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Index Design and Implications for Index Tracking: Evidence from S&P 500 Index Funds

Implications for Index Management

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ABSTRACT

Over the past decade the growth of index funds has been substantial. This period has also witnessed increased availability of new index-linked products (e.g. exchange traded funds) and the computation of new market indices and sub-indices. While the objective of index funds is to replicate both the returns and risks of the underlying index, tracking error in performance is unavoidable. Tracking error arises because the underlying index is measured as a 'paper' portfolio, and the index assumes perfect replication can be achieved instantaneously and without cost. While index mutual fund managers will attempt to minimise tracking error, an important distinction is that tracking error can be decomposed into two components – *exogenous* tracking error (index rules and maintenance procedures applied to the underlying index) and *endogenous* tracking error (induced from the individual activities of index managers managing open-end passive funds). While endogenous tracking error can be influenced by index mutual fund managers, the second component of tracking error (associated with the indexes' design and maintenance procedures) is beyond the direct control of the index fund manager. Employing a sample of S&P 500 index mutual funds, this paper examines the exogeneity of tracking error that arises from changes in the Index Divisor. The paper identifies a number of exogenous factors that are important determinants of tracking error for S&P 500 index funds.

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Index funds aim to deliver the returns and the risk of the underlying benchmark index. Theoretically, the management of index portfolios is straightforward and requires the passive portfolio manager to invest in all index constituent securities in the exact same proportions as the underlying benchmark (known as a 'full replication' strategy). However Chiang [1998] highlights that in reality an index fund cannot guarantee their performance will be identical to the benchmark index (before costs). The existence of tracking error in performance arises because an index represents a mathematical calculation derived from a portfolio of securities that are not subject to the same market frictions faced by index mutual fund managers. Therefore, if the composition of the underlying index changes, the benchmark assumes the theoretical portfolio's new weights to each stock can be achieved instantaneously and without cost. However, index fund managers are indeed required to engage in physical trading of stocks within the index in order to re-align the portfolio with the underlying benchmark. Market frictions therefore give rise to tracking error, and performance differentials must be minimized to ensure an index fund's objectives are not significantly compromised.

Tracking error in index fund performance can be decomposed into two components – an *endogenous* component arising from an open-end index fund's replication of the underlying index and an *exogenous* component that arises given changes in the constituents of the underlying benchmark. This research extends Frino and Gallagher [2002] by examining *exogenous* factors that drive index mutual fund tracking error. The exogenous factors are defined as any change impacting on the S&P 500 Index Divisor, which ultimately requires index portfolio rebalancing. In particular, this study examines four exogenous determinants; revisions in S&P 500 index composition, share issuances, share repurchases and spin-offs. The study also examines two related factors that are associated with index maintenance rules – the treatment of dividends by the index and implicit transaction costs (measured by the bid-ask spread) that are incurred when changes arise in the Index Divisor.

The focus of this study is important for a wide range of audiences, however the three most important participants are index fund managers, index providers and investors utilising passively managed investment offerings. Firstly, index fund managers should be aware of the determinants of tracking error, and indeed the likely impact of changes reflected in the Index Divisor which arise from time-to-time. Secondly, this research directly addresses the index management process instituted by the index provider, and especially how an Index Committee can have significant influence on a seemingly routine re-balancing process. In the case examined in the paper, the S&P Index Committee's decisions include all corporate actions (takeovers and mergers, share issuances, repurchases, spin-offs, rights issues, dividend payments) and assessment of the guidelines in determining whether stocks are added or removed from the S&P 500. Thirdly, the study provides S&P 500 index fund investors with knowledge of the most significant drivers of tracking error, as well as highlighting the challenges facing managers that seek to track benchmarks at low cost.

It should be noted that there are many indices that are used as the basis for index fund tracking purposes, and there are many different methodologies and index management philosophies applied by their respective index calculators. While the S&P 500 remains the undisputed leader in terms of assets managed against it, there are a number of newer indices that are gaining significant amounts of assets. The reasons for this vary greatly, however index management and maintenance procedures used by these newer indices tend to involve more rules-based and transparent transaction-oriented communications to users, and this may be a factor explaining their increased acceptance. This proposition should not be construed as either an endorsement or criticism of any of the methods, and instead should be used in weighing the potential impact of similar corporate actions across different index management styles.

Index investors should be cognizant of the ramifications of each index calculator's methods and philosophies as it relates to the stated objective of the particular target index, i.e. "large-cap, benchmark index," "small-cap growth index," etc. S&P's methodology for managing the S&P 500 can be described as a combination of generally published guidelines that are overseen by the Index Committee. The Committee's primary role is to manage additions and deletions to the 500 in accordance with the Indexes' stated objective that claims, "The 500 is an index of leading companies in leading industries."

On the contrary, many of the modern indices use a more statistically rigorous index management process that tends to involve regular reviews on a monthly or quarterly basis, using market-cap rankings to determine index constituents and share weighting schemes. The rules for changing constituents and weights are published, and are hence, transparent. This allows fund-tracking managers to anticipate index portfolio weightings to replicate those of the target index. However, there are tradeoffs with these methodologies as well, and these are the subject of future research. The investor should simply be aware of the fact that the S&P 500 is but one index methodology among many and each management process will create different tracking results around similar market-related events.

THE SOURCES OF TRACKING ERROR

Chiang [1998] identifies the main factors driving index fund tracking error as transaction costs, fund cash flows, the treatment of dividends by the index, the volatility of the benchmark, corporate activity and index composition changes. The liquidity of the underlying index will also have implications for transaction costs and hence the tracking error incurred by index funds (Keim [1999]).

Transaction costs associated with trading in securities markets influence the ability of index mutual funds to replicate the performance of the benchmark. The index itself is calculated as a 'paper' portfolio that assumes transactions can occur instantaneously, in unlimited quantities, and without cost (Perold [1988]). In reality, index funds incur transaction costs that are associated with portfolio implementation, rebalancing and client capital flows. Since index funds are required to trade securities in order to mimic the underlying benchmark index, transaction costs (both explicit and implicit) ensure index funds exhibit tracking error.

Tracking error may also be related to changes in the composition of the index. These include index adjustments related to company additions and deletions, share changes and corporate restructuring. Periodical changes to the index can make it difficult for an index fund to exactly replicate the target benchmark return. Depending on the relative size of the stocks entering and exiting the index (in terms of market capitalization), changes will require a number of odd-lot transactions in order to match the rebalanced index. In the case of securities that are subject to corporate restructuring, such as a merger or takeover by another company outside the index, a timing delay may exist between the date when the index fund receives the cash settlement and the target firm is ultimately removed from the index. In addition, 'front-running' by 'risk arbitrageurs' (who acquire securities ahead of their inclusion in the index) may also have an undesirable impact (Beneish and Whaley [1996]).

The literature documents the impact on returns for S&P 500 Index constituent stocks coinciding with amendments to the benchmark. A number of studies find abnormal returns for securities associated with revisions in index constituents.[1] For example, Graham and Pirie [1994] find significantly positive abnormal returns for stocks added to the S&P 500 on the date of the inclusion, and this finding is attributed to the rebalancing activities of index funds. In terms of tracking error, index managers should prefer to execute portfolio rebalancing trades on the effective date of an Index revision, to remain in alignment with the underlying Index (Beneish and Whaley [1996]). In

the case of risk arbitrageurs, one would expect such agents to accumulate impending stocks immediately following the announcement date, with the expectation of selling at higher prices when the change becomes effective. Given the presence of market frictions associated with changes to the Index Divisor, such amendments should be expected to induce tracking error in index mutual fund portfolios. In addition, index fund managers will also be required to rebalance the individual weightings of stocks included in their portfolio in order to mimic the underlying benchmark. Similarly, index fund managers will also be required to rebalance their portfolios following any corporate actions that alter the Index Divisors i.e. share repurchases, share issuances and spin-offs. This act of rebalancing automatically translates into additional transaction costs and tracking error.

Dividends may also cause tracking error in performance where there is a timing delay in their receipt as well as the index rules governing the treatment of dividends. For example, if there is a timing delay between when the index incorporates the dividend (at the ex-dividend date) and the actual receipt of the dividend by the index fund (after the ex-dividend date), tracking error will be unavoidable. In the case of S&P 500 constituent securities, actual receipt of dividends can take as long as several weeks. Index managers, through participation in dividend reinvestment plans, may minimize this 'dividend effect', however it is generally uncommon for S&P 500 constituent securities to distribute dividends in the form of new securities.

Finally, larger index funds are expected to exhibit lower relative transaction costs upon portfolio rebalancing. However, larger funds are likely to be more sensitive to exogenous factors inducing tracking error given the larger (in terms of dollar value) rebalancing that will be required.

INSTITUTIONAL DETAILS AND THE S&P 500 INDEX

This study investigates the impact of S&P 500 Index Divisor adjustments on S&P 500 index mutual fund tracking error. The choice of the S&P 500 Index as the subject index for this study is predominantly driven by the magnitude of assets benchmarked to the index, both by open-end index mutual funds and exchange traded funds (Standard and Poor's Depositary Receipts, or Spiders).[2]

Responsibility for decisions concerning the S&P 500 Index rests with the S&P Index Committee. The principal task of the Committee is the maintenance of the Index Divisor – in particular, the impact of corporate actions and additions/deletions on the individual stock weights comprising the S&P 500. Exhibit 1 summarizes the types of maintenance adjustments performed by the Committee and Exhibit 2 outlines the general guidelines of S&P 500 stock additions and deletions.

<INSERT EXHIBIT 1 ABOUT HERE>

<INSERT EXHIBIT 2. ABOUT HERE>

The S&P 500 Index is calculated using a base-weighted aggregate methodology, with 1941-43 as the base period. The market value of all stocks listed during the base period is set to equal an indexed value of 10. Therefore, the level of the Index reflects the total market value of all stocks listed in the S&P 500 Index relative to the base period. The S&P 500 Index Divisor preserves the link between the current Index value and the original base period value. Hence, the daily S&P 500 Index is calculated by dividing the total market value of all 500 companies with the latest Index Divisor as follows:

$$\text{S \& P 500 Index Value} = \frac{\text{Total Market Value of 500 Companies}}{\text{Latest Index Divisor}} \qquad (1)$$

Following corporate actions, adjustments to the Index Divisor will be required. For example, assuming the current *Total Market Value* of S&P 500 constituents is equal to $US150 and the *Latest Index Divisor* is equal to 10, employing equation (1) yields an Index Value equal to 15.

Following a revision in the Index composition, the Index value increases to $US180. Thus, the New Divisor is equal to 12.

$$\text{New Divisor} = \frac{180}{15} = 12 \qquad (2)$$

A similar methodology is utilized for other corporate actions, which alters the *Total Market Value* of stocks listed in the S&P 500 Index.[3]

DATA AND RESEARCH DESIGN

The measures of monthly tracking error are obtained for 119 S&P 500 index mutual funds for the five-year period between January 1994 and December 1999 using the *Morningstar Principia Pro* CD-ROM. The sample represents 4,960 monthly index fund performance observations and total net assets at December 1999 is $US109.33 billion.[4] Following the approach of Frino and Gallagher [2001], the five-year sample period is selected in order to maximise the number of funds included in the sample as well as providing a reasonable length of the evaluation horizon. However, this study is not confined to examining funds that exist for the full five-year sample period and only includes surviving funds.[5] Additionally, the *Vanguard 500* index mutual fund is excluded due to its significant size ($US104.65 billion at December 1999), and to avoid any potential bias given the uniqueness of this large investment vehicle.[6] Exhibit 3 reports the descriptive statistics of the sample of index mutual funds utilized in the study.

<INSERT EXHIBIT 3 ABOUT HERE>

Morningstar Inc. reports returns after management fees, administration and 12b-1 fees, and other asset-based costs, but excludes brokerage costs. The index mutual fund returns are then adjusted with historical fund expenses ratios in order to approximate the index funds' gross return.

Information on the underlying index, S&P 500 is attained from *Datastream* and the *S&P 500 Directories* (1994 – 1999). Stock information such as bid-ask spread is extracted from the *Trading and Quote* (TAQ) database. With the exception of the index returns and bid-ask spread, all other information is reported on a monthly basis. In order to ensure consistency, the index returns and bid-ask spread are aggregated on a monthly basis.

A number of tracking error measures are documented by Roll [1992], Pope and Yadav [1994] and Larsen and Resnick [1998]. This study concentrates on two measures of tracking error. First, tracking error in month *t* is calculated as the absolute difference in returns of the index portfolio and benchmark index ($e_{pt} = R_{pt} - R_{bt}$), where the monthly average absolute tracking error over *n* months ($TE_{1,p}$) and is defined as follows:

$$TE_{1,p} = \frac{\sum_{t=1}^{n} |e_p|}{n} \qquad (3)$$

The second method of tracking error estimation is derived from the absolute value of the residuals of a returns regression ($TE_{2,p}$). The returns on the index fund portfolio ($R_{p,t}$) is regressed against the returns on the benchmark index ($R_{b,t}$).

$$R_{pt} = \alpha_i + \beta_i R_{bt} + \varepsilon_{pt} \qquad (4)$$

Due to the passive strategy implemented, index funds beta risk is generally close to that of the market, i.e. a beta of 1. Given that this study includes all funds that are listed in the sample period, young funds that are established during the sample period are also incorporated.

The tracking error measures $TE_{1,p}$ and $TE_{2,p}$ encompass both time-series and cross-sectional aspects of index mutual fund tracking error. The cross-sectional aspects of tracking error include factors such as the difference in fund size and the replication strategy adopted. This study also examines

the exogenous component of tracking error after controlling for the cross-sectional variation. This is achieved by standardizing the $TE_{1,p}$ and $TE_{2,p}$ measures as follows:

$$TE_{3,p} = \frac{TE_{1,p,i} - \overline{TE}_{1,p}}{\sigma_{1,p}} \tag{5}$$

$$TE_{4,p} = \frac{TE_{2,p,i} - \overline{TE}_{2,p}}{\sigma_{2,p}} \tag{6}$$

The standardized measures ($TE_{3,p}$ and $TE_{4,p}$) are calculated by subtracting the index fund's average tracking error ($\overline{TE}_{1,p}$ and $\overline{TE}_{2,p}$) from the observed monthly time-series ($TE_{1,p,t}$ and $TE_{2,p,t}$), and then dividing by the standard deviation of the fund's tracking error ($\sigma_{1,p}$ and $\sigma_{2,p}$).

Monthly tracking errors are computed using all four TE measures for the full sample period. An examination of the exogenous determinants of tracking error are performed by regressing index fund tracking error against four exogenous factors which require an Index Divisor adjustment – revisions in the composition of the index, share issuances, share repurchases and spin-offs. The changes in the Index Divisor are extracted from the S&P 500 Directories and measured on an aggregate monthly basis. The model is specified as follows:

$$TE_{s,p,i} = \alpha_0 + \beta_1 |\Delta MV| + \beta_2 SI_i + \beta_3 SR + \beta_4 SO + \beta_5 BAS_i + \beta_6 DIV_i + \beta_7 DR_i + \beta_8 DS_i + \sum_{m=2}^{12} \pi_m D_m + \varepsilon_t \tag{7}$$

$TE_{s,p,i}$ represents the method of estimation of tracking error (as defined in equations 3 to 6). The measure for revisions of index constituents |ΔMV|, represents the absolute difference in the market capitalisation of stocks that are included and excluded in month *i*, calculated on the effective date. All other exogenous factors – Share Issuances (SI_i), Share Repurchases (SR_i) and Spin-offs (SO_i) – are measured using the market capitalisation values associated with these specific changes. Monthly average time-weighted relative bid-ask spread, BAS_i, is also included to account for the

implicit transaction costs associated with securities trading that arises from changes in the Index Divisor. DIV_i measures the dividend component of index returns, measured as the difference in returns between the S&P 500 Price and the Composite Indices. DR_i is a dummy variable that takes on the value of 1 if the fund follows a full replication strategy and zero otherwise. *DS* is a dummy variable for net assets of index funds, which takes on the value of 1 for funds with above median assets and zero otherwise. $\sum_{m=2}^{12} \pi_m D_m$ accounts for the seasonal dummy variables for month *m*, which are included to re-examine the possibility that tracking error exhibits seasonality across calendar months. The month of February is excluded to avoid the dummy variable trap. Evaluating seasonality is important, given the seasonal pattern in tracking error documented by Frino and Gallagher [2001].

RESULTS

This section presents the empirical findings of tracking error determinants that are associated with changes in the S&P 500 Index Divisor.[7] Overall, the results presented in Exhibit 4 indeed confirm that changes in the S&P 500 index composition, and associated changes in the Divisor, are significant determinants of index fund tracking error. Index revisions, |ΔMV|, is found to be positive and significant across all four specifications of tracking error.[8] In addition, share issuance (*SI*) is also found to be a positive and significant. According to Exhibit 3, these two variables cause the largest impact (by market value and frequency) for Index Divisor changes over the entire period, and indicates that portfolio rebalancing by index funds induces exogenous tracking error. Spin-offs (SO) in the period required relatively smaller adjustments to the Divisor, and Exhibit 4 reveals that all models yield positive coefficients, however, only the standardized tracking error specifications ($TE_{3,p}$ and $TE_{4,p}$) are statistically significant. Share repurchases (SR) is found to be negatively related to tracking error for three of the four models, and $TE_{3,p}$ and $TE_{4,p}$ are both statistically

significant. While the finding for SR is perplexing, this variable is the smallest component (measured by size and frequency as reported by Exhibit 3) of all maintenance adjustments undertaken by the S&P Index Committee.

<INSERT EXHIBIT 4. ABOUT HERE>

The remaining determinants of tracking error include two exogenous factors that are expected to drive tracking error (bid-ask spread and dividends). The proxy for implicit transaction costs (*BAS*) associated with securities trading reveals positive coefficients for three of the four specifications, however the majority are statistically insignificant. The coefficient for dividends (*DIV*) is found to be both positive and significant across all models. This indicates that the treatment of dividends by the Index (and the possible delays in the fund receiving cash) induces tracking error in performance. While the Australian findings of Frino and Gallagher [2002] indicate that dividends are not significant drivers of tracking error, there are differences in the treatment of dividends between the S&P 500 and All Ordinaries Index. Australian index managers also seek to minimise the delays in receipt of dividend payments through active participation in dividend re-investment plans (DRPs).

The model also includes two fund-specific dummy variables (replication strategy and net asset size) that captures the cross-sectional variation of our sample. Index funds that implement a full-replication strategy (*DR*) are found to have significantly lower tracking error for $TE_{1,p}$ and $TE_{2,p}$. This is consistent with the Australian evidence reported by Frino and Gallagher [2002]. The insignificant *DR* coefficients for both standardized measures ($TE_{3,p}$ and $TE_{4,p}$) arise because these models control for the cross-sectional variation across funds. Exhibit 4 also reveals that tracking error is significantly lower for large index funds (*DS*) according to $TE_{2,p}$, where large funds are defined as above median. Recognizing that tracking error might also be determined according to the level of a fund's net assets, we also examined the sensitivity of exogenous factors based on fund

size (results not reported directly). The full sample was partitioned into quartiles based on net asset size and tests were performed for the largest quartile and smallest fund quartiles. The evidence revealed consistent findings with the results reported in Exhibit 4, however the models for the larger fund sample provided improved explanatory power, measured by the coefficient of determination (or adjusted R^2). The average adjusted R2 between large and small funds was 21.8 percent and 8.2 percent, respectively.

In terms of seasonality of tracking error, an evaluation across calendar months indicates a very similar pattern as reported by Frino and Gallagher [2001]. They document tracking error being highest in May, lowest in the month of June, and quarterly troughs in tracking error for March, June, September and December. In terms of the model specifications for tracking error presented in Exhibit 4, the evidence does suggest tracking error is significantly higher in January, April, May, July and significantly lower in December. The reasons for this phenomenon are unclear, however future research should examine the causes of season patterns in tracking error.

CONCLUSIONS

This study examines the exogenous determinants of tracking error in S&P 500 Index funds that arise from amendments to the Index Divisor. The research also considers the effect of transaction costs in trading and the treatment of dividends by S&P 500 index. The research is of significant importance to the investment industry, in particular Index Committees, investors, and mutual fund managers. In better understanding the drivers of tracking error, market participants can more easily identify the implications that maintenance procedures to an Index might have for index-mimicking portfolios. Tracking error is found to be significantly related to index revisions, share issuances, spin-offs, share repurchases, index replication strategy and fund size. Consistent with Frino and

Gallagher [2001], index funds exhibit a seasonal pattern in their tracking error across calendar months.

EXHIBIT 1.
TYPES OF S&P 500 INDEX MAINTENANCE ADJUSTMENTS

Maintenance Adjustment	Adjustment Factor	Divisor Adjustment Required?
Constituent Change	Market Value of New Company – Market Value of Old Company	Yes
Share Issuance	Shares Outstanding + Newly Issued Shares	Yes
Share Repurchase	Shares Outstanding – Repurchased Shares	Yes
Spin-off	Price of Parent Company – (Price of Spin-off Co. / Share Exchange Ratio)	Yes
Stock Split (ex. 2 x 1)	Double Number of Shares Outstanding and Reduce the Stock Price by Half	No
Special Cash Dividends	Share Price – Special Dividend	Yes
Rights Offering	Price of Parent Company – (Price of Rights/ Right Ratio)	Yes

(Source: S&P 500 Directory, 2001, p.28)

EXHIBIT 2.
GENERAL GUIDELINES FOR STOCKS ADDITIONS AND DELETIONS

General Guidelines for Stocks Additions
1. The chosen company generally have the market value within their industry
2. Selected companies represent important industry segments within the U.S economy
3. Lower preference for closely held companies
4. Subjected stocks are to exhibit adequate trading activities and liquidity
5. Higher preference for stocks with solid fundamentals
6. Companies in emerging industries are candidates as long as they meet the guidelines above
General Guidelines for Stocks Removals
1. Merger, acquisition and leveraged buyout
2. Bankruptcy
3. Restructuring and Spin-off
4. Companies that are no longer meet current criteria of inclusion and / or is no longer representatives of its industry group are removed

(Source: S&P 500 Directory, 2001, p.35)

EXHIBIT 3.
DESCRIPTIVE STATISTICS

	Mean	Median	Std Dev	Min	Max	N	ADF (1 Lag)
$TE_{1,p}$	0.18	0.16	0.10	0.00	0.98	4960	**
$TE_{2,p}$	0.09	0.05	0.11	0.00	1.11	4960	**
$TE_{3,p}$	0.77	0.67	0.54	0.00	3.05	4960	**
$TE_{4,p}$	0.76	0.65	0.56	0.00	2.91	4960	**
$\|\Delta MV\|$	8,739.54	6,702.00	7,455.83	0.00	26,158.00	193	15.50 ***
$INCLUDE_{eff}$	26,179.11	16,761.00	29,981.63	0.00	132,349.00	193	8.92 *
$EXCLUDE_{eff}$	20,295.41	9,652.00	29,989.23	0.00	149,509.00	193	9.26 *
SI	12,668.52	10,393.62	12,793.94	503.23	61,925.00	369	15.60 ***
SO	1,686.69	306.42	3,122.95	0.00	15,215.98	98	18.71 ***
SR	1,407.35	429.49	2,484.37	0.00	10,933.50	78	19.40 ***
DIV	0.16	0.14	0.06	0.08	0.42	60	2.93
BAS	0.09	0.10	0.02	0.04	0.13	60	12.94 ***

*** denotes significant at 0.001 Level of Significance (LOS) under two-tailed test. ** denotes significant at 0.01 LOS under two-tailed test and * denotes significant at 0.05 LOS under two-tailed test. The results for the Augmented Dickey Fuller (ADF) test for the tracking error measures are performed on each fund. The null hypothesis of unit-root is rejected for all funds at 0.01 LOS. Due to space limitations and to enhance presentation clarity, these results are not directly reported.

EXHIBIT 4.
FULL SPECIFICATIONS (S&P 500 INDEX REVISIONS MEASURED AT EFFECTIVE DATE)

	$TE_{1,p}$	$TE_{2,p}$	$TE_{3,p}$	$TE_{4,p}$
Intercept	**0.11** ***	**0.18** ***	**0.33** ***	**0.27** ***
|ΔMV|	**$1.78*10^{-6}$** ***	**$1.73*10^{-6}$** **	**$4.67*10^{-6}$** **	**$4.99*10^{-6}$** ***
SI	**$7.50*10^{-7}$** **	**$6.91*10^{-7}$** *	**$5.52*10^{-6}$** ***	**$5.41*10^{-6}$** ***
SO	$1.58*10^{-6}$	$6.35*10^{-7}$	**$1.10*10^{-5}$** *	**$1.00*10^{-5}$** *
SR	$3.06*10^{-6}$	$-2.19*10^{-6}$	**$-3.00*10^{-5}$** ***	**$-2.00*10^{-5}$** ***
BAS	**0.47** *	-0.16	0.71	1.16
DIV	**0.77** ***	**0.62** ***	**1.34** ***	**1.22** ***
DR	**-0.12** ***	**-0.22** ***	0.07	0.04
DS	-0.01	**-0.02** ***	-0.01	-0.01
D_1 (Jan)	-0.01	**0.04** ***	**0.19** ***	**0.19** ***
D_3 (Mar)	-0.01	0.01	-0.07	**-0.10** *
D_4 (Apr)	**-0.03** *	**0.04** *	**0.26** ***	**0.26** ***
D_5 (May)	$1.7*10^{-4}$	0.01	**0.31** ***	**0.32** ***
D_6 (Jun)	$4.41*10^{3}$	**0.02** *	-0.03	-0.04
D_7 (Jul)	**0.01** *	**0.04** **	**0.12** **	0.09
D_8 (Aug)	0.02	0.01	-0.02	-0.04
D_9 (Sep)	**-0.02** *	$3.17*10^{-3}$	-0.01	-0.04
D_{10} (Oct)	$2.19*10^{-3}$	**0.03** *	0.03	0.02
D_{11} (Nov)	$-6.65*10^{3}$	$-8.2*10^{-4}$	-0.09	**-0.09** *
D_{12} (Dec)	$-1.3*10^{4}$	0.01	**-0.19** **	**-0.20** ***
Adj R-Sq	15.35	14.71	7.66	8.03
F-Value	**32.90** ***	**31.34** ***	**15.56** ***	**16.32** ***
CI	23.74	23.75	23.73	23.73
N	4960	4960	4960	4960

*** denotes significant at 0.001 Level of Significance (LOS) under two-tailed test. ** denotes significant at 0.01 LOS under two-tailed test and * denotes significant at 0.05 LOS under two-tailed test. CI reports the regression's Condition Index, the measure for multicollinearity. The *t*-statistics are adjusted for heteroskedasticity and autocorrelation using the Newey-West method.

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END NOTES

[1] Studies concerning revisions to indices include Shleifer [1986], Harris and Gurel [1986], Woolridge and Ghosh [1986], Lamoureux and Wansley [1987], Goetzmann and Garry [1996], Lynch and Mendenhall [1997], Bos [2000a] and Dash [2002].

[2] Blitzer [2001].

[3] More extensive information on S&P 500 Index's institutional details, procedures of Index Divisor adjustment and examples on Index Divisor adjustments are available from the S&P 500 Directories and Bos [2000b].

[4] While the Morningstar dataset has the standard survivorship-bias problem, the effect is expected to be minimal given the short period of observation and the passive strategy implemented by the subjected funds.

[5] The market would not expect as high a dropout rate for index funds, compared with active funds, by virtue of the passive strategy being adopted by mutual fund managers.

[6] With the exception of *Vanguard 500* index fund, all index funds examined by Frino and Gallagher [2001] is included in the sample.

[7] All results are tested for heteroskedasticity and autocorrelation, and *t*-statistics are adjusted using the Newey-West adjustment procedure.

[8] Consistent results are found when the announcement date is used instead of the effective date for index revisions. Due to space limitations, and to enhance presentation clarity, these results for announcement date are not directly reported.