The Relative Impact Of Public Information In Shaping Investor Expectations

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ABSTRACT

Empirical studies at the individual level (event studies) and those using more general measures of information and/or aggregate price movements often yield somewhat conflicting results regarding the relative importance of public information. Employing a more focused methodology that begins with no prior limitations on the number and types of public news announcements that may affect the underlying risk-return relationship, we are able to offer additional insight regarding the relative impact of public information. We find that approximately two-thirds of the changes can be associated with the arrival of public information. While, in general, this is a stronger link than previously found, it is a weaker link than expected; leading us to conclude that factors other than public information clearly play an important role. We also provide new results on the relative importance of different information types, and on correlates (such as firm size) of the effect of information.

Keywords: public information, information arrival, information event, switching regression

I. INTRODUCTION

The influence of public information on stock returns has been an ongoing focus of financial research. Previous research has indicated that, in the aggregate, public information plays a relatively minor role in influencing stock returns. Yet event studies indicate that, examining each information type separately, public information can be an important determinant of changes in stock prices. In this study we examine the role of public information by assessing how it relates to structural changes in the underlying risk-return relationship, as well as determine which types of public information are more likely to result in those changes. By offering an alternative approach to studying the market's response to informational events, we are able to provide additional insights into determining and characterizing the informational events and economic factors that affect firm valuation.

In theory, new information leads investors to revise their expectations of future cash flows, the riskiness of those cash flows and, hence, the expected return and price of the asset. Given that new information arrivals have the potential for causing a response, market participants are naturally interested in knowing if and, more importantly, how the market responds to different types of information. Traditionally, the response researchers are interested in is that of price; and the major set of studies that identify the timing and magnitude of a firm's stock price response to information arrivals are event studies. However, investors can also respond to new information by reassessing their expectations regarding the underlying risk-return tradeoff. That is to say, even though information events can, at least potentially, elicit a market response in the form of price (i.e. abnormal returns), in this study we are interested in analyzing the effects related to a more fundamental response. Specifically, we are interested in those events that actually produce a structural change in the underlying risk-return relationship. In other words, apart from a stock's short-term price reaction to new information, a more fundamental response can also occur. It is this response, that of changes in the underlying risk-return relationship, that we investigate in this study.

In addition to focusing on structural changes in the underlying expected returns instead of price, we also use a more focused approach to studying the market's response to informational events. The combination, we believe, allows

us to provide additional insights into the ongoing study of determining and characterizing the informational events and economic factors that affect firm valuation.

In a typical event study a specific informational event is identified *a priori*. The market's response to the announcement of the event is usually measured as the abnormal return relative to a return-generating model. Our approach is to first identify the market's response, in this case changes in the parameters of the return-generating model, and then search for the informational events that may be linked to those changes. As stated earlier, we know that information events may elicit revisions of expectations of future cash flows and the riskiness of those cash flows. Therefore, it should also be true that an empirically identified change in the underlying return-generating model should be associated with a change in a fundamental firm characteristic. In other words, given that a structural change has been observed, there should be a fundamental reason for observing the change.

The important implication of this approach is that we begin with no prior expectations as to which informational events elicit a change, or shift, in the underlying risk-return relationship. Instead, we first identify the locations of the shifts. Then, given the changes, our objective is to determine and characterize the informational events that can be associated with the changes. A switching regression model is used to identify the change points. Once the change points have been detected, the *Wall Street Journal* (*Index*) is used to associate the informational events with the change points.

Our results indicate that approximately two-thirds of the changes can be associated with the arrival of public information. We are quick to note, however, that the other one-third of the changes are not readily explainable by public information, leading us to conclude that factors other than public information clearly play an important role as well. In terms of firm-specific events, earnings and/or dividend announcements, capital structure changes, and corporate control changes (mergers, acquisitions, divestitures and takeovers) account for a large percentage of the associated events. With regard to market-wide, nonfirm-specific informational events, announcements by the Federal Reserve Bank regarding interest rate changes or future interest rate policy were equally influential. In addition, uncertainty regarding the content and passage of an important piece of financial legislation could also be linked to many of the changes.

II. PREVIOUS RESEARCH

Previous research on the relative impact of public information tends to look at the aggregate price movement associated with a specific informational event (event studies), or the price movement associated with more general (or aggregate) measures of information.

Taken as a whole, the event study literature has examined the effects of many different types of information on the prices of individual stocks. Readers are by now well aware of this literature which is far too extensive to cite here. Numerous event-type studies indicate that the public announcement of firm-specific information such as earnings, dividends, tender offers, stock repurchases, etc., can influence stock returns. That is, when specific informational events are examined individually, there is evidence that these events can influence the short-term stock prices of individual firms. However, the event study methodology is inherently limited in that only one type of information is examined at a time. This implies that direct comparisons of the relative importance of different types of information cannot be made.

The second set of studies address the importance of public information using more general measures of information and/or aggregate price movements. While it could be argued that many of these studies tend to provide a truer study of the overall impact of public information, they have yielded much less positive results. The early studies, such as Roll (1988), Thompson, Olsen and Deitrich (1987), Cutler, Poterba and Summers (1989) and Mitchell and Mulherin (1994) found only a weak relationship between general measures of information and movements in prices. Later researchers have not faired much better. Brown's (1999) follow up of Roll (1988) to control for private information flow indicated only a marginal improvement in explanatory power. Fair (2002) identified large price changes in the S&P 500 Stock Index futures contract, then searched for specific events that led to the changes. He was able to associate only 69 of the 220 changes with so-called macro shocks, with 53 of them directly or indirectly related to monetary policy. In trying to determine whether overreaction or underreaction depends on the information underlying

the event, Larson and Madura (2003) classified only 35 percent of extreme, one-day price fluctuations as "informed" events; that is, corresponding to an announcement in the *Wall Street Journal*.

Studies of the relationship between aggregate measures of information and general market movements also have inherent limitations since the use of either market-wide price movements or aggregate measures of public information may obscure the influence of information on asset prices. In the first case, if public information has a different impact on individual firm price movements, this effect may be diversified away when examining only aggregate price movements (e.g., Fair, 2002). In the second case, aggregate measures of public information are generally based on counts of the number of news releases per unit of time (e.g., Neiderhoffer, 1971; Berry and Howe, 1994; Mitchell and Mulherin, 1994). However, since some news releases are "noise" in the sense that they provide no new information, or provide irrelevant information, the use of counts of news releases presumes a high "signal-to-noise ratio." Further, the use of aggregate information measures does not provide any indication of the types of public information that impact asset prices or their relative impact.

In a more recent study, Ryan and Taffler (2004) overcome many of these shortcomings and find solid evidence that "reported corporate news events drive a significant proportion of companies' economically significant price changes and trading volume activity." Using a more focused methodology that first identifies large price and volume movements in individual stocks, and then searches for the firm-specific news items that can be associated with those movements, the authors find that 65 percent of significant price changes (82 percent for those firms in the FTSE 100 index) can be explained by readily available public domain information. Given previously inconclusive results, the Ryan and Taffler (2004) study sheds new light on the debate over the relative importance of public information in determining individual stock prices, specifically major stock price movements.

Until now, previous research has largely overlooked the possible association of informational events with empirically determined changes (or shifts) in the underlying structural risk-return relationship, even though researchers have recognized the need for such a study for years.[1] A few studies investigating nonstationarity in the market model parameters have only tangentially addressed its informational implications. Looking at beta shifts in weekly returns for Chrysler Corporation, Hsu (1982) offered a few macroeconomic events as possible causes, but did not consider firm-specific events. Examining quarterly returns of AT&T, Mehta and Beranek (1982) found a single shift and simply speculated that its cause was a higher P-E ratio for AT&T as it became well known as a popular growth stock. Finally, motivated by the application of the CAPM to the regulation of public utility companies, Bey (1983) was able to associate about 43 percent of the nonstationarities with two energy-related events (the influence of the oil embargo of 1973, and the decision by Consolidated Edison to miss a dividend payment), but did not attempt to associate any of the remaining ones. Ellul (2006), analyzing price discovery in European equity markets, uses the Mehta-Beranek methodology to control for parameter shifts due to stock-specific changes in information flows around large trades.

This study will provide an important contribution to the ongoing study of information flow and its market impact by filling this gap. Recognizing that many informational events can, at least potentially, elicit a price response in the form of major price movements or abnormal returns, no study has explicitly set out to examine the association of informational events with empirically determined changes in the structural risk-return relationship. In this study we provide that examination. Our approach is to begin with no prior expectations as to the types of public news announcements that may cause a shift in the market model parameters. Instead, we first examine the return series of a random sample of firms to locate points that correspond to a shift, or change, in the parameters (we make these notions more precise below). We then determine if these so-called change points can be associated with a firm-specific information event. If no firm-specific event can be associated with a change point, we explore alternative explanations. We place no prior limitations on the types of information, but consider many possibilities in seeking to determine which types of information events are associated with changes in expectations. This approach allows us to examine the importance of public information in general, as well as the relative importance of different types of information.

In the remainder of the paper, Section III briefly describes the methodology and data set used to detect the change points, Section IV analyzes the impact of the different types of information events, and Section V analyzes correlates of the information events. Section VI summarizes and concludes the paper.

III. METHODOLOGY AND DATA

A. Methodology

Recall from previous discussions that the research objective is first to determine the strength of the relationship between new public information and changes in the underlying return expectations, and second to characterize the types of public information that influence those changes. Our first task, then, is to determine, for each security, the points at which a change in the underlying return-generating process has occurred. Then we determine which, if any, public information events may be associated with these changes.

We begin by assuming investor expectations are formed according to the standard single index market model:

$$(1) \qquad R_t = \alpha + \beta R_{mt} + \varepsilon_t \qquad t = 0, \ldots, T$$

where R_t is the return on a given security at time t and R_{mt} is the return on the market at time t. α and β are the regression parameters and ε is the random error term. In the absence of any new information, the parameters of the market model would be constant across the entire time period. Suppose, however, that information arrives at times $\tau_1, \ldots, \tau_p$ (where $0 = \tau_0 < \tau_1 < \ldots < \tau_p < \tau_{p+1} = T$). In this case the parameters of the return generating process are constant for a given information set, but may change in response to the arrival of new information at τ_j. This provides the context for examining the relationship between the arrival of information events and changes in the underlying return generating process.

The framework described here is best served by a switching regression (SR) type of model. A SR model does not merely seek out the observations or time points corresponding to an abnormal, or excess, return. Instead, it seeks out a more fundamental response. As the name implies, it attempts to determine the set of points within the time series where the return generating process switches from a regime characterized by one set of regression parameters to a regime characterized by a new set of parameters. In other words, the methodology allows for investors' expectations to form one set of parameters for a certain period of time, but then switch to another set of parameters based on the arrival of new information at a point in time, τ_j. It does so by essentially searching over the entire time series of returns to locate the most likely set of these switch points. If a security happens to have fairly stable returns over time, then the SR may not find a single switch point. On the other hand, if investors frequently change their expectations regarding a security's risk/return characteristics, then the SR may reveal several switch points.[2]

This research methodology imposes two important requirements on the statistical technique used. First, the requirement of identifying the switch points (or change points) in the return generating process requires a technique that treats changes in the model parameters as occurring discretely. Second, since throughout the analysis we hold no prior expectations regarding the change points, a further requirement is that the technique imposes no *ex ante* restrictions on either the number or the temporal locations of the change points. This implies that the technique must be capable of handling more than one change point, and that both the number and location of change points must be entirely data-determined.

Even though similar techniques exist, the Bayesian SR model developed by Mehta and Beranek (1982) was chosen since it satisfies each of the requirements in determining the number and location of the change points. What follows is a brief summary of the technique and its application to our study. A more detailed derivation and explanation of the model is available in Mehta and Beranek (1982) or from the authors.

Expectations are formed according to the single index market model, so that:

$$(2) \qquad R_t = \alpha + \beta R_{mt} + \varepsilon_t \qquad t = 0, \ldots, T$$

If information arrives at times τ_r, r = 1, ... p, then there are p change points that form p+1 regression regimes. Generalizing the model to allow for the different regimes yields:

$$R_t = \alpha_t + \beta_t R_{mt} + \varepsilon_t \quad (3)$$

where, when t is in the r^{th} interval $[\tau_{r-1}+1 , \tau_{r-1}+2 , \ldots \tau_r]$, we have $\alpha_t = \alpha_r$, $\beta_t = \beta_r$ and $\varepsilon_t \sim N(0, \sigma_r^2)$. Given the information arrival times, the SR model can be viewed as a (p+1)-equation regression system such that:

$$\begin{aligned} y_1 &= X_1\zeta_1 + \varepsilon_1 \\ y_2 &= X_2\zeta_2 + \varepsilon_2 \\ &\vdots \\ y_{p+1} &= X_{p+1}\zeta_{p+1} + \varepsilon_{p+1} \end{aligned} \quad (4)$$

where $\zeta_r = (\alpha_r, \beta_r)$ and each regression regime contains $n_r = \tau_r - \tau_{r-1}$ observations. For our analysis, interest centers on $\delta = (\tau, p)$, the location and number of change points. In other words, we need to determine both the number of change points and their locations. In order to make inferences on δ, we calculate the marginal posterior pdf for δ, and the corresponding integrated likelihood function (ILF). For a given number of change points, p, we calculate the value of the ILF for all possible change point locations. The vector of change points, τ^*, that maximizes the ILF corresponds to the most likely set of change points for that number of change points. The Schwarz (1978) information criterion is then used to determine which is the "correct" model (i.e., number of change points and locations) since it selects the *a posteriori* most probable model.

B. Data

The final sample for the study contained 136 firms. Originally, a random sample of 150 firms was chosen. The subsequent analysis revealed that 14 of the firms were investment companies, REITs, or holding companies. Since their corporate organization does not fit the spirit of the study they were eliminated, leaving a sample of 136 firms. The firms were randomly chosen from the set of NYSE and AMEX firms in the Center for Research in Security Prices (CRSP) database. The resulting sample is comparable to the population of NYSE and AMEX firms with 43 (31.6%) traded on the AMEX and 93 (68.4%) on the NYSE. This breakdown is very similar to the breakdown in the population where about 34% of the firms trade on the AMEX. The market values of the sample and the population also have similar distributions, with estimated mean values of $1.131B and $1.085B respectively. Similarly, mean sales for the two groups are $2.901B and $1.608B respectively; and total assets are $4.081B and $3.068B respectively. None of the mean differences are significantly different from zero.

Calendar year, 1986, was chosen as the time frame for the study. Given the objective and initial scope of the study, we believe it is prudent to consider a year that predates the internet. Recall that our study seeks to isolate the direct relationship between information arrivals and changes in the fundamental risk-return relationship. Once we locate change points, we then search for possible news announcements that may be associated with the changes. Since, prior to the internet, the *Wall Street Journal* could be regarded as the definitive source of investment information, this allows us to rely solely on the *Wall Street Journal* (and *Wall Street Journal Index*) as the main source of informational events. The *Wall Street Journal* could still be regarded as the most definitive source of investment information; but one cannot deny the influence the internet has had on the structure and sources of information availability, particularly investment information. While not impossible, it is well beyond the scope of our effort to sort through the internet to know what sources to include as definitive, independent, or influential sources of information events. The *Wall Street Journal* provides a much cleaner and concise source of informational events. While we do not believe this choice of study year materially affects our general conclusions, clearly this is an aspect of the study that is ripe for further investigation. In terms of the choice of 1986, it simply represents the most convenient calendar year before the advent of the internet in the 1990's and the market crash of 1987.

For each of the firms, a time series of daily returns[3] was taken from the CRSP database for the period from December 1, 1985 to January 31, 1987. Change points were identified only for the year 1986. The two 20+ trading day

periods at either end of 1986 were used to insure that the initial and final regression regimes were estimated with at least 20 return observations. For intermediate regimes, change points were permitted no fewer than 10 trading days apart.

IV. RESULTS

A. The Relative Importance Of Public Information

A total of 216 change points were identified for the 136 firms in the sample. For the full sample, Table 1 presents the distribution of the number of change points detected in each firm. No change points were detected in 37 of the firms, one change point was detected in 18, two in 45, and three change points were detected in 36 of the firms.[4] The switching regression model locates the most likely set of change points. Bayesian Highest Posterior Density (HPD) intervals are used to determine which of the parameter change points are statistically significant. Change points are considered significant if the difference in the parameters lies outside the fifty percent HPD interval; that is, if there are better than even posterior odds that the parameters are different. In 200 of the 216 change points, the parameter changes were statistically significant, leaving only 16 statistically insignificant change points.

Table 1
Distribution of the Number of Change Points Detected

Number of Change Points Detected	Number of Firms
0	37 (27.2%)
1	18 (13.2%)
2	45 (33.1%)
3	36 (26.5%)
TOTAL	136

As we show in the sections to follow, of the 200 significant change points, 111 (55.5%) can be associated with firm-specific public information events. Nine (4.5%) more can be associated with a January effect and another 18 (9%) can be associated with nonfirm-specific or macroeconomic events. This is a total of 138, or 69.0%, of the change points that can be associated. Given that we identified significant structural changes in the underlying risk-return relationship, we expected to find a high percentage of information associations. If we include the change points associated with the January effect in the category of those for which we cannot provide an association, 71 (35.5%) of the change points are not explained by the public announcement of new information. Thus, even though the largest percentage of changes can be associated with the release of new public information, a significant percentage can not. This seems to lend further weight to the argument that factors other than public information play an important role in driving fundamental changes in investor expectations. These other factors may be motivated, for example, by certain investor behavior or by market constructs in the same way the January anomaly may be motivated by tax-loss selling.

On the other hand, generally speaking these are much larger percentages than earlier studies have found using aggregate measures of public information and/or market returns. The larger percentages may be due in part to the methodology and empirical technique employed. Other than the earlier cited studies that only tangentially attempted to associate market model parameter changes with actual information events, no other study has attempted to provide detailed associations of individual public information events with fundamental changes in the underlying risk-return relationship. Recall that Ryan and Taffler (2004), employing a similar methodology but looking at abnormal price and volume changes, found that a similar percentage of their significant price changes could be explained by publicly available information.

Of the 111 associated informational events, nine of them fell on the change point date, 33% were within +/- one day of the change point, 56% within two days, 70% within three days, and over 80% within four days. In total, about 44% occurred before the change point and about 55% occurred after. While this indicates a slight bias for the change points to precede the associated informational event, it would not be appropriate to draw any strong conclusions regarding the nature and speed of the market's adjustment to new information. Recall that, instead of looking at changes

in stock price, we are investigating a more fundamental reaction (or adjustment) -- that of changes in the underlying return generating process. Therefore, contrary to the typical event study, we would not expect the change points we are investigating here to necessarily occur on the exact day of the information arrival. As with previous studies, we allow for the fact that an informational event associated with a fundamental shift in the model parameters from one regime to another may occur slightly before or after the change point.

In the next section we examine our results in more detail as well as examine the types of public information that influence fundamental changes in investors' underlying expectations.

B. Distribution Of Information Types

In order to determine the relative importance of the various types of firm-specific information events, it is necessary to know the distribution of all news announcements by information type. To estimate the total number of announcements, we classified all news announcements listed in the *Wall Street Journal Index* for each of the 136 firms by type of announcement. The results are shown in Table 2.

Table 2
All Event Announcements Categorized by Type of Announcement

	All Announcements		First Announcements	
Announcement Type	**Number**	**Percent**	**Number**	**Percent**
A. Earnings/Dividends	**828**	**33.6**	**791**	**35.8**
1. Earnings	444		416	
2. Dividend	259		250	
3. Combination	125		125	
B. Corporate Control	**257**	**10.4**	**147**	**6.7**
C. Capital Structure	**136**	**5.5**	**107**	**4.8**
D. Changes in Business Activity	**539**	**21.9**	**511**	**23.1**
1. Contracts	235		227	
2. Product Additions/ Discontinuations/Pricing	61		57	
3. Changes in Scope/Scale of Business	243		227	
E. Regulatory/Legal	**96**	**3.9**	**85**	**3.8**
1. Regulatory	29		26	
2. Legal	67		59	
F. Corporate Analysis	**87**	**3.5**	**87**	**3.9**
1. Analyst's Recommendations/ Forecasts/Projections	49		49	
2. S&P/Moody's Rating Changes	38		38	
G. Industry-Related	**115**	**4.7**	**108**	**4.9**
H. Management-Related	**154**	**6.3**	**152**	**6.9**
1. Insider Stock Holdings	14		14	
2. Other	140		138	
I. Labor-Related	**73**	**3.0**	**48**	**2.2**
J. Miscellaneous	**177**	**7.2**	**172**	**7.8**
TOTAL	**2462**	**100.0**	**2208**	**100.0**

Naturally, some of these announcements represent follow-up information concerning previous announcements. Since most empirical studies focus on the initial announcement of an event as the point of market reaction, it is more informative to consider the number of announcements that occurred as first-time announcements of firm-specific events. The number of first-time announcements is given in the second half of Table 2. Most of the event categories are self-explanatory and are similar to those used by Thompson, Olsen and Dietrich (1987).[5] The earnings/dividends category

consists of announcements of quarterly or annual earnings and/or dividend announcements. Earnings and dividends are placed in the same category because many firms announce both at the same time, or within a day or two of each other. The corporate control category contains information events related to both target firms and bidding firms. Corporate analysis consists of information or analyses of companies that is generated by third parties. The most common type of information event is earnings/dividend announcements, with announcements of changes in business activity the second most common. Together these two categories account for almost sixty percent of all first announcements.

There are substantial differences in the number of first announcements across firms. Two firms in our sample had no first announcements. At the other extreme, General Motors had 405 first announcements, many of which are routine items such as weekly production and weekly sales figures. General Motors has more than twice as many first announcements as any other firm, being followed by Boeing and Goodyear with 169 and 168 first announcements respectively. For all firms in the sample, the average number of first announcements is 16.24, or a first announcement roughly every fifteen and a half trading days. Excluding General Motors, the average number of first announcements is 13.35, or roughly one every nineteen trading days. Taking the categorization differences into account, the distribution of the types of announcements in our sample is similar to that found by Thompson, Olsen and Dietrich (1987). This is consistent with, and reinforces, their finding that the distribution of the types of news is stable over time.

C. Firm-Specific Events: General Results

The next task is to associate information events with each change point to determine the types of information that result in changes in the underlying return-generating process. To do this, we searched the *Wall Street Journal*. The *Wall Street Journal* was occasionally supplemented by other news sources in order to corroborate the existence or absence of an information event. Since we are searching for fundamental, structural changes in the underlying return-generating function, we don't expect for a news item that may be associated with a change point to always occur on the exact change point date, as may be the case for price reactions. As a result, we search for news items that were reported within an 11-day window surrounding the change point. The 11-day window included the 5 trading days prior to, and the 5 trading days following, the change point date as well as the change point date itself. Only first announcements were considered. For example, if an official earnings announcement appeared in the 11-day window, but an announcement of the earnings had been made prior to the 5 days preceding the change point date (i.e. outside the 11-day window), then the earnings announcement in the 11-day window was deemed a second announcement and discarded as a possible information event associated with the change point. If more than one event occurred in the 11-day window, the most notable event was chosen. Examples of events that were not considered as probable change point events include announcements of the commencement of sales on a previously announced bond issue, routine appointments of new directors, and articles in which the firm was only tangentially discussed.

Of the 200 significant change points, 111 or 55.5% can be associated with a firm-specific public information event. The information events associated with change points are categorized by type and presented in Table 3.

An obvious question is whether these results are significant or are merely due to chance. Over the 253 trading days in 1986, the 136 firms in the sample made 2208 first announcements, or an average of 0.0641 announcements per firm per day. This implies that firms made a first announcement on average every fifteen and a half trading days. We associate an information event with a change point if it falls within five trading days of the change point. Assuming the number of first announcements in an 11-day interval follows a Poisson distribution with λ=0.706, there is a 0.5063 probability of at least one announcement within an 11-day period. Under the null hypothesis that information events are statistically independent of change points, the number of associated change points has a mean of 101.3 and a standard error of 7.07. Therefore, the probability of associating 111 or more change points by chance is only 0.085.

Table 3
Distribution of the Firm-Specific Information Events Associated with Change Points

Event Type	Number (Percent)	Percent of First Announcements	Good News	Bad News
A. Earnings/Dividend	**57 (51.4)**	**7.2**	**41**	**16**
1. Earnings	41 (36.9)	9.9	29	12
2. Dividend	7 (6.3)	2.8	7	0
3. Combination	9 (8.1)	7.2	5	4
B. Corporate Control	**18 (16.2)**	**12.2**	**7**	**11**
C. Capital Structure	**3 (2.7)**	**2.8**	**3**	**0**
D. Changes in Business Activity	**16 (14.4)**	**3.1**	**10**	**6**
1. Contracts	3 (2.7)	1.3	2	1
2. Product Additions/ Discontinuations/Pricing	5 (4.5)	8.8	2	3
3. Changes in Scope/Scale of Business	8 (7.2)	3.5	6	2
E. Regulatory/Legal	**4 (3.6)**	**4.7**	**2**	**2**
1. Regulatory	2 (1.8)	7.7	1	1
2. Legal	2 (1.8)	3.4	1	1
F. Corporate Analysis	**4 (3.6)**	**4.6**	**1**	**3**
1. Analyst's Recommendations/ Forecasts/Projections	3 (2.7)	6.1	1	2
2. S&P/Moody's Rating Changes	1 (0.9)	2.6	0	1
G. Industry-Related	**5 (4.5)**	**4.6**	**2**	**3**
H. Management-Related	**0 (0.0)**	**0.0**	**0**	**0**
1. Insider Stock Holdings	0 (0.0)	0.0	0	0
2. Other	0 (0.0)	0.0	0	0
I. Labor-Related	**0 (0.0)**	**0.0**	**0**	**0**
J. Miscellaneous	**4 (3.6)**	**2.3**	**4**	**0**
TOTAL	**111 (100.0)**		**70**	**41**

D. Firm-Specific Information Associations

D.1. Earnings. The first category is earnings and dividend announcements. Fifty-seven of the 111 associated change points, or about 51%, can be associated with earnings and/or dividend announcements. It is tempting to argue that this result should be anticipated since earnings and dividend announcements are the most frequent types of first announcements made by firms as a whole. However, the probability of associating 57 or more change points with earnings announcements by chance is only 0.0222. Hence, even though most of the change points in this category correspond to regularly scheduled quarterly or annual announcements of either earnings or dividends, presumably the content of the announcements was significant enough to change investors' perception of expected future cash flows. Of the 57 change points associated with earnings/dividend announcements, 49 correspond to a scheduled earnings and/or dividend announcement and 8 could be considered unscheduled. When broken down by firm size (68 largest firms versus 68 smallest), it turns out that 7 of the 8 unscheduled announcements came from large firms. Calculated another way, 25% of the large firms' earnings/dividend change points are associated with unscheduled announcements compared to only 3.4% of the small firms'. Given that larger firms tend to be more widely held and, hence, generate a higher demand for information, it is more likely for relevant information regarding an upcoming earnings/dividend announcement to appear before the scheduled announcement. Therefore, it seems reasonable that there is a much greater chance that a change point associated with an unscheduled earnings/dividend announcement comes from a large firm rather than a small one. The converse is true for small firms. A lower volume of information would indicate that small firms' scheduled earnings/dividend announcements are more likely to contain a significant unanticipated component.

Most importantly, these results imply that earnings announcements contain information not available elsewhere. Even when all announcement types are considered simultaneously, earnings announcements remain an important source of information.

D.2. Corporate Control. The next category, corporate control, consists of 18 change points, with 14 of the change points associated with takeover targets. Given the relatively low number of corporate control announcements, the probability of associating 18 change points by chance is less than 0.0001. Of the 18 change points in this category, many occur early in the takeover attempt, with many at the rumor stage. Five are associated with reported rumors and two with the announcement of a single investor's acquisition of at least a 5% stake in the company. Three change points are associated with the end of a possible takeover attempt -- one with the announcement of the end of a leveraged buyout attempt, and two with the announcement of the payment of greenmail.

D.3. Other Announcements. In the capital structure category, two of the three change points are associated with the announcement of major recapitalization plans. The other is associated with an equity shelf registration. Announcements of changes in capital structure account for 5% of first announcements, but are associated with only 3 change points (2.7%). The probability of finding three or fewer change points associated with capital structure changes by chance is just under 0.05. It is interesting to note that no change points are associated with the announcement of a specific new equity issue or a new bond issue, even though firms in the sample made such announcements during 1986. Perhaps the new issues were not of sufficient magnitude so as to materially change market perceptions of expected future cash flows. It is also interesting to note that none of the change points were associated with changes in bond ratings. However, the question of market reactions to ratings changes is often mixed, especially between downgrades and upgrades (Jorion and Zhang, 2007). In addition, Goh and Ederington (1993) point out that many ratings changes are, on average, anticipated by the market and, therefore, no market reaction is expected.

The next category, changes in business activity, is divided into three subcategories. In the contracts subcategory, three change points are associated with major new contracts. In the product/pricing category, five change points are associated with announcements of new product lines (three change points) or major changes in pricing policy (two change points). The last subcategory, changes in scope/scale, consists of eight change points associated primarily with the announcement of the sale of large divisions or units of the company, or announcements of major restructuring plans.

Changes in business activity account for 23.1% of all first time announcements, but only 16 change points (14.4%) are associated. Excluding General Motors (who alone accounts for nearly 40% of all first announcements of changes in business activity, many of which are routine), 16 associated change points is not significantly different from the number expected by chance in this category. However, for the larger firms in the sample, we find significantly fewer change points than would be expected by chance (with General Motors included, the probability is < 0.0001, otherwise, the probability $= 0.0174$). For the smaller firms we find significantly more change points associated with changes in business activity than expected by chance (probability < 0.0001). One possible explanation for this phenomenon is that by the time large firms formally announce a change in business activity, e.g., the sale of a division, the information has been anticipated by the market. For smaller firms, such announcements are less likely to be anticipated. In addition, for small firms, contracts or other changes in business activity that are sufficiently important to be reported are more likely to have a proportionally larger impact on the value of the firm.

The regulatory and legal announcements category contains four change points associated with announcements of new government regulations or announcements of court decisions that affect expected cash flows. The two change points in the legal subcategory are associated with the settlement of legal disputes involving large monetary awards. In one case the company won the settlement, in the other it lost.

The next category, corporate analysis, is interesting in that it directly relates to analysts' projections of stock price performance rather than to changes in expected cash flows. One announcement in this category is particularly interesting. This change point is associated with a recommendation to buy Unitil stock by *Barron's* analysts in the "Up and Down Wall Street, On the Margin" column. A few days after the recommendation, the *Wall Street Journal* reported

that Unitil's stock price had increased dramatically, and cited the *Barron's* recommendation as the probable cause. It would be difficult to determine the exact cause, and it is not our intention to argue for a particular point of view. Perhaps *Barron's* analysts based their recommendation on anticipated changes in corporate cash flows and the resulting change is consistent with fundamental firm performance. On the other hand, behaviorists might argue that the market responded to the recommendation independent of any changes in underlying business activity. But if information is costly and analysts have a comparative advantage in collecting and processing information, then analysts may act as information brokers or information intermediaries.

Of the next three categories, change points can be associated only with industry-related information. Although firms in the sample made management-related and labor-related announcements, none were associated with change points. For labor-related announcements, zero associated change points is not significantly different from the number expected by chance. For management-related announcements, it is significantly fewer than the expected number of associated change points. This appears to be due primarily to large firms. For large firms especially, many management-related announcements are perfunctory and contain little information that is directly related to the firm's future cash flows.

D.4. Summary. Summarizing these results, the types of information events that appear to be most likely associated with a change point are earnings/dividend announcements and corporate control announcements. These are also the types of announcements that most directly lead to a revision of the market's expectation of future cash flows. In fact, looking at the third column in Table 3 one can see that the number of change points associated with corporate control announcements accounts for a higher percentage of first-time corporate control announcements (12.2%) than does the number of change points associated with earnings/dividend announcements (7.2%). In other words, even though the market is confronted with more announcements of earnings and dividends, corporate control announcements have a higher probability of generating a change point. Conversely, business activity, capital structure, management-related and labor-related announcements actually appear to reduce the probability of a change point occurring. This may suggest that these types of announcements are anticipated by the market and, if anything, may have a stabilizing effect on the market's perception of the firm's future cash flows.

D.5. Good News versus Bad News. The last two columns of Table 3 classify each of the informational associations as conveying either good news or bad news. In the aggregate, more of the change points are associated with good news than bad news (63% vs. 37%). Most of the categories have about an equal number of good and bad news, or slightly more good than bad. However, more than twice as many of the earnings/dividend associated events can be regarded as good news. Recall that the associated informational events were determined to be the first announcement of the event; hence, the content of the announcement should have been unanticipated. This would seem to suggest that a greater percentage of unanticipated earnings announcements correspond to positive earnings news rather than negative. In other words, investors may be less able to anticipate positive earnings news. Hence, positive earning surprises are more likely to elicit a revision of investor expectations. This is consistent with evidence that seems to suggest that firms tend to release less news leading up to a positive earnings surprise, thereby increasing the impact of the positive surprise. Kasznik and Lev (1995) found that the frequency of voluntary disclosure of negative earnings information (warnings) was about twice that of positive information. Therefore, negative earnings surprises are more likely to be anticipated and less likely to be associated with a change point.

The only category that has significantly more bad news than good is corporate control. As discussed in section *D.2*, the news events in this category consist mainly of takeover attempts and leveraged buyouts (LBOs). Since the announcements in this category also have the highest probability of generating a revision of investor expectations (i.e., a change point), it is not surprising that the announcement of such contentious news seems to elicit strong responses from investors.

E. Macroeconomic Events

Previous research indicates that the market responds to different types of market-wide informational events (e.g., Fair, 2002). In the context of our study, the average impact of major economic news on stock prices should be

reflected through the market index. The focus of this study is on firm-level, rather than market-level, responses to information events. Positive and negative impacts on individual firms may be averaged out, and thus obscured, in a market index. Only if the impact on a specific firm is significantly different from the average impact on all firms will a change point be detected.

If a macro-type information event differentially affects a large number of firms, either positively or negatively, then there should be a group or cluster of change points associated with the event. To determine if any of the unassociated change points might be associated with specific market-wide events, we searched for clusters or groups of unassociated change points. Maintaining a consistent time-frame, the remaining unassociated change points were "scanned" using a 6-day moving interval scheme to determine the number of unassociated change points in every 6-day period in 1986. A frequency distribution of the 6-day intervals indicated that there are definite clusters of the unassociated change points. Two of the intervals each contained six change points and two others each contained five change points. The two five change point intervals were only one day apart and contained four of the same change points. Therefore, we combined them into one 8-day interval containing six change points. The three resulting time intervals are presented in Table 4. Next, we searched the *Wall Street Journal* for market-wide, non-firm-specific information events that could be associated with these change points.

Table 4
Macroeconomic Information Events

Change Point Cluster	Interval	Number of Change Points	Announcement
1	3/11 - 3/18	6	3/7 - Fed lowers the discount rate half a point.
2	9/8 - 9/15	6	9/9 - Influential Senate Finance Committee Chairman predicts that the Tax Reform bill will pass the House and Senate easily.
3	9/30 - 10/9	6	9/28 - Tax Reform bill passes the Senate.

The first cluster of change points occurred between March 11 and March 18. Prior to this period, on February 19, Paul Volcker, Federal Reserve Chairman at the time, announced unexpectedly that the Fed was not pursuing policies designed to lower interest rates. The S&P Index fell by almost 1% and a similar slide in the interest rate futures market were credited to Volcker's remark. But only twelve trading days after Volcker's previous announcement of no interest rate cuts, the Fed unexpectedly lowered the discount rate on Friday, March 7. Although the announcement did not actually occur in the 6-day interval, its effect was felt during the week of Monday, March 10 to Friday, March 14. Many analysts attributed the stock market rally on March 11 to the lower interest rates and expectations of continued lower rates. On March 13, the *Wall Street Journal* reported that many firms were retiring short-term debt with long-term debt at lower rates. The firms with change points in this cluster may represent firms which were significantly more, or significantly less, affected by the change in current and anticipated interest rates.

The next two change point clusters can be linked to important events associated with the Tax Reform Act of 1986. On September 9 the most influential figure in the tax reform process, Senate Finance Committee Chairman Robert Packwood, predicted that the Tax Reform bill would easily pass the House and Senate by the end of the month. Since the bill was still being hotly debated, Packwood's prediction increased the uncertainty and speculation over whether the bill would ultimately pass, what it would or would not include, eliminate or change, and what its effect would be. One *Wall Street Journal* editorial concluded that increased uncertainty over the tax bill was a major cause of the stock market's downturns on September 11 and 12. The bill finally passed the Senate on September 28, just two days before the third cluster of change points.

F. Additional Information Associations

Recall that of the 200 significant change points generated for the 136 firms, 111 or 55.5% can be associated with firm-specific events, which leaves 89 (52 from small firms and 37 from large firms) or 44.5% which could not be

associated with a firm-specific event. Although it is difficult to determine the "causes" of these remaining change points, other explanations seem plausible.

F.1. January Effect. Nine of the change points not associated with firm-specific information events occurred in the last six days of the year, with six occurring on the very last day. Given the low probability of observing six change points on a given day, the January effect is a logical choice as a possible explanation for these points.[6] For time periods prior to 1986, the most common explanation given for the January effect is tax-loss selling. Investors, trying to reduce their tax liability, realize short-term capital losses at the end of the year to offset the more highly taxed short-term gains. However, the Tax Reform Act of 1986 increased the tax rate on long-term capital gains and decreased the rate on short-term gains so the two rates were the same as the rate on ordinary income. Consequently, in addition to the usual tax-loss selling, the end of 1986 saw many investors selling long-term investments that had performed well in order to avoid the higher capital gains tax coming in 1987. On July 15 it was reported in the *Wall Street Journal* that some stockbrokers were already recommending that their clients liquidate some of their long-term holdings because of the anticipated increased capital gains tax in 1987. In an empirical study of the effect, Bolster, Lindsey and Mitrusi (1989) found substantially increased trading activity in December 1986 for stocks that had long-term gains. The nine firms in this category exhibited both kinds of stock behavior. Two of them sustained steady declines in price of 40 and 65 percent throughout the year, creating definite short-term capital losses. The remaining seven firms generally increased in price over the year. Five of the firms had steady price increases between 19 and 218 percent over the year. The remaining two exhibited overall price increases from the first of the year to the end of the year, but had large price swings throughout the year. An inspection of the long-term price behavior of these last seven firms indicates that they all had steady price increases in each of the previous five years.

F.2. Other Explanations. In other cases, it may be possible that the event responsible for the change point lies just outside the 11-day window, either because the technique did not pinpoint the exact location of the change point or because the technique is powerful enough to pick the location where the market began to trade based on rumors of information that later became public. The evidence in this study seems to favor the latter, indicating that the market may, at times, respond to information prior to its publication. First, simulations of the switching regression model (see Mehta and Beranek (1982)) indicate that the technique is highly accurate in detecting unknown change points. Second, our analysis indicates that many change points are associated with rumors. In particular, the result that many of the change points associated with takeovers occur in conjunction with rumors of an impending takeover offer. Finally, almost ten percent more of the associated information events occur after the change point than before. These would all seem to make it plausible that some of the unassociated change points may represent pre-publication responses to firm-specific information.

V. CORRELATES OF INFORMATION EVENTS

It is well-known that there are important firm size effects and calendar effects in the risk-return relationship. In this section we explore how these factors affect the relationship between information flows and changes in the underlying expectations.

A. Firm Size

Firm size has an important effect on the flow of information to the market. There are differences in both the number and types of first announcements due to firm size. Firm size is measured by the market value of equity, estimated as the number of shares outstanding multiplied by the price on the first trading day of 1986. The largest 68 firms in our sample accounted for nearly eighty percent of all first announcements made during the year. The correlation between firm size and the number of first announcements is 0.4395 for all firms, and 0.7948 excluding General Motors. Excluding General Motors, the largest 68 firms averaged 19.97 first announcements (25.63 including General Motors), while the 68 smallest firms averaged 6.84 announcements. The main difference in the types of first announcements between large and small firms is shown in Panel A of Table 5. For small firms, earnings and dividend announcements comprise about three-fourths of all first announcements, while for large firms they comprise about one-fourth of first

announcements. A chi-square test of the hypothesis that firm size and announcement categories are independent is clearly rejected with a chi-square value of 348.18.[7]

Table 5
Distribution of Information Flows by Firm Size

A. First Announcements

Category	Small Firms[a]	Large Firms[a]
Earnings/Dividends	338 (72.7%)	453 (26.0%)
All Other	127 (27.3%)	1290 (74.0%)
TOTAL	465	1743
	$\chi^2 = 348.18$	
	p = 0.000	

B. Number of Change Points Detected

Number of Change Points Detected	Small[a] Firms	Large[a] Firms	Smallest 20 Firms	Largest 20 Firms
0	19 (27.9%)	18 (26.5%)	3 (15.0%)	7 (35.0%)
1	7 (10.3%)	11 (16.2%)	3 (15.0%)	7 (35.0%)
2	23 (33.8%)	22 (32.4%)	5 (25.0%)	2 (10.0%)
3	19 (27.9%)	17 (25.0%)	9 (45.0%)	4 (20.0%)
TOTAL	68	68	20	20
	$\chi^2 = 1.05$ p = 0.79		$\chi^2 = 6.41$ p = 0.09	

C. Firm-Specific Information Events

Change Points	Small Firms[a]	Large Firms[b]
Associated	49	62
Unassociated	52	37
TOTAL	101	99
	$\chi^2 = 4.03$	
	p = 0.045	

[a] Small Firms: 68 smallest firms
[b] Large Firms: 68 largest firms

Given that firm size can be taken as a proxy for the amount of information available about a company, it is instructive to examine a breakdown of the number of change points by firm size. Panel B of Table 5 presents the distribution of the number of change points according to firm size. In the first case, the sample is divided into two equal groups, and in the second case only the 20 smallest firms and 20 largest firms are included. The average market value for the 68 small and large firms is $69.69 million and $2,192.32 million, respectively. The average size of the smallest 20 firms is $12.09 million, and the average size of the largest 20 firms is $5,664.19 million. Panel B also reports chi-square tests of the hypothesis that the number of change points detected is independent of firm size. Although the number of change points appears to be skewed toward a smaller number of change points for large firms, in each case the null hypothesis of independence cannot be rejected.

A breakdown of the associated and unassociated change points by firm size is given in Panel C of Table 5. The number of change points detected in small firms and large firms is almost equal with 101 of the 200 change points detected in small firms, and 99 detected in large firms. However, even though there is no statistically identifiable difference in the number of change points detected, large firms account for a much higher percentage of the 111 change points associated with firm-specific public information events. A chi-square test rejects the hypothesis (p=0.045) that the number of associated change points and firm size are independent, implying that large firms have a larger number of change points which are associated with a firm-specific event. One explanation is, simply, that more information is generated concerning larger firms. Clearly, larger firms that generate more business activity are more heavily invested in and, therefore, generate a higher demand for information.

Smaller firms have both fewer information events and fewer change points associated with those information events. Nevertheless, the number of associated change points for small firms is approximately twice the number that would be expected by chance. The probability of associating at least 49 change points by chance is less than 0.0001. Interestingly, for the 68 largest firms, the probability of at least 62 associations is 0.8051. This is largely due to General Motors, which has 405 first announcements and one change point. Excluding General Motors from the sample of large firms, the probability of at least the observed number of associated change points occurring by chance falls to 0.2297. Thus, for large firms the results are not statistically significant, but for small firms and for the sample as a whole, the results are statistically significant.

There seem to be two related reasons for the difference in the results for large and small firms. As we have shown, earnings and dividend announcements are the type of announcement most often associated with a change point. Earnings and dividend announcements account for nearly three-fourths of all first announcements by small firms, but only one-fourth of announcements by large firms. Thus, small firms are more likely to make the type of announcement most frequently associated with a change point. Related to this is the fact that larger firms tend to be more widely held. This leads to greater availability of information, more analysis of the available information, and consequently, more accurate estimates of future cash flows. Put differently, small firms' announcements, particularly earnings and dividend announcements, are more likely to contain a significant unanticipated component.

B. Day Of The Week And Month Of The Year

Thompson, Olsen and Dietrich (1987) report that fewer news items appear in the *Wall Street Journal Index* on Mondays than on any other day, reflecting the fact that firms are less likely to release news on Fridays. They also report that fewer news items appear in December than any other month. Given these observations, we question if the change points in our sample follow the same pattern. The day of the week and month of each firm-specific information event associated with a change point were recorded and the frequencies noted in Table 6. A chi-square goodness-of-fit test indicates that we cannot reject the hypothesis that the number of news items associated with change points is evenly distributed across the days of the week.

Table 6
Distribution of Firm-Specific News Items Associated with Change Points

A. Across days of the week.

	Day of the Week					
	Monday	Tuesday	Wednesday	Thursday	Friday	TOTAL
Frequency	20	26	20	22	23	111
			$\chi^2 = 1.12$			
			p = 0.89			

B. Across months of the year.

Month	Frequency
January	2
February	10
March	11
April	16
May	11
June	7
July	10
August	8
September	11
October	9
November	8
December	8
TOTAL	111
	$\chi^2 = 12.78$
	p = 0.31

We find the smallest number of information arrivals in January and relatively more in April. The relatively few number of news items in January leads us to speculate that the significantly higher returns in January, at least for small firms, are not related to the release of firm-specific information. The larger number of news items in April is most likely associated with the large number of annual earnings reports that appear in April (Thompson, Olsen, and Dietrich, 1987). Of the sixteen change points in April, ten are associated with earnings and/or dividend reports. This suggests that the tendency of some months to have returns that are higher (or lower) than in other months may be partially due to the prevalence of certain types of information (which significantly alter market perceptions) to be released in certain months. Again, using a chi-square test we cannot reject the null hypothesis that the number of firm-specific information events associated with change points is evenly distributed across months. Thus, there is no evidence to indicate that firm-specific information events which are important enough to change long-term market perceptions of expected future cash flows are more prevalent at the beginning or end of the week, or during a particular month.

VI. CONCLUSION

Our objective has been to re-examine the role of public information by assessing how it relates to structural changes in the underlying risk-return relationship, as well as determine the types of public information that are more likely to result in those changes. Our approach is unique since we look for the impact of information on the return-generating process first, then associate the empirically observed changes with a public information event if one exists. We find that public information may be responsible for approximately two-thirds of all empirically observed change points. However, we are left to conclude that the other one-third is due to factors other than public information. Thus, while new public information plays a large role, factors other than public information such as investor behavior or institutional constructs (e.g. tax laws) also play a significant role.

The most frequent type of public, firm-specific announcements are earnings and dividend announcements, accounting for approximately one third of all public announcements. Public announcements of changes in business activity and changes in corporate control account for another thirty percent of announcements. Corporate control and earnings/dividend announcements are the leading causes of change points in the sense that they have the highest probability of generating a market response. Interestingly, we find that the market reacts less frequently to capital structure and management-related announcements. In other words, these are more likely to represent "noise" rather than information.

We find that firm size is an important determinant of the flow of information and the effects of information on the underlying return-generating process. Firm size is highly correlated with the number of announcements, with the largest fifty percent of the firms in the sample accounting for about eighty percent of all announcements. Firm size also affects the type of information that is available. For the smallest fifty percent of firms, earnings and dividend announcements account for about three-fourths of all their announcements, while for the largest fifty percent they account for approximately one-fourth of the announcements. We find that the number of change points is independent of firm size, so that large and small firms are equally likely to have significant changes in stock prices. However, we find that for large firms the change points are more likely to be associated with firm-specific public information. Firm size also appears to affect the types of information that lead to change points. For large firms, announcements of changes in business activity appear to reduce the likelihood of a market response; that is, they are more likely to represent noise than information.

Finally, although the amount of public information is related to the day of the week and month of the year, we find that the empirically observed changes that are related to firm-specific information are independent of both the day of the week and month of the year.

ENDNOTES

1. Hays and Upton (1986, p. 308) suggest that, "An understanding of the nature of the shift and its approximate location is of value in the search for causal parameters and prediction from fundamentals."

2. An anonymous referee has pointed out that a thorough comparison of these techniques should also consider their econometric properties such as power, size, and robustness to outliers. While we agree, such an analysis is beyond the scope of this study, but should be considered an interesting avenue for further research.
3. In general, these techniques perform better with less variable data. Unfortunately, monthly data would not be appropriate for what we are trying to accomplish. With monthly observations, the switch points could only be located at the nearest monthly observation, making any kind of meaningful association to informational events impractical. Daily data, on the other hand, allows us to determine a more accurate location of the switch points. That, in turn, allows us to make meaningful associations to informational events.
4. Obviously there is a theoretical limit to the number of change points. It turns out that there is also a practical limit. The Bayesian SR technique is not inherently limited to three change points. Each attempt to search for more than three change points with just one firm took so much computer time that none of the computer runs to search for four change points successfully completed. It is for computational reasons that we limit the maximum number of change points. Hence, a completely accurate claim is that, within the limits of our computational resources, we place no prior restrictions on the number of parameter change points. The important point is that we do not artificially constrain the number and locations of the change points as other techniques are required to do. Assessments of the sensitivity of our results to this limitation indicate only slight qualitative differences.
5. At the time of our study Thompson, Olsen and Dietrich (1987) was the only study that had developed a similar taxonomy. Ryan and Taffler (2004) appeared after we began our study. They start with a much larger list of news categories (32 in all). Of the top eight that they report on, only one is a category we do not specifically include, "Share deals", which relates to large trading volume activity in a company's shares.
6. The average number of change points per day is 0.854. Assuming the number of change points per day is Poisson distributed with $\lambda = 0.854$, the probability of observing six change points in a given day is 0.0002.
7. Expanding Panel A of Table 5 to include all announcement categories also rejects with a chi-square value of 312.57.

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