Information Release and the Fit of the Fama-French Model *

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ABSTRACT

We show that over 75% of the reduction in pricing error (alpha) of the Fama-French three-factor model relative to the CAPM occurs in the four main earnings announcement months: January, April, July and October. Large firms and value firms tend to announce in these months whereas small firms and growth firms tend to announce in the later months of the quarter. We build a model where the CAPM is augmented by a factor based on the spread between early and late announcers. We show that the addition of this second factor primarily reduces pricing errors relative to the CAPM in the early reporting period. We hypothesize that one reason SMB and HML reduce the CAPM's alpha is that they capture this factor. Consistent with this hypothesis, we find that small firms that announce early have a smaller exposure to SMB, behaving as if they were larger firms, and vice versa for large firms that announce late. Similarly, value firms that announce late have a smaller exposure to HML, behaving as if they had lower book-to-market ratios, and vice versa for growth stocks that announce early. Taken together, our results suggest that the structure of information release, in addition to the underlying fundamental risk, needs to be taken into account when interpreting the presence of an additional factor in asset returns. Lastly, our results provide a mechanism whereby characteristics can generate covariances.

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It has been 20 years since Fama and French (1992, 1993, 1996) showed how the co-movements between small versus big stocks and value versus growth stocks help explain the mispricing of assets under the CAPM. Many mechanisms have been proposed to explain these factors including financial distress and default risk (Fama and French, 1993; Ferguson and Shockley, 2003; Hahn and Lee, 2006; Griffin and Lemmon, 2002; Vassalou and Xing, 2004; Garlappi and Yan, 2011); human capital, outside income and technological change (Kogan, Papanikolaou, and Stoffman, 2013); assets in place versus growth options (Zhang, 2005); high frequency conditioning information and time aggregation (Longstaff, 1989); or size proxying for general omitted risk (Berk, 1995). Yet the source of these risk factors remains unsettled.

We add a new dimension to the understanding of how the SMB and HML factors help to price assets. We show that the alphas of the CAPM and the reduction in these alphas from using the Fama-French 3 factor model (henceforth FF3M) are highly concentrated. 82% of the alpha reduction for the 30 Fama-French industry portfolios and 71% of the alpha reduction for the 25 size and book-to-market sorted portfolios occur in just four months. These months are not random. They are the four months at the beginning of each quarter when firms report their earnings: January, April, July and October. Each of these months, except January, contain the largest fraction of earnings announcements each quarter. In the first quarter, the longer processing time required by firms to produce their annual reports makes February contain the largest fraction of earnings announcements. In fact, February is the only other month of the year to contain a substantial alpha reduction for the FF3M over the CAPM. Including February, the fraction of the alpha reduction for the 30 industry portfolios and the 25 size and book-to-market sorted portfolios in these five months increases to 104% and 82%. For either case, the four or five reporting months, the alpha reduction is more than twice what would be expected were the alpha reduction simply spread randomly across months. Any economic explanation of the economic risk behind SMB and HML must explain this new fact.

Motivated by the connection between alpha reductions in the FF3M and earnings announcements, we investigate the constituent stocks of the 25 Fama-French size and book-to-market portfolios, examining what types of firms announce each month. We find that big stocks tend to report earlier in each quarter than small stocks and that value stocks tend to report earlier than growth stocks. This differential reporting pattern holds across all four quarters. The first quarter shows a substantial announcement delay across all types of firms with substantially more firms reporting in February than January, but no change in the pattern of big versus small or value versus growth announcement timing.

Building on this connection between the concentration of alpha reductions in earnings announcement months and the differential timing of earnings announcements across the types of firms the FF3M helps to price, we reexamine the implicit assumption built into all the previous explanations for SMB and HML that the fundamental risk underlying these factors and missed by the CAPM occurs uniformly through time–in the sense of stationarity–subject to conditioning on economic variables. It may seem strange that most economic time series exhibit some seasonality yet asset pricing tests ignore seasonality, comparing models by looking at the alphas of each model averaged across all dates. Ignoring seasonality in asset pricing models comes from the intuition that just because a firm's sales are highly seasonal, the return on its equity need not be higher in months with typically high sales or lower in months with typically low sales. Equity returns should only reflect unexpected information, and making seasonal adjustments to time series amounts to removing the predictable quantities which efficient markets should already do for returns.

If, however, there are seasonal patterns in the release of systematic news then this type of seasonality can propagate into returns. This second type of seasonality includes seasonality in the second or higher moments of returns compared to seasonality in the first moment only. There is, in fact, substantial seasonality in the release of information in the economy. This seasonality is most obvious in the announcement of earnings each quarter and year, which is so pronounced that these times are commonly referred to as "earnings season." Following the idea that the return from bearing risk occurs not just from the passage of time but also depends on when the information about the risk's outcome is learned, the seasonality of earnings announcements should be present in the historical factor returns themselves.

We show that the returns of the underlying size (SMB) and book-to-market (HML) factors themselves exhibit strong seasonality that coincides with the seasonality we find in earnings announcements. This seasonal pattern is consistent with the findings of the earnings announcement premium literature (Beaver, 1968; Penman, 1987; Chari, Jagannathan, and Ofer, 1988; Ball and Kothari, 1991; Cohen, Dey, Lys, and Sunder, 2007; Barber, George, Lehavy, and Trueman, 2013) and the literature which shows that seasonality in returns is widespread, persists over time and can be decomposed with its own factor structure (Lakonishok and Smidt, 1988; Heston and Sadka, 2008; Keloharju, Linnainmaa, and Nyberg, 2013). This seasonality in stock returns and factors also connects with the large literature on the January effect (Keim, 1983; Reinganum, 1983; Roll, 1983; Chan and Chen, 1991; Blume and Stambaugh, 1983; Rozeff and Kinney Jr, 1976; Haugen and Lakonishok, 1988). The January effect literature has focused on tax or trading needs of individuals or institutions around the turn of the year as an explanation of the CAPM alphas in January. We show that the importance of seasonal effects to the fit of the FF3M extends beyond January to the other reporting months (February, April, July and October), and that it encompasses large firms as well as small.

We propose differential information release across firms as a new mechanism for how SMB and HML help improve the pricing of assets. We hypothesize that SMB and HML help correct the pricing of assets, in part, because they load on the differential timing of information release across small versus big and value versus growth stocks. This new mechanism for generating return factors adds to a growing literature showing that announcements, including earnings, affect stock returns (Penman, 1987; Savor, 2012; Savor and Wilson, 2011a, 2013).

To demonstrate how this mechanism operates, we build a model with two types of firms: early announcers and late announcers. We show that in this model the CAPM misprices both types of firms and the average mispricing is higher in the early announcement period–the analog for the key reporting months January, February, April, July and October. The reason for this mispricing is that the differential announcement timing leads to the market betas being incomplete measures of the firms' long-run systematic risk. We then form a second factor in this model which is based on the spread between early and late announcers. We show that the addition of this second factor eliminates the pricing errors across all stocks. Because the pricing errors under the CAPM are larger in the early reporting period, the majority of the pricing error reduction is concentrated in the early reporting periods, as we see in the data.

We hypothesize that one reason SMB and HML reduce the CAPM's alpha is that they capture this additional factor based on differential earnings announcement timing. If SMB and HML capture exposure to this factor, then the SMB and HML exposures of firms should vary with the announcement timing of each firm. We test this hypothesis by dividing the stocks within each of the Fama-French 25 size and book-to-market sorted portfolios into three groups based on the timing of the earnings reports within each quarter. We calculate the average SMB and HML exposure of the stocks within each of these three categories. For each of the 25 Fama-French portfolios, as we move from firms that announce early to those that announce late within the quarter, the average SMB exposure rises. Thus, in terms of exposure to SMB, firms that announce late–even big stocks–act more like small stocks, and firms that announce early–even small stocks–act more like big stocks. The difference is economically significant with firms that report late in the quarter acting as one quintile smaller firms.

A similar pattern occurs for HML. As we move from early to late announcers within each of the 25 Fama-French portfolios the average HML exposure falls. Thus, in terms of exposure to HML, firms that announce late–even value stocks–act more like growth stocks, and firms that announce early–even growth stocks–act more like value stocks. This difference is economically large (especially for value stocks) with later announcing firms acting like firms that are in one (or more) lower quintile of book-to-market equity.

Our paper adds further insights on the debate about whether HML and SMB are firm characteristics or covariance risk factors (Davis, Fama, and French, 2000; Daniel and Titman, 1997; Lin and Zhang, 2013). Our results show that the characteristics of firms (size and book-to-market ratio) are strongly correlated with the characteristic of the timing of firms' earnings announcements. We then show how the characteristic of when firms announce earnings can create a covariance in returns and, indeed, how variation in the characteristic of earnings announcement timing shows up as variation in the covariance with the SMB and HML factors. Thus we show how firms' characteristics can actually lead to covariances in returns. This causal mechanism between particular characteristics (announcement timing in our case) and covariances is different from the notion that characteristics serve as a proxy for difficult-to-measure covariances, and it therefore provides an alternative mechanism to rationalize the ability of characteristics to price assets.

Savor and Wilson (2011b) use a factor based on announcement dates to *replace* the market factor and claim that early announcing stocks are riskier than late announcer stocks. In contrast, our paper does not rely on a difference in the underlying riskiness of stocks across announcement dates. Instead, the objective of our paper is to demonstrate how factors based on the differential timing of earnings announcements can *supplement* the market factor to improve pricing and, in particular, help explain the economics of the fit of the existing widely used FF3M.

Taken together, our results suggest that the structure of information release, in addition to the underlying fundamental risk, needs to be taken into account when interpreting the presence of an additional factor in asset returns. Risk factors that show up because of information release can lead to different economic consequences than risk factors that arise because of underlying systematic shocks. Risk factors generated by seasonal information releases fit naturally with findings that factor models fit differently at different return frequencies (Handa, Kothari, and Wasley, 1989; Kothari, Shanken, and Sloan, 1995; Gilbert, Hrdlicka, Kalodimos, and Siegel, 2013; Kamara, Korajczyk, Lou, and Sadka, 2013) as factors that are important for explaining seasonal patterns may not be necessary at lower frequencies. Moreover, our model provides a mechanism, the differential timing of information release, to generate differential exposures to cash flow and discount rate shocks for small versus big stocks and value versus growth stocks in a manner consistent with the good versus bad beta findings of Campbell and Vuolteenaho (2004).

Our paper puts additional constraints on what the fundamental risks driving SMB and HML must look like. When modeling the risks that may drive such factors, one must consider the additional constraint that this risk seems to not be realized uniformly over the year. Thus, for example, if one wants to use default risk or technological change to explain HML, one must explain why these types of risk show up disproportionately in certain months of the year. One explanation is that information about these risks is revealed in the manner we suggest in this paper.

We present our empirical results in Section I and our model in Section II. In Section III we present additional empirical results that test our model. We conclude in Section IV.

I. Empirical Results

A. Data

We obtain returns for the market, SMB and HML factors, the 25 size and book-to-market sorted portfolios and the 30 industry portfolios from Kenneth French's website.[1] For results at the aggregate level we use the post-war sample period 1950 to 2012. The results are robust to other sample periods as well.

The disaggregated stock level data come from CRSP and Compustat.[2] The earnings announcement data comes from Quarterly Compustat and is the first date of any announce-

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[2] See Fama and French (1993, 1996) for details on the construction of their aggregated portfolios from the stock level data.

ment of a company's earnings in a given quarter. The earnings announcement data begins in 1972, so our disaggregated sample is shorter, running from 1972 to 2012. To be included in the disaggregated data in a given year, a firm must have at least four months with earnings announcement. If a firm has restated its earnings, Compustat has the restatement date as the earnings announcement data, rather than the original earnings announcement date. To eliminate restatement announcements, we require that an earnings announcement refers to a fiscal quarter that ended at most six months prior.

B. Monthly Alphas

Standard tests of the CAPM and FF3M rely on a single alpha estimate for each asset as measured by the intercept of the time series regression of each test asset on the market excess return and the return on SMB and HML:

$$r^e_{i,t} = \alpha_i^{CAPM} + \beta_{rmrf,i} r^e_{rmrf,t} + \epsilon_{i,t} \tag{1}$$

$$r^e_{i,t} = \alpha_i^{FF3M} + \beta_{rmrf,i} r^e_{rmrf,t} + \beta_{smb,i} r_{smb,t} + \beta_{hml,i} r_{hml,t} + \epsilon_{i,t} \tag{2}$$

where i denotes each test asset.

We explore how the FF3M improves asset pricing relative to the CAPM by considering the fit of the models across each month. We measure the monthly fit by interacting the alpha estimate with a dummy variable for the month of the return:

$$r^e_{i,t} = \alpha_{i,jan}^{CAPM} + \alpha_{i,feb}^{CAPM} + \ldots + \alpha_{i,dec}^{CAPM} + \beta_{rmrf,i} r^e_{rmrf,t} + \epsilon_{i,t} \tag{3}$$

$$r^e_{i,t} = \alpha_{i,jan}^{FF3M} + \alpha_{i,feb}^{FF3M} + \ldots + \alpha_{i,dec}^{FF3M} + \beta_{rmrf,i} r^e_{rmrf,t} + \beta_{smb,i} r_{smb,t} + \beta_{hml,i} r_{hml,t} + \epsilon_{i,t} \tag{4}$$

where i denotes each test asset.

We summarize the fit of the models by calculating the average absolute alpha for each month:

$$\frac{1}{N}\sum_{i}\left|\alpha_{m,i}^{model}\right| \tag{5}$$

where i denotes the test asset, m denotes the month and N is the number of test assets. If the CAPM and FF3M fit equally well across all months, then we expect these average absolute alphas for each model to be similar across months. In Table I we report these monthly alphas (CAPM in the first row and FF3M in the second row) using the Fama-French 30 value weighted industry portfolios as test assets.[3] We find that there is substantial heterogeneity in the sum of absolute alphas across months for each model. In the third row, we report the improvement in pricing by month for the FF3M over the CAPM:

$$\frac{1}{N}\sum_{i}\left|\alpha_{m,i}^{FF3F}\right| - \frac{1}{N}\sum_{i}\left|\alpha_{m,i}^{CAPM}\right| \tag{6}$$

where an improvement or reduction in average absolute alpha is a negative number.

We see that almost all of the improvement of the FF3M relative to the CAPM is concentrated in four months: January, April, July and October. With the effect being strongest in January and October. The only other month besides these reporting months to have a substantial alpha reduction under the FF3M is February.[4] In the last column we report the total reduction across these four months and these four months plus February. For comparison, we also tabulate the total average absolute alpha reduction across all months. These totals show that almost no improvement occurs outside of these five months: 82% of the improvement occurs in January, April, July and October and more than 100% of the improvement occurs in the five months including February. The greater than 100% indicates that the FF3M actually prices assets slightly *worse* in other months. In both cases the concentration of alpha reduction is more than twice what one would expect if the alpha reduction were evenly spread across months.

[3]Untabulated results for the equal weighted portfolios reveal similar patterns.

[4]We show below that because firms tend to delay their annual reports, February can also be considered a major earnings announcement month.

We test how unlikely this concentration of alpha would be under the null that the alpha reduction is equally spread across months via bootstrapping (further details are in Appendix B). We find that both the concentration in January and October are significant at the 1% level and the concentration in July is significant at the 5% level. The concentration across January, April, July and October as a group, and the group with the addition of February are significant at the 1% level as well.

By examining the 30 Fama-French industry portfolios, we show that the seasonal concentration of the improvement in the fit of the FF3M over the CAPM is applicable to a broad cross-section of assets and portfolios that are not sorted by size and book-to-market. To further investigate the relation between the timing of earnings announcements and the improved fit offered by the FF3M, we now switch to examining the Fama-French 25 value-weighted size and book-to-market sorted portfolios. Examining these portfolios allows us to control for size and book-to-market exposures and uncover further patterns in the seasonal fit of the FF3M.

We report the monthly CAPM and FF3M alphas for the Fama-French 25 value-weighted size and book-to-market sorted portfolios in the first two rows of Panel A in Table II.[5] The difference in alphas is again in row three. We see a concentration of the alpha reduction in these test assets similar to that for the industry portfolios: 71% of the alpha reduction occurs in just four months, January, April, July and October. February is again the month with the next largest alpha reduction outside of these four months. The addition of February brings this reduction to 82%, still more than twice what a null hypothesis of equal reduction in monthly alphas across the year would predict. The concentration in January and October relative to this null hypothesis is significant at the 1% level, the concentration in February is significant at the 10% level and the concentrations across the four and five months as groups are significant at the 1% level. Clearly, these concentrations in alpha reductions are unlikely to occur by chance.

[5]Untabulated results for the equal weighted portfolios reveal similar patterns.

In Figure 1 we disaggregate the absolute alpha improvement to the test asset level for the 25 size and book-to-market sorted portfolios. We show a heat map of the absolute alpha improvement between the FF3M and the CAPM for each of the 25 portfolios for each month. Dark blue represents the least improvement and this ranges through light blue, white, yellow, dark yellow, orange and finally red which represents the most improvement. In this figure we see where and when the FF3M reduces pricing errors. We see that the reduction in January, February and October is a broad effect across all test assets, though smaller stocks have the largest alpha reduction. In January we also see some alpha reduction in the extreme value portfolios across both size and book-to-market ratios. In April and July we see that the alpha reduction is concentrated in about six portfolios–always either an extreme value or growth portfolio. In the other months we see occasional moderate reduction in alphas in individual portfolios but no overall patterns.

To see how SMB and HML contribute separately to the reduction in alphas, we calculate monthly alphas under the CAPM plus each factor separately:

$$r^e_{i,t} = \alpha^{FF2MS}_{i,jan} + \alpha^{FF2MS}_{i,feb} + \ldots + \alpha^{FF2MS}_{i,dec} + \beta_{rmrf,i} r^e_{rmrf,t} + \beta_{smb,i} r_{smb,t} + \epsilon_{i,t} \tag{7}$$

and

$$r^e_{i,t} = \alpha^{FF2MH}_{i,jan} + \alpha^{FF2MH}_{i,feb} + \ldots + \alpha^{FF2MH}_{i,dec} + \beta_{rmrf,i} r^e_{rmrf,t} + \beta_{hml,i} r_{hml,t} + \epsilon_{i,t}. \tag{8}$$

We compare these alphas to the CAPM alphas to see the effect of each factor over the market alone. We also compare these alphas to the FF3M to understand the marginal impact of each factor while allowing for interactions between SMB and HML. We present these results for SMB alone in Panel B of Table II and HML alone Panel D of Table II. We present the marginal impact of SMB allowing interactions in Panel C and the marginal impact of HML allowing interactions in Panel E.

In Panel B, we see that SMB is responsible for the concentration of the alpha reductions in January, February and October, all highly statistically significant. While in Panel D the results for HML show it to be responsible for a portion of the alpha reduction in January and almost all the alpha reduction in April and July. Thus SMB seems to capture information about the first and fourth quarters, while HML captures information about the first, second and third quarters.

In Panel C and Panel D we see that there is a significant interaction effect between SMB and HML that allows them to reduce asset mispricing. This interaction effect is concentrated in the announcing months: January, February, April, July and October. Comparing Panel D and Panel E, we see that the interaction is especially important for the marginal contribution of HML. The reduction in alphas in the reporting months from adding HML is 50% larger in the presence of SMB than without it.

B.1. Monthly Alphas Robustness Tests

We now show that the improvement in fit by the FF3M over the CAPM in certain months is not driven simply by the FF3M providing additional flexibility to match seasonal variation in market betas. We show this by comparing the fit of the CAPM each month with the fit of a conditional CAPM each month where we allow each test asset to have a different beta each month. We present the results of this alternative specification in Table III. Allowing the CAPM this additional conditioning flexibility does not result in lower alphas each month. Thus the reduction in alpha for the FF3M is not simply due to SMB and HML proxying for monthly seasonality in conditional betas. This result is consistent with the finding of Lewellen and Nagel (2006) that a conditional CAPM cannot explain observed alphas.

We also find that the particularly bad fit of the CAPM in months like October and the FF3M's ability to reduce these pricing errors is not simply due to a random occurrence of extreme returns in those months–such as the stock market crash of 1987. To control for these effects we omit the months with the 20 worst market returns. In Table IV we present the alpha of this censored data set. We see that censoring the data leaves our results virtually unchanged. This insensitivity is robust to various censoring levels (e.g. 10 or 30 worst months).

C. *Understanding the Seasonal Patterns*

The months in which the FF3M improves over the CAPM are not random. January, April, July and October are the main earnings reporting months. Even February can rightly be considered an earnings announcement month. In Figure 2 we show the fraction of firm earnings announcements in each month of our sample. We see the well known pattern that announcers cluster at the beginning of the quarter. Only the first quarter differs from this pattern of most announcements occurring in the first month of the quarter. In the first quarter many firms delay their announcements to February causing February to have the highest number of announcers for months in that quarter. This delay is due to the longer time required to complete annual reports compared to quarterly reports.[6] Despite this delay January still has nearly twice the number of announcements as does March. Nevertheless, March still has a larger percentage of announcements than does any other third month of a quarter.

The concentration of announcements in the beginning months of each quarter suggests a connection between earnings announcements and our finding that the alpha reductions of the FF3M are concentrated in January, April, July and October. Moreover the relative spike of announcers in February is consistent with February being the only other month with a substantial alpha reduction. Lastly, the more even earnings announcement release pattern across the months of the first quarter is consistent with the first quarter having substantial alpha reductions across all three months (see Table II Panel A), something no other quarter has.

Looking at the aggregate level, we see that this uneven release of information throughout the year coincides with variation in the factor returns. In Table V we report the average ex-

[6] Note that in recent years, more than 80% of firms have December 31 fiscal year ends and hence release their annual numbers during the first quarter of the calendar year.

cess return of the market (RMRF) as well as the average return of the HML and SMB factors in the first, second and third months of the quarter. We see that the average market return is highest in the first month of the quarter when there is the largest release of information through earnings announcements and lowest in the third month of the quarter when there is the smallest release of information through earnings announcements. The average return of HML is also substantially higher in the first month of the quarter than in the second and third months. SMB has what at first appears to be a contradictory pattern in its average returns with its highest average return occurring in the third month of the quarter and its lowest average return occurring in the first month of the quarter. We will see, however, why the within-quarter pattern in the average SMB return is ultimately consistent with those of RMRF and HML.

To understand this channel connecting the alpha improvement, earnings announcement concentration and factor return variation, we investigate whether stocks sorted on size and book-to-market equity announce uniformly or if these characteristics are associated with patterns in the timing of announcements. For there to be a more than coincidental connection between these facts, we would expect to see a differential earnings announcement pattern across the types of stocks the FF3M helps to price.

To test this channel, we disaggregate the 25 Fama-French size and book-to-market sorted portfolios. For each stock we obtain its earnings announcement dates from quarterly Compustat. Using these announcement data, for each quarter we assign a firm to one of three categories: month 1 announcer, month 2 announcer or month 3 announcer, based on the first reported announcement date for a firm in that quarter. We aggregate across quarters, grouping all the month 1 announcers across all quarters, all the month 2 announcers across all quarters and all the month 3 announcers across all quarters. We then calculate the fraction of stocks in each of the 25 Fama-French portfolios that announce in each month. The fraction of announcers must sum to 100% across the three month groups.

In Panel A of Table VI we tabulate this fraction of firms that announce. Looking at the announcement patterns for the first month of the quarter, we see that big stocks tend to announce earlier than small stocks. Moving down each column from small stocks to big stocks we see that approximately 40% of small stocks announce in the first month of the quarter while approximately 75% of big stocks announce in the first month of the quarter. Looking at the second month of the quarter we see that almost all of the remaining big stocks announce in the second month leaving about 5% to announce in the third month of the quarter. However, we see that approximately another 40% of small stocks announce in the second month of the quarter leaving about 15% percent of small firms to announce in the last month. We plot these announcement patterns in Panel A of Figure 3. We see clear upward sloping lines of announcer fractions in month 1 and downward sloping lines in months 2 and 3.

In Panel A of Table VI we also see a difference in the announcement timing of value stocks compared to growth stocks. However, the pattern is most clearly visible in Panel B of Figure 3 where we plot the fractions of announcements across firms sorted by book-to-market. In the first month of the quarter, we see a U-shape line for each size quintile: the fraction increases from quintile G to quintiles 3 or 4, and then falls for quintile V, and the fractions for G and V are not much different. In the second month we see similar, but reverse, U-shape lines. The differences in announcement fractions across book-to-market sorts can be seen most clearly in the third month of the quarter. There, aside from the line for the smallest size quintile, the fractions fall as we move across the book-to-market quintiles, and the differences in value versus growth announcements become evident among average size to large firms (size quintiles 3, 4 and 5).

In Panel B through of Panel E of Table VI we show the reporting patterns by individual quarter. Across all quarters we see broadly the same pattern: big firms announce earlier than small firms and value firms announce earlier than growth firms. Quarters 2 through 4 have very similar announcement patterns. Only quarter 1 differs, with a delay in announcements across all firms, but even in that first quarter, we still see that big firms report earlier than small firms.

The magnitude of this differential reporting becomes especially significant when we consider the interaction of the size and book-to-market reporting patterns. We see this by looking at the ratio of the percent of firm reporting in group biggest-value (BV) and the percent of firm reporting in group smallest-growth (SG). The ratio falls from about 2.0 (73 versus 36) in the first month, to 0.5 (26 versus 49) in the second month, and 0.13 (2 versus 16) in the third month.

In untabulated results we find that the pattern of big stocks announcing earlier than small stocks persist when we only sort on size and not on book-to-market ratio to form five rather than 25 portfolios. However, when we sort only on book-to-market ratio to form five portfolios, we no longer observe the earlier announcement of value stocks. This earlier announcement of value stocks is masked by the later announcement of small stocks because value stocks tend to be smaller than growth stocks. Thus, to see the earlier announcement of value stocks it is important to sort along both the size and book-to-market ratio dimensions.

That big stock and value stocks tend to announce earlier in the quarter than small and growth stocks helps us understand why SMB's average returns across months of the quarter are indeed consistent with those of RMRF and HML (see Table V). Big stocks announce early and form the short part of the SMB portfolio; thus, they pull SMB's return down at the beginning of the quarter. Small stocks announce late and form the long part of SMB; thus, they push SMB's return up at the end of the quarter. Similarly for HML, value stocks announce early in the quarter and form the long position in HML; thus, they push up HML's return at the beginning of the quarter. Growth stocks announce late in the quarter and form the short position in HML; thus, they pull HML's return down at the end of the quarter.

II. Model

In this section, we build a rational two period model where one set of firms announces in the first period and a second set of firms announces in the second period. The goal of this simple model is to exemplify how a factor that loads on late versus early announcers can generate a concentration of alpha reduction relative the CAPM in the early announcement period. In each period, there is a systematic cash flow shock to each firm and announcing consists of revealing what each firm's specific exposure to this shock is. This information structure captures the idea that from early announcers we learn their firm specific exposure at the same time as the systematic shock. For late announcing firms we infer information about the systematic shock from the early announcer but we do not fully learn the firm's specific exposure until the late announcing firm actually announces. This model is based on that from Gilbert et al. (2013) that studies how delayed information release of opaque firms compared to transparent firms interferes with beta measurement and creates a need for a second factor based on a long short portfolio of opaque and transparent firms to price assets at high frequency.

A. Model Setup

We consider an economy populated by a continuum of identical risk averse agents indexed by $j \in [0, 1]$ who value only terminal wealth $W_{j,T}$. All agents have exponential utility:

$$u[W_{j,2}] = -\exp[-\gamma W_{j,2}], \tag{9}$$

where γ is the agents' coefficient of absolute risk aversion. The economy has 3 dates: 0, 1, and 2. At all dates before 2, agents trade a risk-free bond and N risky assets. At the terminal date 2, agents consume their terminal wealth $W_{j,2}$. We let agents in the model have risk aversion of five.

A.1. Assets

The risk-free bond has a certain payoff of 1 and serves as the numeraire. Each risky asset i pays a single cash flow at terminal date 2. At every date following date 0, each risky asset i accrues a portion of its terminal cash flow. The cash flow accrued at date t is determined by an economy wide systematic shock (event or news) denoted $\tilde{f}_t$, and an asset specific exposure to that shock denoted $\tilde{b}_{i,t}$. This asset level exposure is time varying. The final cash flow to asset i therefore is:

$$\tilde{C}_{i,2} = \sum_{\tau=1}^{2} \tilde{b}_{i,\tau} \tilde{f}_{\tau}. \tag{10}$$

There are two types of risky firms: M early announcing firms and $(N - M)$ late announcing firms, and there is one net share of each risky firm.

For tractability, we make the set of states finite. The systematic news events, $\tilde{f}_t$, and firm specific exposures, $\tilde{b}_{i,t}$, are either 0 or 1 with equal probability. All the shocks are i.i.d. across firms and dates. This parametrization captures the fact that expected cash flows of firms have a positive mean, consistent with limited liability and ensuring that there can never be negative cash flows in aggregate.[7] We choose the firm level exposures to be $b^H = 1$ and $b^L = 0$ with marginal probabilities $P_b^H = P_b^L = 0.5$. This captures the fact that sometimes a firm is strongly exposed to a piece of systematic news, and at other times it is not (or weakly) exposed to a piece of systematic news.

A.2. Information Release: Early and Late Announcers

The information structure of this model is the main innovation to capture the effect of early and late announcers. All individuals have the same information set. At each date t, the systematic realization, $\tilde{f}_t$, is revealed. For the early announcing firms, the time-varying firm specific exposure, $\tilde{b}_{i,t}$ is also revealed. However, for the late announcing firms, the firm's

[7] In our multiplicative cash flow structure the model is not invariant to translations in the values of f, meaning a normalization of the expected cash flows to zero is not harmless. Standard exponential utility models with purely additive cash flows are invariant to such normalization. Our results hold for other values of f, but do require the positive mean in the f shocks.

specific exposure, $\tilde{b}_{i,1}$ is revealed after a lag of one period. For the late announcers $\tilde{b}_{i,2}$ is revealed in date 2 as well when they announce.

As always, a firm's long term beta is its average response to an average type of systematic news, even though firms respond differently to different pieces of systematic news. Our model captures this variation in exposure by the stochastic $\tilde{b}_{i,t}$. When a piece of systematic news is announced, agents must consider each firm's exposure to that specific shock. For each systematic news event, the market must process both its overall importance (magnitude) and how the shock affects each firm individually. A firm's earnings announcement provides the firm specific exposure for this second step of determining the $\tilde{b}_{i,t}$.

Our information structure captures the idea that early announcers have their firm specific exposure known (at least some of the time) before the firm specific exposures of late announcers are known. When early announcing firms announce, the market evaluates the impact of systematic news on early announcing firms and incorporates it into their prices. While for late announcing firms the market learns about the systematic exposure from the early announcers but must wait for the firm specific information. When the early announcers announce, the market also updates the prices of the late announcers based on their best (conditional) expectation of the response of the late announcers' cash flows to the available information

Importantly, early and late announcements are not directly related to a firm's overall level of long term risk. There can be risky firms that announce early and risky firms that announce late. This differs from the work of Savor and Wilson (2011b) that relies on early announcing firms being riskier than late announcing firms.

B. Asset Pricing Models

The agents' problem, equilibrium and endogenous pricing equations in this economy are standard and details can be found in Appendix A. We now consider how the CAPM and a two factor model based on the market and a long short portfolio of late versus early announcers price assets. This second factor based based on the difference between late and early announcing firms is labeled with a subscript ΔA and *supplements* the market factor rather than *replaces* it. We view this factor as a proxy for SMB and HML which, based on our previous results, one can view as being factors at least partially based on the spread between early and late announcers.

Throughout this section let $\mathbb{L}$ denote the set of late-announcing assets and $\mathbb{E}$ denote the set of early-announcing assets. It is important to keep in mind that the exponential utility of our agents means returns are additive and not multiplicative. The market factor is the sum of the returns on the two types assets:

$$R_{mkt,t} = \sum_{i \in \mathbb{E}} R_{i,t} + \sum_{i \in \mathbb{L}} R_{i,t}. \tag{11}$$

We construct a second factor (labeled with subscript ΔA) by forming a zero investment portfolio that is long the late announcers and short early announcers assets:

$$R_{\Delta A, \tau \to t} = \frac{1}{1 - \omega_{\mathbb{E}}} \sum_{i \in \mathbb{L}} R_{i, \tau \to t} - \frac{1}{\omega_{\mathbb{E}}} \sum_{i \in \mathbb{E}} R_{i, \tau \to t} \tag{12}$$

where $\omega_{\mathbb{E}}$ is the fraction of assets that are early announcers.

We calculate unconditional betas in the standard way. However, the expected returns variation across dates leads to some complications, the details of which can be found in Appendix A.C.

We calculate pricing errors under the CAPM in each period as:

$$\alpha_{i,t}^{CAPM} = \bar{R}_{i,t} - \beta_{i,mkt} \bar{R}_{mkt} \tag{13}$$

and we calculate pricing errors under the 2-factor model each period as:

$$\alpha_{i,t}^{2Factor} = \bar{R}_{i,t} - \beta_{mkt,i}^{2Factor} \bar{R}_{mkt} - \beta_{\Delta A,i}^{2Factor} \bar{R}_{\Delta A}. \tag{14}$$

C. Model Results

We solve the model in closed form. But due to the large state space, the closed-form solutions are long and cannot be conveniently reported. In Table VII we report results when the fraction of the market that is late announcers is set to 40%. We obtain similar results so long as the fraction of late announcers is not too small, which makes sense for in the case of no late announcers, the effect must disappear.

Table VII presents the results of this calibration. We see that the alphas of the CAPM in our model are nearly twice as large in the first period when most firms announce as in the second period when the remaining firms announce. Adding a factor based on the spread between early and late announcing firms yields zero alphas in both periods. Thus the alpha improvement from a second factor is concentrated in the early announcement period, just as we find in the data (see Table II).

The intuition of our model can be seen by decomposing the price movements in the early announcement period into cash flow shocks and discount rates shocks in the spirit of Campbell and Vuolteenaho (2004). For the early announcers, the simultaneous revelation of the systematic shock and their firms specific exposure makes their price moves entirely due to cash flow shocks. For the late announcers, split of information across two periods–the systematic shock in the first period and firm level exposure in the second period–makes their price change partially due to a cash flow shock and a discount rate shock. The discount rate shock comes from the conditional change in riskiness that these firms experience when the systematic shock is large (i.e. $f_t = 1$) compared to if the systematic shock is small (i.e. $f_t = 0$). Ultimately the risk of the securities is determined by their exposure to the cash flow shocks, so the discount rate component alters both the market price process and the co-movement between stock prices and the market from what these would be if there were only cash flow shocks. Thus the discount rate shocks confound the ability of market beta alone to measure stocks' riskiness. Adding a second factor allows for a way to distinguish exposures to cash flow shocks from discount rate shocks, similar to the decomposition of market beta into good beta and bad beta by Campbell and Vuolteenaho (2004).

In the late announcement period there is no more splitting of information across periods, meaning that more of the price changes in the second period are due to cash flow changes. Hence the improvement in alpha from the second factor is concentrated in the first period where these two types of price changes most confound the ability of market betas to provide a proper measure of risk.

We build our model around the differential earnings announcements of big versus small stocks and growth versus value stocks that we document in Table VI. One test of our model is that it is able to deliver the concentration of alpha improvement in early reporting months that we document in Table II. A key component of our model is that our additional factor is based on a long-short position in late versus early announcers. Thus a firm's exposure to the factor differs based on when it announces. In the next section, we test whether a firm's exposure to SMB and HML does differ with variation in the timing of the firms' earning announcements.

Our model differs in several important ways from that of Savor and Wilson (2011b). Our model has an endogenous return process generated from cash flow news and investors' utility functions. Our model also does *not* rely on early announcing firms being riskier than late announcing firms. Instead our model shows that early announcing firms have higher market betas in a mis-specified one factor model even though both types of firms have the same underlying risk (total cash flow volatility) and expected returns. Adding a second factor based on a long short position in late versus early announcers corrects this mis-specification. Thus this second factor *supplements* the CAPM as in the FF3M rather than *replaces* the market factor as in the asset pricing model proposed by Savor and Wilson (2011b).

III. Differential Beta Exposures of Early vs. Late Announcers

If, as our model predicts, part of the effect that SMB and HML capture is the interference of the timing of earnings announcements with the market beta's ability to capture a firm's risk, then the timing of a firm's announcements should play a role in how exposed a firm is to the SMB and HML factors. More specifically, we test two hypotheses inspired by our model. First, if a firm announces when big stocks announce then it will have an SMB exposure more like big firms even when it is a small firm. Conversely, if a stock announces when small stocks announce, then it will have an SMB exposure more like small stocks, even when it is a big firm. Second, if a firm announces when value stocks tend to announce, it will have an HML exposure like those of value stocks, even if it is not a value stock. And if a firm announces with growth stocks, it will have an HML exposure similar to growth stocks, even if it is not a growth stock.

To test these hypotheses, we compare how the SMB and HML exposures of the stocks *within* each of the 25 Fama-French size and book-to-market sorted portfolios change when we sort these portfolios along the third dimension of the month in which these firms announce. For each quarter we split the Fama French 25 portfolios into 75 portfolios based on which month of the quarter each constituent stock announces. We rebalance the portfolios at the beginning of July as the regular size and book-to-market sorted portfolios are. We report results for these new value weighted portfolios in Table VIII, and in untabulated results we verify that the patterns for equal weighted portfolios are similar.

In Panel A of Table VIII we report the SMB exposures for these triple sorts. Our hypothesis implies that early announcing firms should have lower SMB betas (act more like big stocks) and later announcers should have higher SMB betas (act more like small stocks). Thus, as we move across the reporting categories from firms that announce in the first month of the quarter to firms that announce in the last month of the quarter within a size and book-to-market category, the SMB beta should increase. We shade all rows whose difference between month 1 and month 3 announcer SMB betas match this predicted pattern. This pattern holds for 78 out of 100 rows (25 size and book-to-market portfolios times 4 quarters) and many of these rows that fail to match this pattern do so only marginally. The magnitude of the beta change across announcer categories is economically large at approximately an SMB beta difference of 0.2 between early announcer and late announcers. This difference is roughly equivalent to changing one size category. We test whether these differences in beta exposures are statistically significant by testing whether the SMB beta on a portfolio long the month 1 announcers and short the month 3 announcers is negative. We find that two thirds of the differences are statistically significant at the 5% level or higher (shaded dark gray) and almost half are significant at the 1% level (depicted with red bold font).

Looking at the SMB beta differences in the first quarter, we see that 21 of the 25 portfolios, including all the portfolios in the largest size quintile have significantly (at less than 10%) lower betas when they announce in January compared to those that announce in March. This suggests that our January findings are distinct from the small-firm (and turn-of-the-year) January effect reported in the literature (Keim, 1983; Reinganum, 1983; and others). More broadly, our analysis suggests that our proposed mechanism (differential timing of information releases) may help explain part of the January effect since there is a pattern in the type of firms announcing their earnings in that month.

In Panel B of Table VIII we report the results of our analysis for HML exposures. Our hypothesis implies that early announcers should have higher HML exposure (behave more like value stocks) while late announcers should have lower HML exposure (behave more like growth stocks). Thus, as we move across the reporting categories from firms that announce in the first month of the quarter to firms that announce in the last month of the quarter, we expect the HML exposure to decrease. We shade all rows whose difference between month 1 and month 3 announcer HML betas match this predicted pattern. We indeed see this pattern, observing a decrease in 64 out of 100 rows. HML exposures changing in the opposite direction are concentrated among the small and growth stocks. This is consistent with the results of Table VI that shows there are no clear differences in the timing of announcements for small growth versus small value stocks. The economic magnitude of the HML exposure decrease is large and especially large for value stocks. Moving from an early announcing stock to a late announcing stock moves a stock's HML exposure down about 0.5, an amount equivalent to stepping down two to three value quintiles. We again test for statistical significance of these beta differences, by testing if the HML beta of a long short portfolio of month 1 and month 3 announcers is positive. We find that almost two thirds of the beta difference following the predicted pattern are statistically significant at the 5% level and one third are significant at the 1% level.

Summarizing, we find strong support for our two hypotheses. We show that the size and value characteristics are strongly related to the characteristic of when a firm announces even after controlling for a firm's size and book-to-market ratio. In the process, we also show how the announcement timing characteristic is connected to variation in SMB and HML exposures, i.e. covariances. Thus we provide a mechanism by which characteristics of when firms announce can lead to covariances in returns of firms with similar market equity and book-to-market ratios. This sheds light on the on-going characteristics versus covariances debate.

IV. Conclusion

We show that a large part of the improvement from adding SMB and HML to the market factor in asset pricing tests arises from seasonality in information releases. First, the FF3M alpha reduction over the CAPM comes primarily in the months with the largest concentration of earnings announcements: January (and February), April, July and October. SMB reduces alphas mostly in January, February and October while HML reduces alphas primarily in January, April and July. Second, we find that the big and value stocks tend to report earlier in each quarter while small and growth stocks tend to report later in each quarter. Third, we find that after controlling for size and book-to-market ratios, when a firm announces has a significant effect on its SMB and HML exposures: firms that announce earlier have lower SMB exposures and higher HML exposures regardless of their firm level market equity and book-to-market equity characteristics.

We build a model with two types of firms: early and late announcers. In this model we show that a multiple factor structure can arise due to this difference in announcement timing. Under the CAPM, assets in this model are mispriced and the mispricing is concentrated in the earlier reporting period–just as in the data. When we add a second factor based on the spread between early and late announcers, the alphas are eliminated. This second factor's alpha improvement is concentrated in the early announcement period, just as in the data. If we view SMB and HML as, at least partially, proxying for the spread in earnings announcement timing, we can understand the concentration of the alpha reduction of the FF3M over the CAPM in announcement months.

Our results show that the informational release structure in the economy can lead to a multiple factor structure in returns. Any future economic explanation of the underlying risk associated with SMB and HML must take account of these new seasonal patterns we document in the fit of the FF3M.

A. Model Details

In this appendix we present the supporting details of our model.

A. *Equilibrium*

The economy is populated by a continuum of identical risk averse agents indexed by $j \in [0,1]$ who value only terminal wealth $W_{j,T}$. All agents have exponential utility:

$$u[W_{j,2}] = -\exp[-\gamma W_{j,2}], \tag{A-1}$$

where γ is the agents' coefficient of absolute risk aversion. The economy has 3 dates: 0, 1, and 2. At all dates before 2, agents trade a risk-free bond and N risky assets. At the terminal date 2, agents consume their terminal wealth $W_{j,2}$.

Let each agent begin with wealth $W_{j,0}$ and let $S_{j,t}$ denote the vector of shareholdings for agent j at date t. Furthermore let P_t denote the vector of risky asset prices at date t and C_T denote the vector of terminal cash flows of the assets. We have the following definitions of each agent's problem and of the model's equilibrium.

DEFINITION 1: *Each agent solves the following problem at each date t, 0 through $T-1$:*

$$\max_{\{S_{j,\tau}\}_{\tau=t}^{T-1}} E_t[-\exp(-\gamma \tilde{W}_{j,T})] \tag{A-2}$$

subject to price process P_t and wealth transition equations:

$$W_{j,t+1} = S_{j,t}P_{t+1} + (W_{j,t} - S_{j,t}P_t), \tag{A-3}$$

$$W_{j,t+2} = S_{j,t+1}P_{t+2} + (W_{j,t+1} - S_{j,t+1}P_{t+1}), \tag{A-4}$$

$$\vdots$$

$$W_{j,T} = S_{j,T-1}C_T + (W_{j,T-1} - S_{j,T-1}P_{T-1}). \tag{A-5}$$

DEFINITION 2: *An equilibrium in this economy is a series of shareholding policies* $\{S_{j,0}, \ldots, S_{j,T-1}\}$ *for each agent that solve the agent's problem and a price process* P_t *that clears the market at each state and date:*

$$\int_{j=0}^{1} S_{j,t} dj = 1. \tag{A-6}$$

B. Prices

In equilibrium, since agents are identical, they all hold the same portfolio. We normalize the initial wealth of each agent to be that from holding only risky assets. We obtain the standard form for the equilibrium price process for asset i at date t:

$$P_{i,t} = \frac{E_t[-\exp[-\gamma \tilde{W}_T]\tilde{C}_{i,T}]}{E_t[-\exp[-\gamma \tilde{W}_T]]} \tag{A-7}$$

where $W_T \equiv W_{j,T} = \sum_{i=1}^{N} C_{i,T}$, i.e., terminal wealth is the sum of the cash flow of the individual assets and is the same for all agents.

To compute the expectations in equation (A-7), we take advantage of the discrete nature of the state space, converting the expectations into summations over the state space:

$$P_{i,t} = \frac{\sum_{s \in \mathbb{S}_t} Pr(s)[-\exp[-\gamma \tilde{W}_T]\tilde{C}_{i,T}]}{\sum_{s \in \mathbb{S}_t} Pr(s)[-\exp[-\gamma \tilde{W}_T]]} \tag{A-8}$$

where $\mathbb{S}_t$ is the set of all possible states conditional on the information present at date t and $Pr(s)$ is the probability of state s.

C. Betas Calculations

C.1. CAPM

Calculating the beta is slightly more complicated than usual because the differential information release creates a conditional covariance structure between the market factor and each asset return. Returns in each period have a slightly different distribution, which means that the expected return and covariance structure change across each period. We calculate these unconditional betas in the same way an econometrician would if she were to ignore these variations in return distributions. Knowing the true distribution of the random variables makes our beta the limit of the econometrician's estimate. Hence our beta is not subject to estimation error. We have:

$$\beta_{mkt,i} = \frac{E_0\left[\frac{1}{T}\sum_{t=1}^{T}\left((R_{i,t-1\to t} - \bar{R}_i)(R_{mkt,t-1\to t} - \bar{R}_{mkt})\right)\right]}{E_0\left[\frac{1}{T}\sum_{t=1}^{T}(R_{mkt,t-1\to t} - \bar{R}_{mkt})^2\right]}, \tag{A-9}$$

where

$$\bar{R}_i = E_0\left[\frac{1}{T}\sum_{t=1}^{T} R_{mkt,t-1\to t}\right] = \frac{1}{T}\sum_{t=1}^{T} E_0[R_{mkt,t-1\to t}] \tag{A-10}$$

and

$$\bar{R}_{mkt} = E_0\left[\frac{1}{T}\sum_{t=1}^{T} R_{mkt,t-1\to t}\right] = \frac{1}{T}\sum_{t=1}^{T} E_0[R_{mkt,t-1\to t}] \tag{A-11}$$

are the unconditional means used by the econometrician. These means ignore the variation in expected returns across periods and hence are an average of the expected returns across all the periods.

We calculate pricing errors under the CAPM as:

$$\alpha_i^{CAPM} = \bar{R}_i - \beta_{i,mkt}\bar{R}_{mkt}. \tag{A-12}$$

C.2. Two Factor Model

We define both factor betas in the standard way:

$$\beta_i^{2Factor} = \Sigma^{-1}\Lambda_i \tag{A-13}$$

where $\beta_i^{2Factor} = [\beta_{mkt,i}^{2Factor}, \beta_{\Delta A,i}^{2Factor}]'$, Σ is the covariance matrix of the factors, and Λ is the vector of covariances between the factors and asset i. The key complication lies in the calculation of these covariance matrices (and vectors). Similar to our calculations for the CAPM betas, we calculate these covariances as would an econometrician who only calculates a single (unconditional) expected return for each asset and factor. The covariances in each matrix entry are computed using the following covariance function:

$$cov^*(R_i, R_j) = E_0\left[\frac{1}{T}\sum_{t=1}^{T}(R_{i,t-1\to t} - \bar{R}_i)(R_{j,t-1\to t} - \bar{R}_j)\right] \tag{A-14}$$

where $\bar{R}_i$ is the econometrician's single mean as defined in the CAPM section.

We calculate pricing errors under the 2-factor model as:

$$\alpha_i^{2Factor} = \bar{R}_i - \beta_{mkt,i}^{2Factor}\bar{R}_{mkt} - \beta_{\Delta A,i}^{2Factor}\bar{R}_{\Delta A}. \tag{A-15}$$

B. Statistical Test of Alpha Concentration

We test whether the seasonal concentration of alpha reduction from the CAPM to the FF3M is more than one would simply expect by chance. Our null hypothesis is that there is no seasonal pattern in alpha reduction and any concentration in alpha reduction is due to a random concentration in particular months of returns inconsistent with the CAPM but consistent with the FF3M.

To see how likely such return concentrations are, we bootstrap 10,000 alternative return sample paths and compare the concentration of the alpha reduction between the CAPM and FF3M in those paths versus the reduction we observe in reality.

One sample path consists of selecting, with replacement, the same number of random months from the overall time series to create a new hypothetical time series of the same length. When a month is selected we take the returns for the factors and all relevant test assets that month. With this hypothetical time series we estimate both the CAPM and FF3M and calculate the concentration of the alpha reduction for a single fixed month, the sum across four fixed months and the sum across five fixed months.

Using these 10,000 alpha reduction concentrations we calculate critical values 10%, 5% and 1% levels for a one month concentration, four month sum concentration and five month sum concentration. We compare the actual individual month concentrations to this first set of critical values. We compare the total alpha reduction concentration for the reporting months January, April, July and August to the four month critical values and we compare the reporting months plus February concentration to the five month critical values.

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Figure 1.

Reduction in Unconditional Mean Absolute Alphas per Month and per Fama-French 25 Size and Book-to-Market Sorted Portfolios

This table shows absolute difference in the absolute alphas between the CAPM and Fama-French 3 factor model by month for the Fama-French 25 size and book-to-market sorted portfolios (1950 to 2012). Monthly alphas are calculated using calendar month dummy variables in time series regressions. Dark blue represents values close to zero, this ranges through light blue, white, yellow, orange and then red represents the highest values.

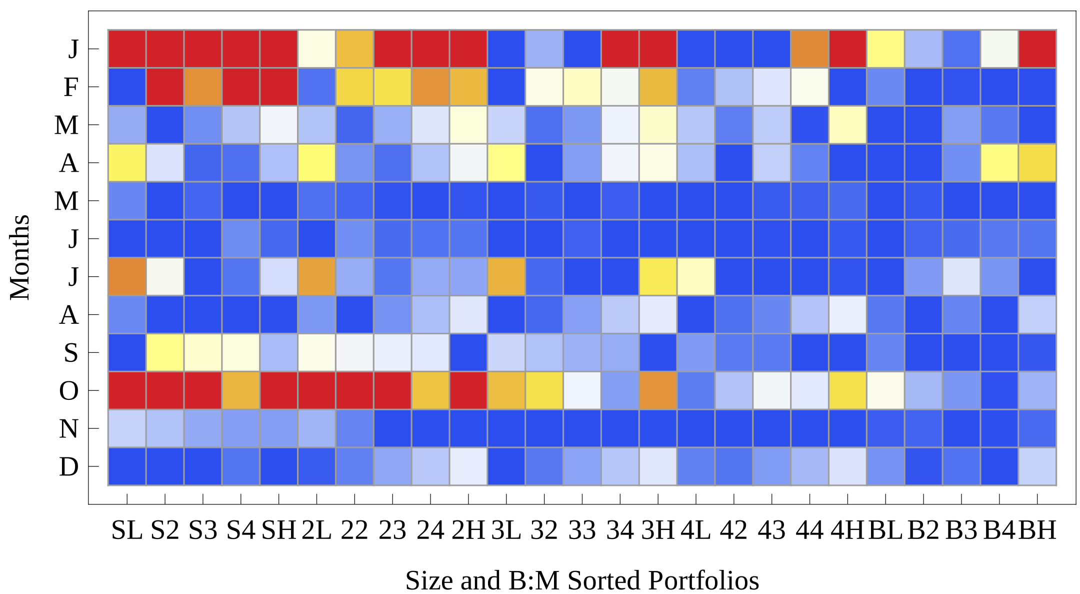


Figure 2.
Percentage of Earnings Announcements in Each Month
This figure shows the percentage of firms with a quarterly announcement in each calendar month. Data are from CRSP and Compustat and cover the time period 1975 to 2012. To be included in the sample a firm must both be assigned to one of the Fama-French 25 size and book-to-market sorted portfolios in a year and have at least four earnings announcements within that year.

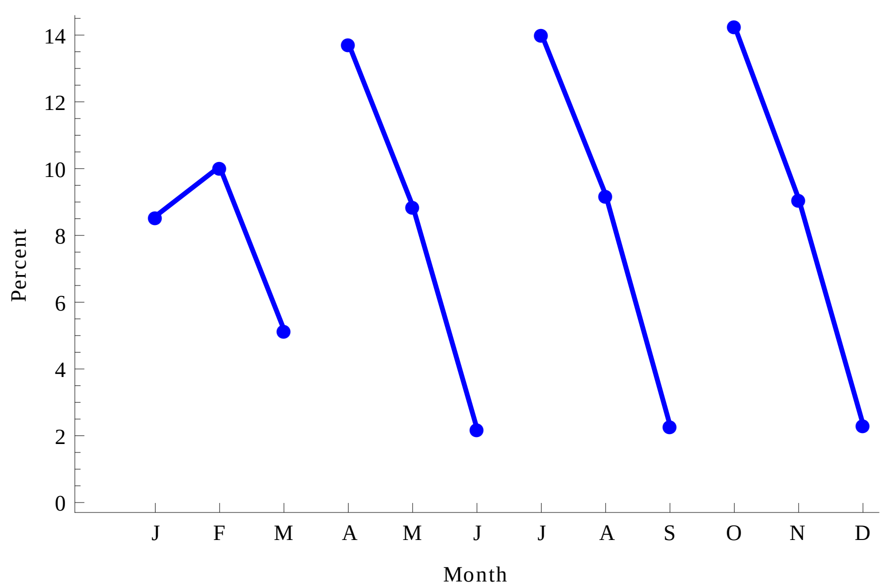
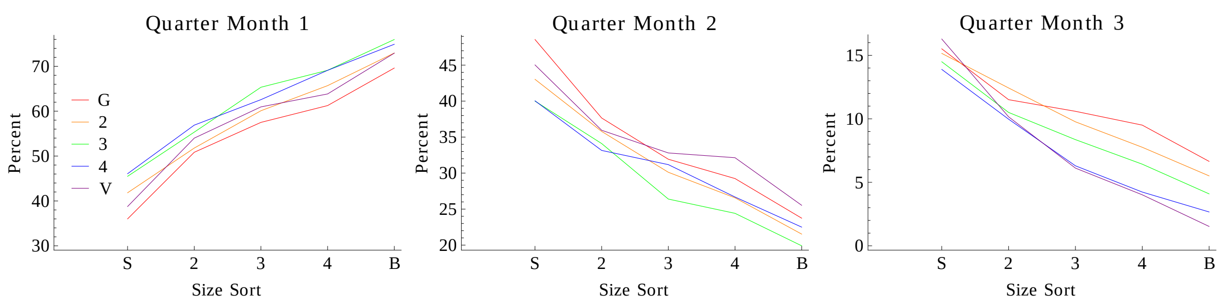


Figure 3.
Fraction of Reporting Firms By Quarter-Month for the Fama-French 25 Size and Book-to-Market Sorted Portfolios
This figure shows the fraction of firms (across all years) within each of the 25 size and book-to-market sorted portfolios that have their first earnings announcement of the quarter in month 1, month 2 or month 3 of the quarter. This figure aggregates across all quarters from 1975 to 2012. Panel A connects portfolios within a book-to-market equity quintile. Moving along a line left to right is moving from small stocks to big stocks. Panel B connects portfolios within a size quintile. Moving along a line from left to right is moving from growth stocks to value stocks. Observations are firm years. To be included a firm year must have at least four earning reports in that year.

Panel A: Percent Report All Quarters: Connecting BE:ME Categories



Panel B: Percent Report All Quarters: Connecting Size Categories

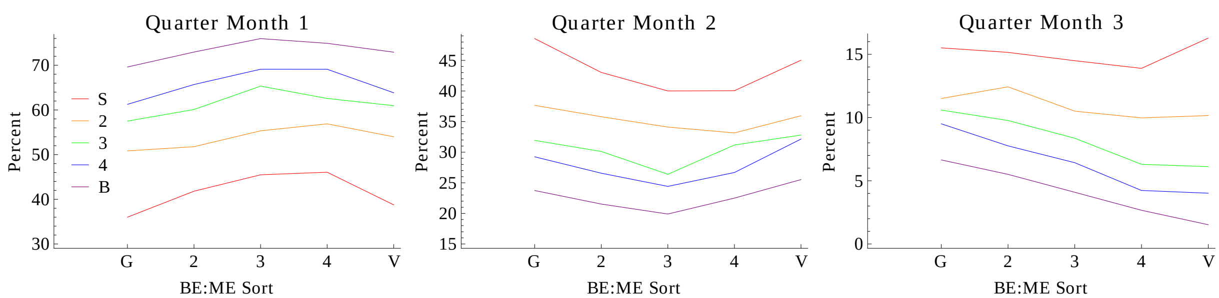


Table I

Unconditional Mean Absolute Alphas: Fama French 30 Industry Portfolios

This table shows the mean absolute alphas by month for the CAPM and Fama-French three-factor model. The table also shows the difference in the monthly mean absolute alpha across the two models. We also present the total mean absolute alpha reduction across models concentrated in two sets of months: the main reporting months of January, April, July and October; and the main reporting months plus February. Monthly alphas are calculated using calendar month dummy variables in time series regressions (1950 to 2012). Test assets are the value weighted Fama-French 30 industry portfolios. On the monthly alpha improvement or sum of improvements in the main reporting months we perform a one sided test for statistical significance against the null that concentration in improvement is due to randomness rather than seasonality. Further details of this null and the bootstrapping procedure used is in Appendix B. The lightest gray background indicates significance at the 10% level, light gray significance at the 5% level and gray significance at the 1% level.

Full Fama French 3 Factor Model

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	0.66	0.46	0.39	0.53	0.42	0.52	0.52	0.38	0.50	0.72	0.49	0.50	JAJO	−0.42
FF3M	0.50	0.35	0.40	0.55	0.42	0.54	0.43	0.42	0.50	0.53	0.49	0.47	JFAJO	−0.53
Chng	−0.16	−0.11	0.02	0.01	−0.00	0.02	−0.09	0.04	−0.01	−0.19	−0.00	−0.04	All	−0.51

Table II
Unconditional Mean Absolute Alphas: Fama French 25 Size and Book-to-Market Sorted Portfolios

This table shows the mean absolute alphas by month for the CAPM and Fama-French three-factor model. The table also shows the difference in the monthly mean absolute alpha across the two models. We also present the total mean absolute alpha reduction across models concentrated in two sets of months: the main reporting months of January, April, July and October; and the main reporting months plus February. Monthly alphas are calculated using calendar month dummy variables in time series regressions (1950 to 2012). Test assets are the value weighted Fama-French 25 size and book-to-market sorted portfolios. On the monthly alpha improvement or sum of improvements in the main reporting months we perform a one sided test for statistical significance against the null that concentration in improvement is due to randomness rather than seasonality. Further details of this null and the bootstrapping procedure used is in Appendix B. The lightest gray background indicates significance at the 10% level, light gray significance at the 5% level and gray significance at the 1% level. Panel A includes both SMB and HML in addition to the market. Panel B includes only SMB in addition to the market, and Panel C includes only HML in addition to the market.

Panel A: Full Fama French 3 Factor Model

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	1.60	0.58	0.38	0.40	0.14	0.20	0.45	0.28	0.31	0.88	0.32	0.37	JAJO	-2.20
FF3M	0.52	0.23	0.20	0.15	0.14	0.20	0.27	0.20	0.19	0.17	0.31	0.23	JFAJO	-2.54
Chng	-1.07	-0.35	-0.19	-0.24	0.00	0.00	-0.18	-0.08	-0.12	-0.70	-0.01	-0.14	All	-3.08

Panel B: Partial Fama French Model with Market and SMB

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	1.60	0.58	0.38	0.40	0.14	0.20	0.45	0.28	0.31	0.88	0.32	0.37	JAJO	-1.26
FF2MS	0.99	0.34	0.39	0.39	0.14	0.21	0.42	0.28	0.19	0.26	0.31	0.37	JFAJO	-1.50
Chng	-0.60	-0.24	0.00	-0.01	0.01	0.01	-0.03	-0.00	-0.12	-0.61	-0.01	-0.00	All	-1.62

Panel C: Contribution of SMB over Partial Fama French Model with Market and HML

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
FF2MH	1.27	0.56	0.22	0.22	0.14	0.20	0.35	0.19	0.31	0.82	0.32	0.25	JAJO	-1.53
FF3M	0.52	0.23	0.20	0.15	0.14	0.20	0.27	0.20	0.19	0.17	0.31	0.23	JFAJO	-1.86
Chng	-0.74	-0.33	-0.02	-0.06	0.01	0.01	-0.08	0.00	-0.12	-0.65	-0.01	-0.02	All	-2.02

Panel D: Partial Fama French Model with Market and HML

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	1.60	0.58	0.38	0.40	0.14	0.20	0.45	0.28	0.31	0.88	0.32	0.37	JAJO	-0.66
FF2MH	1.27	0.56	0.22	0.22	0.14	0.20	0.35	0.19	0.31	0.82	0.32	0.25	JFAJO	-0.68
Chng	-0.33	-0.02	-0.17	-0.18	-0.00	-0.00	-0.10	-0.08	-0.00	-0.06	-0.00	-0.12	All	-1.06

Panel E: Contribution of HML over Partial Fama French Model with Market and SMB

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
FF2MS	0.99	0.34	0.39	0.39	0.14	0.21	0.42	0.28	0.19	0.26	0.31	0.37	JAJO	-0.94
FF3M	0.52	0.23	0.20	0.15	0.14	0.20	0.27	0.20	0.19	0.17	0.31	0.23	JFAJO	-1.05
Chng	-0.47	-0.11	-0.19	-0.24	-0.00	-0.01	-0.14	-0.08	-0.00	-0.09	-0.00	-0.14	All	-1.46

Table III
Conditional and Unconditional CAPM Mean Absolute Alphas: Fama French 25 Size and Book-to-Market Sorted and 30 Industry Portfolios

This table shows the mean absolute alphas by month for the CAPM and conditional CAPM where betas are allowed to differ each calendar month. For each portfolio a conditional beta is estimated each month by interacting a monthly dummy with the market return. The table also shows the difference in the monthly mean absolute alpha across the two models. We also present the total mean absolute alpha reduction across models concentrated in two sets of months: the main reporting months of January, April, July and October; and the main reporting months plus February. Monthly alphas are calculated using calendar month dummy variables in time series regressions (1950 to 2012). Test assets are the value weighted Fama-French 25 size and book-to-market sorted and 30 industry portfolios. On the monthly alpha improvement or sum of improvements in the main reporting months we perform a one sided test for statistical significance against the null that concentration in improvement is due to randomness rather than seasonality. Further details of this null and the bootstrapping procedure used is in Appendix B. The lightest gray background indicates significance at the 10% level, light gray significance at the 5% level and gray significance at the 1% level. Panel A shows the size and book-to-market sorted portfolios. Panel B shows the industry portfolios.

Panel A: Fama French 25 Size and Book-to-Market Sorted Portfolios

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	1.60	0.58	0.38	0.40	0.14	0.20	0.45	0.28	0.31	0.88	0.32	0.37	JAJO	−0.02
COND	1.54	0.58	0.37	0.44	0.14	0.20	0.45	0.27	0.29	0.88	0.38	0.43	JFAJO	−0.02
Chng	−0.05	0.00	−0.01	0.04	0.00	0.01	−0.00	−0.00	−0.02	0.00	0.06	0.06	All	0.07

Panel B: Fama French 30 Industry Portfolios

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	0.66	0.46	0.39	0.53	0.42	0.52	0.52	0.38	0.50	0.72	0.49	0.50	JAJO	−0.02
COND	0.66	0.47	0.39	0.51	0.41	0.54	0.52	0.37	0.52	0.72	0.60	0.57	JFAJO	−0.01
Chng	−0.00	0.01	0.00	−0.02	−0.01	0.01	0.00	−0.00	0.02	0.00	0.11	0.07	All	0.19

Table IV

Censored Mean Absolute Alphas: Fama French 25 Size and Book-to-Market Sorted and 30 Industry Portfolios

This table shows the mean absolute alphas by month for the CAPM and Fama-French three-factor model. The table also shows the difference in the monthly mean absolute alpha across the two models. We also present the total mean absolute alpha reduction across models concentrated in two sets of months: the main reporting months of January, April, July and October; and the main reporting months plus February. Monthly alphas are calculated using calendar month dummy variables in time series regressions (1950 to 2012), however we censor the data removing the months with 20 worst market returns. Test assets are the value weighted Fama-French 25 size and book-to-market sorted and 30 industry portfolios. On the monthly alpha improvement or sum of improvements in the main reporting months we perform a one sided test for statistical significance against the null that concentration in improvement is due to randomness rather than seasonality. Further details of this null and the bootstrapping procedure used is in Appendix B. The lightest gray background indicates significance at the 10% level, light gray significance at the 5% level and gray significance at the 1% level. Panel A shows the size and book-to-market sorted portfolios. Panel B shows the industry portfolios.

Panel A: Fama French 25 Size and Book-to-Market Sorted Portfolios

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	1.60	0.54	0.42	0.37	0.14	0.21	0.45	0.27	0.25	0.77	0.31	0.37	JAJO	−2.08
FF3M	0.51	0.23	0.20	0.15	0.15	0.21	0.27	0.19	0.16	0.18	0.31	0.24	JFAJO	−2.39
Chng	−1.10	−0.31	−0.22	−0.22	0.00	−0.00	−0.17	−0.08	−0.09	−0.59	0.01	−0.13	Al	−2.90

Panel B: Fama French 30 Industry Portfolios

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Totals
CAPM	0.67	0.41	0.39	0.53	0.44	0.54	0.52	0.38	0.54	0.66	0.46	0.50	JAJO	−0.42
FF3M	0.48	0.33	0.42	0.55	0.43	0.55	0.42	0.42	0.53	0.52	0.45	0.46	JFAJO	−0.50
Chng	−0.19	−0.08	0.02	0.02	−0.00	0.01	−0.10	0.03	−0.00	−0.15	−0.01	−0.03	Al	−0.49

Table V
Mean Factor Returns by Month of Quarter
This table shows the average return for the market excess return, SMB and HML for each month of the quarter. Month 1 is an average over January, April, July and October. Month 2 is an average over February, May, August and November. Month 3 is an average over March, June, September and December. Averages are presented as percent per month. Data are from 1950 to 2012

	RMRF	SMB	HML
Month 1	0.75	0.06	0.76
Month 2	0.61	0.22	0.17
Month 3	0.42	0.25	0.20

Table VI
Fraction of Reporting Firms By Quarter-Month for the Fama-French 25 Size and Book-to-Market Sorted Portfolios

This table shows the fraction of firms (across all years) within each of the 25 size and book-to-market sorted portfolios that have their first earnings announcement of the quarter in month 1, month 2 or month 3 of the quarter from 1972 to 2012. Panel A aggregates all four quarters. Panels B through E present results for each quarter separately. Observations are firm years. To be included a firm year must have at least four earning reports in that year.

Panel A: Percent Reporting All Four Quarters

	Quarter Month 1					Quarter Month 2					Quarter Month 3				
	G	2	3	4	V	G	2	3	4	V	G	2	3	4	V
S	36.	42.	45.	46.	39.	49.	43.	40.	40.	45.	16.	15.	14.	14.	16.
2	51.	52.	55.	57.	54.	38.	36.	34.	33.	36.	12.	12.	11.	10.	10.
3	58.	60.	65.	63.	61.	32.	30.	26.	31.	33.	11.	10.	8.	6.	6.
4	61.	66.	69.	69.	64.	29.	27.	24.	27.	32.	10.	8.	6.	4.	4.
B	70.	73.	76.	75.	73.	24.	22.	20.	22.	26.	7.	6.	4.	3.	2.

Panel B: Percent Reporting in 1st Quarter

	Quarter Month 1					Quarter Month 2					Quarter Month 3				
	G	2	3	4	V	G	2	3	4	V	G	2	3	4	V
S	22.	27.	31.	31.	25.	42.	41.	40.	40.	40.	31.	28.	26.	25.	31.
2	33.	33.	38.	40.	35.	46.	47.	45.	44.	46.	20.	20.	16.	15.	18.
3	39.	45.	50.	47.	42.	45.	42.	38.	44.	47.	16.	14.	12.	10.	11.
4	44.	47.	51.	51.	43.	42.	42.	40.	41.	50.	14.	11.	9.	7.	8.
B	55.	57.	63.	63.	59.	37.	36.	32.	33.	37.	9.	7.	6.	4.	4.

Panel C: Percent Reporting in 2nd Quarter

	Quarter Month 1					Quarter Month 2					Quarter Month 3				
	G	2	3	4	V	G	2	3	4	V	G	2	3	4	V
S	41.	47.	51.	52.	46.	53.	44.	41.	41.	47.	10.	11.	11.	10.	12.
2	56.	57.	61.	63.	61.	36.	33.	31.	30.	33.	9.	11.	8.	8.	8.
3	63.	65.	71.	69.	67.	29.	27.	23.	26.	29.	9.	9.	7.	5.	5.
4	67.	72.	76.	75.	70.	25.	21.	19.	22.	28.	9.	6.	5.	4.	3.
B	75.	79.	80.	78.	77.	19.	17.	17.	20.	23.	5.	4.	3.	2.	1.

Panel D: Percent Reporting in 3rd Quarter

	Quarter Month 1					Quarter Month 2					Quarter Month 3				
	G	2	3	4	V	G	2	3	4	V	G	2	3	4	V
S	39.	45.	49.	50.	41.	49.	44.	40.	39.	46.	11.	11.	10.	10.	12.
2	56.	57.	60.	63.	59.	35.	32.	31.	29.	34.	8.	10.	9.	8.	8.
3	62.	65.	71.	67.	67.	29.	27.	23.	28.	29.	8.	8.	7.	5.	5.
4	66.	71.	74.	74.	70.	27.	23.	21.	23.	27.	8.	7.	5.	3.	2.
B	74.	78.	81.	79.	77.	19.	17.	16.	20.	22.	7.	5.	4.	2.	0.

Panel E: Percent Reporting in 4th Quarter

	Quarter Month 1					Quarter Month 2					Quarter Month 3				
	G	2	3	4	V	G	2	3	4	V	G	2	3	4	V
S	41.	47.	50.	50.	42.	50.	43.	39.	40.	47.	10.	11.	11.	10.	12.
2	58.	59.	62.	62.	60.	33.	31.	29.	29.	32.	9.	10.	9.	9.	8.
3	66.	66.	69.	67.	67.	25.	25.	22.	27.	28.	9.	8.	7.	5.	4.
4	67.	72.	75.	76.	72.	24.	20.	18.	21.	25.	7.	7.	6.	4.	3.
B	74.	78.	81.	80.	78.	20.	17.	15.	17.	21.	6.	5.	4.	3.	1.

Table VII
Alpha Reduction in Model with Early and Late Announcers

This table shows at the two dates in the model the average absolute alphas produced by the model under the CAPM, the average absolute alphas under two factor model and the difference between the two. Negative numbers in the difference row indicate improvement by the two factor model. The second factor is constructed from a long position in the late announcers and a short position in the early announcers. The table is for the calibration parameters where agents have a risk aversion of 5, 40% of the firms are late announcers (3 early announcers and 2 late announcers) and both the systematic shock, f_t, and firm specific shocks, $b_{i,t}$, can take values either 0 or 1 with equal probability.

	First Period	Second Period
CAPM	0.13	0.08
2 Factor Model	0.00	0.00
Improvement	-0.13	-0.08

Table VIII

Variation in Beta Exposure With Report Timing

This table shows the exposures to SMB and HML of the subportfolios of 25 Fama-French size and book-to-market sorted portfolios. Each of the Fama French portfolio are further subdivided into three groups based on which month of the quarter (first, second or third) each firm first reports earnings in a given a quarter. These triple sorts are repeated for each of the four quarters. These subportfolios are rebalance in July. Portfolios are grouped first by size then book-to-market ratio for presentation. Panel A shows SMB exposures and portfolios. Panel B shows HML exposures. Rows where the factor loading change across early v. late announcers as predicted are shaded light gray. Rows where this move is statistically significant at the 10% level are shaded gray. Rows significant at the 5% level are in bold. Rows significant at the 1% level are in red and bold. Statistical significance is tested based on a one sided t-test for the a long short portfolio of the month 1 and month 3 announcers. Data are from 1972 to 2012.

Panel A: SMB Exposure

	Quarter 1		
	Mo. 1	Mo. 2	Mo. 3
SL	1.43	1.32	1.46
S2	1.24	1.41	1.18
S3	**0.91**	**1.23**	**1.16**
S4	0.99	1.00	1.03
SH	1.09	1.02	1.12
2L	**0.91**	**0.92**	**1.03**
22	0.83	0.96	0.91
23	**0.69**	**0.77**	**0.89**
24	0.75	0.69	0.85
2H	0.75	0.85	0.90
3L	0.87	0.61	0.67
32	**0.48**	**0.51**	**0.67**
33	**0.40**	**0.44**	**0.57**
34	**0.32**	**0.40**	**0.64**
3H	0.49	0.49	0.66
4L	0.46	0.44	0.38
42	0.24	0.31	0.22
43	0.20	0.15	0.25
44	**0.17**	**0.08**	**0.74**
4H	0.14	0.24	0.27
BL	**−0.31**	**−0.23**	**0.16**
B2	**−0.28**	**−0.20**	**−0.08**
B3	−0.26	−0.16	−0.11
B4	−0.19	−0.13	−0.07
BH	**−0.28**	**0.06**	**0.09**

	Quarter 2		
	Mo. 1	Mo. 2	Mo. 3
SL	**1.29**	**1.43**	**1.59**
S2	1.26	1.41	1.03
S3	1.01	1.21	1.09
S4	**1.02**	**0.94**	**1.17**
SH	**1.05**	**1.07**	**1.23**
2L	**0.90**	**0.92**	**1.12**
22	0.87	0.97	0.82
23	0.72	0.83	0.74
24	0.76	0.67	0.83
2H	0.82	0.82	0.83
3L	0.80	0.54	0.66
32	0.48	0.57	0.59
33	**0.39**	**0.43**	**0.73**
34	0.39	0.36	0.52
3H	0.50	0.52	0.61
4L	0.44	0.48	0.17
42	0.22	0.32	0.28
43	0.19	0.15	0.37
44	**0.09**	**0.26**	**0.84**
4H	**0.20**	**0.24**	**0.59**
BL	**−0.31**	**−0.10**	**0.12**
B2	−0.26	−0.10	−0.24
B3	−0.25	−0.05	−0.25
B4	−0.17	−0.09	−0.16
BH	−0.11	0.01	−0.35

	Quarter 3		
	Mo. 1	Mo. 2	Mo. 3
SL	1.38	1.29	0.99
S2	1.28	1.41	1.01
S3	**1.02**	**1.29**	**1.22**
S4	1.02	1.01	1.10
SH	**1.04**	**1.08**	**1.31**
2L	0.88	1.04	0.98
22	0.85	1.08	0.94
23	0.73	0.81	0.80
24	0.77	0.78	0.72
2H	0.86	0.78	0.85
3L	0.75	0.66	0.64
32	**0.50**	**0.59**	**0.75**
33	0.40	0.56	0.51
34	0.41	0.37	0.44
3H	0.48	0.59	0.47
4L	0.44	0.57	0.06
42	**0.20**	**0.40**	**0.41**
43	**0.21**	**0.11**	**0.49**
44	**0.15**	**0.14**	**0.93**
4H	0.21	0.20	0.49
BL	**−0.32**	**−0.11**	**0.18**
B2	−0.27	−0.10	−0.37
B3	−0.24	−0.01	−0.18
B4	−0.15	−0.05	−0.16
BH	−0.08	−0.21	0.35

	Quarter 4		
	Mo. 1	Mo. 2	Mo. 3
SL	1.24	1.48	1.20
S2	1.24	1.48	1.02
S3	**1.05**	**1.19**	**1.15**
S4	**0.98**	**1.08**	**1.18**
SH	**1.02**	**1.09**	**1.34**
2L	0.86	1.01	0.90
22	**0.86**	**1.01**	**1.07**
23	0.74	0.79	0.79
24	0.73	0.88	0.83
2H	0.84	0.77	0.96
3L	0.77	0.54	0.53
32	**0.54**	**0.46**	**0.89**
33	**0.41**	**0.44**	**0.62**
34	0.38	0.48	0.48
3H	0.51	0.57	0.72
4L	**0.43**	**0.58**	**0.56**
42	**0.22**	**0.22**	**0.52**
43	0.20	0.19	0.37
44	**0.12**	**0.26**	**0.84**
4H	**0.18**	**0.25**	**0.82**
BL	**−0.33**	**−0.08**	**0.13**
B2	−0.26	−0.06	−0.32
B3	−0.25	−0.06	−0.09
B4	−0.16	−0.11	0.14
BH	−0.08	−0.16	0.53

Table VIII Continued:
Variation in Beta Exposure With Report Timing

Panel B: HML Exposure

	Quarter 1			Quarter 2			Quarter 3			Quarter 4		
	Mo. 1	Mo. 2	Mo. 3	Mo. 1	Mo. 2	Mo. 3	Mo. 1	Mo. 2	Mo. 3	Mo. 1	Mo. 2	Mo. 3
SL	-0.38	-0.40	-0.19	-0.39	-0.31	-0.27	-0.40	-0.28	-0.13	-0.41	-0.24	-0.37
S2	0.02	-0.08	0.14	0.02	-0.07	0.22	0.03	-0.09	0.25	0.01	-0.09	0.24
S3	0.37	0.21	0.31	**0.36**	**0.18**	**0.18**	**0.33**	**0.17**	**0.20**	0.32	0.14	0.33
S4	0.49	0.46	0.50	**0.49**	**0.50**	**0.32**	0.46	0.47	0.44	**0.46**	**0.50**	**0.32**
SH	**0.78**	**0.73**	**0.66**	0.75	0.71	0.70	0.73	0.70	0.68	0.73	0.70	0.68
2L	-0.43	-0.42	-0.34	-0.45	-0.41	-0.29	-0.46	-0.26	-0.42	-0.47	-0.33	-0.38
22	0.18	0.08	0.17	0.16	0.09	0.19	0.19	0.03	0.15	0.15	0.11	0.10
23	0.43	0.37	0.37	0.40	0.44	0.36	**0.43**	**0.39**	**0.26**	0.41	0.41	0.40
24	0.59	0.55	0.60	**0.60**	**0.58**	**0.45**	**0.62**	**0.52**	**0.43**	**0.61**	**0.53**	**0.41**
2H	0.84	0.88	0.96	**0.87**	**0.92**	**0.64**	**0.86**	**0.90**	**0.64**	0.85	0.92	0.79
3L	-0.37	-0.42	-0.28	-0.44	-0.34	-0.37	-0.44	-0.37	-0.28	-0.45	-0.33	-0.20
32	0.20	0.24	0.20	0.23	0.13	0.28	0.22	0.14	0.21	**0.23**	**0.16**	**0.09**
33	0.49	0.47	0.48	0.49	0.49	0.50	0.48	0.46	0.55	0.47	0.54	0.36
34	0.65	0.61	0.68	**0.64**	**0.68**	**0.30**	**0.68**	**0.66**	**0.50**	0.67	0.62	0.54
3H	0.91	0.73	0.75	0.78	0.88	0.60	0.78	0.80	0.61	0.77	0.85	0.93
4L	-0.44	-0.39	-0.22	-0.39	-0.46	-0.28	-0.38	-0.44	-0.36	-0.41	-0.39	-0.39
42	**0.30**	**0.18**	**0.02**	**0.30**	**0.09**	**-0.23**	0.30	0.11	0.15	**0.30**	**0.19**	**-0.17**
43	**0.56**	**0.50**	**0.28**	0.53	0.43	0.44	**0.58**	**0.37**	**0.38**	0.55	0.33	0.43
44	**0.66**	**0.58**	**0.18**	**0.65**	**0.54**	**0.15**	**0.65**	**0.51**	**0.20**	**0.63**	**0.55**	**0.19**
4H	1.01	0.84	1.05	0.92	0.79	0.92	0.93	0.90	0.96	0.91	0.83	0.89
BL	-0.33	-0.38	-0.44	**-0.32**	**-0.42**	**-0.52**	**-0.32**	**-0.38**	**-0.64**	**-0.32**	**-0.42**	**-0.64**
B2	0.15	0.12	0.34	0.17	0.12	0.03	0.18	-0.04	0.02	**0.15**	**0.16**	**-0.08**
B3	0.31	0.30	0.44	0.31	0.32	0.39	0.32	0.25	0.24	**0.30**	**0.37**	**0.04**
B4	**0.75**	**0.67**	**0.20**	**0.76**	**0.50**	**0.06**	**0.76**	**0.55**	**0.12**	0.76	0.51	0.51
BH	0.77	0.86	0.49	0.91	0.59	0.51	0.92	0.47	0.57	0.92	0.47	0.57