Applied Financial Economics, 2014
Vol. 24, No. 11, 777–791, http://dx.doi.org/10.1080/09603107.2014.904489

Routledge
Taylor & Francis Group

S&P 500 Index reconstitutions and information asymmetry

L. C. Baran[a] and T. H. D. King[b,*]

[a]*Department of Finance, Kent State University, Kent, OH 44242, USA*
[b]*Department of Finance, University of North Carolina at Charlotte, Charlotte, NC 28223, USA*

We examine the changes in information asymmetry around Standard and Poors (S&P) 500 Index additions and deletions as a possible explanation for the stock price reaction to index revision events. Using an array of information asymmetry measures to represent the complex information environment of corporations, we find a significant decrease in information asymmetry following index inclusions but show that the drop provides limited explanatory power for the announcement return. On the other hand, we find strong support for an increase in information asymmetry after deletion events, and firms with a higher level of information asymmetry prior to deletion accrue larger losses upon deletion announcements. Finally, relative to the behaviour of other firms in the S&P 500 Index, forecast error declines but forecast optimism remains consistent following index inclusions for newly added firms. This study adds to the ongoing debate over demand curves for S&P 500 Index stocks and shows that changes in information asymmetry are a significant determinant of the price reaction for newly removed firms.

Keywords: S&P 500 Index; index reconstitutions; information asymmetry; price reaction

JEL Classification: G14; G10

I. Introduction

Information asymmetry between management and investors is costly to existing shareholders. Theoretical models, such as Diamond and Verrecchia (1991), find that reductions in information asymmetry lead to decreases in the cost of capital and increases in the value of stock. Similarly, Easley and O'Hara (2004) show that the presence of informed and uniformed traders causes a higher required rate of return for firms with more private information. Krishnaswami and Subramaniam (1999) provide empirical support for this theory when they examine how gains around spin-offs relate to the level of information asymmetry. Therefore, events that reduce information asymmetry positively impact shareholders, and we draw upon this theory to study changes to the Standard and Poors (S&P) 500 Index between 1990 and 2010.

Several studies of S&P 500 Index reconstitutions suggest that firms added to the S&P 500 Index may experience a reduction in information asymmetry. For example, Chen *et al.* (2004), Hedge and McDermott (2003) and Becker-Blease and Paul (2006) point to the reduction in information asymmetry as a possible source of gains to shareholders around S&P 500 Index inclusions. In particular, Hedge and McDermott (2003) examine the changes in the asymmetric information component of bid–ask spread and use it as a measure

*Corresponding author. E-mail: tking3@uncc.edu

of information asymmetry.[1] As Duarte *et al.* (2008) explain, information environment of a firm is complex and consists of both information asymmetry and information dissemination. Bid–ask spread does not capture the full complexity of information asymmetry, and existing literature points to additional proxy variables which help further explain the relation between information asymmetry and abnormal returns around S&P 500 Index changes. For example, Kanagaretnam *et al.* (2005) describe bid–ask spread and analyst forecast properties as measuring different dimensions of information asymmetry, namely between uninformed and informed investors and the amount of private information processed by analysts respectively. Our study of information asymmetry proxy variables adds to the findings of Hedge and McDermott (2003) who focus on the asymmetric information component of bid–ask spread.

Aside from Hedge and McDermott (2003), there have not been studies that empirically test the reduction in information asymmetry and its relation to returns to the newly included and excluded firms. This article directly tests these propositions by presenting the changes in information asymmetry around S&P 500 Index reconstitutions and examines their relation to announcement returns. First, we select information asymmetry proxy variables suggested by the extant literature and study their changes around the index reconstitution events. Based on the proxies employed, we find support for changes in information asymmetry following index inclusions and deletions. In particular, relative to the other S&P 500 firms, inclusion firms have a decrease in the market/book ratio, accruals, volatility of stock returns, quarterly earnings announcement reaction and analyst forecast error and dispersion. These findings point to a decline in information asymmetry for inclusion firms. For deletion firms, our results show an increase in the market/book ratio, volatility of stock returns, earnings announcement reaction and analyst forecast error. The result supports an increase in information asymmetry for deletion firms. We conduct further analysis to explore the relation between information asymmetry and stock price reaction to the announcements of index changes.

We use two methods to explore the relation between information asymmetry and stock price reaction to the announcements of S&P 500 Index reconstitutions. First, we partition firms into halves by their level of information asymmetry prior to the index change and test the difference in abnormal announcement return between the two groups. Second, we conduct a multivariate regression analysis of the abnormal announcement returns to examine the explanatory power of information asymmetry variables. We find no significant difference in announcement return between high and low information asymmetry groups for addition firms. Multivariate regression results suggest weak evidence that market/book ratio and volatility of stock returns are determinants of announcement returns. Given the decline in information asymmetry around the inclusion events, we conjecture that inclusion firms are rising stars in the years leading up to inclusion and have been experiencing a reduction in information asymmetry during this time. Any benefits from the drop in information asymmetry may have already been incorporated prior to inclusion. As a result, information asymmetry has limited explanatory power for announcement returns at inclusion. For deletion firms, we find that firms with higher information asymmetry before exclusion from the index accrue larger losses at the announcement. This is true if we partition by the market/book ratio, volatility of stock returns, earnings announcement reaction, analyst forecast errors and forecast dispersion. In the multivariate regressions, volatility of stock returns, earnings announcement reaction and forecast error are significant predictors of abnormal announcement returns. Thus, we find strong evidence that information asymmetry is a significant factor of stock price reactions at deletion.

In the final section, we examine the use of analyst forecast error as a proxy for information asymmetry in the context of S&P 500 Index additions. Zhang *et al.* (2010) find that forecast error increases after inclusion to the S&P 500 Index because of an increase in analyst optimism. However, when we adjust the analyst forecast error relative to those of the other firms in the S&P 500 Index, the adjusted forecast error in fact *declines* after the inclusion events for newly added firms. We confirm this finding both graphically and in a multivariate analysis: analyst forecast error decreases and forecast optimism remains the same. Our finding does not contradict with the finding of Zhang *et al.* (2010). Rather, we confirm that the use of market-adjusted forecast error as a proxy for information asymmetry is consistent with other measures and shows that market-adjusted forecast error declines after inclusion events.

Studies on S&P 500 Index changes suggest that information asymmetry is a major determinant of the abnormal stockholder gains (losses) around the reconstitution events (e.g. Chen *et al.*, 2004; Becker-Blease and Paul, 2006). Our study provides a strong empirical support for this proposition, especially for the deletion events. In particular, we make the following important contributions to the literature. First, we present clear patterns of a significant

[1] Several studies explore the bid–ask spread changes around S&P 500 Index changes including Beneish and Whaley (1996), Edmister *et al.* (1996) and Erwin and Miller (1998); Hedge and McDermott (2003) are unique in decomposing the bid–ask spread to specifically look at the asymmetric information component. In addition, Çolak (2012) studies the information asymmetry at the time of IPO and relates this to the probability of inclusion to the S&P 500.

decrease (increase) in information asymmetry for inclusion (deletion) firms around the events. Second, we show a strong relation between information asymmetry and abnormal returns at deletion announcements and identify the major drivers (proxies of information asymmetry) of announcement return. Interestingly, we find information asymmetry provides limited explanatory power for addition announcement return. Finally, we explore how analyst forecast error and optimism change around index inclusions. Studies of changes to the S&P 500 Index are numerous because scholars are interested in disentangling whether the price response to inclusions or deletions from the index are consistent with flat or downward-sloping demand curves. We conclude that there is a significant increase in information asymmetry around deletion events, and part of the negative response to the announcement can be explained by the increase in firms' opacity. We cannot rule out a concurrent price response due to a downward-sloping demand curve, but rather we provide evidence that this effect is not the only one with explanatory power. On the other hand, inclusion firms experience a significant drop in information asymmetry in the years leading up to the event and prices have already reflected this change over time. Therefore, information asymmetry has minimal explanatory power for announcement return.

The remainder of this article is structured as follows. Section II reviews the literature pertaining to S&P 500 Index changes and information asymmetry. Section III discusses our sample data and proxies for information asymmetry. Section IV presents the empirical results and Section V concludes.

II. Literature Review

Previous studies on the S&P 500 Index reconstitutions have sought to explain the price reactions surrounding these events. Five hypotheses emerge in this literature to explain the observation of a positive and sustained stock reaction to index additions and a short-term negative stock reaction to index deletions. Kappou *et al.* (2008) provide a clear summary of these hypotheses, so we include only those studies most relevant to our analysis. Several studies of S&P 500 Index changes suggest that changes in information asymmetry may occur around index revisions and that these changes help explain the price response of stocks added to or removed from the index. Specifically, Chen *et al.* (2004) indicate that an increased investor awareness after index inclusion may alter information gathering to reduce information asymmetry for added firms, but symmetric increases in information asymmetry for deletion firms are not expected. Hedge and McDermott (2003), in their study of liquidity and decomposition of the bid–ask spread, show that the asymmetric information component of bid–ask spread marginally declines. They suggest that information asymmetry decreases can explain the increases in price around index inclusion. Finally, Becker-Blease and Paul (2006) explain that they must control for changes in information asymmetry in their study of liquidity and investment opportunity set because information asymmetry may decline with increases in investor awareness. All three studies link changes in information asymmetry to stock price responses through the cost of capital for added or removed firms as developed by Diamond and Verrecchia (1991) and Easley and O'Hara (2004). As Denis *et al.* (2003) correctly point out, a finding such as the one in this study that information is conveyed about changes in information asymmetry does not mean that there are also simultaneous impacts on price because of downward-sloping demand curves. However, this study implies that demand curves do not necessarily have to be downward sloping in order to explain the price response of S&P 500 Index changes. If investors are aware of these reductions in information asymmetry upon inclusion, this can partially explain the positive price response. Similarly, investor anticipation of increases in information asymmetry can explain the price increase at deletion from the index.

Our study is also related to studies that examine the factors determining analyst forecast errors since we explore analyst forecast error and optimism in the concluding section of our article. Zhang *et al.* (2010) study forecast accuracy and optimism of firms added to the S&P 500 Index. They show that analysts exhibit over-optimism following a firm's inclusion to the S&P 500 Index, which leads to a reduction in forecast accuracy (or increase in forecast errors). Analyst incentives may shift around a firm's inclusion to a high-profile index such that analysts find favour with the management by issuing positive forecasts. In addition, analyst optimism after S&P 500 Index inclusions can be due to an irrational belief in the certification provided by Standard and Poors. Ackert and Athanassakos (2003) show that there is a positive relationship between analyst optimism and institutional ownership which may impact the relationship in the case of newly added S&P 500 Index firms as well. According to Pruitt and Wei (1989), institutional ownership increases for S&P 500 Index firms, and this may increase analyst optimism. Cowen *et al.* (2006) argue that certain analysts have an incentive to provide optimistic forecasts to attract new underwriting businesses. Inclusion to the S&P 500 Index may provide a firm the ability to attract more capital (Chen *et al.*, 2004; Kappou *et al.*, 2008), so underwriting opportunities increase following index inclusions. Finally, Zhang *et al.* (2010) point out that many new analysts are added to the pool of analysts following a firm after its inclusion to the S&P 500 Index. New analysts may use optimistic forecasts to win the favour of management and inside information. We consider both the motivation to

attract new underwriting business and the motivation of new analysts to win the favour of management to issue optimistic forecasts in our final section of analysis following the methodology of Haw *et al.* (1994), Bernard (2008) and Lang *et al.* (2003).

III. Sample Data and Proxies for Information Asymmetry

Sample data

Our sample includes firms added to or removed from the S&P 500 Index from 1990 to 2010. Although a longer history of index changes exists, Standard and Poors began pre-announcing index changes in October 1989 to alleviate price pressure from index fund rebalancing. In our sample, the mean (median) length between the announcement and actual change dates is 5.88 (6) days. To create the list of index changes, we collect the monthly lists of S&P 500 Index constituents from Compustat. For each month, we identify firms that have been added or removed. We then use the news accounts from LexisNexis to verify the announcement and implementation dates. This procedure identifies 1052 total sample firms with 526 additions and 526 deletions. At times, a precipitating event such as a merger or bankruptcy initiates an index change, and other times S&P rebalances the index for industry representativeness. After verifying the reason for the index change via news accounts, we further exclude the following types of index changes: (1) When a nonindex firm acquires or merges with an existing index firm and replaces the existing firm (17 added and 17 deleted firms), (2) when an S&P 500 firm acquires another index firm and the acquired firm is removed from the index (15 deleted firms), (3) when two existing index firms merge and the resulting merged firm remains on the index (10 added and 20 deleted firms), (4) when an index firm spins off a subsidiary (or multiple subsidiaries) which is subsequently added to the index (25 added and 19 deleted firms) and (5) when an existing firm spins off a subsidiary which replaces another firm on the index (33 added firms). Our final sample contains 441 added firms and 455 deleted firms.

Proxies for information asymmetry

To study if and how information asymmetry changes around S&P 500 Index revision events, we draw upon existing literature that suggests several proxy variables for the level of information asymmetry. The first set of variables relates to firm characteristics that lead to an information disparity between a firm's insiders and outside investors. Growth opportunities allow managers to have more inside information about the firm's investments (Smith and Watts, 1992). Market/book ratio measures the level of growth opportunities relative to assets in place and serves as a proxy for information asymmetry. McLaughlin *et al.* (1998) use this proxy in their study of information asymmetry in seasoned equity and debt offerings. The other proxy we include in this category is the level of accruals.[2] In a study of the financing arrangement of syndicated loans, Sufi (2007) uses positive accruals as a proxy for information asymmetry.

The next set of proxy variables for information asymmetry is associated with the variability in a firm's stock and earnings. We use stock return volatility to proxy for the difficulty in estimating firm performance by an outsider as in Lang *et al.* (2003) in their study of cross-listing events. In addition, we follow Dierkens (1991) who uses the absolute value of the abnormal return surrounding quarterly earnings announcements as a proxy for information asymmetry. This proxy captures the stock response to the unanticipated component of quarterly earnings announcements and increases with information asymmetry.

The final group of proxy variables relates to the presence of analysts and their ability to provide accurate earnings forecasts. These measures include analyst forecasting accuracy and analyst forecast dispersion. While several studies point to the number of analysts following a firm as a proxy for information asymmetry, Yu (2008) highlights, increases in analyst coverage for S&P 500 Index inclusion firms are endogenous. Therefore, we exclude this measure from our analysis. Alternatively, the accuracy and dispersion of analyst forecasts of earnings per share are frequently used as measures of information asymmetry. Lobo and Tung (1997), Krishnaswami and Subramaniam (1999), Clarke and Shastri (2001), Gilson *et al.* (2001) and Thomas (2002) use the accuracy and dispersion of analyst forecasts to proxy for the level of information asymmetry. We note that the forecast errors and dispersion may be driven by firm risk in addition to information asymmetry.

For each proxy variable of the sample firms, we measure the unadjusted level and the adjusted level relative to all S&P 500 Index firms. In particular, we compute the mean of that proxy for all firms in the S&P 500 Index for each variable, after excluding firms that have been added during the previous 3 years and those that are removed within the next 3 years. The adjusted level of the proxy variable is the difference between the unadjusted level and

[2] We exclude two measures of information asymmetry, research and development and intangible assets, which can be used on a cross-sectional basis to measure information asymmetry that are unlikely to change over time simply due to index inclusion because they are based on firm policy decisions and industry.

the mean of the proxy for all index firms. This method allows us to examine the changes in the information asymmetry proxies while controlling for time trends of the variable in the market as a whole.[3] We use the cumulative abnormal returns computed in EVENTUS to measure the quarterly earnings announcement reactions. Data from CRSP and Compustat are used to calculate firm characteristics and proxies for information asymmetry. We use data from I/B/E/S to calculate the analyst earnings forecasts.

IV. Empirical Results

In this article, we employ several methods to examine changes in information asymmetry for the newly included or excluded firms on the S&P 500 Index. We follow the methodology of Krishnaswami and Subramaniam (1999) who test whether information asymmetry motivates spin-offs and if reductions in information asymmetry help explain the gains surrounding spin-offs, Ford *et al.* (2012) who look at the impact of information asymmetry on stock split returns and Yoon *et al.* (2011) who examine information asymmetry changes. Specifically, we first present the changes in the measures of information asymmetry around index reconstitution events. Next, we break the sample into high and low information asymmetry groups based on each of the proxies and examine the relation between abnormal returns and information asymmetry. We further explore how abnormal returns are affected by the changes in information asymmetry in a multivariate regression framework. Finally, in a robustness check, we examine analyst forecast error and optimism related to index inclusion events.

Changes in information asymmetry around inclusions and deletions

Based on the literature on information asymmetry, we include six proxy variables grouped in three categories to examine the level of information asymmetry surrounding changes to the S&P 500 Index. We define the variables and their measurements in Table 1. We present the levels of the information asymmetry proxy variables and their changes in Table 2. Panel A (B) shows the mean and median levels and differences in the proxy variables on an unadjusted (adjusted) basis for the addition firms. In the

Table 1. Description of information asymmetry proxy variables

Firm characteristics	
Market/book ratio	The market/book ratio measures the market value of assets to the book value of assets where the market value of assets is calculated as the book value of assets plus the market value of equity minus the book value of equity. We measure this value in the fiscal year prior to and following the index change.
Accruals	Accruals is defined following Sloan (1996). Specifically, accruals is (ΔCurrent assets – ΔCash) – (ΔCurrent liabilities – ΔDebt in current liabilities – ΔTaxes payable) – Depreciation.
Variability factors	
Volatility of stock returns	The volatility of stock returns is the SD of the monthly excess stock returns for the 24 months preceding or the 24 months following the index change. Excess stock returns are calculated by subtracting the return on the CRSP value-weighted index for each month from the individual stock's monthly return.
Earnings announcement reaction	The earnings announcement reaction measures the abnormal return in the 3-day window surrounding the announcement of quarterly earnings. Specifically, we measure the cumulative abnormal return on days [–1, +1] where day 0 is the earnings announcement date. We then average the cumulative abnormal return over the 20 quarters preceding or the 20 quarters following the index change.
Analyst forecast factors	
Analyst forecast error	The consensus forecast is the mean of all individual analyst forecasts. The analyst forecast error is the absolute value of the difference between consensus forecast and the actual EPS. We measure this value in the three fiscal years prior to and following the index change and compute an average over the 3 years. This measure is scaled by the stock price at the end of the fiscal year.
Dispersion of analyst forecasts	Forecast dispersion is the SE of all individual analyst forecasts. We measure this value in the three fiscal years prior to and following the index change and compute an average over the 3 years. This measure is scaled by the stock price at the end of the fiscal year.

Notes: The sample includes all firms added to and removed from the S&P 500 Index between 1990 and 2010. We compute several proxy variables for information asymmetry in three categories: firm characteristics, variability factors and analyst forecast factors.

[3] In contrast, we could also use matched firms to control for these trends as Krishnaswami and Subramaniam (1999) who match firms involved in a spin-off to an industry- and size-matched peer. This method has been used previously in S&P 500 Index reconstitution studies (see, e.g., Becker-Blease and Paul, 2006; Cai, 2007); however, the matched firms are often significantly smaller than those added to the index as detailed in Becker-Blease and Paul. Given that firm size has been used as a proxy for information asymmetry (Chari *et al.*, 1988; McLaughlin *et al.*, 1998), this discrepancy creates a problem for the use of matched pairs. Therefore, consistent with Denis *et al.* (2003), we use the overall market trends in the information asymmetry proxies as a comparison.

Table 2. Changes in information asymmetry proxies

Variable	*N*	Before		After		Change	
		Mean	Median	Mean	Median	Mean	Median
Panel A: Addition firms – unadjusted changes in information asymmetry proxies							
Firm characteristics							
Market/book ratio	419	3.4139	2.0093	2.4016	1.7175	−1.0123***	−0.1014***
Accruals	314	−0.0330	−0.0367	−0.0458	−0.0386	−0.0128***	−0.0029
Variability factors							
Volatility of stock returns	418	0.1013	0.0899	0.1081	0.0925	0.0067***	0.0036**
Earnings announcement reaction	358	0.0482	0.0416	0.0506	0.0453	0.0025*	0.0033***
Analyst forecast factors							
Analyst forecast error	406	0.0021	0.0006	0.0442	0.0011	0.0421	0.0003***
Forecast dispersion	400	0.0011	0.0005	0.0066	0.0008	0.0055**	0.0002***
Panel B: Addition firms – market-adjusted changes in information asymmetry proxies							
Firm characteristics							
Market/book ratio	419	1.4155	0.0386	0.5130	−0.1573	−0.9025***	−0.0697***
Accruals	314	0.0105	0.0066	0.0018	0.0085	−0.0087*	0.0016
Variability factors							
Volatility of stock returns	418	0.0189	0.0118	0.0163	0.0035	−0.0026	−0.0052***
Earnings announcement reaction	358	0.0116	0.0046	0.0079	0.0031	−0.0037***	−0.0021***
Analyst forecast factors							
Analyst forecast error	406	−0.0212	−0.0025	−0.0042	−0.0070	0.0171	−0.0028***
Forecast dispersion	400	−0.0063	−0.0016	−0.0100	−0.0031	−0.0037	−0.0007***
Panel C: Deletion firms – unadjusted changes in information asymmetry proxies							
Firm characteristics							
Market/book ratio	179	1.3840	1.1589	1.3786	1.1980	−0.0054	0.0450
Accruals	167	−0.0552	−0.0488	−0.0550	−0.0491	0.0002	0.0020
Variability factors							
Volatility of stock returns	166	0.1260	0.1096	0.1789	0.1338	0.0529***	0.0156***
Earnings announcement reaction	149	0.0467	0.0406	0.0655	0.0558	0.0188***	0.0128***
Analyst forecast factors							
Analyst forecast error	136	0.0452	0.0066	0.3298	0.0074	0.2847*	0.0001
Forecast dispersion	126	0.0155	0.0034	0.0389	0.0038	0.0234*	0.0000
Panel D: Deletion firms – market-adjusted changes in information asymmetry proxies							
Firm characteristics							
Market/book ratio	179	−0.5532	−0.6924	−0.4750	−0.5988	0.0782	0.1055***
Accruals	167	−0.0108	−0.0065	−0.0076	−0.0028	0.0033	0.0027
Variability factors							
Volatility of stock returns	166	0.0406	0.0248	0.0916	0.0494	0.0510***	0.0163***
Earnings announcement reaction	149	0.0091	0.0025	0.0243	0.0145	0.0152***	0.0066***
Analyst forecast factors							
Analyst forecast error	136	0.0101	0.0010	0.3011	−0.0005	0.2909*	0.0005
Forecast dispersion	126	0.0058	0.0000	0.0280	−0.0002	0.0221	0.0004

Notes: The sample includes all firms added to and removed from the S&P 500 Index between 1990 and 2010. We exclude mergers or acquisitions of index firms, spin-offs or divestitures from index firms for a total sample of 441 additions and 455 deletions. All information asymmetry proxies are defined in Table 1. We measure statistical significance using a *t*-test for means and the Wilcoxon–Mann–Whitney test for difference in medians. *** indicates significance at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level.

first category of firm characteristics, we observe a significant decline in the market/book ratio based on the unadjusted and adjusted changes. This drop in the market/book ratio provides support that information asymmetry declines following index inclusions. However, the market/book ratio can also capture other factors about a firm, such as growth opportunities, and may not solely indicate information asymmetry changes. The next proxy variable in this category is accruals, and the mean level of accruals falls on both an unadjusted (significant at the 1% level) and adjusted (significant at the 10% level) basis.

The next group of factors pertains to variability. On an unadjusted basis, we find a significant increase in the volatility of stock returns and in the abnormal reaction to earnings announcements. Looking at these two measures in comparison to market levels of stock return volatility

and abnormal earnings announcement reaction, however, shows that on a market-adjusted basis, the volatility of stock returns falls after index inclusion. The mean change is statistically insignificant, but the median decrease in market-adjusted stock return volatility is –0.0052 (significant at the 1% level). Both the mean and median changes in the market-adjusted earnings announcement reactions show statistically significant declines for added firms (significant at the 1% level). Therefore, we show that on a market-adjusted basis, information asymmetry levels decline for newly added firms.

Our final set of information asymmetry variables relates to analyst forecasts of earnings per share. We observe a similar pattern as found in the variability factors when we look at analyst forecast error and forecast dispersion. On an unadjusted basis, both the analyst forecast error and dispersion increase. Conversely, when we control for market changes in analyst forecast error and dispersion, median analyst forecast error and forecast dispersion experience significant (at the 1% level) declines in the sample medians. Since the market-adjusted method controls for time trends and industry effects, we focus on the results shown in the market-adjusted changes. Our findings for newly added S&P 500 firms generally suggest a decrease in information asymmetry.

Panel C (D) shows the mean and median levels and differences in the proxy variables on an unadjusted (adjusted) basis for the deletion firms. On an unadjusted basis, the market/book ratio displays insignificant changes; however, if we control for the market level of the ratio, the market/book ratio increases with a median increase of 0.1055 (significant at the 1% level). For accruals, the mean and median change in accruals is positive on both an unadjusted and a market-adjusted basis, but these changes are statistically insignificant. These two proxy variables provide marginal evidence of an increase in information asymmetry for deleted firms.

In the group of firm variability factors, we find that the volatility of stock returns as well as the quarterly earnings announcement reaction increase following removal from the index based on both unadjusted and market-adjusted changes. Interestingly, even before removal from the S&P 500, the average deleted firm displayed higher levels of information asymmetry than the market. These proxies provide support for an increase in information asymmetry following index deletions. For the analyst forecast proxy variables, firms newly removed from the S&P 500 Index experience significant mean increases in forecast error and dispersion on an unadjusted basis. On a market-adjusted basis, firms experience a significant increase in the mean forecast error.

Overall, we find evidence for a reduction in information asymmetry for inclusion firms. Specifically, the sample has declines in the market-adjusted changes in the market/book ratio, accruals, earnings announcement reaction, market-adjusted volatility of stock returns, analyst forecast error and analyst forecast dispersion. For deletion firms, we find support for an increase in information asymmetry based on positive changes in the volatility of stock returns, earnings announcement reaction and analyst forecast error and dispersion. We provide the direct examination of how information asymmetry changes associated with index reconstitutions in addition to the changes in bid–ask spread reported in the literature. The significant changes in the information asymmetry proxies are interesting and valuable findings on their own. What is important is to explore if and how the changes in information asymmetry link to the understanding of stock price response to index changes. In the subsequent section, we address the relation between abnormal returns around index reconstitutions and information asymmetry.

Information asymmetry and abnormal returns

Consistent with the implications suggested by literature, we find evidence that information asymmetry increases for inclusion firms and decreases for deletion firms. In this section, we examine how information asymmetry helps explain the abnormal returns surrounding these events. In Table 3, we partition sample firms into two groups based on the sample median of the information asymmetry proxy variable prior to the index change. Then, we compute the difference in the median abnormal return between the high and low information asymmetry groups. We expect that addition firms with greater pre-inclusion information asymmetry have higher abnormal returns because these firms benefit most from the reduction in information asymmetry. For deletion firms whose information asymmetry may increase, those with higher pre-removal information asymmetry should have larger losses at announcements.

We present the results for addition firms in Panel A of Table 3. The striking finding is that partitioning newly added firms into high and low information asymmetry groups by any of our proxy variables does not show a difference in abnormal returns between these groups. While firms in the above median information asymmetry group partitioned by volatility of stock returns, earnings announcement reaction and analyst forecast error and dispersion all have higher abnormal returns, none of these differences are statistically significant. Given that we find evidence of a decline in information asymmetry around the inclusion events for addition firms, we conjecture that these firms are positive performers in the years leading up to inclusion and have been experiencing a reduction in information asymmetry during this time (e.g. as a result of an increasing firm size). Any benefits from declines in information asymmetry may have already been incorporated prior to inclusion, specifically for those with high pre-inclusion levels of information asymmetry. As a

Table 3. Announcement returns to index changes by information asymmetry proxy

	Below median	Above median	Above median – below median
Panel A: Additions			
Firm characteristics			
Market/book ratio	4.08%	3.35%	–0.73%
Accruals	3.88%	3.68%	–0.20%
Variability factors			
Volatility of stock returns	3.45%	3.98%	0.53%
Earnings announcement reaction	3.63%	4.22%	0.59%
Analyst forecast factors			
Analyst forecast error (price scaled)	3.55%	3.94%	0.39%
Forecast dispersion (price scaled)	3.55%	4.16%	0.61%
Panel B: Deletions			
Firm characteristics			
Market/book ratio	–2.71%	–0.34%	2.37%***
Accruals	–1.49%	–1.23%	0.26%
Variability factors			
Volatility of stock returns	–0.93%	–1.94%	–1.01%*
Earnings announcement reaction	–0.54%	–1.81%	–1.28%**
Analyst forecast factors			
Analyst forecast error (price scaled)	–0.04%	–2.23%	–2.20%***
Forecast dispersion (price scaled)	–0.34%	–1.91%	–1.57%***

Notes: The sample includes all firms added to and removed from the S&P 500 Index between 1990 and 2010. We exclude mergers or acquisitions of index firms, spin-offs or divestitures from index firms for a total sample of 441 additions and 455 deletions. In this analysis, we divide the sample into two groups by the level of the information asymmetry proxy variable before the index change is announced. For each group, we compute the average cumulative abnormal return over the period of [–1, +5] days where day 0 is the date of announcement of the index reconstitution. All information asymmetry proxies are defined in Table 1. We test the difference between the average abnormal return from above and below the median level of the information asymmetry proxy variable using the Wilcoxon signed rank test of difference in medians. *** indicates significance at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level.

result, these firms tend not to have higher abnormal returns upon inclusion to the index. To support this conjecture, we examine the before-mentioned information asymmetry proxies during the 5 years prior to the inclusion events. We find (in unreported tables) that during the pre-inclusion period, addition firms have experienced declines in almost all proxy variables, except for market/book ratio. The results support our argument that the inclusion firms are 'rising stars' with decreasing information asymmetry in the pre-inclusion period, and the benefits of information asymmetry have been incorporated in prices. This finding and the corresponding explanation are important because prior literature (Chen *et al.*, 2004; Becker-Blease and Paul, 2006) propose that information asymmetry may be one component that explains the positive price response around inclusion dates. Our analysis in this section does not support this proposition.

Panel B of Table 3 reports the same analysis for firms removed from the index. Interestingly, when we separate the sample by market/book ratio, firms with a low market/book ratio suffer a larger loss upon removal than those with a high market/book ratio. While we use market/book ratio as a proxy for information asymmetry (McLaughlin *et al.*, 1998), it is also a measure of growth opportunities (Dierkens, 1991; Denis, 1994; Krishnaswami *et al.*, 1999). Firms with fewer growth opportunities (a smaller market/book ratio) may experience larger losses upon index exclusion, which can be independent of information asymmetry. Separating firms based on the pre-removal level of accruals yields no significant difference in abnormal returns around deletions.

Partitioning deletion firms based on variability measures (the volatility of stock returns and earnings announcement reaction) leads to a statistically significant difference in abnormal return between high and low information asymmetry groups. In these cases, firms with a high level of information asymmetry accrue larger losses upon removal from the index. In the final set of proxy variables, all findings suggest that the high information asymmetry group incurs larger losses than the low information asymmetry group. The difference in abnormal return between the two groups is statistically significant at the 1% level when we partition by analyst forecast error or analyst forecast dispersion. As a robustness check, we

examine the information asymmetry variables in the 5-year period prior to the deletion events as we have done for the additions. We find little evidence to suggest an increase in information asymmetry during this period. Therefore, in stark contrast to the findings for firms added to the S&P 500 Index, firms with a higher level of information asymmetry prior to exclusion from the index tend to suffer larger losses upon index deletion. This is consistent across most of the proxy variables and aligns with the proposed relation between information asymmetry and stockholder losses for deletion firms.

To sum up, for inclusion firms, we find little difference in abnormal returns between groups partitioned by information asymmetry. One explanation is that newly added firms have typically been strong performers in their industries with market value increases that allow the firms to be large enough for inclusion to the index. Therefore, in the period leading up to inclusion event, these firms have experienced significant reductions in information asymmetry and their stock returns reflect these changes. On the other hand, firms that are deleted from the index do not exhibit an upward trend in information asymmetry in the period leading up to their removal. Thus, the price reaction around deletion events is partially explained by the level of information asymmetry prior to deletion since the firms with a higher level of information asymmetry are likely to have a larger negative impact from the increase in information asymmetry as a result of exclusion.

Multivariate analysis of abnormal announcement returns

To further explore the relation between abnormal returns and information asymmetry, we conduct a multivariate analysis. We conduct regressions of the announcement abnormal returns on each of the information asymmetry proxies. The dependent variable is the percentage cumulative abnormal return over days [–1, +5] where day 0 is the date that the index reconstitution was announced. We include firm size, ROE, leverage and turnover as control variables. Firm size is the log of the market value of equity, ROE is net income divided by total equity and leverage is measured as long-term debt plus debt in current liabilities divided by the market value of assets. We compute the market value of assets as the book value of assets plus the difference between the market and book values of equity. Finally, as a measure of liquidity, we compute monthly turnover as the number of shares traded divided by the shares outstanding, and our turnover measure is the average over the 12 calendar monthly values in the year prior to the index change. All variables (including controls) are measured in the period prior to the index change. Although the coefficient estimates are not shown in the presented results, we control for time and industry effects by including yearly dummy variables and industry controls for the 11 S&P economic sectors. Results for the multivariate regressions of abnormal returns are presented in Table 4. Each row represents a regression of cumulative abnormal return on an information proxy variable and the four control variables, with inclusion of time and industry effects.

In Panel A of Table 4, we present the results for index inclusions. Of the information asymmetry proxy variables, market/book ratio and stock return volatility are the two variables that exhibit a significantly positive relation with announcement abnormal returns. The market/book ratio is significant at the 5% level, but the volatility of stock return coefficient is marginally significant at the 10% level. The pre-inclusion levels of the market/book ratio and stock return volatility are positively related to abnormal returns. We do not find significant effects of the remaining proxy variables on abnormal returns. Given that market/book ratio can proxy for both information asymmetry and growth opportunities, we do not have a clear interpretation from the coefficient on this measure. As a result, our finding provides limited support that firms with a higher information asymmetry prior to inclusion have larger abnormal gains at inclusions. For the control variables, the finding on the turnover ratio is consistent with the results in Baran and King (2012), which show that liquidity improvements upon index inclusions reduce the cost of equity for newly added firms. Positive announcement returns are related to these changes in the cost of equity. The relatively weak results on information asymmetry proxies are generally consistent with those in Table 3, in which the abnormal returns for inclusion firms are not different between firms with high and low levels of information asymmetry. Taken together, these results show that information asymmetry provided limited explanatory power for the positive price response of firms added to the S&P 500 Index.

In Panel B of Table 4, we present the same analysis for index deletions. We observe several significant results on the relation between information asymmetry and announcement returns. Specifically, there is a negative relation between abnormal returns and stock return volatility (significant at the 1% level) and between abnormal returns and earnings announcement reaction (significant at the 1% level). These findings provide further support for the results in previous section that firms with a higher level of information asymmetry experience larger losses. In addition and supporting the finding in the previous analysis, we find a negative and significant coefficient on the analyst forecast error (significant at the 5% level). For the control variables, firm size and the return on equity mitigate the losses that firms experience upon deletion from the S&P 500 Index. Thus, larger firms or firms with better equity returns have smaller losses when removed from the index than smaller firms or who have lower returns.

Table 4. Announcement return multivariate regressions

Variable	Info proxy	Firm size	ROE	Turnover	*N*	Adjusted R^2
Panel A: Additions						
Firm characteristics						
Market/book ratio	0.2341**	–0.2956	–0.5099	0.4681**	415	6.94%
	2.25	*–0.40*	*–0.35*	*2.01*		
Accruals	10.0149	0.2821	–0.4777	0.6479***	305	3.96%
	1.44	*0.34*	*–0.29*	*2.72*		
Variability factors						
Volatility of stock returns	21.6328*	0.4507	–0.3326	0.4503*	409	6.53%
	1.88	*0.63*	*–0.23*	*1.83*		
Earnings announcement reaction	8.0847	0.2603	–0.6388	0.7268**	365	3.47%
	0.39	*0.33*	*–0.41*	*2.57*		
Analyst forecast factors						
Analyst forecast error	–0.1558	0.2138	–0.4049	0.6712***	404	5.58%
	–0.17	*0.30*	*–0.27*	*3.08*		
Forecast dispersion	–1.2030	0.1957	–0.4576	0.6668***	395	5.52%
	–0.40	*0.27*	*–0.30*	*3.02*		
Panel B: Deletions						
Firm characteristics						
Market/book ratio	0.1801	1.7437**	2.3137***	–0.4554	407	10.32%
	0.20	*2.33*	*3.20*	*–0.76*		
Accruals	–3.7369	1.9786***	2.3447***	–1.1080*	326	14.30%
	–0.27	*2.61*	*3.39*	*–1.69*		
Variability factors						
Volatility of stock returns	–72.3481***	0.9469	1.8753***	0.4421	406	14.15%
	–4.09	*1.30*	*2.62*	*0.71*		
Earnings announcement reaction	–119.9975***	1.3932*	2.4851***	–0.1195	401	11.80%
	–2.63	*1.89*	*3.43*	*–0.19*		
Analyst forecast factors						
Analyst forecast error	–0.0045**	1.7781**	2.8320***	–0.0456	381	11.57%
	–1.98	*2.41*	*3.73*	*–0.07*		
Forecast dispersion	–0.0857	1.6972**	2.8340***	–0.0949	372	8.30%
	–0.59	*2.20*	*3.68*	*–0.15*		

Notes: The sample includes all firms added to and removed from the S&P 500 Index between 1990 and 2010. We exclude mergers or acquisitions of index firms, spin-offs or divestitures from index firms for a total sample of 441 additions and 455 deletions. In this analysis, the dependent variable is the cumulative abnormal return measured over the period of [–1, +5] days around the announcement day. In each regression, we include one of the information asymmetry proxies as well as several control variables. Firm size is the log of the market value of equity. Return on assets is net income divided by total assets, and leverage is total long-term debt plus debt in current liabilities divided by the market value of assets. The market value of assets is the book value of assets plus the market value of equity. Turnover is the average of the monthly volume divided by shares outstanding in the calendar year before the event announcement. Variable definitions for information asymmetry proxies are in Table 1. Though coefficients are suppressed, we include year and industry dummy variables in all models. Parameter estimates are presented with *t*-statistics beneath. *** indicates significance at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level.

In summary, the multivariate analysis provides additional empirical support for the relation between information asymmetry and abnormal returns. Consistent with the results above, there is minimal evidence that information asymmetry prior to index addition is positively related to gains at inclusion events. On the other hand, we find a strong and negative relation between information asymmetry and abnormal returns for deletion firms. Our findings for deletion firms are generally consistent with the implication in Hedge and McDermott (2003), Chen *et al.* (2004) and Becker-Blease and Paul (2006): abnormal returns around index changes can be partially explained by changes in information asymmetry.

Analyst forecast error and optimism for inclusion events

Literature on information asymmetry suggests that factors based on analyst forecasts are appropriately and commonly used measures for information asymmetry. The regression results of index inclusions indicate that none of the analyst forecast factors have significant effects on abnormal returns around index changes. As a robustness check, we explore analyst forecast error and optimism as they relate to index inclusions to shed light on this finding. Zhang *et al.* (2010) study analyst forecasts around inclusions to the S&P 500 Index and document that analyst forecast error increases, which is likely

due to an increase in analyst optimism following index inclusions. In Table 2, we find that forecast error increases when we look at the changes in the addition firms. However, when we look at the behaviour of forecast errors relative to the median forecast error of all index firms, the market-adjusted forecast errors actually decline. Figure 1 plots both forecast error and forecast optimism for index additions for a period of 5 years before to 5 years after the index reconstitution. Forecast error is measured as the absolute value of the difference between the median analyst EPS estimate and the actual EPS using the estimate closest to the announcement of actual EPS. Forecast optimism is the difference between the median analyst EPS made between April and June and the actual EPS. We present the measures on an un-scaled basis and on a scaled basis by scaling each measure using the end-of-fiscal-year stock price. In addition, we adjust the sample values relative to those of the S&P 500 Index firms. For each year, we compute the median forecast error and forecast optimism (both un-scaled and scaled by stock price) for all firms on the S&P 500 Index that have not been added within the last 3 years or are removed within the next 3 years. This median index value is then subtracted from the sample firm value to create an index-adjusted measure. In Fig. 1, we observe that forecast error increases in Panels A and B when the values are not adjusted to reflect market trends. In addition, forecast optimism jumps following index inclusion in these panels. These patterns are similar to those found in Zhang *et al.* (2010). Interestingly, we note a different pattern in Panels C and D when we adjust the sample values by the S&P 500 Index median values. Index-adjusted forecast error is negative both before and after the inclusion, indicating that newly added firms to the S&P 500 Index have smaller forecast errors than current index firms. Interestingly, forecast error declines slightly based on the un-scaled values, but has a more material drop based on the price-scaled values. Forecast optimism plunges in the 2 years surrounding the index inclusion.

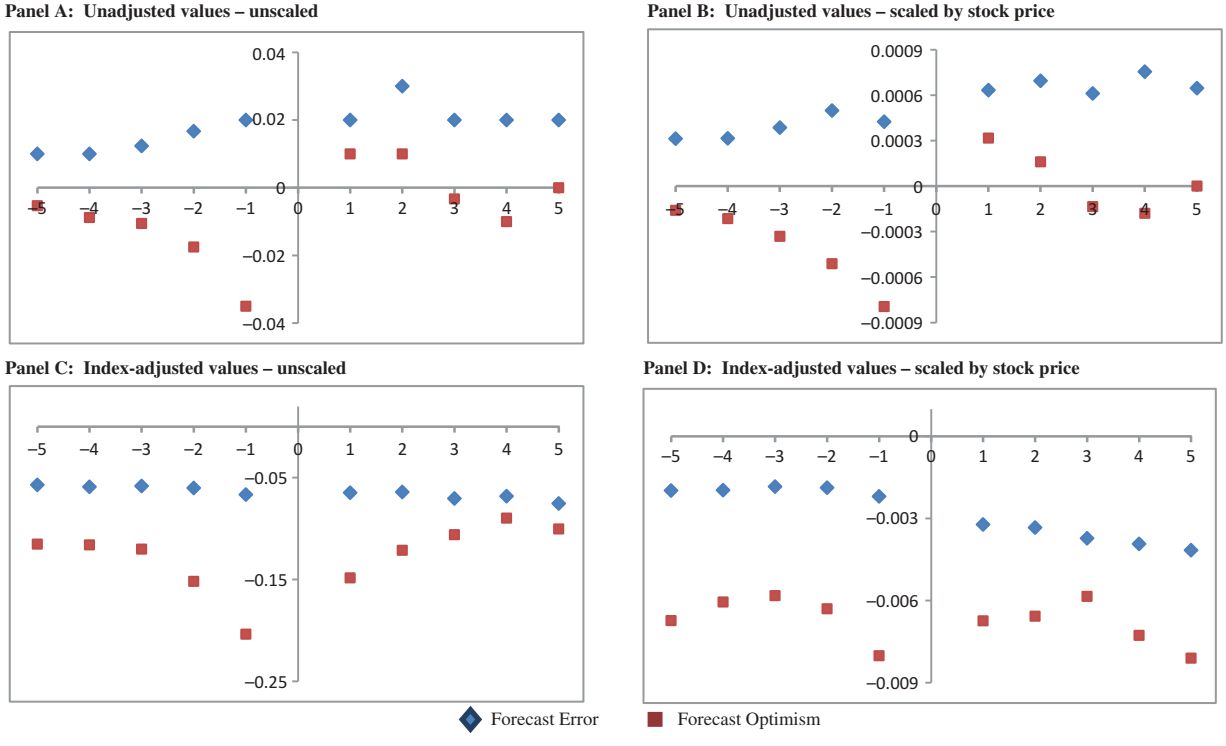

Fig. 1. Median forecast error and optimism for index additions – years [–5, +5]
Notes: The sample includes all firms added to the S&P 500 Index between 1990 and 2010. We exclude mergers or acquisitions of index firms, spin-offs or divestitures from index firms for a total sample of 441 additions and 455 deletions. The figures contain median annual analyst forecast error and analyst forecast optimism for a period of 5 years before and after index reconstitution. Year –1 is defined as the fiscal year end immediately prior to 60 days before the index announcement date and year +1 is defined as the fiscal year end immediately after 90 days following the index announcement date. Year 0 is purposefully omitted. Forecast error is the absolute difference between the median analyst estimate and the actual EPS, where the estimate is made as close to the end of the fiscal year as possible. Forecast optimism is the difference between the median analyst estimate and the actual EPS, where the estimate is the earliest estimate made between April and June of the given year. In panels B and D, we scale the error and optimism by the stock price at the end of the fiscal year, and in panels C and D we adjust the sample firm forecast error and optimism by the mean values for firm in the S&P 500 Index in the same year.

Given the findings from Fig. 1 for index additions on an index-adjusted basis, we further explore the findings of Zhang *et al.* (2010). In particular, we include analyst forecast error or forecast optimism scaled by stock price as the dependent variable. In Panel A of Table 5, the dependent variable is the unadjusted value for the index addition firm. In Panel B, the dependent variable is market-adjusted value. To be consistent with Zhang *et al.* (2010), we include observations from 3 years before and after the index reconstitution. Our main

Table 5. Regressions of forecast error and optimism

	Forecast error			Forecast optimism		
Panel A: Index additions with unadjusted forecast error and optimism						
After index change dummy	0.0006	–0.0001	–0.0016	0.0077**	0.0087**	0.0132**
	0.31	*–0.03*	*–0.49*	*2.20*	*2.46*	*2.00*
Unexpected earnings	–0.0001	–0.0002	–0.0047***	0.0393***	0.0395***	0.0413***
	–0.09	*–0.18*	*–2.93*	*16.53*	*16.61*	*12.66*
Loss	0.0375***	0.0372***	0.0388***	0.1024***	0.1029***	0.1335***
	8.33	*8.28*	*5.40*	*11.94*	*12.00*	*8.92*
Market size	0.0010	0.0011	0.0024	–0.0037	–0.0040	–0.0081*
	0.70	*0.80*	*1.09*	*–1.45*	*–1.54*	*–1.79*
SD of analyst forecasts	0.1299***	0.1285***	0.2211***	–0.0325**	–0.0301**	–0.0483*
	16.71	*16.52*	*17.56*	*–2.14*	*–1.98*	*–1.89*
Number of analysts	0.0001	0.0002	0.0003	0.0000	–0.0002	–0.0003
	0.53	*1.25*	*1.48*	*–0.13*	*–0.71*	*–0.56*
Analyst change	N/A	–0.0007**	–0.0010**	N/A	0.0010**	0.0022**
	N/A	*–2.57*	*–2.39*	*N/A*	*2.04*	*2.44*
Total debt and stock issuance	N/A	N/A	–0.0005*	N/A	N/A	0.0009
	N/A	*N/A*	*–1.78*	*N/A*	*N/A*	*1.51*
N	1963	1963	1062	1928	1928	1032
Adjusted R^2	0.1870	0.1894	0.2914	0.1781	0.1794	0.1862
Panel B: Index additions with index-adjusted forecast error and optimism						
After index change dummy	–0.0033	–0.0038*	–0.0058*	0.0026	0.0038	0.0066
	–1.48	*–1.68*	*–1.66*	*0.72*	*1.05*	*0.99*
Unexpected earnings	0.0004	0.0003	–0.0043**	0.0399***	0.0401***	0.0416***
	0.23	*0.18*	*–2.44*	*16.50*	*16.59*	*12.66*
Loss	0.0371***	0.0369***	0.0359***	0.1010***	0.1017***	0.1289***
	6.76	*6.72*	*4.57*	*11.57*	*11.66*	*8.56*
Market size	0.0066***	0.0067***	0.0042*	–0.0041	–0.0044*	–0.0082*
	4.01	*4.07*	*1.77*	*–1.58*	*–1.69*	*–1.82*
SD of analyst forecasts	0.1237***	0.1226***	0.2159***	–0.0366**	–0.0336**	–0.0480*
	13.03	*12.89*	*15.69*	*–2.37*	*–2.18*	*–1.86*
Number of analysts	0.0001	0.0002	0.0003	0.0000	–0.0002	–0.0002
	0.50	*0.96*	*1.26*	*0.10*	*–0.62*	*–0.54*
Analyst change	N/A	–0.0005*	–0.0008*	N/A	0.0013**	0.0022**
	N/A	*–1.67*	*–1.72*	*N/A*	*2.51*	*2.43*
Total debt and stock issuance	N/A	N/A	–0.0006*	N/A	N/A	0.0007
	N/A	*N/A*	*–1.88*	*N/A*	*N/A*	*1.12*
N	1963	1963	1062	1928	1928	1032
Adjusted R^2	0.1316	0.1324	0.2444	0.1704	0.1726	0.1800

Notes: The sample includes all firms added to the S&P 500 Index between 1990 and 2010. We exclude mergers or acquisitions of index firms, spin-offs or divestitures from index firms for a total sample of 441 additions. The dependent variables include analyst forecast error and analyst forecast optimism. Forecast error is measured as the absolute value of the difference between the median analyst EPS estimate and the actual EPS. We include the analyst estimate made as close as possible to the announcement of the actual EPS. Forecast optimism is measured as the difference between the median analyst EPS made between April and June and the actual EPS. Forecast error and optimism for 5 years before and 5 years after the index reconstitution are included, and forecast error and optimism are scaled by the actual EPS. The independent variables include a dummy variable for forecasts that occur after the index change. Unexpected earnings is the difference in EPS between the current and previous years scaled by the stock price, and loss is a dummy variable equal to 1 if the EPS is negative. Market size is the log of the market value of equity, and we include the SD of the analyst forecasts made in the prior fiscal year and the number of analysts making the current year forecast. We also measure the change in analysts covering the firm as the difference between the current number of forecasts and the number of forecasts made in the previous year. We include the log of one plus the total dollar amount of stock and debt issued in the 5-year period either before or after the index inclusion. Parameter estimates are presented with *t*-statistics beneath. *** indicates significance at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level.

variable of interest is a dummy variable, indicating the time period after the index change. We include unexpected earnings, which is the change in EPS from the previous to the current year divided by the stock price at the end of the previous year. Loss is a dummy variable taking the value of 1 for negative EPS and 0 otherwise. Market size is the log of the market value of equity at the end of the previous year. We include the SD of analyst forecasts in the previous year and the number of analysts in the current year. Finally, we include two variables to help distinguish between the possible motivations for analysts to make optimistic forecasts after index inclusions. Cowen *et al.* (2006) point out that optimistic recommendation may stem from the desire to garner more underwriting business, and analyst reputation plays a large role in the selection of an underwriting firm. Additionally, Zhang *et al.* (2010) suggest that increased optimism following index inclusion may be driven by new analysts attempting to earn the favour of company executives or trying to attract new underwriting business. To examine these possibilities, we include the change in the number of analysts from the previous to the current period as a proxy for the number of new analysts vying for executive attention. We also include the log of the total dollar amount of debt and stock issued in the period before or after the index change as a measure of optimism designed to garner investment banking business.[4] We measure the total dollar amount of debt and stock issued in the 5-year period before and the 5-year period after the index inclusion date. The results in Table 5 Panel A show that forecast error remains level after firms are added to the S&P 500 Index, but forecast optimism increases significantly. While in Panel A of Fig. 1 we observe a slight increase in forecast error, the coefficient on the after index change dummy variable is negative but insignificant. Consistent with Fig. 1, the index-adjusted forecast error declines upon index inclusion in two out of three models, and there is an insignificant increase in forecast optimism. When looking at the two factors for forecast optimism, we find mild support that firms with more active stock and debt issuance have a higher level of analyst optimism. We find little evidence that the change in the number of analysts impacts forecast optimism. The difference in the impact of index inclusion on forecast error on an unadjusted versus adjusted basis confirms the results from prior tables: Relative to other firms on the index, forecast error does decline following inclusion which is evidence of a decrease in relative information asymmetry. We confirm the finding of Zhang *et al.* (2010) that the unadjusted forecast optimism increases following index inclusion. However, we show that on an adjusted basis, forecast optimism actually has an insignificant change following inclusion.

V. Conclusion

In this study, we explore an unanswered proposition in the literature about one explanatory factor for the price changes around S&P 500 reconstitutions. We draw upon several studies, including Hedge and McDermott (2003), Chen *et al.* (2004) and Becker-Blease and Paul (2006), who suggest that information asymmetry changes may help explain the price changes. We use an array of information asymmetry measures to represent various dimensions of the complex information environment of a firm, providing significant contributions to the existing studies based on bid–ask spread as the only information asymmetry measure. We first look at the changes in information asymmetry immediately around index changes for firms added to and removed from the index. We find a significant decline in information asymmetry for inclusion firms and a significant increase in information asymmetry for deletion firms.

We further link changes in information asymmetry to stock price reactions using two methods. First, we partition the sample firms into two groups based on the level of information asymmetry proxy before the index revision and compare the average cumulative abnormal return for each group. For newly included firms, we find no significant difference in announcement return between high and low information asymmetry groups. For deleted firms, we show that firms with a higher level of information asymmetry prior to exclusion suffer greater losses than those with a lower level of information asymmetry. We further confirm these results using a multivariate regression analysis. For inclusion events, we find that market/book ratio and volatility of stock returns have a weakly significant impact on abnormal returns once other controls are included. On the other hand, volatility of stock returns, earnings announcement reaction and analyst forecast errors are found to be significant information asymmetry determinants for price reaction at deletions. Our results suggest that information asymmetry is a significant determinant of the price reaction at S&P 500 Index deletion events, but provides limited explanatory power for price reaction at inclusion events.

Finally, we extend the study by Zhang *et al.* (2010) who examine analyst forecast error and optimism for firms added to the S&P 500 Index. Similar to Zhang *et al.* (2010), we show that, on an unadjusted basis, forecast optimism increases. However, when we adjust for the market trends, we observe a decline in analyst forecast

[4] This variable is only available through 2008, so specifications including this variable are limited to the time period of 1990 to 2008.

error and no significant change in forecast optimism following index inclusions.

References

Ackert, L. and Athanassakos, G. (2003) A simultaneous equations analysis of analysts' forecast bias, analyst following, and institutional ownership, *Journal of Business Finance and Accounting*, **30**, 1017–42. doi:10.1111/1468-5957.05452.

Baran, L. and King, T. H. D. (2012) Cost of equity and S&P 500 Index revisions, *Financial Management*, **41**, 457–81. doi:10.1111/j.1755-053X.2012.01186.x.

Becker-Blease, J. and Paul, D. (2006) Stock liquidity and investment opportunities: evidence from index additions, *Financial Management*, **35**, 35–51. doi:10.1111/j.1755-053X.2006.tb00146.x.

Beneish, M. and Whaley, R. (1996) An anatomy of the S&P game: the effect of changing the rules, *Journal of Finance*, **51**, 1909–30.

Bernard, M. (2008) The impacts of CEO turnover and degree of internalization on the accuracy of analyst forecasts, *International Business and Economics Research Journal*, **7**, 1–29.

Cai, J. (2007) What's in the news? Information content of S&P 500 additions, *Financial Management*, **36**, 113–24. doi:10.1111/j.1755-053X.2007.tb00083.x.

Chari, V., Jagannathan, R. and Ofer, A. (1988) Seasonalities in security returns, *Journal of Financial Economics*, **21**, 101–21. doi:10.1016/0304-405X(88)90033-5.

Chen, H., Noronha, G. and Singal, V. (2004) The price response to S&P 500 Index additions and deletions: evidence of asymmetry and a new explanation, *The Journal of Finance*, **59**, 1901–30. doi:10.1111/j.1540-6261.2004.00683.x.

Clarke, J. and Shastri, K. (2001) On information asymmetry metrics, Social Science Research Network Working Paper No. 251938, Social Science Research Network, Rochester, NY.

Çolak, G. (2012) IPO characteristics of index firms, *Managerial Finance*, **38**, 1134–59. doi:10.1108/03074351211271265.

Cowen, A., Groysberg, B. and Healy, P. (2006) Which types of analyst firms are more optimistic?, *Journal of Accounting and Economics*, **41**, 119–46. doi:10.1016/j.jacceco.2005.09.001.

Denis, D. (1994) Investment opportunities and the market reaction to equity offerings, *The Journal of Financial and Quantitative Analysis*, **29**, 159–77. doi:10.2307/2331220.

Denis, D., McConnell, J., Ovtchinnikov, A., *et al.* (2003) S&P 500 Index additions and earnings expectations, *The Journal of Finance*, **58**, 1821–40. doi:10.1111/1540-6261.00589.

Diamond, D. and Verrecchia, R. (1991) Disclosure, liquidity, and the cost of capital, *The Journal of Finance*, **46**, 1325–59. doi:10.1111/j.1540-6261.1991.tb04620.x.

Dierkens, N. (1991) Information asymmetry and equity issues, *The Journal of Financial and Quantitative Analysis*, **26**, 181–99. doi:10.2307/2331264.

Duarte, J., Han, X., Harford, J., *et al.* (2008) Information asymmetry, information dissemination and the effect of regulation FD on the cost of capital, *Journal of Financial Economics*, **87**, 24–44. doi:10.1016/j.jfineco.2006.12.005.

Easley, D. and O'Hara, M. (2004) Information and the cost of capital, *The Journal of Finance*, **59**, 1553–83. doi:10.1111/j.1540-6261.2004.00672.x.

Edmister, R., Graham, A. S. and Pirie, W. (1996) Trading cost expectations: evidence from S&P 500 Index replacement stock announcements, *Journal of Economics and Finance*, **20**, 75–85. doi:10.1007/BF02920893.

Erwin, G. and Miller, J. (1998) The liquidity effects associated with addition of a stock to the S&P 500 Index: evidence from bid/ask spreads, *The Financial Review*, **33**, 131–46. doi:10.1111/j.1540-6288.1998.tb01612.x.

Ford, D., Nguyen, H. and Nguyen, V. (2012) Analyst coverage and market reaction around stock split announcements, *Applied Financial Economics*, **22**, 135–45. doi:10.1080/09603107.2011.605755.

Gilson, S., Healy, P., Noe, C., *et al.* (2001) Analyst specialization and conglomerate stock breakups, *Journal of Accounting Research*, **39**, 565–82. doi:10.1111/1475-679X.00028.

Haw, I., Jung, K. and Ruland, W. (1994) The accuracy of financial analysts' forecasts after mergers, *Journal of Accounting, Auditing, and Finance*, **9**, 465–86.

Hedge, S. and McDermott, J. (2003) The liquidity effects of revisions to the S&P 500 Index: an empirical analysis, *Journal of Financial Markets*, **6**, 413–59. doi:10.1016/S1386-4181(02)00046-0.

Kanagaretnam, K., Lobo, G. and Whalen, D. (2005) Relationship between analyst forecast properties and equity bid-ask spreads and depths around quarterly earnings announcements, *Journal of Business Finance and Accounting*, **32**, 1773–99. doi:10.1111/j.0306-686X.2005.00647.x.

Kappou, K., Brooks, C. and Ward, C. (2008) A re-examination of the index effect: gambling on additions to and deletions from the S&P 500's 'gold seal', *Research in International Business and Finance*, **22**, 325–50. doi:10.1016/j.ribaf.2007.12.001.

Krishnaswami, S., Spindt, P. and Subramaniam, V. (1999) Information asymmetry, monitoring, and the placement structure of corporate debt, *Journal of Financial Economics*, **51**, 407–34. doi:10.1016/S0304-405X(98)00059-2.

Krishnaswami, S. and Subramaniam, V. (1999) Information asymmetry, valuation, and the corporate spin-off decision, *Journal of Financial Economics*, **53**, 73–112. doi:10.1016/S0304-405X(99)00017-3.

Lang, M., Lins, K. and Miller, D. (2003) ADRs, analysts, and accuracy: does cross listing in the United States improve a firm's information environment and increase market value?, *Journal of Accounting Research*, **41**, 317–45. doi:10.1111/1475-679X.00106.

Lobo, G. and Tung, S. (1997) Relation between predisclosure information asymmetry and trading volume reaction around quarterly earnings announcements, *Journal of Business Finance and Accounting*, **24**, 851–67. doi:10.1111/1468-5957.00137.

McLaughlin, R., Safieddine, A. and Vasudevan, G. (1998) The information content of corporate offerings of seasoned securities: an empirical analysis, *Financial Management*, **27**, 31–45. doi:10.2307/3666291.

Pruitt, S. and Wei, K. (1989) Institutional ownership and changes to the S&P 500, *Journal of Finance*, **44**, 509–13.

Sloan, R. (1996) Do stock prices fully reflect information in accruals and cash flows about future earnings?, *Accounting Review*, **71**, 289–315.

Smith, C. and Watts, R. (1992) The investment opportunity set and corporate financing, dividend and compensation policies, *Journal of Financial Economics*, **32**, 263–92. doi:10.1016/0304-405X(92)90029-W.

Sufi, A. (2007) Information asymmetry and financing arrangements: evidence from syndicated loans, *The Journal of Finance*, **62**, 629–68. doi:10.1111/j.1540-6261.2007.01219.x.

Thomas, S. (2002) Firm diversification and asymmetric information: evidence from analysts' forecasts and earnings announcements, *Journal of Financial Economics*, **64**, 373–96. doi:10.1016/S0304-405X(02)00129-0.

Yoon, H., Zo, H. and Ciganek, A. (2011) Does XBRL adoption reduce information asymmetry?, *Journal of Business Research*, **64**, 157–63. doi:10.1016/j.jbusres.2010.01.008.

Yu, F. (2008) Analyst coverage and earnings management, *Journal of Financial Economics*, **88**, 245–71. doi:10.1016/j.jfineco.2007.05.008.

Zhang, J., Lin, E. and Shin, H. (2010) S&P 500 Index inclusions and analysts' forecast optimism, *The Journal of Investing*, **19**, 50–7. doi:10.3905/joi.2010.19.4.050.