_1}{\sqrt{1-\rho^2}} \Rightarrow dz = \frac{dz_2}{\sqrt{1-\rho^2}}$. Making the substitution and integrating by parts, we have

$$
\begin{aligned}
&E_f(z_1, C \equiv z_1 > \mu_1, z_2 > \mu_2) \\
&= \int_{\mu_1}^{\infty} \frac{z_1}{\sqrt{2\pi}} e^{-\frac{1}{2}z_1^2} \Phi\left(\frac{\rho z_1 - \mu_2}{\sqrt{1-\rho^2}}\right) dz_1 \\
&= \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\mu_1^2} \Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \frac{1}{\sqrt{2\pi}} \frac{\rho}{\sqrt{1-\rho^2}} \int_{\mu_1}^{\infty} e^{-\frac{1}{2}z_1^2} \phi\left(\frac{\rho z_1-\mu_2}{\sqrt{1-\rho^2}}\right) dz_1 \\
&= \phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \frac{1}{\sqrt{2\pi}} \frac{\rho}{\sqrt{1-\rho^2}} \int_{\mu_1}^{\infty} e^{-\frac{1}{2}z_1^2} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{\rho z_1-\mu_2}{\sqrt{1-\rho^2}}\right)^2} dz_1 \\
&= \phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \frac{1}{2\pi} \frac{\rho}{\sqrt{1-\rho^2}} \int_{\mu_1}^{\infty} e^{-\frac{z_1^2+\mu_2^2-2\rho z_1\mu_2}{2(1-\rho^2)}} dz_1 \\
&= \phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \frac{1}{2\pi} \frac{\rho}{\sqrt{1-\rho^2}} \int_{\mu_1}^{\infty} e^{-\frac{1}{2}\left(\frac{z_1-\rho\mu_2}{\sqrt{1-\rho^2}}\right)^2} e^{-\frac{1}{2}\mu_2^2} dz_1.
\end{aligned}
$$

We make the second substitution $z = \frac{z_1-\rho\mu_2}{\sqrt{1-\rho^2}} \Rightarrow dz = \frac{dz_1}{\sqrt{1-\rho^2}}$. Making the substitution and integrating by parts, we have

$$
\begin{aligned}
E_f(z_1, C \equiv z_1 > \mu_1, z_2 > \mu_2) &= \phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \frac{1}{\sqrt{2\pi}} \rho e^{-\frac{1}{2}\mu_2^2} \int_{\frac{\mu_1-\rho\mu_2}{\sqrt{1-\rho^2}}}^{\infty} e^{-\frac{1}{2}z^2} dz \\
&= \phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \rho\phi(\mu_2)\Phi\left(\frac{\rho\mu_2-\mu_1}{\sqrt{1-\rho^2}}\right).
\end{aligned}
$$

Proceeding in exactly the same manner, we get

$$
\begin{aligned}
E_f(z_1, C \equiv z_1 > \mu_1, z_2 < \mu_2) &= \phi(\mu_1)\Phi\left(\frac{\mu_2-\rho\mu_1}{\sqrt{1-\rho^2}}\right) - \rho\phi(\mu_2)\Phi\left(\frac{\mu_1-\rho\mu_2}{\sqrt{1-\rho^2}}\right) \\
E_f(z_1, C \equiv z_1 < \mu_1, z_2 > \mu_2) &= -\phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \rho\phi(\mu_2)\Phi\left(\frac{\rho\mu_2-\mu_1}{\sqrt{1-\rho^2}}\right) \\
E_f(z_1, C \equiv z_1 < \mu_1, z_2 < \mu_2) &= -\phi(\mu_1)\Phi\left(\frac{\mu_2-\rho\mu_1}{\sqrt{1-\rho^2}}\right) - \rho\phi(\mu_2)\Phi\left(\frac{\mu_1-\rho\mu_2}{\sqrt{1-\rho^2}}\right).
\end{aligned}
$$

Hence, the final expressions for bivariate probit conditional expectations are

$$E(z_1 \mid z_1 > \mu_1, z_2 > \mu_2) = \frac{\phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \rho\phi(\mu_2)\Phi\left(\frac{\rho\mu_2-\mu_1}{\sqrt{1-\rho^2}}\right)}{1-\Phi(\mu_1)-\Phi(\mu_2)+\Phi_2(\mu_1,\mu_2,\rho)}$$

$$E(z_1 \mid z_1 > \mu_1, z_2 < \mu_2) = \frac{\phi(\mu_1)\Phi\left(\frac{\mu_2-\rho\mu_1}{\sqrt{1-\rho^2}}\right) - \rho\phi(\mu_2)\Phi\left(\frac{\mu_1-\rho\mu_2}{\sqrt{1-\rho^2}}\right)}{\Phi(\mu_2)-\Phi_2(\mu_1,\mu_2,\rho)}$$

$$E(z_1 \mid z_1 < \mu_1, z_2 > \mu_2) = \frac{-\phi(\mu_1)\Phi\left(\frac{\rho\mu_1-\mu_2}{\sqrt{1-\rho^2}}\right) + \rho\phi(\mu_2)\Phi\left(\frac{\rho\mu_2-\mu_1}{\sqrt{1-\rho^2}}\right)}{\Phi(\mu_1)-\Phi_2(\mu_1,\mu_2,\rho)}$$

$$E(z_1 \mid z_1 < \mu_1, z_2 < \mu_2) = \frac{-\phi(\mu_1)\Phi\left(\frac{\mu_2-\rho\mu_1}{\sqrt{1-\rho^2}}\right) - \rho\phi(\mu_2)\Phi\left(\frac{\mu_1-\rho\mu_2}{\sqrt{1-\rho^2}}\right)}{\Phi_2(\mu_1,\mu_2,\rho)}.$$

References

Acharya, S., 1988, "A Generalized Econometric Model and Tests of a Signaling Hypothesis with Two Discrete Signals," *Journal of Finance*, 43, 413–429.

Asquith, P., P. Healy, and K. Palepu, 1989, "Earnings and Stock Splits," *Accounting Review*, 66, 387–403.

Asquith, P., and D. Mullins, 1983, "The Impact of Initiating Dividend Payments on Shareholders' Wealth," *Journal of Business*, 56, 76–96.

Brealey, R. A., and S. C. Myers, 1991, *Principles of Corporate Finance*, 4th ed., McGraw-Hill, New York.

Brown, S. J., W. Goetzmann, and S. Ross, 1995, "Survival," *Journal of Finance*, 50, 853–873.

Brown, S. J., and J. B. Warner, 1985, "Using Daily Stock Returns: The Case of Event Studies," *Journal of Financial Economics*, 14, 3–31.

Collins, D., and S. Kothari, 1989, "An Analysis of Intertemporal and Cross-sectional Variation of Earnings Response Coefficients," *Journal of Accounting and Economics*, 11, 143–181.

Copeland, T. E., 1979, "Liquidity Changes Following Stock Splits," *Journal of Finance*, 34, 115–141.

Denis, D., D. Denis, and A. Sarin, 1994, "The Information Content of Dividend Changes: Cashflow Signaling, Overinvestment and Dividend Clienteles," *Journal of Financial and Quantitative Analysis*, 29, 567–587.

Eades, K., 1982, "Empirical Evidence of Dividends as a Signal of Firm Value," *Journal of Financial and Quantitative Analysis*, 17, 471–500.

Eckbo, E., V. Maksimovic, and J. Williams, 1990, "Consistent Estimation of Cross-Sectional Models in Event-Studies," *Review of Financial Studies*, 3, 343–365.

Fama, E. F., L. Fisher, M. C. Jensen, and R. Roll, 1969, "The Adjustment of Stock Prices to New Information," *International Economic Review*, 10, 1–21.

Greene, W. H., 1993, *Econometric Analysis*, Macmillan, New York.

Grinblatt, M. S., R. W. Masulis, and S. Titman, 1984, "The Valuation Effects of Stock Splits and Stock Dividends," *Journal of Financial Economics*, 13, 461–490.

Heckman, J., 1979, "Sample Selection Bias as a Specification Error," *Econometrica*, 47, 153–161.

Lakonishok, J., and B. Lev, 1987, "Stock Splits and Stock Dividends: Why, Who and When," *Journal of Finance*, 42, 913–932.

Lamoureux, C. G., and P. Poon, 1987, "The Market Reaction to Stock Splits," *Journal of Finance*, 42, 1347–1370.

Manski, C. F., and D. McFadden, 1981, "Alternative Estimators and Sample Designs for Discrete Choice Analysis," in C. F. Manski and D. McFadden (eds.), *Structural Analysis of Discrete Data with Econometric Applications*, MIT Press, Cambridge, MA.

McNichols, M., and A. Dravid, 1990, "Stock Dividends, Stock Splits and Signaling," *Journal of Finance*, 45, 857–879.

Muscarella, C., and M. Vetsuypens, 1996, "Stock Splits: Signaling or Liquidity? The Case of ADR 'Solo-Splits'," *Journal of Financial Economics*, 42, 3–26.

Palepu, K., 1986, "Predicting Takeover Targets: A Methodological and Empirical Analysis," *Journal of Accounting and Economics*, 8, 3–35.

Prabhala, N. R., 1997, "Conditional Methods in Event-Studies and an Equilibrium Oriented Justification for Using Standard Event-Study Procedures," *Review of Financial Studies*, 10, 1–38.

Thompson, Rex, 1985, "Conditioning the Return Generating Process on Firm-Specific Events: A Discussion of Event-Study Methods," *Journal of Financial and Quantitative Analysis*, 20, 151–168.

Venkatesh, P., 1989, "The Impact of Dividend Initiation on the Earnings Announcements and Returns Volatility," *Journal of Business*, 62, 175–197.