Is There Really Excess Comovement? Causal Evidence from FTSE 100 Index Turnover

Christian von Drathen*

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Abstract

Stock returns appear to comove in excess of common news about stock fundamentals. I examine comovement when stocks are added to or deleted from the FTSE 100 stock index, which are events without news about fundamantals. Using a natural experiment created by FTSE's index balancing rule, I find that random index turnover has no significant effect on comovement. Furthermore, non-random index turnover can introduce a selection bias that overstates the effect on comovement. Index turnover does not cause a change in comovement, but much rather it seems to be the reverse: a change in comovement can cause index turnover. My findings are consistent with the fundamentals-based hypothesis; rejections in the previous literature may be due to non-random index turnover. *(JEL: G10, G14, G15)*

*Jindal School of Management, The University of Texas at Dallas (UTD), 800 West Campbell Road, Richardson, TX 75080, USA. Email: vondrathen@utdallas.edu. I thank Ulf Axelson, Vicente Cuñat, Greg Durham, Dong Lou, Daniel Paravisini, Christopher Polk, Joel Shapiro, Andrea Vedolin and seminar participants at ESADE, KLU Hamburg, Lancaster University, LSE, Queens University Belfast, Texas A&M, University of Groningen, and UTD for helpful comments and discussions. All errors are my own.

1 Introduction

If investors are rational and there are no limits to arbitrage, then stocks should be valued fundamentally by discounted cash flows. Accordingly, the comovement of stock prices with each other should reflect common variation of news about stock fundamentals, such as future cash flows and discount rates. However, empirical research finds comovement in excess of the common variation of fundamental factors. In particular, events that contain no news about fundamentals seem to affect stock comovement. For example, a stock's comovement with an index increases when the stock is added to the index and decreases when it is deleted. Excess comovement is attributed to correlated trading patterns of investor groups: many institutions are forced to hold index stocks[1] and create a correlated demand shock when a stock is added to the index. Based on these findings, the empirical literature rejects the fundamentals-based hypothesis. However, an important concern with these studies is that they rely on variation in index membership that is unlikely to be random. The correlation between unobserved stock characteristics and index turnover cannot be ruled out. It is therefore difficult to establish whether or not index turnover really causes excess comovement.

I examine if stock index turnover causes a change in the comovement of stock and index returns through investors who allocate capital to categories defined by index membership. FTSE chooses index constituents with simple and transparent rules, based on market capitalization rank. The FTSE 100 balancing rule generates index turnover that is random, after controlling for market capitalization rank. A change in comovement around these events identifies the causal effect of FTSE 100 index membership changes. Using this random sample, I find no significant effect on comovement. I also show that index turnover can be non-random and introduce a selection bias that exaggerates the effect on comovement. It

[1] According to the Investment Management Association, in 2012 index tracker funds accounted for £71.7bn of savings in Britain, or 9.6 percent of the total money invested. Five years ago, this figure was £30bn.

therefore appears that index turnover does not cause a change in comovement, but much rather the reverse effect exists: a change in comovement, possibly correlated with unobserved stock characteristics, seems to cause index turnover.

When a stock is added to the FTSE 100, buying by institutions that are forced to hold the index for benchmarking and tracking purposes creates a correlated demand shock. Provided the covariance structure of fundamental factors is stationary, the fundamentals-based hypothesis predicts that such demand shocks do not affect the comovement of stock returns. However, finding a change in stock comovement upon index turnover alone is not sufficient to reject the fundamentals-based hypothesis. A change in the covariance structure of fundamental factors may cause index turnover and a contemporaneous change in stock comovement. This paper uses a random sample of FTSE 100 index turnover stocks that have a stationary covariance structure of fundamental factors and provides a causal test of the fundamentals-based hypothesis.

The FTSE index membership rules are straightforward. Every quarter all eligible U.K.-listed stocks are ranked by market capitalization. FTSE uses a banding policy in order to avoid frequent index turnover. Stocks must climb to rank 90 or better to be included in the FTSE 100 index, and drop to rank 111 or worse to be excluded. Generally, stocks within the rank band from 91 to 110 are not turned over.

The identification strategy uses three aspects of these rules: first, unobserved variables have no direct influence on index turnover. The sole stock characteristic that causes index turnover is market capitalization rank; therefore, only stock characteristics correlated with market capitalization rank affect index turnover. Second, the FTSE 100 must always have 100 constituents. Whenever the number of additions from banding differs from the number of deletions, FTSE must shift marginal stocks either into or out of the index in order to balance the total to 100 constituents. These marginal stocks are *always located inside the band*. Balancing of these stocks only depends on the rank of *other stocks outside the band* and is therefore plausibly random. Marginal stocks that would otherwise have remained just outside (inside) the index are therefore randomly added to (deleted from) it. Third, the banding policy generates a control group for empirical tests. After every quarterly review, there are 10 index and 10 non-index stocks within the market capitalization rank band on arbitrary and overlapping ranks. The characteristics of marginal stocks are random, conditional on market capitalization rank and prior index membership. Marginal stocks that experience no balancing index turnover are therefore a suitable control group for those that do.

Using the full sample of FTSE 100 index turnover stocks, I regress daily stock on index returns and show that comovement changes significantly around index turnover, a finding consistent with Barberis et al. (2005) analysis of the S&P 500. However, if only balancing index turnover is used in a difference-in-differences (DID) analysis with controls for market capitalization rank, then the effect of index turnover on comovement disappears. Similarly, a DID analysis that matches balancing index turnover with non-turnover stocks by rank also shows no significant effect on comovement. Non-random index turnover therefore appears to create a substantial selection bias that exaggerates the index turnover effect on comovement. However, random FTSE 100 balancing index turnover causes no significant change in comovement. I check these findings using turnover generated from a simulated placebo index. Non-random banding turnover from the placebo index creates a similar selection bias that disappears for random balancing. My results are therefore consistent with the fundamentals-based hypothesis and suggest that rejections in the previous literature may be due to non-random index turnover.

The previous literature maintains that excess comovement in stock returns is connected to trading patterns of investor groups. Delong et al. (1993), Pindyck and Rotemberg (1993), Vijh (1994) find that excess comovement can be explained by common liquidity shocks from the price impact of correlated investor demand. Antón and Polk (2013) find that common analyst coverage and stock ownership increases covariation. Index turnover is frequently used to analyze changes in comovement. Vijh (1994) and Barberis et al. (2005) find that S&P 500 index turnover changes comovement and relate it to investors trading index stocks together. FTSE membership rules are mechanical and fully transparent, but S&P constituents are determined by committee in confidential discussions. These papers therefore cannot rule out that S&P 500 index turnover is correlated with unobserved stock characteristics. Denis et al. (2003) suggest that S&P 500 index turnover causes stock characteristics to change. Antón (2010) finds that S&P selects stocks with increasing betas. Chen et al. (2014) find that S&P additions display high momentum. Greenwood and Sosner (2007) examines a one-time re-weighting of the Nikkei 225 and associates excess comovement with commonality of trading. In a cross-sectional analysis, Greenwood (2008) finds excess comovement and relates it to the overweighting of certain stocks in the Nikkei 225 index. A closely related paper by Boyer (2011) claims that S&P/Barra stock labeling into investing style categories induces excess comovement. The S&P/Barra balancing index turnover is similar in that it depends on the difference in total market capitalization between two style categories. However, the single cut-off provides neither random index turnover nor a contemporaneous control group. In contrast, FTSE 100 banding creates both random balancing index turnover and a contemporaneous control group. Chang et al. (2013) focus on the Russell 1000 index and find excess comovement in index turnover. However, they use data from before Russell introduced a banding policy and therefore index turnover is unlikely to be random.

The rest of the paper is organized as follows: Section 2 explains the FTSE 100 index and balancing index turnover, Section 3 introduces the empirical tests, Section 4 describes the data, Section 5 presents the main results, Section 6 analyzes the robustness of the results, and Section 7 closes with a summary.

2 FTSE 100 Balancing Turnover

The main empirical challenge of measuring the effect of index turnover on comovement is to establish causality: does index turnover cause a change in stock comovement, or does a change in comovement cause an addition to or deletion from the index? Most previous studies simply assume that index turnover, which is usually caused by a change in market capitalization rank, is not correlated with stock characteristics. However, this assumption is questionable. I use the FTSE 100 banding policy to neutralize the non-random effect of market capitalization rank on index turnover. There may be some additional residual endogenous variation, but eliminating the correlation between market capitalization rank and index turnover alone explains almost all the "excess" comovement in the literature. This approach is a departure from most empirical work on comovement, which has failed to establish a causal effect. The rest of the section describes a natural experiment embedded in he FTSE 100 banding policy, which I use as a source of random variation in index turnover. The main goal is to motivate my identification assumption that FTSE 100 index balancing has a random effect on stock characteristics including comovement, when controlled for market capitalization rank.

2.1 The FTSE 100 Index

The Financial Times-Stock Exchange 100 Index (FTSE 100), informally called "Footsie", is the most widely used stock market index of the 100 largest firms listed in the U.K. The FTSE 250 index contains stocks too small for the FTSE 100. The FTSE 100 is more popular than the FTSE 250 as a benchmark for investors, and stocks promoted to the FTSE 100 receive a positive demand shock. Stocks moving between the FTSE 100 and the FTSE 250 are the main focus of this study.

FTSE membership is rule-based, fully transparent, and based on market capitalization rank. The FTSE 100 index constituents are reviewed quarterly[2] to ensure that the index remains representative of the largest firms listed in the market. FTSE uses a banding policy in order to avoid

[2] Since 1993, on the Wednesday after the first Friday in March, June, September and December. The market capitalization rank is determined based on the closing prices of the quarterly review date. Constituent and weight changes are announced before the market opens the next day and usually become effective 12 calendar days after the review.

frequent membership changes.

There are four types of FTSE 100 index turnover:

1. Ordinary banding turnover (Type-1). At each quarterly review, index membership changes when stocks leave the market capitalization rank band: stocks ranked 90 or better are included, and stocks ranked 111 or worse are excluded.

2. Ordinary balancing turnover (Type-2) . If the number of Type-1 additions and deletions does not match, then FTSE shifts marginal stocks into or out of the index in order to balance the total to 100 constituents. If there are more Type-1 banding additions than deletions, then the lowest ranked FTSE 100 stocks are deleted. If there are more Type-1 banding deletions than additions, then the highest ranked FTSE 250 stocks are added.

3. Extraordinary turnover (Type-3). Membership changes between quarterly reviews if large new issues are added under fast entry rules, and stocks bound to be de-listed, including firms subject to unconditional takeover bids, are deleted from the index.

4. Extraordinary balancing turnover (Type-4). For every extraordinary addition, FTSE deletes the lowest-ranked FTSE 100 member on the previous trading day. For every extraordinary deletion, FTSE adds the highest-ranked stock on the reserve list. The reserve list includes the six highest-ranked FTSE 250 members on the previous quarterly review date.

Figure 1 shows an example of ordinary FTSE 100 index turnover: Stock A climbs to rank 90 and is added to the index. Stocks C and D fall to rank 111 and 112, respectively, and are both deleted. Stock B has to be added in order to balance the index. Stocks A, C, and D are Type-1 banding index turnover because they move outside the market capitalization band. Stock B is the highest-ranked marginal stock inside the rank band and solely added to the index because the number of Type-1 deletions (i.e.

Stocks C and D) exceeds the number of Type-1 additions (i.e. Stock A). Without the Type-1 mismatch Stock B would not be added to the FTSE 100 and remain in the FTSE 250. After the review, the rank band contains the 10 lowest-ranked FTSE 100 stocks, arbitrarily overlapping with the 10 highest-ranked FTSE 250 stocks. In a review these 20 marginal stocks are not turned over other than for balancing purposes.

2.2 Natural Experiment: Balancing Index Turnover

An important concern with many previous studies is, that they rely on time-series variation in market capitalization rank and, thus, in index membership, which is likely to be correlated with unobserved stock characteristics. Such index turnover is not random and can create a selection bias.

Figure 2 illustrates that index turnover is highest when markets are volatile (Dimson and Marsh (2001)). Moreover, comovement varies greatly over time: the largest change in comovement coincides with the Internet bubble and the subsequent crash, a period when expectations about stock fundamentals changed substantially (Table 5). It is therefore entirely possible that a change in unobserved stock characteristics causes a concurrent change in comovement and index turnover.

Whether or not there really is correlation between stock characteristics and index turnover depends on the specific rules governing index membership changes. For most popular indices, including the FTSE 100, market value is an important selection criterion. Marginal stocks just outside the index are therefore more likely to be added if they experience increasing market value, or equivalently high stock returns.

A consequence of market capitalization-based index membership rules is that additions have high recent stock returns. Figure 3 displays the cumulative abnormal returns[3] for additions to the FTSE 100 index by type (Figure 4 shows deletions). The chart demonstrates that Type-1 banding

[3]The event study analysis uses daily returns over a 250-day window ending (starting) 10 trading days before (after) the index turnover announcement date to estimate the pre-(post-)event single-factor market model. Normal returns for the pre-(post-)event are calculated using the pre-(post-) event estimates for alpha and beta.

additions have a much higher pre-event stock price increase than Type-2 balancing additions. The stock price run-up, however, may occur because certain unobserved stock characteristics have changed, altering the stock's systematic risk and comovement (Antón (2010)). It therefore appears that index turnover does not cause a change in comovement, but much rather the reverse effect exists: a change in comovement, possibly correlated with unobserved stock characteristics, seems to cause index turnover.

In order to investigate the selection issue further, it is useful to analyze the relationship between the change in comovement and stock return performance. The change in comovement, commonly measured by stock beta, is most positive for additions, which outperformed the index in strong markets (Table 6). It therefore appears that stocks with a high increase in beta join the index when markets rally. This group includes firms that increase their systematic risk either by adding leverage or by entering riskier businesses when stock markets perform well. Stocks that experience a change in comovement therefore seem to self-select into the index.

The FTSE 100 balancing rule can be used to eliminate the self-selection effect. The FTSE rules generate Type-2 balancing index turnover that is driven by market capitalization changes of other stocks. Unlike Type-1 banding additions, Type-2 balancing index turnover is *not solely* caused by the stock's own stock price appreciation. However, in order to move to the top of the list of candidates for balancing additions, the stock must also experience a moderate run-up. Figure 3 shows that Type-2 balancing additions have also appreciated, but less than Type-1 banding additions. The moderate appreciation could nonetheless be caused by a change in fundamental stock characteristics concurrently to an increase in systematic risk.

However, since only market capitalization rank causes index turnover, controlling Type-2 balancing turnover for market capitalization rank eliminates the run-up bias. Conditional on rank, stocks located inside the FTSE 100 band are therefore assigned randomly.

In other words, Type-1 banding index turnover is *solely* caused by the stock's own return. Since fundamental stock characteristics, returns and market capitalization rank are likely to be correlated, stock fundamentals also affect Type-1 banding index turnover. Such non-random index turnover usually results in a selection bias. In contrast, Type-2 balancing index turnover is *not only* caused by the stock's own return but *also* by other stocks. Since the partial effect of the stock's own return can be eliminated by controlling for market capitalization rank, conditional Type-2 balancing index turnover is random. Tests involving conditional Type-2 balancing index turnover are therefore unbiased and have a causal interpretation.

3 Tests

I present four models to test the effect of index turnover on comovement: a univariate regression, a bivariate regression, a standard difference-in-differences (DID) analysis, and a DID model with matching. The exposition starts with the two models used in the previous literature before moving to the two DID approaches that generate my main results.

3.1 Univariate Regression

Comovement is commonly measured by the regression coefficient beta of stock returns on index returns. A simple benchmark to evaluate the effect of index turnover on comovement is to separately estimate the stock's beta before and after each turnover event and to analyze the average change (Vijh (1994)). This difference is attractive because it provides an estimate of the index turnover effect on comovement that is not affected by the stocks' time-invariant characteristics. For each index turnover event, I estimate the univariate regression model

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t} \qquad (1)$$

separately before and after each index turnover event, and note the change in beta $\Delta\beta_i$. $R_{i,t}$ is the stock's total return between date $t-1$ and t, and $R_{100,t}$ is the corresponding total adjusted return on the FTSE 100 index[4]. The daily returns are over a 250-day period ending (starting) 10 trading days before (after) the index turnover announcement date. The average change in beta is $\overline{\Delta\beta}$ and use I bootstrap simulations in order to compute heteroskedasticity-robust standard errors.

3.2 Bivariate Regression

A shortcoming of the univariate analysis is that it only measures the effect of entry into one index, *or* the exit from another, but not both simultaneously. Barberis et al. (2005) present a bivariate analysis to test the prediction that a stock moving from one index to another becomes less sensitive to the former and more sensitive to the latter. In the present analysis, the adjusted FT All Share index[5] serves as a proxy for non-FTSE 100 returns. For each index addition and deletion event, I estimate the bivariate regression

$$R_{i,t} = \alpha_i + \beta_{i,100} R_{100,t} + \beta_{i,AS} R_{AS,t} + \epsilon_{i,t} \tag{2}$$

before and after each event, and record the change in betas, $\Delta\beta_{i,100}$, and $\Delta\beta_{i,AS}$. $R_{i,t}$ is the stock's total return, $R_{100,t}$ is the total adjusted return of the FTSE 100 index, and $R_{AS,t}$ is the total adjusted return of the FT All Share index, between time $t-1$ and t, respectively. The daily returns are again over a 250-day period ending (starting) 10 trading days before (after) the event announcement date. The average change in betas are $\overline{\Delta\beta_{100}}$ and $\overline{\Delta\beta_{AS}}$ and I again bootstrap in order to compute heteroskedasticity-robust standard errors.

[4] FTSE 100 returns are adjusted by excluding the market capitalization-weighted return of stock i after (before) the stock is added to (deleted from) the index.

[5] FTSE All Share returns are adjusted by excluding the market capitalization-weighted return of the FTSE 100 stocks and the return of stock i after (before) the stock is added to (deleted from) the index.

3.3 Standard Difference-in-Differences

A potential drawback of the univariate and bivariate models is that they determine only the change in comovement for index turnover stocks, but do not control for contemporaneous changes in non-turnover stocks. These models cannot distinguish a change in comovement specific to index turnover stocks from a more general market trend in comovement. A common solution to this problem is using a standard difference-in-differences (DID) analysis relative to a control group. I estimate the effect of index turnover on the change in beta using the model

$$\beta_{i,q}^{Post} - \beta_{i,q}^{Pre} = \alpha_r + \alpha_q + \Delta\beta + \Delta\Delta\beta \text{ Turnover}_{i,q} + \varepsilon_{i,q}. \tag{3}$$

The left-hand side is the change in beta for firm i around the index review during quarter q. $\beta_{i,q}^{Pre}$ and $\beta_{i,q}^{Post}$ are the pre- and post-review estimates of beta from Equation (1), collapsed into one observation. α_r is a rank-fixed effect and α_q is a quarter-fixed effect. The coefficient $\Delta\beta$ is the average change between post- and pre-review beta and the coefficient $\Delta\Delta\beta$ is the average change in beta between index turnover and non-turnover stocks. $\text{Turnover}_{i,q}$ is an indicator variable for FTSE 100 index turnover of stock i in quarter q. The control group for index additions are the FTSE 250 stocks, and for deletions I use the FTSE 100 stocks. The standard errors are heteroskedasticity-robust.

Specification (3) is first-differenced and eliminates any time-invariant unobserved heterogeneity of stocks. This is equivalent to including stock-fixed effects in a panel estimation and the estimates are therefore attained from the changes in the dependent variable for the same stock.

A key requirement in regression analyses of this type is that index turnover must be uncorrelated with the change in comovement. This assumption is challenging because unobserved stock characteristics correlated with comovement can indeed cause index turnover and introduce a selection bias.

The standard DID model uses market capitalization rank-fixed effects to control for non-randomness in index turnover. The joint null hypothesis is therefore firstly, that markets are weak-form efficient in that market capitalization is a sufficient statistic for index turnover, and secondly, that index turnover has no effect on comovement. The alternative hypothesis is either that markets are not weak-form efficient or that index turnover does have an effect on comovement.

3.4 Difference-in-Differences with Matching

Another remedy for non-random index turnover is matching. Within the FTSE rank band from 91 to 110, there is random overlap between Type-2 balancing index turnover stocks and non-turnover stocks, and also between index and non-index stocks. Type-2 balancing index turnover stocks can therefore be matched by rank with non-turnover stocks in order to eliminate the selection bias. I estimate the model

$$\beta_{i,q}^{Post} - \beta_{i,q}^{Pre} = \alpha_q + \Delta\beta + \Delta\Delta\beta \text{ Turnover}_{i,q} + \varepsilon_{i,q}. \tag{4}$$

by matching each Type-2 index turnover stock with a sample of non-turnover stocks with the same index membership status that fall into a defined market capitalization rank bandwidth. This method provides a consistent estimator for the causal effect of balancing index turnover on comovement because, conditional on market capitalization rank, index turnover is random and there is overlap (Wooldridge (2010), pp. 934).

This analysis uses matching by rank interval in order to control for residual non-randomness in Type-2 balancing index turnover. As before, the joint null hypothesis is that markets are weak-form efficient in that market capitalization is a sufficient statistic for index turnover and that index turnover has no effect on comovement. The alternative hypothesis is that markets are not weak-form efficient or index turnover does have an effect on comovement.

4 Data and Descriptive Statistics

Historical FTSE[6] index members from December 1985 through December 2012 are collected manually from Brumwell (2003) and FTSE. Index membership information is combined with daily stock prices from Compustat Global, LSPD and Datastream. All eligible stocks are ranked by market capitalization at the quarterly FTSE review dates in March, June, September, and December. An index turnover event occurs when a stock's addition to or deletion from the FTSE 100 is announced. Stocks with a history of less than 60 trading days before or after an index turnover event are excluded.

FTSE 100 index turnover falls into four categories: ordinary banding (Type-1), ordinary balancing (Type-2), extra-ordinary turnover (Type-3), and extra-ordinary balancing (Type-4).

Table 1 displays index turnover by type. This study focuses on Type-1 banding and Type-2 balancing index turnover[7]: Type-1 banding represents 169 additions and 186 deletions, and Type-2 balancing accounts for 59 additions and 71 deletions.

Figure 2 presents the evolution of Type-1 and Type-2 index turnover over time. Type-1 banding index turnover is clustered in periods of high stock market volatility. Type-2 balancing index turnover depends on the difference between Type-1 additions and deletions and appears more stable over time.

Table 2 shows the empirical probability of Type-2 balancing index turnover by market capitalization rank and index membership status. Market capitalization rank and past index membership fully determine Type-1 banding and Type-2 balancing index turnover. The difference between the number of Type-1 banding additions and deletions and the proximity to

[6]The sample includes the FTSE 100 and FTSE 250 index members, which jointly form the FTSE 350 index. The FTSE 250 started in October 1992. Prior to that date the 250 largest members of the FTSE All Share index were used.

[7]Type 3 extra-ordinary turnover is excluded because most time-series are shorter than 60 trading days. I also exclude Type 4 extra-ordinary balancing turnover because it can be anticipated by investors and is therefore unlikely to be random: index additions are from a reserve list that is announced at the previous quarterly review.

the rank band influence the likelihood of Type-2 balancing turnover. As expected, the closer the rank of non-index stocks to the cut-off at 91, the higher the probability of a Type-2 balancing index addition. Accordingly, the closer the rank of an index member to the threshold at 110, the greater the likelihood of a Type-2 balancing index deletion.

Table 3 displays the estimated probability of Type-2 balancing index turnover by lagged position. Position is the Type-1 imbalance required to shift a marginal stock into becomingType-2 index turnover. Position is used to estimate the likelihood of Type-2 index turnover based on information available on the day before the quarterly review. The table shows that the highest-ranked marginal non-index stock on the day before a review has a 20.6 percent chance of a Type-2 shift into the index, while the lowest-ranked marginal index stock faces a 26.5 percent probability of a Type-2 deletion from the index. Type-2 balancing turnover is negatively correlated with past index returns, indicating that balancing is less likely in volatile markets. After controlling for lagged rank, however, Type-2 index additions can no longer be predicted by lagged position or past index returns and appear to be random. Market capitalization rank therefore seems to be a sufficient statistic for Type-2 balancing additions.

Table 4 displays the characteristics for marginal stocks. Stocks experiencing Type-2 balancing index turnover should have the same characteristics as those that do not. In Panel A, Type-2 index additions display no significant difference in pre-event alpha, beta, and stock returns from other stocks in the FTSE rank band. However, Panel B shows that Type-2 deletions have a significantly lower alpha and stock return than other stocks in the band. The results in Panel A are consistent with conditional Type-2 balancing index additions being uncorrelated with stock characteristics.

Table 5 displays the change in comovement, measured by univariate change in stock beta, around FTSE 100 index turnover by period. The index turnover effect on beta is time-varying and is stronger for index additions than for deletions. It grows from insignificant, from 1986 to 1988, and reaches a peak between 1995 and 2000. For the years from 1988 to 2000 the change in beta is 0.349 for FTSE 100 index additions. The increase in and the level of excess comovement are consistent with the analysis of Barberis et al. (2005) for the S&P 500[8]. The S&P 500 and the FTSE 100 indices therefore seem to produce similar results.

The magnitude of the effect declines considerably during recent years. Table 5 shows that between 2007 and 2012, the change in beta falls to 0.181 for additions and becomes insignificant for deletions.

Table 6 shows the change in comovement for stock return performance groups. The change in beta is most positive for additions that outperformed the index in strong markets. When stock markets advance these stocks that outperform are the most likely to be added to the index. Stocks with high increases in beta are therefore added to the index when markets rally. Hence, stocks that experience a change in comovement seem to self-select into the index.

5 Main Results

5.1 Univariate Regression

The basic univariate model is an intuitive initial reference point.

Table 7 presents the univariate change in beta for index turnover by type. In Panel A, Column 2 indicates that all index additions have comparable levels of beta before turnover. However, Column 4 shows that for additions the change in beta differs considerably: while Type-1 banding additions experience an increase by 0.313, Type-2 balancing additions display only a change of 0.111. Panel B shows no such difference for deletions: Type-1 banding deletions have a change in beta of -0.152 versus -0.156 for Type-2 balancing deletions.

Table 7, Panel A demonstrates that Type-2 balancing eliminates part of the selection problem and reduces the effect of index addition on beta by more than half. As explained in Section 2.2, the remainder is removed by conditioning on market capitalization rank. However, the univariate

[8] For S&P 500 index additions, the univariate change in beta is 0.067 from 1976 to 1987 and increases to 0.214 between 1988 and 2000.

model uses only index turnover stocks and by design excludes stocks that experience no turnover. But eliminating the effect of market capitalization rank requires the use of all stocks, i.e. index turnover and non-index turnover stocks, because otherwise the effects of rank and of index turnover cannot be identified separately. Moreover, the univariate model does not account for general trends in the change in beta. The univariate estimates for Type-2 balancing index turnover are therefore likely to contain an upward (downward) bias resulting from the pre-event increase (decrease) in stock prices for index additions (deletions).

5.2 Bivariate Regression

The bivariate model permits a more powerful test of the fundamentals-based hypothesis. It tests simultaneously whether index turnover stocks become less sensitive to the index they leave and more sensitive to the index they join.

Table 8 displays the bivariate change in beta for index turnover by type. Columns 3 and 4 show that turnover stocks indeed experience increases in beta with the index they join, and the converse with the index they leave. Column 2 and 3 show that, consistent with Barberis et al. (2005)[9], the bivariate coefficients for the FTSE 100 are greater than the univariate coefficients. However, just as in the univariate model, the change in beta for the FTSE 100 differs by index turnover type: Type-1 banding additions show a significant increase by 0.581, while Type-2 balancing additions display only a change by 0.272. The change in beta is -0.556 for Type-1 banding deletions, whereas it is -0.397 for Type-2 balancing deletions.

Similar to in the univariate case, Type-2 balancing reduces the effect of index addition on beta by approximately half. The remainder cannot be eliminated by conditioning on rank because its effect on comovement is not separately identified. Furthermore, the bivariate model also fails to account for general trends in the change in beta. The bivariate tests are

[9] Unlike Barberis et al. (2005), my results show no signs of collinearity between the adjusted returns on the FTSE 100 and the FT All Share indices.

therefore also biased.

Summarizing the results so far, the uni- and bivariate models both show that using Type-2 balancing reduces the effect of index addition on beta by at least half. However, without a good control for market capitalization rank these models cannot eliminate the remaining selection bias and are likely to overstate the index turnover effect on comovement.

5.3 Standard Difference-in-Differences

The standard differences-in-differences (DID) analysis estimates the change in beta specific to index turnover relative to the change for non-turnover stocks. Furthermore, the first-differencing on the left-hand-side of Equation (3) removes any time-invariant, unobserved heterogeneity of stocks. Moreover, controlling for market capitalization rank eliminates the remainder of the selection bias for Type-2 balancing index turnover.

Table 9 displays the difference in differences in beta for FTSE 100 index turnover. The coefficient $\Delta\beta$ is the average change between post- and pre-review beta and the coefficient $\Delta\Delta\beta$ is the average change in beta between index turnover and non-turnover stocks.

Panel A presents the standard DID results for index additions. Column 3 displays a change in beta for Type-1 banding additions of 0.252, and Column 5 shows that for Type-2 balancing additions the corresponding change in beta is 0.122. Quarter-fixed effects eliminate any change in beta that is common across all stocks during a quarter. Column 6 shows that the change in beta for Type-2 balancing additions increases to 0.158, indicating that such turnover coincides with a general decline in beta.

Panel B exhibits the equivalent results for index deletions. Column 3 shows a change in beta for Type-1 banding deletions of -0.0822, and Column 5 displays a change in beta of -0.0922 for Type-2 balancing deletions. The effect of index deletions again appears to be weaker than for additions.

To identify the causal effect of index turnover on comovement, the remaining selection bias in Type-2 balancing turnover must be removed. Since FTSE index turnover is determined exclusively by market capitalization rank, using rank-fixed effects makes index turnover ignorable (Wooldridge (2010), p. 908). Introducing rank-fixed effects eliminates the remaining selection bias for Type-2 index balancing stocks due to the overlap between index turnover and non-index turnover stocks within the FTSE rank band.

In Panel A, Column 7 demonstrates that the change in beta for Type-2 index balancing additions becomes insignificant when rank-fixed effects are added. Column 8 confirms that the change in beta for Type-2 index balancing additions is also insignificant when quarter-fixed effects are included.

Panel B shows a different result for index deletions. Column 7 and 8 demonstrate that Type-2 balancing and rank-fixed effects do not materially alter the effect of index deletion on comovement. Unlike index addition, FTSE 100 index deletion seems to have a weak negative causal effect on comovement.

Type-2 balancing index turnover controlled for market capitalization rank produces unbiased results. Table 9 shows that when this approach is used, the effect of FTSE 100 index addition on comovement disappears.

5.4 Difference-in-Differences with Matching

Matching is an alternative approach to eliminate the selection bias in index turnover. I take advantage of the overlap between Type-2 balancing stocks and non-turnover stocks within the rank band. Table 2 shows that Type-2 balancing additions are usually ranked between 91 and 100. The closest matches that remain outside the FTSE 100 are therefore FTSE 250 stocks ranked between 91 and 100. These stocks form the control group for index additions. For index deletions, the control group are FTSE 100 stocks ranked between 101 and 110.

Table 10 presents the difference in differences in beta for Type-2 balancing additions with matching. As before, $\Delta\beta$ is the average change between post- and pre-review beta and $\Delta\Delta\beta$ is the average change in beta between index turnover and non-turnover stocks.

For additions, Panel A, Column 1 shows an insignificant change in beta for Type-2 balancing with matching. In Column 2, quarter-fixed effects do not materially alter the result: the change in beta for Type-2 balancing additions with matching is 0.0685 and remains insignificant.

For deletions, Panel B, Columns 1 and 2 show that the change in beta is economically small and weakly significant.

Matching Type-2 balancing index turnover on market capitalization rank produces unbiased results. Consistent with the previous analysis, Table 10 demonstrates that this method equally eliminates the effect of FTSE 100 index addition on comovement.

In summary, both the standard DID controlled for market capitalization rank and the DID analysis with matching by rank produce consistent and unbiased results for Type-2 balancing index turnover. For both approaches the effect of FTSE 100 index addition on comovement is insignificant. Samples using non-random index turnover seem to create a substantial upward selection bias that overstates the index turnover effect on comovement. In the present sample of FTSE 100 index additions, I fail to find evidence for excess comovement and therefore cannot reject the fundamentals-based hypothesis of stock markets.

6 Robustness

6.1 Placebo Index Test

Section 5 demonstrates that non-random FTSE 100 Type-1 banding additions experience a significant increase in comovement, while random Type-2 balancing additions, conditional on market capitalization rank, do not. If the index rules are really the cause for non-random additions and the comovement effect observed in the FTSE 100, then applying these rules to a fictional placebo index should lead to the same effect. However, tests that show a significant change in comovement for additions to an index that does not exist are false rejections: the actual market should not react to a fictional index turnover event.

The placebo index is constructed of 200 members that are selected by market capitalization rank from the universe of FTSE 350 stocks. The Placebo 200 is rebalanced quarterly, equivalently to the FTSE 100: Stocks crossing either border of the market capitalization rank band from 181 to 220 are classified Type-1 banding index turnover; Type-2 balancing occurs when stocks inside the rank band are shifted into or out of the placebo index.

Table 11 presents the standard DID analysis of beta for Placebo 200 index turnover. The average difference between post- and pre-review beta is $\Delta\beta$, and between index turnover and non-turnover stocks is $\Delta\Delta\beta$. Panel A, Column 3 shows that the change in beta for Type-1 banding additions is 0.165 and significant. In contrast, Column 7 and 8 demonstrate that the Type-2 balancing turnover, conditional on market capitalization rank, has no significant effect on beta. Since the Placebo 200 is fictional and there is no actual index turnover; the Type-2 balancing sample correctly detects no effect, and the Type-1 banding sample incorrectly reports a change in beta that is caused by non-random sample selection. Panel B shows that the change in beta for all types of deletions is insignificant. Since the test correctly finds no effect for any sample, there seems to be no general selection issue for index deletions.

Table 12 shows the results for DID with matching for Type-2 balancing additions to the Placebo 200. The average difference between post- and pre-review beta is $\Delta\beta$, and between index turnover and non-turnover stocks is $\Delta\Delta\beta$. However, now the matching restricts the sample to stocks ranked between 181 and 220. As expected, the effect of addition to (Panel A) and deletion from (Panel B) the Placebo 200 index are insignificant, as in the case of the standard DID analysis.

The placebo index tests indicate that the observed change in comovement for index additions can be attributed to membership rules that generate a severe selection issue. In contrast, index deletions do not seem to create non-random samples.

6.2 Non-Synchronous Trading

A non-synchronous trading bias occurs when stocks trade infrequently and no longer incorporate market information in a timely fashion; this was first documented by Scholes and Williams (1977). In such cases, comovement simply increases because a stock is added to a major index and trades more frequently after inclusion. I use a test suggested by Vijh (1994) and adopted by Barberis et al. (2005) to test, if non-synchronous trading might also cause a change in comovement. The sample is divided into two parts: stocks whose average trading volume decreases after inclusion into the index, and those whose trading volume increases. If non-synchronous trading accounts for these results, then comovement should only increase for stocks whose trading volume also increases. Comovement for stocks whose trading volume decreases, however, should not be affected by a non-synchronous trading bias.

Table 13 accordingly presents a standard DID analysis of the change in beta for index turnover stocks whose trading volume decreases. Panel A displays the results for index additions. Columns 7 and 8 display that, after controlling for quarter and rank-fixed effects, the change in comovement for Type-2 additions with decreased trading remains insignificant .

Panel B exhibits index deletions. Similarly, Column 7 and 8 show that Type-2 deletions with decreased trading volume experience no significant change in comovement, after controlling for quarter and rank-fixed effects. The magnitude of the results for Type-2 index turnover in Table 13 resemble the estimates in Table 9, indicating that asynchronous trading does not materially affect the results.

6.3 Excluding Turnover Stocks from Index

If either index additions or deletions are highly correlated with each other at the time of turnover, then a bias could arise. The change in comovement would be overstated because a turnover stock would be highly correlated with all other stocks either added to or deleted from the index. The potential bias is therefore eliminated by excluding all turnover stocks from the

FTSE 100 index around the review date. Since portfolio betas are weighted averages of stock beta, I adjust the previous beta estimates by subtracting the weighted betas of index turnover stocks.

Table 14 displays the difference in differences in beta for FTSE 100 index turnover, where turnover stocks are excluded from the index. Panel A presents index additions and Panel B deletions. Across the board the regression coefficients are very close to those in Table 9, indicating that correlation between index turnover stocks does not materially affect the results.

7 Conclusion

With noise-trader sentiment and market frictions, forced institutional buying creates a demand shock when stocks are added to or deleted from an index. These shocks could create comovement in stock returns that exceeds that explained by common news about fundamentals, like future cash flows and discount rates. If investors are rational and there are no limits to arbitrage, then events that contain no news about stock fundamentals should have no effect on comovement.

This paper takes advantage of the FTSE 100 index banding policy, which contains a balancing rule that, after controlling for market capitalization rank, generates random index turnover stocks. Using this sample of stocks, I find no significant effect of index turnover on comovement and, hence, cannot reject the fundamentals-based hypothesis.

These findings are in contrast to previous studies that observe a large effect of index turnover on comovement. However, these studies rely on variation in index membership that is unlikely to be random. In fact, I find that non-random turnover generated from a simulated placebo index generates a false effect on comovement. Therefore, index turnover does not cause a change in comovement, but the reverse effect exists: a change in comovement, possibly correlated with unobserved stock characteristics, causes index turnover. This non-randomness can create a substantial selection bias and lead to incorrect inferences.

Using random balancing index turnover is a method that holds promise for the analysis of asset markets phenomena where selection issues are a concern.

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8 Figures[10]

[10]For legends see Notes

Figure 1: FTSE 100 Index Balancing Policy

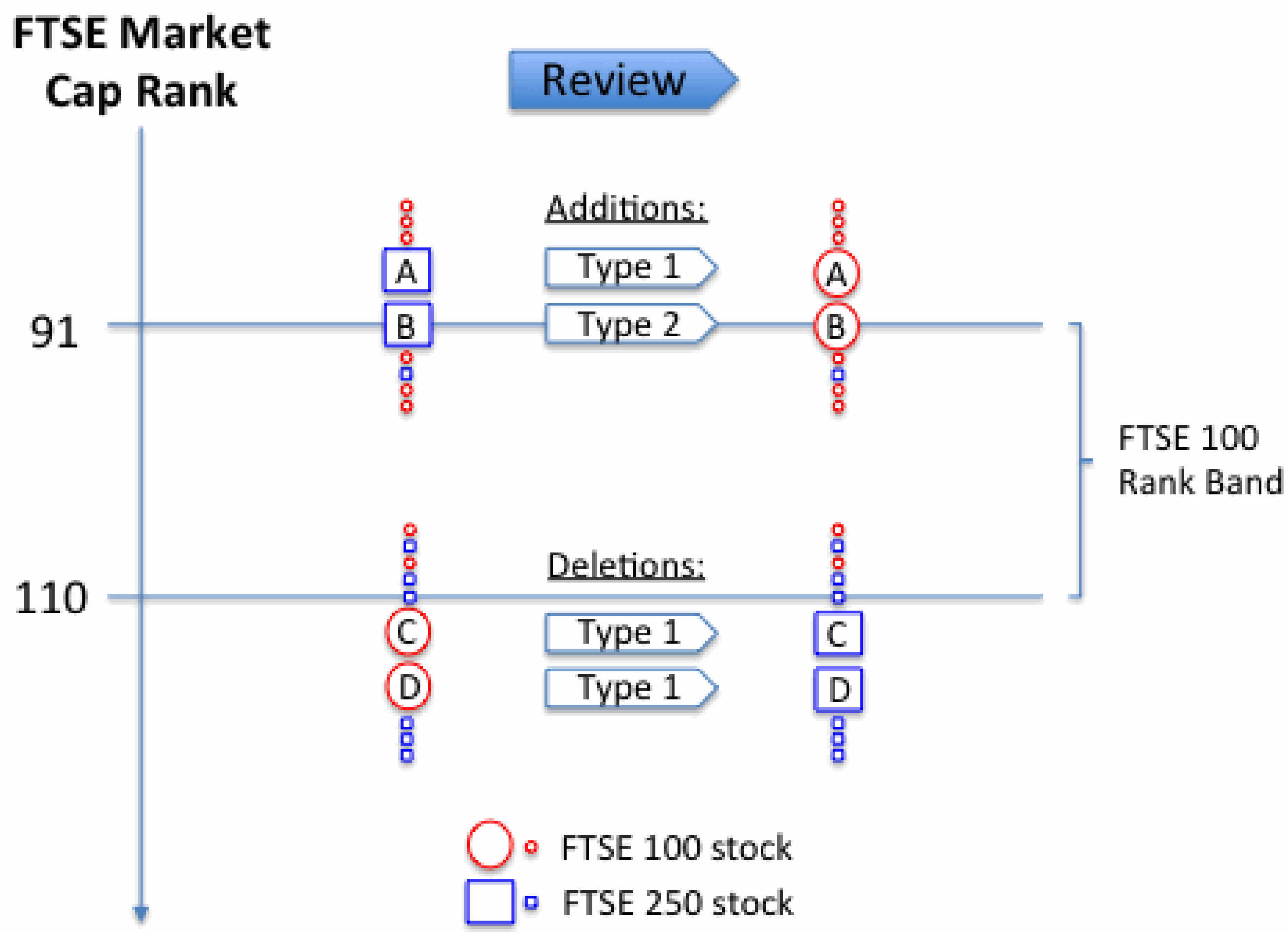

Figure 2: Additions to and Deletions from FTSE 100 Index by Quarter

Figure 3: Cumulative Abnormal Returns for Additions to FTSE 100 Index

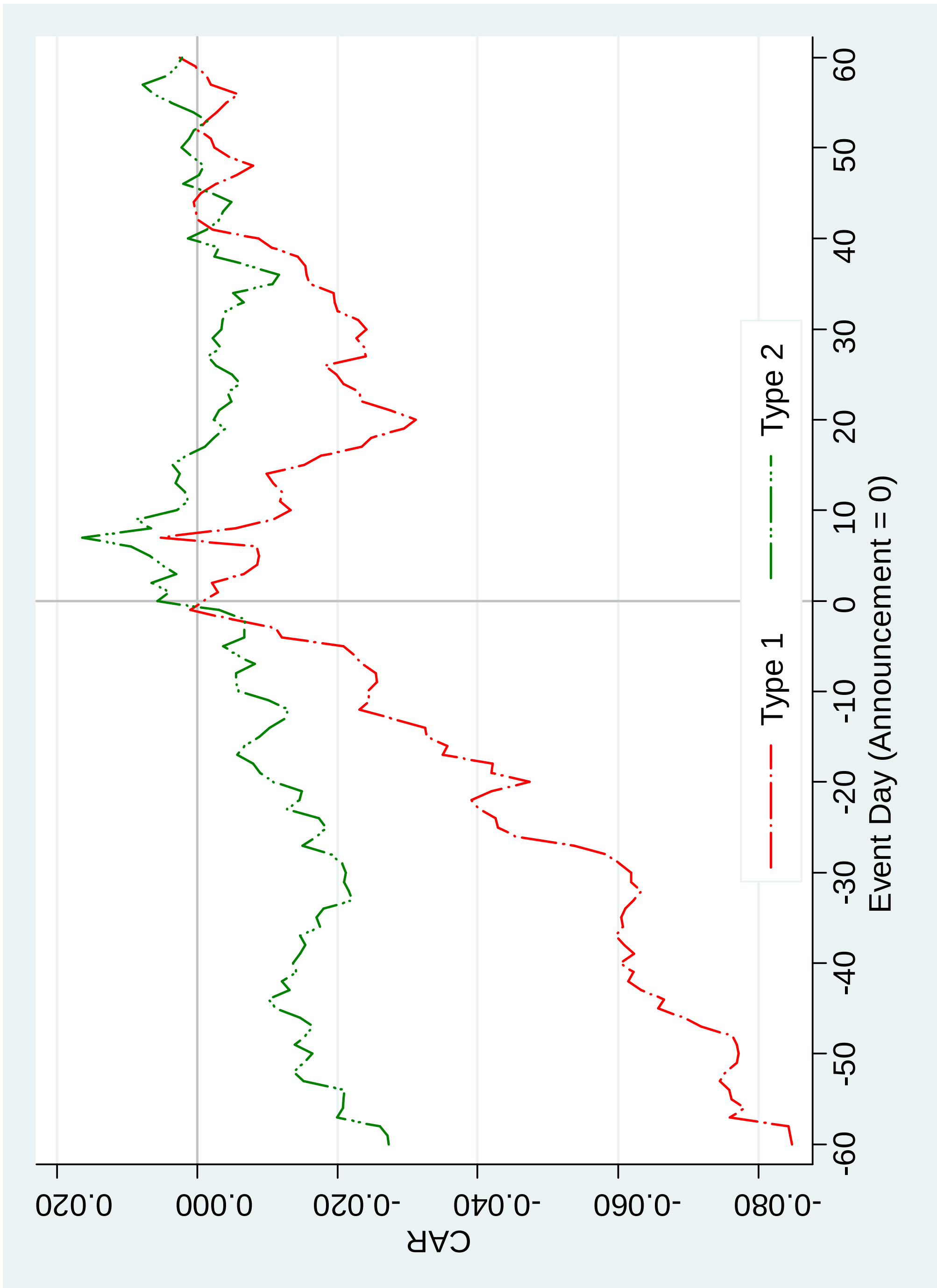

Figure 4: Cumulative Abnormal Returns for Deletions from FTSE 100 Index

Figure 5: Change in Average Beta of Stocks Added to the FTSE 100 Index

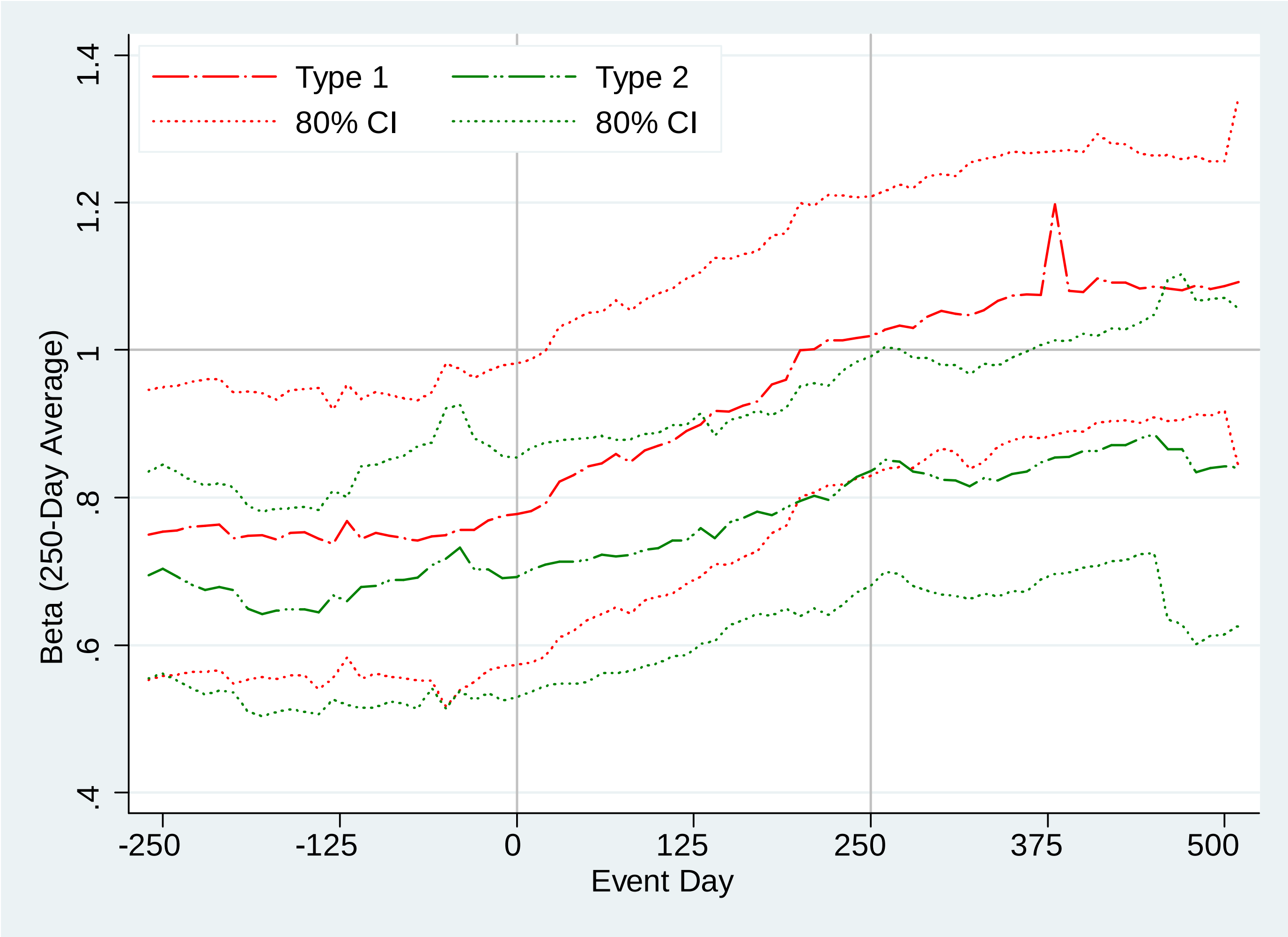

Figure 6: Change in Average Beta for Stocks Deleted from FTSE 100 Index

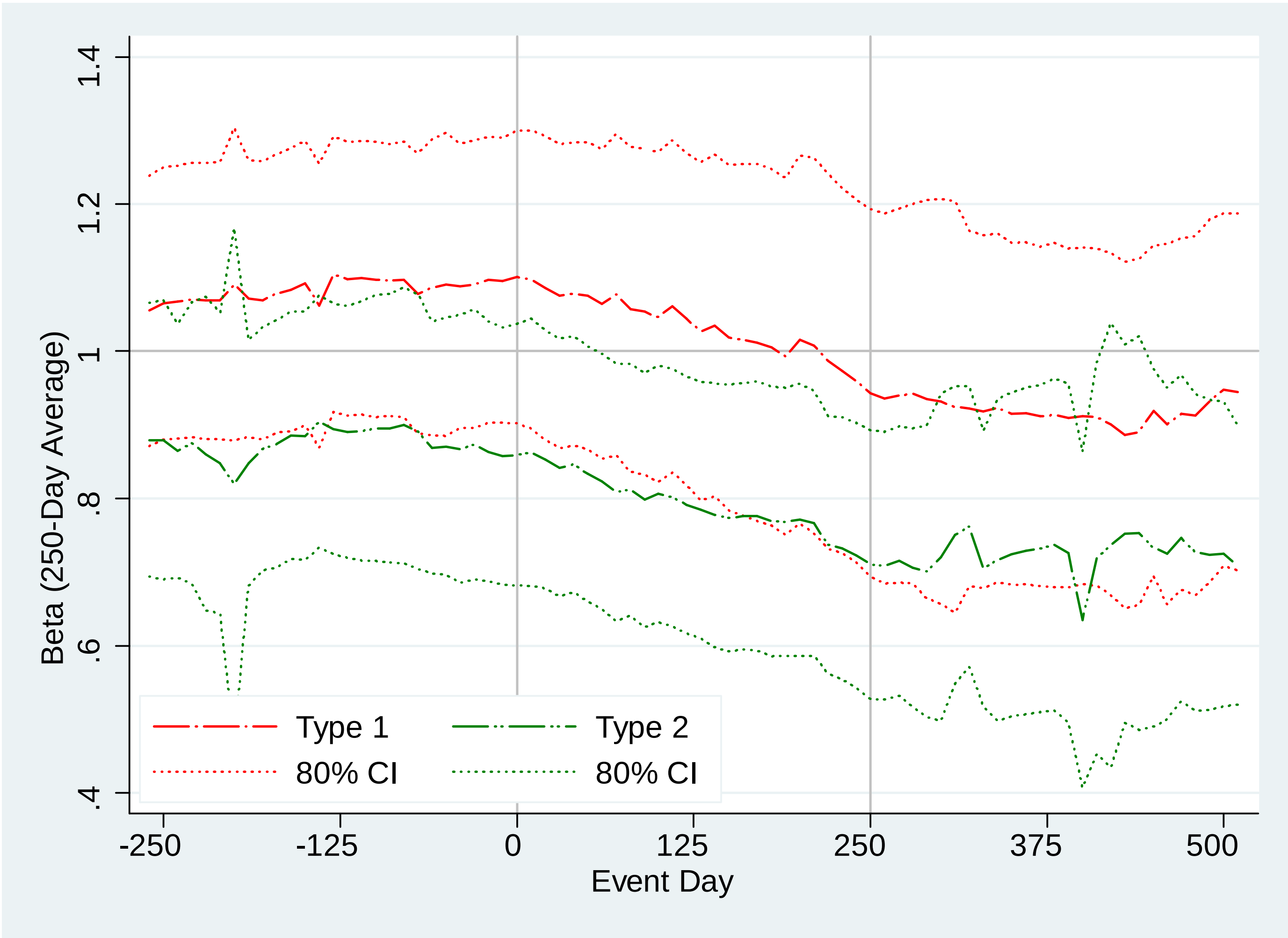

Figure 2

Additions to and deletions from the FTSE 100 index by quarter. The sample includes all FTSE 100 index members from December 1985 until December 2012. The sample also includes the FTSE 250 index members (from October 1992, and the 250 largest members of the FTSE All Share index for prior dates), which, together with the FTSE 100, form the FTSE 350 index. An index turnover event occurs when a stock is added to or deleted from the FTSE 100. The FTSE 100 index turnover information is combined with daily stock market information from Compustat Global and Datastream. Stock with less than 60 days of price data before and after the index turnover announcement date are excluded. At each quarterly review date, all eligible stocks are ranked by market capitalization according to FTSE rules and double-checked with LSPD data. Then, I classify index turnover into four categories: Type-1 are additions ranked 90 or better or deletions ranked 111 or worse at a quarterly review. Type-2 are ranked between 91 and 110 at a quarterly review but added to or deleted from the index for balancing purposes. Type-3 are extra-ordinary additions and deletions between quarterly review dates. Type-4 are additions from the reserve list to the index (deletions from the index) to balance extra-ordinary deletions (additions).

Figure 3

Cumulative abnormal returns of stocks added to the FTSE 100 index. The sample includes stocks added to from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I estimate the market model separately in the pre- and post-index turnover period $R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$ where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index. The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. The stocks are grouped by index turnover type, as defined in Section 2.

Figure 4

Cumulative abnormal returns of stocks deleted from the FTSE 100 index. The sample includes stocks added to from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I estimate the market model separately in the pre- and post-index turnover period $R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$ where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index. The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. The stocks are grouped by index turnover type, as defined in Section 2.

Figure 5
Change in average beta for stocks added to the FTSE 100 index. The sample includes stocks added to the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I use a 250-day rolling estimate of the market model $R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$ where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index. The coefficients are averaged by index turnover type, as defined in Section 2. The bands represent the 10% and the 90% confidence intervals.

Figure 6
Change in average beta for stocks deleted from the FTSE 100 index. The sample includes stocks deleted from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I use a 250-day rolling estimate of the market model $R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$ where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index. The coefficients are averaged by index turnover type, as defined in Section 2. The bands represent the 10% and the 90% confidence intervals.

9 Tables

Table 1: Sample Statistics for Stocks Added to and Deleted from FTSE 100 Index

The table presents the sample statistics for stocks added to and deleted from the FTSE 100 index by type. The sample includes all FTSE 100 index members from December 1985 until December 2012. The sample also includes the FTSE 250 index members (from October 1992, and the 250 largest members of the FTSE All Share index for prior dates), which, together with the FTSE 100, form the FTSE 350 index. An index turnover event occurs when a stock is added to or deleted from the FTSE 100. The FTSE 100 index turnover information is combined with daily stock market information from Compustat Global and Datastream. Stock with less than 60 days of price data before and after the index turnover announcement date are excluded. At each quarterly review date, all eligible stocks are ranked by market capitalization according to FTSE rules and double-checked with LSPD data. Then, I classify index turnover into four categories: Type 1 are additions ranked 90 or better or deletions ranked 111 or worse at a quarterly review. Type 2 are ranked between 91 and 110 at a quarterly review but added to or deleted from the index for balancing purposes. Type 3 are extra-ordinary additions and deletions between quarterly review dates. Type 4 are additions from the reserve list to the index (deletions from the index) to balance extra-ordinary deletions (additions).

	Type 1	Type 2	Type 3	Type 4	Total
Additions	169	59	12	71	311
Deletions	186	71	16	17	290

Table 2: Probability of Type 2 Addition to and Deletion from FTSE 100 Index by Rank

The table presents type 2 stocks added to and deleted from FTSE 100 Index by market capitalization rank.Type 2 are stocks used for quarterly balancing purposes, as defined in section 2. Market capitalization rank is determined at the quarterly review date and forms the basis for index additions and deletions. Type 2 stocks are always ranked 91 to 110. N is the number of additions (deletions) conditional on market capitalization rank and index non-membership (membership). Prob is the probability, defined as N divided by the total number of stocks with the same rank and membership status. SE is the sample standard error of Prob.

Rank	Additions			Deletions		
	N	Prob	SE	N	Prob	SE
91	11	0.647	0.051	0	0.000	0.005
92	13	0.520	0.054	0	0.000	0.005
93	10	0.417	0.049	0	0.000	0.005
94	7	0.226	0.042	0	0.000	0.005
95	5	0.156	0.037	0	0.000	0.005
96	3	0.097	0.029	0	0.000	0.005
97	3	0.100	0.029	0	0.000	0.005
98	1	0.024	0.018	0	0.000	0.005
99	2	0.051	0.024	0	0.000	0.005
100	3	0.054	0.029	0	0.000	0.005
101	1	0.018	0.018	1	0.020	0.015
102	0	0.000	0.005	3	0.060	0.024
103	0	0.000	0.005	2	0.044	0.020
104	0	0.000	0.005	11	0.275	0.043
105	0	0.000	0.005	5	0.132	0.031
106	0	0.000	0.005	5	0.227	0.031
107	0	0.000	0.005	8	0.286	0.038
108	0	0.000	0.005	8	0.364	0.038
109	0	0.000	0.005	10	0.455	0.042
110	0	0.000	0.005	18	0.750	0.052
91 - 110	59	0.057	0.000	71	0.067	0.000

Table 3: Probability of Type 2 Addition to and Deletion from FTSE 100 Index by Position

Marginal effects for pooled logistic regression of Type 2 FTSE 100 Index turnover on lagged rank, position, and index return. Estimation results of the model:

$$\text{Type 2 Turnover} = \alpha_r + \alpha_{Position} + \beta R_{100} + \epsilon$$

The dependent variable is an indicator of type 2 index turnover. α_r is a 1-day lagged market capitalization rank fixed effect. $\alpha_{Position}$ is a 1-day lagged position fixed effect, where position is an indicator variable for the minimum shift required to cause index turnover. Shift is the absolute difference between type 1 deletions and additions. R_{100} is the past quarter return of the FTSE 100 Index. Standard errors are reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: Type 2 Turnover	Additions		Deletions	
Position				
<= 0	0.0135	-0.00673	0.0523***	0.0867**
	(0.0126)	(0.00636)	(0.0182)	(0.0372)
1	0.206***	-0.00357	0.265***	0.0148
	(0.0423)	(0.00645)	(0.0437)	(0.00973)
2	0.115***	-0.00394	0.165***	0.0106
	(0.0325)	(0.00602)	(0.0372)	(0.00766)
3	0.122***	0.00187	0.0753***	0.00597
	(0.0345)	(0.00733)	(0.0250)	(0.00564)
4	0.0325	-0.00301	0.0139	0.000253
	(0.0199)	(0.00630)	(0.0114)	(0.00344)
Index return	-0.210***	-0.0101	0.0994**	0.0594***
	(0.0735)	(0.0163)	(0.0386)	(0.0207)
Rank fixed effects	No	Yes	No	Yes

Table 4: Characteristics of FTSE Index Stocks Ranked from 91 to 110

The table presents characteristics for FTSE stocks ranked between 91 and 110 by market capitalization. Type 2 are stocks used for quarterly balancing purposes, as defined in section 2. Market capitalization rank is determined at the quarterly review date and forms the basis for index additions and deletions. Type 2 stocks are always ranked 91 to 110. To determine alpha and beta, I estimate the regression

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$$

where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index. The estimation period is [-260, -10] trading days before the event. Return is the averagre daily log return over the same period. Standard errors are clustered by event quarter and reported in parenthesis. The standard error for the change is from bootstrap simulations. $***$, $**$, and $*$ denote significant differences from zero at the 1%, 5%, and 10% levels in two-sided tests, respectively.

	Rank 91 - 110		
Variable	Type 2 Balancing	Not Type 2 Balancing	Difference
Panel A: Not FTSE 100 Members			
Beta	0.707	0.777	-0.0704
	(0.0463)	(0.0116)	(0.0477)
Alpha	0.000872	0.000764	0.000108
	(0.000137)	(0.0000350)	(0.000142)
Return	0.00100	0.00111	-0.000113
	(0.000169)	(0.0000398)	(0.000174)
Panel B: FTSE 100 Members			
Beta	0.845	0.905	-0.0596
	(0.0461)	(0.0118)	(0.0476)
Alpha	-0.000479	-0.000131	-0.000348**
	(0.000128)	(0.0000326)	(0.000133)
Return	-0.0000424	0.000242	-0.000285**
	(0.000136)	(0.0000381)	(0.000141)

Table 5: Change in Beta for Stocks Added to and Deleted from FTSE 100 Index - Univariate by Period

Changes in the regression coefficients of returns of stocks added to and deleted from the FTSE 100 index on returns of the FTSE 100 index. The sample includes stocks added to and deleted from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I estimate the regression separately before and after the turnover event, and determine the average change between the pre- and post-turnover regression coefficient, $\overline{\Delta\beta}$.

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$$

where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index to avoid self-correlation. The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. Standard errors are clustered by turnover event and reported in parenthesis. The standard error for the change is from bootstrap simulations. $***$, $**$, and $*$ denote significant differences from zero at the 1%, 5%, and 10% levels in two-sided tests, respectively.

		Univariate		
Sample	Number of Events	Pre-Event	Post-Event	Change
Additions				
1986 - 1988	27	0.949***	0.929***	-0.0206
		(0.0698)	(0.0856)	(0.105)
1989 - 1994	59	0.789***	0.915***	0.126**
		(0.0496)	(0.0540)	(0.0574)
1995 - 2000	79	0.484***	1.050***	0.566***
		(0.0444)	(0.0818)	(0.0729)
2001 - 2006	61	0.522***	0.869***	0.347***
		(0.0575)	(0.0461)	(0.0524)
2007 - 2012	74	0.841***	1.022***	0.181***
		(0.0388)	(0.0523)	(0.0535)
All	309	0.713***	0.981***	0.268***
		(0.0254)	(0.0305)	(0.0332)
1988 - 2000	147	0.661***	1.010***	0.349***
		(0.0407)	(0.0566)	(0.0623)
Deletions				
1986 - 1988	31	0.930***	0.920***	-0.00943
		(0.0608)	(0.0520)	(0.0739)
1989 - 1994	60	1.064***	0.932***	-0.132***
		(0.0500)	(0.0515)	(0.0502)
1995 - 2000	76	0.793***	0.522***	-0.271***
		(0.0615)	(0.0747)	(0.0518)
2001 - 2006	51	1.269***	1.001***	-0.268***
		(0.0922)	(0.0772)	(0.104)
2007 - 2012	63	1.062***	1.036***	-0.0256
		(0.0453)	(0.0567)	(0.0586)
All	290	1.050***	0.901***	-0.149***
		(0.0310)	(0.0342)	(0.0345)
1988 - 2000	144	0.924***	0.663***	-0.262***
		(0.0409)	(0.0542)	(0.0408)

Table 6: Change in Beta for Stocks Added to and Deleted from FTSE 100 Index - Univariate by Performance Group

Changes in the regression coefficients of returns of stocks added to and deleted from the FTSE 100 index on returns of the FTSE 100 index. The sample includes stocks added to and deleted from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I estimate the regression separately before and after the turnover event, and determine the average change between the pre- and post-turnover regression coefficient, $\overline{\Delta\beta}$.

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$$

where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index to avoid self-correlation. The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. The stocks are grouped according to quarterly index and stock returns: FTSE 100 top (bottom) denotes a quarterly index return above (below) the sample median, stock top (bottom) indicates a quarterly stock minus index return above (below) the median. Standard errors are clustered by turnover event and reported in parenthesis. The standard error for the change is from bootstrap simulations. $***$, $**$, and $*$ denote significant differences from zero at the 1%, 5%, and 10% levels in two-sided tests, respectively.

Sample	Number of Events	Univariate		
		Pre-Event	Post-Event	Change
Additions				
FTSE 100 return above median / relative stock return above median	77	0.814***	1.203***	0.389***
		(0.0593)	(0.0625)	(0.0653)
FTSE 100 return above median / relative stock return below median	77	0.697***	0.879***	0.183***
		(0.0580)	(0.0485)	(0.0535)
FTSE 100 return below median / relative stock return above median	77	0.659***	0.981***	0.322***
		(0.0512)	(0.0715)	(0.0746)
FTSE 100 return below median / relative stock return below median	78	0.720***	0.918***	0.198***
		(0.0386)	(0.0399)	(0.0454)
All	309	0.713***	0.981***	0.268***
		(0.0254)	(0.0305)	(0.0332)
Deletions				
FTSE 100 return above median / relative stock return above median	72	0.801***	0.804***	0.00273
		(0.0396)	(0.0530)	(0.0581)
FTSE 100 return above median / relative stock return below median	73	0.946***	0.687***	-0.259***
		(0.0587)	(0.0550)	(0.0517)
FTSE 100 return below median / relative stock return above median	72	0.928***	0.893***	-0.0355
		(0.0462)	(0.0616)	(0.0582)
FTSE 100 return below median / relative stock return below median	73	1.279***	1.051***	-0.229***
		(0.0579)	(0.0678)	(0.0773)
All	290	1.050***	0.901***	-0.149***
		(0.0310)	(0.0342)	(0.0345)

Table 7: Change in Beta for Stocks Added to and Deleted from FTSE 100 Index - Univariate by Type

Changes in the regression coefficients of returns of stocks added to and deleted from the FTSE 100 index on returns of the FTSE 100 index. The sample includes stocks added to and deleted from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, I estimate the regression separately before and after the turnover event, and determine the average change between the pre- and post-turnover regression coefficient, $\overline{\Delta\beta}$.

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$$

where $R_{i,t}$ is the stock return between date $t-1$ and t, and $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index to avoid self-correlation. The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. The stocks are grouped by index turnover type, as defined in Section 2. Standard errors are clustered by turnover event and reported in parenthesis. The standard error for the change is from bootstrap simulations. $***$, $**$, and $*$ denote significant differences from zero at the 1%, 5%, and 10% levels in two-sided tests, respectively.

		Univariate		
Sample	Number of Events	Pre-Event	Post-Event	Change
Additions				
All	309	0.713***	0.981***	0.268***
		(0.0254)	(0.0305)	(0.0332)
Type 1 banding	170	0.734***	1.047***	0.313***
		(0.0363)	(0.0481)	(0.0484)
Type 2 balancing	58	0.716***	0.827***	0.111**
		(0.0501)	(0.0397)	(0.0513)
Deletions				
All	290	1.050***	0.901***	-0.149***
		(0.0310)	(0.0342)	(0.0345)
Type 1 banding	185	1.122***	0.970***	-0.152***
		(0.0389)	(0.0422)	(0.0441)
Type 2 balancing	72	0.870***	0.714***	-0.156***
		(0.0505)	(0.0622)	(0.0568)

Table 8: Change in Beta for Stocks Added to and Deleted from FTSE 100 Index - Bivariate by Type

Changes in the regression coefficients of returns of stocks added to and deleted from the FTSE 100 index on returns of the FTSE 100 index and the FT All Share index. The sample includes stocks added to and deleted from the FTSE 100 index between 1985 and 2012 which have sufficient data. For each stock i, the unvariate and bivariate models are estimated separately for the pre- and post-index turnover period. For the univariate model, I estimate the mean change between the pre- and post-turnover regression coefficient, $\overline{\Delta\beta}$. For the bivariate model, I estimate the mean change between the pre- and post-turnover regression coefficients $\overline{\Delta\beta_{100}}$ and $\overline{\Delta\beta_{AS}}$.

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \epsilon_{i,t}$$

$$R_{i,t} = \alpha_i + \beta_{i,100} R_{100,t} + \beta_{i,AS} R_{AS,t} + \epsilon_{i,t}$$

where $R_{i,t}$ is the stock return between date $t-1$ and t, $R_{100,t}$ is the corresponding return on the FTSE 100 index, with stock i excluded after being added to (before being deleted from) the index to avoid self-correlation, $R_{AS,t}$ is the corresponding orthogonalized return on the FT All Share index (without stock i). The pre- and post-turnover estimation periods are [-260, -10] and [10, 260] trading days around the event. The stocks are grouped by index turnover type, as defined in Section 2. Standard errors are clustered by turnover event and reported in parenthesis. The standard error for the change is from bootstrap simulations. $***$, $**$, and $*$ denote significant differences from zero at the 1%, 5%, and 10% levels in two-sided tests, respectively.

		Univariate	Bivariate	
Sample	Number of Events	FTSE 100	FTSE 100	FT All Share
Additions				
All	309	0.268***	0.513***	-1.903***
		(0.0332)	(0.0413)	(0.291)
Type 1 Banding	170	0.313***	0.581***	-2.315***
		(0.0484)	(0.0608)	(0.460)
Type 2 Balancing	58	0.111**	0.272***	-0.790
		(0.0513)	(0.0758)	(0.514)
Deletions				
All	290	-0.149***	-0.480***	2.898***
		(0.0345)	(0.0611)	(0.514)
Type 1 Banding	185	-0.152***	-0.556***	3.738***
		(0.0441)	(0.0904)	(0.804)
Type 2 Balancing	72	-0.156***	-0.397***	1.477***
		(0.0568)	(0.0606)	(0.446)

Table 9: Change in Beta for Stocks Added to and Deleted from FTSE 100 Index

The difference in differences of stock beta for additions to and deleted from the FTSE 100 index by type. Estimation results of specification (3):

$$\hat{\beta}^{Post}_{i,q} - \hat{\beta}^{Pre}_{i,q} = \alpha_r + \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_r is a market capitalization fixed effect, and α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and Turnover$_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the FTSE 100 index (excluding stock i). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are not members of the FTSE 100 index prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are members of the FTSE 100 index prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	All		Type 1		Type 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Additions								
$\Delta\Delta\beta$	0.211***	0.217***	0.252***	0.247***	0.122***	0.158***	0.0151	0.0674
	(0.0243)	(0.0232)	(0.0360)	(0.0342)	(0.0373)	(0.0367)	(0.0550)	(0.0503)
$\Delta\beta$	0.00541***	0.0675***	0.00609***	0.0677***	0.00723***	0.0686***	0.00593***	0.0671***
	(0.00192)	(0.0175)	(0.00192)	(0.0175)	(0.00192)	(0.0175)	(0.00196)	(0.0176)
Panel B: Deletions								
$\Delta\Delta\beta$	-0.116***	-0.118***	-0.0822**	-0.0924***	-0.0922***	-0.0772**	-0.110**	-0.0883**
	(0.0249)	(0.0242)	(0.0323)	(0.0314)	(0.0350)	(0.0335)	(0.0465)	(0.0444)
$\Delta\beta$	0.00573**	-0.0355*	0.00410	-0.0368*	0.00335	-0.0368*	0.00412	-0.0371*
	(0.00291)	(0.0203)	(0.00291)	(0.0205)	(0.00292)	(0.0205)	(0.00305)	(0.0205)
Rank fixed effects	No	No	No	No	No	No	Yes	Yes
Quarter fixed effects	No	Yes	No	Yes	No	Yes	No	Yes

Table 10: Change in Beta for Stocks Added to and Deleted from the FTSE 100 Index - Matching

The difference in differences of stock beta for additions to and deleted from the FTSE 100 index by type with matching by market capitalization rank. Estimation results of specification (3):

$$\hat{\beta}_{i,q}^{Post} - \hat{\beta}_{i,q}^{Pre} = \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and $\text{Turnover}_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the FTSE 100 index (excluding stock i). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are ranked between 91 and 100, and not members of the FTSE 100 index prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are ranked between 101 and 110, and members of the FTSE 100 index prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	Type 2	
	(1)	(2)
Panel A: Additions		
$\Delta\Delta\beta$	0.0331	0.0685
	(0.0437)	(0.0523)
$\Delta\beta$	0.0934***	0.131
	(0.0216)	(0.143)
Panel B: Deletions		
$\Delta\Delta\beta$	-0.0935**	-0.0801*
	(0.0402)	(0.0479)
$\Delta\beta$	0.00460	0.136
	(0.0198)	(0.161)
Quarter fixed effects	No	Yes

Table 11: Change in Beta for Stocks Added to and Deleted from Placebo 200 Index

The difference in differences of stock beta for additions to and deleted from the Placebo 200 index by type. Estimation results of specification (3):

$$\hat{\beta}_{i,q}^{Post} - \hat{\beta}_{i,q}^{Pre} = \alpha_r + \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{200,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_r is a market capitalization fixed effect, and α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and Turnover$_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the Placebo 200 index (excluding stock i). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are not members of the Placebo 200 index prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are members of the Placebo 200 index prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	All		Type 1		Type 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Additions								
$\Delta\Delta\beta$	0.0925***	0.0931***	0.157***	0.146***	0.0124	0.0274	-0.0340	-0.000123
	(0.0221)	(0.0208)	(0.0364)	(0.0342)	(0.0196)	(0.0188)	(0.0328)	(0.0308)
$\Delta\beta$	-0.00433*	0.128***	-0.00417*	0.128***	-0.00223	0.130***	-0.00557**	0.127***
	(0.00255)	(0.0401)	(0.00253)	(0.0402)	(0.00256)	(0.0401)	(0.00273)	(0.0400)
Panel B: Deletions								
$\Delta\Delta\beta$	-0.0189	-0.0235	-0.0255	-0.0309	0.0221	0.0217	0.0201	0.0286
	(0.0256)	(0.0255)	(0.0294)	(0.0292)	(0.0295)	(0.0287)	(0.0368)	(0.0364)
$\Delta\beta$	0.00509**	0.0201	0.00515**	0.0200	0.00469**	0.0196	0.00364	0.0182
	(0.00222)	(0.0235)	(0.00222)	(0.0235)	(0.00224)	(0.0235)	(0.00236)	(0.0234)
Rank fixed effects	No	No	No	No	No	No	Yes	Yes
Quarter fixed effects	No	Yes	No	Yes	No	Yes	No	Yes

Table 12: Change in Beta for Stocks Added to and Deleted from the Placebo 200 Index - Matching

The difference in differences of stock beta for additions to and deleted from the Placebo 200 index by type with matching by market capitalization rank. Estimation results of specification (3):

$$\hat{\beta}^{Post}_{i,q} - \hat{\beta}^{Pre}_{i,q} = \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{200,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and $\text{Turnover}_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the Placebo 200 index (excluding stock i). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are ranked between 91 and 100, and not members of the Placebo 200 index prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are ranked between 101 and 110, and members of the Placebo 200 index prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	Type 2	
	(1)	(2)
Panel A: Additions		
$\Delta\Delta\beta$	-0.0320	0.0217
	(0.0333)	(0.0361)
$\Delta\beta$	0.0372	-0.0517
	(0.0232)	(0.347)
Panel B: Deletions		
$\Delta\Delta\beta$	0.0199	0.0285
	(0.0369)	(0.0370)
$\Delta\beta$	0.0131	0.203
	(0.0110)	(0.148)
Quarter fixed effects	No	Yes

Table 13: Change in Beta for Stocks Added to FTSE 100 Index with Decreased Trading

The difference in differences of stock beta for additions to and deleted from the FTSE 100 index by type. Estimation results of specification (3):

$$\hat{\beta}_{i,q}^{Post} - \hat{\beta}_{i,q}^{Pre} = \alpha_r + \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_r is a market capitalization fixed effect, and α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and $\text{Turnover}_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the FTSE 100 index (excluding stock i). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are members of the FTSE 250 prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are members of the FTSE 100 prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*$, $**$, $***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	All		Type 1		Type 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Additions								
$\Delta\Delta\beta$	0.179***	0.207***	0.220***	0.242***	0.128**	0.171**	0.0147	0.102
	(0.0441)	(0.0422)	(0.0605)	(0.0568)	(0.0650)	(0.0786)	(0.0937)	(0.0928)
$\Delta\beta$	0.0108***	0.0200	0.0112***	0.0198	0.0126***	0.0210	0.0112***	0.0183
	(0.00366)	(0.0292)	(0.00366)	(0.0292)	(0.00367)	(0.0292)	(0.00374)	(0.0294)
Panel B: Deletions								
$\Delta\Delta\beta$	-0.0992***	-0.109***	-0.0881*	-0.111**	-0.102**	-0.0933*	-0.0860	-0.0975
	(0.0350)	(0.0360)	(0.0476)	(0.0489)	(0.0512)	(0.0490)	(0.0677)	(0.0646)
$\Delta\beta$	-0.00207	-0.0538*	-0.00332	-0.0552*	-0.00433	-0.0540*	-0.00201	-0.0526*
	(0.00539)	(0.0304)	(0.00535)	(0.0303)	(0.00536)	(0.0304)	(0.00563)	(0.0307)
Rank fixed effects	No	No	No	No	No	No	Yes	Yes
Quarter fixed effects	No	Yes	No	Yes	No	Yes	No	Yes

Table 14: Change in Beta for Stocks Added to and Deleted from FTSE 100 - Turnover Stocks Excluded from Index

The difference in differences of stock beta for additions to and deleted from the FTSE 100 index by type. Estimation results of specification (3):

$$\hat{\beta}^{Post}_{i,q} - \hat{\beta}^{Pre}_{i,q} = \alpha_r + \alpha_q + \Delta\beta + \Delta\Delta\beta \cdot \text{Turnover}_{i,q} + \epsilon_{i,q}$$

$$R_{i,t} = \alpha_i + \beta_i R_{100,t} + \varepsilon_{i,t}$$

In the first equation, the left-hand side variable is the estimated change in beta for stock i around the index review date in quarter q. α_r is a market capitalization fixed effect, and α_q is a quarter fixed effect, $\Delta\beta$ is the average change in beta around quarterly index reviews, $\Delta\Delta\beta$ is the average change in beta around index turnover events, and $\text{Turnover}_{i,q}$ is a dummy variable for turnover of stock i to the index in quarter q. In the second equation, for each stock i and quarter q the pre- and post-review betas are estimated from separate regressions of the daily return of stock i on the corresponding return of the FTSE 100 index (excluding stock i, and any stock added to or deleted from the index in quarter q). The estimation periods are [-260, -10] and [10, 260] trading days around the quarterly index review date. In Panel A, the sample is restricted to stocks that are not members of the FTSE 100 index prior to the quarterly index review. In Panel B, the sample is restricted to stocks that are members of the FTSE 100 index prior to the quarterly index review. The stocks are grouped by index turnover type, as defined in Section 2. Heteroskedasticity robust standard errors are clustered by stock i and reported in parenthesis. $*, **, ***$ indicate statistical significance of point estimates at the 10%, 5%, and 1% levels, respectively.

Dep. Variable: $(\hat{\beta}^{Post} - \hat{\beta}^{Pre})$	All		Type 1		Type 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Additions								
$\Delta\Delta\beta$	0.209***	0.216***	0.250***	0.246***	0.121***	0.159***	0.0142	0.0679
	(0.0242)	(0.0231)	(0.0358)	(0.0340)	(0.0373)	(0.0367)	(0.0550)	(0.0503)
$\Delta\beta$	0.00475**	0.0670***	0.00542***	0.0673***	0.00655***	0.0681***	0.00526***	0.0666***
	(0.00192)	(0.0175)	(0.00192)	(0.0175)	(0.00192)	(0.0175)	(0.00196)	(0.0176)
Panel B: Deletions								
$\Delta\Delta\beta$	-0.118***	-0.119***	-0.0854**	-0.0944***	-0.0915***	-0.0765**	-0.109**	-0.0874**
	(0.0253)	(0.0244)	(0.0332)	(0.0320)	(0.0350)	(0.0334)	(0.0466)	(0.0443)
$\Delta\beta$	0.00470	-0.0360*	0.00308	-0.0373*	0.00227	-0.0374*	0.00303	-0.0376*
	(0.00291)	(0.0203)	(0.00291)	(0.0205)	(0.00292)	(0.0205)	(0.00306)	(0.0205)
Rank fixed effects	No	No	No	No	No	No	Yes	Yes
Quarter fixed effects	No	Yes	No	Yes	No	Yes	No	Yes