Effects of changes in stock index compositions: A literature survey

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Abstract

The practice of periodically reconstituting equity indices suggests that changes to the composition of an index can impact the performance of firms whose stocks are added to or dropped from the index. This paper reviews and provides a comprehensive assessment of the academic literature on how changes in the composition of a stock index impacts prices, trading volume and other firm attributes. The review focuses on post-2000 contributions. It highlights and critically discusses major areas of controversy, disagreement and debate in both the empirical and methodological literature, and puts forth a promising agenda for future research. This is the first comprehensive survey of studies on the index effect and it should be particularly useful to portfolio managers and investors.

JEL Classification: G10, G12, G14

Keywords: Index effect, abnormal returns, trading volume, literature review, event study

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1.0 INTRODUCTION

According to the efficient market hypothesis (EMH), competition among profit-maximizing investors to earn returns in excess of the market average implies that no investor can consistently earn above the market average as current stock prices are assumed to reflect all publicly available information. This assertion in fact suggests that active portfolio management is worthless since, in principle, it is impossible to successfully time the market and profit from mispriced stocks on a consistent basis. Consequently, recent years have witnessed a shift towards passive investment strategies, particularly index investing, which allow investors to earn just about the market average without incurring significant trading costs or fees. The growing popularity of such index-tracking investment vehicles implies that revisions to the constituent stocks that make up the underlying index could lead to enormous buying or selling pressure on stocks that enter or leave the index, thus potentially causing prices to drift away from their fundamental equilibrium value.

Although academic research in this area began as far back as the late 1980s, it focused mainly on the price effects on stocks that are added to the S&P 500 index in the US. The literature that examines the effects across a broader spectrum of markets emerged much later, around the early 2000s. Since then research on the subject has blossomed and a growing number of studies have explored the potential effects on other (non-price) attributes such as liquidity, profitability, risk, pricing efficiency, information environment and internal governance characteristics of affected firms.

Hence this paper attempts to review, synthesize and evaluate the body of scholarship that has been produced so far, with a view to providing a holistic assessment of the literature. By outlining some of the major research themes in the literature, this paper provides clarity on the general direction and current state of the literature. Clarity on the wealth effects of a stock's membership of an index has important implications for the investment decisions of investors and portfolio managers alike. Furthermore, establishing the benefit to firms of having their stocks added to an index can inform the priorities and choices of managers. On the whole, by engaging with existing studies and discussing key aspects of their findings, this paper offers some perspectives on the subject and provides a roadmap for future research.

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The remainder of the paper is organized as follows: Section 2 briefly discusses the competing theories and explanations proposed for the observed effects. Section 3 of this review examines the empirical literature. It highlights the key research themes and findings in the literature. Section 4 offers some observations and critical commentary on current findings, and also draws attention to major areas of controversy, disagreement and debate. Section 5 concludes and offers some directions for future research.

2.0 SOME THEORETICAL PERSPECTIVES

As will be argued later, several studies have documented evidence of significant positive (negative) price and non-price effects when stocks are added to (removed from) an index. A number of theories and explanations for the observed effects have been proposed in the literature. These can be classified into two broad categories; demand-based and information-based theories.

2.1 Demand-Based Theories

Proponents of demand-based explanations postulate that increased demand by index-tracking investors for a stock added to the index triggers an upward pressure on the price of the stock, resulting in positive abnormal returns around the inclusion date (Shleifer, 1986; Harris and Gurel, 1986). The specific hypothesis which can be put forward to explain such demand-induced price shocks depends on whether the observed price effects are temporary or permanent: temporary effects lend credence to the *price pressure hypothesis* and permanent effects the *imperfect substitute hypothesis*.

2.1.1 Price Pressure Hypothesis

First proposed by Scholes (1972), the price pressure hypothesis suggests that the demand curve for stocks is downward sloping in the short term. Hence prices will revert to their original levels once the short-term buying/selling pressure eases (Harris and Gurel, 1986). Specifically, this hypothesis suggests that short-term imbalances around the index change dates will cause a temporary stock price reaction as index-tracking investors rebalance their portfolios in line with changes to the index compositions (Vespro, 2006).

2.1.2 Imperfect Substitute Hypothesis

The imperfect substitute hypothesis on the other hand assumes that stocks have a long-term downward sloping demand curve, or 'imperfect substitutability', such that price changes for added or deleted stocks are expected to persist (Shleifer, 1986). Because this hypothesis is based on the assumption that index additions have no close substitutes, the price effect of a firm's inclusion in an index is expected to be permanent.

2.2. Information-Based Theories

For proponents of information-based explanations, the announcement of a stock's addition to (deletion from) an index conveys positive (negative) news about the stock (Chen et al. 2004). In this sense a firm's addition to an index may be seen to convey information about its future prospects or investment value, thereby driving its price up. Several hypotheses have been advanced to explain such information-driven price shocks.

2.2.1 Information Hypothesis

The information signal hypothesis argues that the inclusion of a firm to a major index may be perceived as a testament to a firm's position as an 'industry leader' or a sign of improvement in the quality of its management (Jain, 1987). In addition, Denis, McConnell, Ovtchinnikov and Yu (2003) argue that the announcement of a stock's inclusion to the S&P 500 index may contain information relating to the firm's future prospects. Specifically, they demonstrate that analysts revise their earnings forecasts of firms included to S&P indices. Platikanova (2008) corroborates this view by documenting evidence of significant improvements in firms' earnings quality upon their inclusion to an S&P index. Cai (2007) provides additional evidence to support the hypothesis that S&P 500 addition events are not information-free.

2.2.2 Liquidity Hypothesis

Closely related to the information hypothesis is the liquidity hypothesis which postulates that the addition of a stock to an index leads to an increase in its liquidity, which in turn results in higher prices (Amihud and Mendelson, 1986; Chen et al. 2004). From this perspective, stock analysts are more likely to devote time and resources to producing and analyzing information on firms whose stocks have been added to an index. As analysts disseminate the information they generate on these stocks, the overall amount of available information on the stocks increases. The increase in the total amount of public information (or, conversely, a decline in the degree of

information asymmetry) about a stock leads to a reduction in its bid-ask spread which in turn leads to higher volumes and levels of trading and liquidity (Chung et al. 1995). Improvements in the liquidity of the stocks added to an index will be followed by a decline in their required rate of return, and this will increase their prices (Shleifer, 1986; Goetzmann and Garry, 1986). Deletion of stocks from an index causes opposite effects on their liquidity and price.

2.2.3 Investor Awareness Hypothesis

Rooted in Merton's (1987) model of market segmentation, the investor awareness hypothesis argues that a firm's inclusion to an index raises investors' awareness about its existence. The increased visibility and attention on the firm by the investment community provides an incentive for its management to deliver superior results (Denis et al. 2003). Although increased visibility leads to an expansion in the ownership base of stocks that are added to an index, Chen et al. (2004) argue that there appears to be some asymmetry in the price effects for additions relative to deletions in the S&P 500. Specifically, they explain that adding a firm to an index may lead to a permanent increase in its stock price but firms that are removed from the index may not experience permanent or significant reductions in their stock prices. Put differently, the price reactions for additions (deletions) should be larger (smaller) and permanent (temporary). In providing a rationale for the asymmetric effects, Chen et al. (2004, p. 1917) explain that "while more investors become aware of stocks added to the index, the number of investors *aware* of deleted stocks may not actually fall because it may be difficult for investors to become *'unaware'* of those stocks".

2.2.4 Selection Criteria Hypothesis

The selection criteria hypothesis argues that the effects of index revision are to some extent driven by the criteria used in rebalancing the index. The intuition behind the hypothesis is that selected stocks are likely to be those with higher trading volume (or liquidity), market capitalization or profitability relative to their peers. Consequently, any significant upward pressure on the prices of the newly added stocks could be linked to improvements in liquidity,market capitalization, profitability or any of the specific inclusion criteria laid out

by the index provider (Bechmann, 2004; Edmister et al. 1994). Petajisto (2008) theoretically shows that the magnitude of the index effect is not independent of the specific nature of the

index selection criteria. Specifically, the author argues that significant differences in the size and magnitude of the effects can occur depending on whether the index selection rules are transparent, observable and non-random (e.g. based on market capitalization, trading volume), or whether they are opaque, random and not easily observable. He shows that the greater the transparency of the rules, the more predictable the changes and the smaller the magnitude of the effects. Bechmann (2004) similarly concludes that the selection criteria hypothesis can explain a portion of the market reaction to changes in the Danish KFX index.

3.0THE EMPIRICAL LITERATURE

Nearly all studies in this field of research follow the design, approach and empirical strategy adopted in the pioneering studies of Shleifer (1986) and Harris and Gurel (1986). Shleifer (1986) looked at stocks that were included in the S&P 500 index from 1976 to 1983. Using the standard event study method, the author finds that new inclusions on the average earn abnormal returns of nearly 3% on the announcement day, and that the (abnormal) returns persist up to 20 days after the announcement. Harris and Gurel (1986) reach a similar conclusion that stocks earn just over 3% in abnormal returns upon the announcement of their inclusion to the S&P 500 index. Similarly Lynch and Mendenhall (1997), using data between 1990 and 1995, document evidence of price gains of up to 7% when a stock enters the S&P 500, thus not only corroborating early studies but also suggesting that the S&P 'premium' may have increased overtime. Since the publication of these works on the S&P 500, there has been a proliferation of studies that have looked at a more diverse range of indices (with different selection rules and membership criteria), markets, data frequencies and time periods. The scope has become even wider as more recent studies examine the effects on attributes other than price. This section examines in greater detail the diversity in themore recent literature. Table 1 highlights and summarizes the defining features and key findings of some of the recent contributions.

[Table 1 about here]

3.1 Price and Trading Volume

A cursory look at Table 1 reveals that an overwhelming majority of studies investigate the effects of the changes on price and trading volume. In measuring the price effects, many of the studies focus on analyzing estimates of abnormal returns around the index change dates for the

new inclusions or deletions. Although much of the recent literature corroborates earlier findings that share prices of newly included (deleted) firms increase (decrease), it offers divergent views on the persistence of, and explanations for, the observed price effects. For instance while some studies on the S&P 500 index (for example Wurgler and Zhuravskaya, 2002; Denis et al. 2003) document evidence consistent with the imperfect substitutes hypothesis, studies on the UK's FTSE 100 index (for example Vespro, 2006; Mazouz and Saadouni, 2007) and Australia's S&P/ASX 200 index (for example Pullen and Gannon, 2007) find evidence in support of the price pressure hypothesis.

With regards to volume effects, a selection of the papers (e.g. Chen et al. 2004; Wang et al. 2015) use estimates of the abnormal trading volume to measure the impact on the volume of shares traded for stocks that are added or removed from an index. The findings presented indicate that stocks added to an index experience increased volumes of trading while stocks removed from an index, in some cases, experience declines in trading volume (see for example Chen et al. 2004; Mase, 2007; Biktimirov and Li, 2014; Wang et al. 2015). Fernandes and Mergulhao (2016) further probe the effects on trading by examining the effects on *probable* and *actual* additions to and deletions from the FTSE 100 index, thereby discriminating between stocks that stand a chance of getting promoted (deleted) and stocks that actually get promoted (deleted). After accounting for the anticipatory trades on the probables, the authors report that both additions and deletions experience significant increases in trading volume. Their findings are in contrast with Mase (2007) who fail to find evidence of significant increases in trading volume for *probable* deletions from the FTSE 100 index.

Overall, the literature offers considerable support to the conjecture that the inclusion of a stock to an index tends to be followed by a statistically significant positive impact on its price and trading volume while deletions tend to have a negative impact on the prices and, to a lesser extent, trading volume of deleted stocks. In addition, the findings that the observed price deviations tend to be systematic are inconsistent with the predictions of the efficient markets hypothesis.

3.2 Institutional Stock Holdings

Pruitt and Wei (1989) were among the first to examine the effects of index reshuffles on attributes other than stock price and trading volume. Specifically, they look at how a change in a firm's membership status of the S&P 500 affects its institutional stock holdings. They find

evidence of positive correlations between changes in institutional holdings and stock prices of firms that enter or exit the S&P 500 index. The evidence that institutional investors increase their holdings of stocks that are added to an index is not limited to the S&P 500. Rigamonti and Barontini (2000) and Biktimirov et al. (2004) find evidence of increases in institutional ownership for stocks that enter Italy's Mib30 and the Russell 2000 indices respectively.[2] A survey of the empirical literature further reveals that two main measures have been used to capture changes in institutional ownership: namely, the *number* of institutions holding the stock and the *proportion* of a firm's shares outstanding held by institutions (see for example Chen et al. 2004; Shankar and Miller, 2006; Chan et al. 2013; Biktimirov and Li, 2014; Li and Tan, 2015). Overall, a summary of the findings across a number of indices seem to support the hypothesis that the institutional share ownership of a firm increases when it enters an index, but does not necessarily decrease when it exits the index. The evidence that ownership base of newly added stocks increases, is consistent with the conjecture proposed by Denis et al. (2003) that firms, upon their inclusion to a major index, face increased investor scrutiny and external monitoring.

3.3 Quality of the Information Environment and Liquidity

Possible changes in the quality of the information environment following the inclusion or removal of a stock from an index have also been addressed by researchers. Since investors, financial analysts and the media are somewhat selective in their choice of what firms to follow, they may be motivated to initiate or increase their coverage of firms that are included in an index.[3] The logic is based on the premise that adding a stock to an index increases its visibility to and coverage by analysts, the media and other stakeholders. Increase in analyst or media coverage is likely to impact positively on the volume, quality and flow of information which, in turn, reduces the level of information asymmetry and at the same increases stock liquidity (Chen et al., 2004). In measuring changes in liquidity, majority of the studies use estimates of the turnover ratio (for example Becker-Blease and Paul, 2006), the Amihud illiquidity ratio (for example Chan et al. 2013) and the bid-ask spread (for example Hegde and McDermott, 2003; Kamal, 2014; Wang et al. 2015). A major drawback of both the Amihud illiquidity and turnover ratio, as discussed by Gabrielsen et al. (2011), is that they are somewhat ineffective in

[2] The Russell 2000 index comprises of approximately 2000 small cap stocks in the US.
[3] See McNichols and O'Brien (1997).

distinguishing between temporary and permanent effects of changes in the volume of trading. Although most studies that look at the liquidity effects for S&P 500 additions (for example Edmister et al. 1996; Beneish and Whaley, 1996; Erwin and Miller, 1998; Hegde and McDermott, 2003; Becker-Blease and Paul, 2006) suggest that the bid-ask spread reduces (i.e. liquidity improves), the evidence in support of a *permanent* improvement in liquidity for new additions is not overwhelming. For instance Beneish and Whaley (1996) and Kaul et al. (2000) find only evidence of temporary reductions in the bid-ask spread for firms newly added to the S&P 500 index and Canada's TSE 300 index respectively.

An array ofmeasures have been employed to capture changes in the quality of the information environment of firms that enter or leave an index. Chan et al. (2013) use analyst coverage (measured by the number of analysts following a company) to capture changes in the quality of the information environment. Estimates of the dispersion of analyst earnings forecasts (defined as the standard deviation of earnings forecast deflated by the stock price) aswell as analyst forecast accuracy (defined as the negative of the absolute value of the difference between the firms' forecast and realized earnings deflated by the stock price) have also been used (for example Zhang et al. 2010; Wang et al. 2013; Baran and King, 2014).[4] Some papers (for example Liu 2009; Daya et al. 2012; Xie 2013) used the level of media coverage as proxy for quality of the information environment. The use of this measure, according to Chen et al. (2004), is based on the assumption that firms with greater media coverage tend to be more visible to investors and other stakeholders.

Studies that examine this issue generally produce mixed results, depending on the proxy used to gauge the change in the quality of the information environment. For example, Zhang et al. (2010) and Chan et al. (2013) show that once a firm is included in the S&P 500, the number of analysts following that firm, and hence the information flow, increases significantly. At the same time, however, both authors report evidence of decreased accuracy and wider dispersion of analysts' earnings forecast of stocks following their inclusion to the S&P 500, suggesting deterioration or less transparency in the information environment. Xie (2013) corroborates this finding by

[4] The analyst forecast dispersion after a firm enters (exits) the index is expected to be lower (higher) due to the expected improvement (deterioration) in the quality of the information environment. On the other hand, the forecast accuracy value for firms that enter the index is expected to be closer to zero (reflecting increased accuracy).

documenting evidence that analysts' recommendation upgrades for stocks included to the S&P 500 index weakens the forecast accuracy and, presumably, the information transparency of the new inclusions. Zhang et al. (2010) interpret the decline in forecast accuracy as evidence of over-optimism in analysts' forecast earnings estimates for S&P 500 firms. However after controlling for forecast error of all index firms, Baran and King (2014) show that the forecast accuracy actually increases for S&P 500 additions. On another front, studies on the Nikkei 225 and FTSE 100 indices by Liu (2009) and Daya et al. (2012) respectively used changes in the intensity of media coverage to gauge changes in quality of the information environment. Liu (2009) finds that the extent of media coverage improves (drops) substantially for firms after they enter (exit) the Nikkei 225. However, Daya et al. (2012) fail to find evidence that the information environment for FTSE 100 new additions is significantly influenced by post-addition improvements in the level of media coverage.

On the whole, the evidence presented in the literature suggests that improvements in analyst activity and media intensity for firms that enter an index do not necessarily translate to improved accuracy, reliability or credibility of the forward-looking information provided on those firms.

3.4 Operating Efficiency and Profitability

In addition to examining changes in the quality of the information environment, a strand of the literature has also sought to investigate the impact on firms' operating performance and profitability ratios. In view of the fact that changes in company fundamentals can only be observed or measured over longer horizons, studies that examine this issue consider horizons of at least 1 year. Chan et al. (2013) examine whether there are any discernable changes in profit margin, return on assets, market-to-book ratio and capital spending of firms added to or deleted from the S&P 500 over time. While they find evidence of improvements in the profitability and operating performance of added firms 5 years prior to joining the index, they observe that these performance ratios tend to decline in the subsequent 5 years, after joining the index. Furthermore, the authors find that the ratios for deleted firms initially decline prior to deletion, but then rebound after the deletion occurs. Kot et al. (2015) look at essentially the same variables for Hong Kong's Hang Seng index (HSI). Consistent with the findings for the S&P 500 index, the authors find no evidence of significant improvements in the post-inclusion operating

performance for stocks added to the HSI. However, they do find some evidence of significant improvements in the profitability and operating efficiency of deleted stocks in the 1-, 3- and 5-year post deletion period, again consistent with the findings for the S&P 500 index.

Overall, the evidence seems to suggest that deleted firms experience a reversal of fortunes, with depressed margins in the pre-deletion period giving way to rising profits in the post-deletion period, whereas the profitability of added firms in the post-inclusion period stagnates at best.

3.5 Pricing Efficiency and Systematic Risk

There is a limited but budding literature on the possible implications on the pricing (informational) efficiency and systematic risk of affected stocks. The question of whether firms added to a major index benefit from greater informational efficiency was recently addressed by a paper by Daya et al. (2012) for FTSE 100 stock index constituents. The informational efficiency hypothesis of index composition changes postulates that adding a stock to an index increases the stock's liquidity, trading volume and investor awareness which ultimately improves the stock's pricing efficiency (Daya et al. 2012). Using the Amihud and Mendelson (1987) partial adjustment coefficient and Chelley-Steeley (2008) price inefficiency metric as informational efficiency measures, the authors find that stocks added to the FTSE 100 experience significant improvements in their informational efficiency whereas deleted stocks do not experience any change in that regard.

Since the influential study of Vijh (1994) who documented evidence that the daily and weekly betas of firms added to the S&P 500 increase, very few other studies have examined the effects on the systematic risks of firms that enter or exit an index. In brief, the systematic risk hypothesis posits that the beta of stocks added to (deleted from) an index tend to increase (reduce) due to the increased (reduced) covariance between stocks and the market return (Kot et al., 2015). Using a sample of 44 additions and 35 deletions on Hong Kong's Hang Seng Index (HSI), Kot et al. (2015) test whether the betas of firms added to (deleted from) the index increase (reduce) over the subsequent 5-year period. They find that betas of stocks added to the HSI decrease over the 5-year post-addition period, whereas those of deleted stocks remain largely unchanged, inconsistent with the postulations of the systematic risk hypothesis.

Taken together, the conflicting findings reported in the papers by Vijh (1994) and Kot et al. (2015) may be attributable to distinct differences in the horizon length, sample size and possibly the market indices. On this note, it would seem beneficial to undertake further studies across a broader range of markets, time periods and institutional settings to establish the empirical validity of both the pricing efficiency and systematic risk hypotheses.

3.6 Firms' Internal Corporate Governance mechanisms

One stream of research, recently, has focused on investigating whether significant changes occur in the traditional (internal) corporate governance mechanisms of firms whose stocks are added to an index. The focus on internal governance deviates from much of the extant literature which had focused largely on changes in the intensity of coverage and scrutiny (or external governance) of added firms by analysts, institutional investors and the media. Li and Tan (2015) examine changes in governance mechanisms of firms that are included to the S&P 500 over the period 1994 to 2007. The authors look at eight individual governance mechanisms including CEO duality, board size and the proportion of outsiders on the board, and find evidence that most of these governance attributes improve for firms after they gain membership of the S&P 500 index. They also find evidence of positive association between the observed governance improvements and operating performance for firms after their inclusion to the index.[5] This indeed is an interesting finding, although the dearth of evidence for other markets implies that further clarity is needed on the generalizability of the findings in markets outside the US.

3.7 Can Ownership Status Explain the Abnormal Performance?

Unlike most other markets, a substantial number of the publicly listed companies in China and Hong Kong are owned by the State. Taking advantage of this unique setting, Wang et al. (2015) examine whether firms' ownership status (as in state-owned or non-state-owned) can explain the observed short-term abnormal returns when they are added to or deleted from China's CSI 300 index. They find no evidence that state or non-state ownership significantly contributes to explaining the observed abnormal returns earned by newly added or deleted stocks. In contrast, Kot et al. (2015) find that state and family ownership helps explain the stock performance of

[5] The authors also find some evidence of governance improvements using the aggregated measure of Governance Index proposed by Gompers, Ishii and Metrick (2003).

additions and deletions, respectively, over the long term in Hong Kong's HSI. Specifically, the authors split the sample of additions into state-owned and non-state owned firms, and that of deletions into family-owned and non-family owned firms.[6] They find that "deleted stocks outperform the added stocks with the difference resulting from poorly performing state-owned Chinese firms and better performing family-owned deleted stocks" (Kot et al. 2015, p. 417). On the whole, their finding is consistent with the prediction that controllers of state-owned listed firms, usually government officials who draw their salaries from the State, have weaker incentives to maximize firm performance relative to controllers of privately or family-controlled firms whose remuneration are typically tied to the success of the enterprise (Chen et al. 2009; Wong, 2016).

3.8 Index Funds' Competitiveness

One stream of research that has received far less attention examines the impact of index reshuffles on the performance or competitiveness of index funds. As we noted at the outset, index funds essentially track the underlying index with the objective of earning just about the same return as the benchmark index. The commonly held view is that index fund managers in a bid to minimize tracking error wait until the effective day to rebalance their portfolios.[7] However the practice of pre-announcing the changes several days before they are implemented creates room for short-term speculators, or arbitrageurs, to engage in market timing and other arbitrage activities between the announcement and effective (implementation) dates. The literature in this area therefore focuses on the potential loss to index funds arising from the activities of arbitrageurs. Chen et al. (2006) in a study on the S&P 500 and Russell 2000 indices between 1989 and 2002 find that, by engaging in arbitrage trading around the change dates, arbitrageurs appropriate significant portions of the profits to the detriment of index fund investors. Specifically, they estimate a loss of about USD 1 billion and USD 2.1 billion a year to index fund investors tracking the S&P 500 and Russell 2000 indices respectively. Other studies confirm the findings of Chen et al. (2006) that index funds tracking the S&P 500 suffer losses when they hold off trades until the effective date. One such study by Blume and Edelen (2004) finds that S&P 500 index funds that trade just around the announcement day of S&P 500

[6] The authors note that most of the firms deleted from the HSI are family-owned whereas firms added to the index are mainly state-owned.

[7] Tracking error as defined by Chen et al. (2006) is the absolute difference between each month's benchmark index return and the fund's return.

constituent changes increase their overall fund performance by about 0.19% per annum. Dunham and Simpson (2010) also demonstrate that index funds tracking the S&P 500 are able to reduce their tracking error by adjusting their portfolios very close to the announcement date, and in doing so enhance the performance of their funds. This finding was also echoed in a paper by Kappou et al. (2010) who show that S&P 500 index funds tend to concentrate their portfolio recomposition trades around the effective change date, and thus are less concerned with profits.

In general, as the available evidence (which points to a negative impact on the profitability of index tracking funds) is based solely on data from S&P 500 tracker funds, one wonders whether this evidence is generalizable to funds that track other major non-US indices such as the FTSE 100 and the Nikkei 225.

4.0 DISCUSSION

This review is aimed at identifying the key research streams and themes, summarizing the main findings with respect to each theme and synthesizing the literature with a view to providing a holistic assessment of the current state of knowledge. In this section, we provide some comments and observations on current findings, and also draw attention to major areas of controversy, disagreement and debate.

4.1 Asymmetric Effects and its Causes

In contrast with earlier studies, Chen et al. (2004) report an asymmetric effect for S&P 500 additions and deletions.[8] Specifically, they find that when a stock is included in the index, it is often accompanied by significant improvements in liquidity, analyst coverage and other related variables. Deleted stocks on the other hand are not necessarily accompanied by negative changes in those variables. Mase (2007) also observes that changes in abnormal trading volume occur for additions to the FTSE 100 but not for deletions. He attributes this asymmetric effect to the lack of anticipatory trades by non-index-tracking investors on deleted stocks. Daya et al. (2012) also observe similar asymmetric effects on the level of liquidity and media coverage for FTSE 100

[8] Beginning with Shleifer (1986) and Harris and Gurel (1986), the bulk of the studies find that additions yield significant increases in trading volume and other firm attributes while deletions yield significant decreases in those attributes.

additions and deletions. The authors attribute this occurrence to the disproportionate impact of the changes on firm-specific risks, trading volume and informational efficiency of added stocks relative to deleted stocks. From the studies cited above, it can be inferred that the explanations propounded for the observed asymmetric effects are all empirically motivated; the literature offers little theoretical explanations of how or why index revisions impact added and deleted stocks differently.

4.2 Are the Effects Temporary or Permanent?

One other important observation in the extant literature is that while there appears to be some consensus on the magnitude and direction of the index effect, there are inconsistencies regarding whether the effects are permanent (persistent) or temporary (transitory). As shown in Table 1, while some studies find evidence of permanent effects, others find evidence to the contrary. Although some theoretical explanations have been put forward for both effects, the reasons for the conflicting empirical findings are still unclear. The lack of clarity about whether the effects are temporary or permanent is not helped by the fact that very little has been offered, empirically, on the cause(s) of this inconsistency; existing studies have tended to not go beyond merely mentioning 'underreaction' and 'overreaction' as possible explanations for the observed permanent and temporary effects, respectively. One possible reason for the divergent findings though is the lack of consistency in the literature regarding the length of the event window over which the effects are measured. This makes direct comparison of results across studies a little complicated.

As Duque and Madeira (2004) correctly noted, ascertaining the persistence of the observed effects is crucial for determining the most plausible explanations for the effects. Judging from what has been documented in the wider literature on stock market anomalies, there seems reasonable indication that the persistence, or lack thereof, of the price effects may not be independent of the specific anomalies present in the market(s) under investigation. For example while short term price continuity (or momentum) patterns have been found to be strong in North American and European markets, the Japanese market has been show to exhibit strong short-term reversal patterns (Iihara et al. 2004; Fama and French, 2012). So far no attempt has been made to empirically link the observed effects to market anomalies and investor sentiment.

4.3 Are the Observed Price Patterns Economically Exploitable?

Although an overwhelming majority of the short-run studies document evidence of systematically positive or negative returns in the period around the announcement of a stock's inclusion or deletion from an index, they appear to ignore the possibility of obtaining abnormal profits from trading strategies that exploit the observed return patterns. Having said that, a small number of mainly long horizon studies have explored the profitability of simple strategies designed to exploit the patterns recurrently exhibited in the prices of newly included and deleted stocks on the Russell 2000 and the S&P 500 indices in the US, and also the HSI in Hong Kong. These studies employ the simple zero-cost trading strategy which simultaneously purchases and sells the portfolio of additions and deletions such that the execution costs cancel each other out. Chan et al. (2013) find that shorting the S&P 500 additions and going long on the deletions yields statistically significant abnormal returns of 28% (or 0.78% per month) over the subsequent three-year period and 32% (or 0.54% per month) over the subsequent five-year period respectively. Similarly, Cai and Houge (2008) report that the portfolio of firms deleted from the small-cap Russell 2000 index consistently outperform the portfolio of added firms with statistically significant excess returns across horizons up to four years; excess returns in year one averaged 0.66% per month while in years two to four it averaged 0.36% per month. The results obtained for US markets appear to be unsupported by international evidence. For instance, Kot et al. (2015) examine the profitability of a zero-cost trading strategy for changes to Hong Kong's HSI, and fail to find evidence of statistically significant difference in returns between added stocks and deleted stocks over the one-year horizon. In general, whether the trading strategies can generate consistent and economically significant profits, after taking into account commission fees, transaction costs and taxes, remains to be seen.

Furthermore, when researchers suggest that it might be possible to generate abnormal profits by trading deletions against the additions, they usually do not discuss the issues with deleted samples. But given that most index changes are driven by deletions, there are reasons to believe that the problems posed by deleted stocks can be important. First, majority of indices delist firms facing litigation, liquidation or bankruptcy risks, or firms that are potential buyout or takeover candidates. Under Nikkei 225 index revision rules, constituent stocks that are under "supervision, investigation or monitoring" become candidates for deletion. Similarly, deletions on the S&P 500 are related to firms' poor prospects (Chan et al. 2013). Given the above, deleted stock samples present a unique challenge in that they are likely to be distressed, at risk of

bankruptcy, unattractive for trading and thus illiquid. For researchers, this underscores the need to be wary of the potential bias in the abnormal return estimates for deleted stocks arising from contemporaneous events unrelated to the index change. Moreover, there is a serious limitation to studies that suggest a long-short strategy involving trades between the portfolios of additions and deletions. Deletions samples may be difficult to arbitrage since, as mentioned previously, they are likely to be unprofitable, distressed and not very liquid. To provide a more cautious and reliable basis for implementing a long-short strategy therefore, it is vital for researchers to consider alternative combinations, such as trading additions against the futures contract instead.

4.4 Is the Magnitude of the Effects Declining?

Another important debate in the literature worth highlighting is the question of whether the economic magnitudes of the effect have diminished in recent years. Soe and Dash (2008) compare changes in the magnitude of excess returns earned by stocks added to a number of indices (including the S&P 500, FTSE 100 and Nikkei 225) between two equal periods - September 1998 to August 2003 and September 2003 to August 2008. The authors find that the median excess returns between the announcement day and effective day for the sample of added firms to the S&P 500 contracted from 6.05% in the pre-2003 period to 3.76% in the post-2003 period. They report a similar trend for stocks added to the Nikkei 225. Increases in the number and scale of activity of index arbitrageurs in recent years were cited as possible causes of the diminishing magnitude of the observed price effects. Similarly, Kamal *et al.* (2012) assert that information asymmetry in the financial markets in the post-2000 era may have decreased due to changes in global financial market regulation and tighter rules aimed at boosting corporate transparency. To test their assertion, they examine changes in abnormal returns and liquidity to firms added to the S&P 500 index in the pre-2000 period as well as the post-2000 period. Comparing the magnitude of changes in the two periods, the authors find that announcement-day changes in abnormal returns and post-announcement period changes in liquidity of stocks added to the S&P 500 have become marginal in the post-2000 period.

This issue is probed further in another study by Kamal (2014) who compares the abnormal returns for a sample of stocks deleted from the S&P 500 index from October 1989 to December 2011. Splitting the sample into pre- and post-2000 periods, she finds that although the announcement-day mean abnormal return for the deletions is negative and insignificant in the

post-2000 era, it is not significantly different from the mean abnormal return in the pre-2000 era. Furthermore, the author reports evidence of early reversal of abnormal returns in the post-2000 period compared to the pre-2000 period. She also finds that liquidity changes for deleted stocks in the post-2000 period are insignificant. A study on the S&P 500 and Russell 2000 indices by Petajisto (2011) provides corroborating evidence. Using data from 1990 to 2005, the author traces the evolution of the price effects and finds evidence of a regime shift after the year 2000. Specifically, he finds that the magnitude of the price effects for additions and, to a lesser degree, deletions peaked in 2000 and declined thereafter.

The overall picture emerging from this strand of the literature is one of declining magnitudes of the premium associated with index reshuffles in recent years.

4.5 Effects on Incumbents

As table 1 reveals, the literature in this area has focused almost entirely on the effects on the sample of firms added to or deleted from an index. However Gygax and Otchere (2010) add a new dimension to the existing literature; they examine the effects on the sample of 'incumbents' (i.e. firms that retain their membership after each revision cycle). The authors use data from the S&P 500 index. Specifically, they analyse the effects on (i) industry peers, i.e. incumbents in the same industry as the added or deleted firms, and (ii) non-industry peers, i.e. incumbents in industries different from the added or deleted firms. They report evidence of significant negative abnormal returns for the incumbents on the effective date of the index additions; industry peers of the added firms earn −0.19% and −0.30% in cumulative abnormal returns over the 5-day and 11-day event windows respectively, while the non-industry peers generate significant cumulative abnormal returns of −0.02% over the 5-day event window. By the same token, the industry peers of deleted firms earn abnormal returns of −0.10% and −0.33% over the 5-day and 11-day event windows respectively. In addition the authors report that, from the announcement date to the effective date, industry peers of additions earn -0.06% and that of deletions -0.32%, consistent with the notion that markets react more strongly to bad news than to good news. They conclude that addition to (deletion from) the S&P 500 generates significant positive (negative) industry effects for incumbents. Outside this study on the S&P 500, there is almost no literature on how revisions affect incumbent firms.

4.6 The Case of Emerging Markets

One observation that emerges from this survey is that existing studies have focused predominantly on indices domiciled in North American, European and the Asia-Pacific markets. Studies on emerging or frontier markets are few and far between, and tend to be carried out in multi-country index settings. For example Chakrabarti et al. (2005) examine the effects on changes to Morgan Stanley Capital International (MSCI) country indices in a broad sample of countries, consisting of both developed and emerging economies.[9] Using data drawn between 1998 and 2001, the authors find that stocks added to (deleted from) the developed country indices experience statistically significant price increases (declines) of 3.29% (-4.51%) on the day following the announcement. Emerging market stocks on the other hand experience insignificant price changes of 1.06% and -0.91% for inclusions and deletions, respectively. Hacibedel and Bommel (2007) echo the findings of Chakrabarti et al. (2005). Using data on MSCI Emerging Markets (EM) index comprising a total of 26 emerging markets from 1996 to 2004,[10] they find that the observed price gains of roughly 2% are slightly smaller in magnitude than what has been observed for US and, presumably, other developed market indices. On the whole, these studies suggest that index investor demand shocks are smaller in emerging markets compared to developed markets.

However, some particularly astounding results have been reported by authors using single country data from emerging markets. Miller and Ward (2015) examine the price effects of index changes for additions and deletion using data from four South African stock indices between September 2002 and June 2011. They find significant price increases (declines) of about 7% (17%) for index additions (deletions) 70 days (100 days) before the index reconstitution date. Immediately after the index reconstitution date, the price increases (declines) dramatically reverse, with the deletions outperforming the additions. Their finding is quite intriguing in the sense that it indicates that a significant portion of the price reactions occur several months before the index revisions are made. In our view, an in-depth investigation into the nature of the institutional, legal, regulatory and general market microstructure of the South African stock

[9] Developed markets in the sample are Australia, Canada, Finland, France, Germany, Hong Kong, Italy, Netherlands, New Zealand, Norway, Singapore, Sweden and Switzerland, and the stand-alone markets of the US, UK and Japan. The emerging markets are Brazil, China, India, Indonesia, Malaysia, Philippines, South Africa, South Korea, Taiwan, Thailand, Turkey and Venezuela.

[10] The countries include: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, Turkey and Venezuela.

market may help rationalize this incongruence. Wang et al. (2015) provide far less intriguing evidence on the index effect in emerging markets. The authors looked at the effects on inclusions and deletions on China's CSI 300 index between 2005 and 2012. The magnitudes of the price and volume effects they report are much smaller than what has been documented for S&P 500 firms, consistent with the findings of Hacibedel and Bommel (2007) and Chakrabarti et al. (2005).

Although the studies by Miller and Ward (2015) and Wang et al. (2015) were carried out under single-country settings, it will be interesting to see more such studies on emerging markets. This is pertinent as there are distinct differences in the nature of the institutional, legal and microstructure framework within the emerging and frontier markets themselves. For example, Khanna and Palepu (2010) (as cited in Marquis and Raynard, 2015, p. 297) note that there are clear differences between the emerging markets of Africa, Latin America and those in East Asia, Eastern Europe and the Middle East in terms of the extent of institutional, legal and corporate governance reforms and their degree of liberalization and integration with the global markets. Such differences underscore the need for the price discovery process in emerging equity markets to be understood and studied individually, rather than as a homogenous group. Adopting this approach in future studies may help uncover the extent to which complexities in the institutional, economic and political environment of the individual markets influence the index effect.

4.7 Differences in Index Rebalancing Policy and Membership Selection Criteria

One theme that has emerged in this survey so far relates to some discrepancies in the literature about the magnitude of the rebalancing effects. As the selection criteria hypothesis suggests, the degree to which the market anticipates or predicts changes to an index can be expected to affect the magnitude of the price and volume effects. Central to this debate is the effect of using different index rebalancing procedures, selection criteria and eligibility rules. For example stock indices differ in terms of whether they have a regular (scheduled) rebalancing calendar or an irregular (unscheduled, ad hoc) one. These differences, some argue, may affect the extent to which market participants are able to form expectations about the exact timing of future rebalancing events, which in turn may affect the magnitude of the observed price or trading volume effects. Table 2 provides a snapshot of some key differences in index revision policy among a selection of index providers. As the table indicates, indices with unscheduled changes, such as the S&P 500, generally do not follow a regular rebalancing calendar, and as such market

participants are unaware of any potential changes in the index until when such changes are announced. By contrast, revisions to the FTSE 100, Nikkei 225 and the MSCI indices occur regularly and have a set schedule. The FSTE 100 for instance is rebalanced on a quarterly basis. The changes are implemented at the close of business on the third Friday of the months of March, June, September and December. According to the London Stock Exchange, announcements to the changes are made twelve (12) business days before the implementation date to "provide clients a longer notice period to prepare for the trades involved following each review."[11] Similarly, the Nikkei 225 index is revised and changes implemented once a year at the beginning of October. Before then, announcements of any changes are made around the middle of September. However the Nikkei 225 Index Committee may, in addition to the scheduled changes, make "extraordinary replacements" to the index on an as-needed basis. Since changes to the constituents of these indices in general are scheduled to occur at clearly specified calendar times, investors are more likely to form expectations and be prepared for possible changes to the composition of the indices. These expectations, coupled with the greater lead time, can produce price and volume reactions that differ in magnitude from those observed for indices with irregular or unscheduled changes such as the S&P 500.

A closely related issue concerns how the level of anticipation of what stocks might be expected to be included or delisted from an index is influenced by the degree to which rules governing index membership are transparent (opaque) and objective (subjective). For example S&P 500 index membership criteria are subjective and may be seen to convey information about the future prospects of the firms (Elliot et al. 2006). Also, the candidate replacement pool is unknown and kept secret (Sui, 2006). In a recent blog post, the Chairman of the S&P 500 Index Committee, David Blitzer, alluded to the subjective nature of S&P 500 revisions in the following words: "Unlike many other S&P Dow Jones Indices and the majority of indices offered by other index providers, there are no rigid or absolute rules for the S&P 500; the Index Committee have some discretion in selecting stocks or responding to market events" (August 7, 2014).[12] Given the above, revisions to the S&P 500 index are not only difficult to predict but also may signal what the Index Committee believes is the future prospect of the affected firms. And because of this,

[11] Prior to March 2014, announcements of changes to the index were made on the Wednesday after the first Friday of the month.

[12] "Inside the S&P 500: An Active Committee", Available on the S&P Dow Jones Indices blog: www.indexologyblog.com/2014/08/07/inside-the-sp-500-an-active-committee/

changes to the index could be expected to have a relatively large impact on the market price and trading volume of stocks that are added or removed from the index.

Changes to the FTSE 100, on the other hand, are based mainly on market capitalization (firm size) - stocks inside the index whose market capitalization ranking falls to 111th or below become candidates for automatic deletion while any stock whose market capitalization ranking rises to 90th position or above becomes a candidate for automatic addition.[13] A similar situation occurs in the case of Nikkei 225 revisions. However, instead of ranking stocks according to market capitalization, the index ranks stocks according to their liquidity.[14] Specifically, stocks with low liquidity may be removed from the index and replaced by stocks within the same sector selected from the list of the top 450 most liquid stocks listed on the First Section of the Tokyo Stock Exchange. Since the revision rules for the FTSE 100 and the Nikkei 225 are published, predefined and based on publicly available information, changes to the indices are, in principle, 'non-informational' and reflect nothing more than jumps in market capitalization and liquidity respectively. More importantly, this implies that not only can index trackers easily predict changes to the FTSE 100 and the Nikkei 225 indices but also the magnitudes of the market impact of the revisions should be smaller, relative to the S&P 500, since investors are able to anticipate the changes ahead of time and thus spread out their trades over a longer time.

4.8 Level of Indexing

As index funds track closely the performance of the underlying index, the magnitude of the observed price and volume effects may also be heavily influenced by the amount of money directly tracking a given index. This is reflected in the size of the demand for stocks that are added to an index. If the amount of money is marginal, we can expect the demand shock, and hence the observed magnitude of the price and volume effects, on newly included stocks to be small (all else being equal). On the other hand if the amount of money directly tied to an index is substantial, we can expect the magnitude of the effects to be large. From this perspective, heavily tracked indices such as the S&P 500 with an estimated USD 2.2 trillion in directly-linked funds may face significant short-term price pressures due to exceptionally high trading volumes by

[13] Market capitalization, or firm size, is calculated by multiplying the number of issued shares of a company by the current share price.

[14] The Nikkei 225 Index Committee assesses liquidity of a stock by two measures: "trading value" and "magnitude of price fluctuation by volume" computed as (High price/Low price) / Volume.

index trackers on newly included stocks. Short term price pressures will occur when there is not enough volume to absorb the demand for added stocks by index trackers, and this ultimately will influence the overall magnitude of the observed effects. As this survey clearly indicates, the S&P 500, apart from being the most popular index in the world, has been the reference point for academic research on the index effect largely because the estimated USD 2.2 trillion directly linked to the index dwarfs other relatively lightly tracked indices such as the MSCI indices (USD 473 billion) and the Nikkei 225 index (USD 84 billion). Table 3 shows the figures corresponding to the amount of money tracking a selection of major indices.[15] There are instances, though, where the (lack of) liquidity of the additions and deletions may supersede the impact of the amount of money tied to an index. For example, although more money tracks the S&P 500, the magnitude of the rebalancing effects is greater for the less heavily tracked Russell 2000 index which is composed of predominantly small, illiquid stocks (Quinn and Wang, 2003).

4.9 Econometric and statistical inferential issues

Since the initial study by Shleifer (1986), almost all subsequent studies employed the event study methodology to investigate the effects of index composition changes. However, the difficulty of dealing with the econometric and statistical inferential issues associated with event study methods may appear to weaken the robustness, reliability and validity of some of the results of these studies, particularly the long-term and the multi-country studies (Kothari and Warner, 2007; Campbell et al. 2010).

4.9.1 Sensitivity of results to the model of computing abnormal returns

Estimating abnormal returns requires the use of a benchmark model for estimating "normal" returns, or returns that would have been "expected" in the absence of the event being analyzed. There are several alternative models used in computing abnormal returns. Some of the commonly used ones include the market model, the market-adjusted model and the Fama and French (1996) three-factor model. Each of these models has its own assumptions about the relationship between risk and expected return and how risk should be measured. As such, the results of a study may be influenced by the researcher's choice of abnormal return calculation method. For example expected return in the *market model* is,

[15] Figures are as at August 2016 for all indices except for the FTSE Indices which is as at February 2013

$$E[R_i] = \alpha_i + \beta_i \; E[R_m], \tag{1}$$

where α_i and β_i are the model parameters and R_m the market return. In this context, abnormal return is,

$$AR_i = R_i - (\hat{\alpha}_i + \hat{\beta}_i R_m), \tag{2}$$

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ are ordinary least squares (OLS) estimates of the model parameters α_i and β_i. However, in the *market-adjusted model*, the parameters α_i and β_i in equation [1] are restricted to be equal to zero and one respectively. The market-adjusted returns model, also known as the index model, equates each security's expected returns to the return earned on a broad market index, as follows:

$$E[R_i] = E[R_m]. \tag{3}$$

Because the parameters are predefined, a separate estimation window is usually not required in computing abnormal returns under this setting. Consequently, abnormal return is simply computed as:

$$AR_i = R_i - R_m. \tag{4}$$

Another model of expected returns used in the literature is the *Fama and French three-factor model*. Unlike the market model that considers only one source of risk (i.e. market risk), the Fama and French (1996) model adds two additional sources of risk that capture variations related to *size* and *book-to-market* (or *value*) factors. Specifically, expected return in the three model framework is,

$$E(R_i) - R_f = b_i [E(R_m) - R_f] + s_i E(SMB) + h_i E(HML), \tag{5}$$

where $E(R_m) - R_f$, $E(SMB)$ and $E(HML)$ are expected premiums on the market, size and value factors respectively, while their corresponding loadings, b_i, s_i and h_i, are the slopes in the regression equation:

$$R_i - R_f = \alpha_i + \beta_i (R_m - R_f) + s_i SMB + h_i HML + \varepsilon_i \quad \text{with} \quad \varepsilon \sim N(0, \sigma_i^2), \tag{6}$$

where the intercept, α_i, is the event firms' portfolio 'alpha' and provides an estimate of the abnormal return while b_i, s_i and h_i indicate how much of the event firms' portfolio returns are associated with the respective risk factors.[16]

On the whole, by including the size and value risk factors, the Fama and French three factor model adjusts downward the abnormal return estimates. As a result, the magnitude of event-induced abnormal returns reported by studies that use the three factor model may be smaller compared to studies that employ single-factor models.

4.9.2 Other methodological issues

A key methodological problem encountered by researchers concerns the estimation of the model parameters. An overwhelming majority of studies estimate the betas from the pre-event (historical) period. One drawback of this approach is that it ignores any shifts in the betas over time. Indeed, Jain (1987) demonstrates that stocks that are added to the S&P 500 index tend to perform better in the pre-event period. Thus the estimation of the event stock alphas and betas from periods that overlap with the pre-event period may produce inaccurate and misleading abnormal return estimates.

Furthermore, since most index revisions are announced or effected on the same day, it is possible that some of the existing studies may have been exposed to biases in standard errors associated with date-clustered event studies.[17] This is particularly significant for studies that focus on a single event change in an index composition (for example Hanaeda and Sarita, 2003; Wilkens and Wimschulte, 2005). More fundamentally, since index changes are often clustered in calendar time, empirical tests of the index effect could embrace new test procedures and methods, such as the one proposed by Kolari and Pynonnen (2010) which takes into cognizance cross- correlation of abnormal returns induced by event-date clustering. Also, limiting the horizon length for long run studies to a maximum of 3 years may enhance the reliability of the estimate since inference

[16] In the three factor model specification, SMB is the average return on a diversified portfolio of small stocks minus the average return on a diversified portfolio of big stocks; HML is the average spread in returns between portfolios of value stocks (or stocks with high book-to-market ratios) and portfolios of growth stocks (or stocks with low book-to-market ratios).

[17] Afego (2016) exemplified the importance of such exercise in a recent study on the price effects of Nikkei 225 revisions. The author found little evidence of statistically significant price effects after controlling for cross-sectional dependence in the data.

for tests of post-event abnormal performance become increasingly biased as the horizon length extends farther out (Cowan and Sergeant, 2001; Kothari and Warner, 2007).

On the whole, researchers have proposed a number of other approaches and methods, including bootstrapping, to address some of the econometric and statistical problems associated with estimating the wealth effects of index composition changes.[18]

5.0 CONCLUDING REMARKS AND AREAS FOR FUTURE RESEARCH

This paper has surveyed the literature on market reaction to index composition changes. A vast majority of the early studies in this research area focused on price and volume effects for S&P 500 firms due, possibly, to the substantial value of investment assets directly benchmarked to the index. But more recent studies have attempted to quantify the impact on variables other than price and trading volume, albeit predominantly on the U.S and a few other developed markets in Europe and the Asia-Pacific region. Despite the increasing number of indices with exposure to emerging markets, research on these markets has received little attention and, for the most part, has tended to employ data on multi-country indices as opposed to single-country indices. Similarly, controversy as to whether the observed effects are permanent or transitory still remains.

Some areas for future research are evident from this survey. First, to better understand the complex interrelationship between investor behaviour and local contexts, future studies could look at how the price formation process around the index revision dates in emerging markets differ from those in developed markets. For instance, given the unique socio-political and regulatory environments of emerging markets, is trading behaviour around the index change dates distinctively affected by lax laws and weak regulation relating to, say, insider trading? What are the implications of the lower levels of informational efficiency and liquidity in these markets on price behaviour around the time of index revisions? Is country risk premium reflected in the magnitudes of the returns earned on trades around the index change dates in these markets relative to their developed-country counterparts? Furthermore, cross-country studies can help shed light on whether country-specific anomalies matter in driving the magnitude and persistence – or lack of persistence – of the price effects both in the short- and long-term. For example while

[18] A detailed review of the methodological literature on event studies is beyond the scope of this survey. We refer interested readers to Kothari and Warner (2007) and Dionysiou (2015) for a detailed discussion of these topics.

momentum effects are found to be particularly strong and persistent in US and European markets, they do not seem to be present in the Japanese market (Fama and French, 2012, Asness et al. 2013). Hence establishing the potential role of market-specific anomalies may provide some pointers on the dichotomy between studies that document temporary price effects and those that report permanent effects.

Second, more research from a micro-institutional perspective is needed to better understand how an index's repertoire of policies, rules and tracker funds influence the magnitude of the rebalancing effects. As our review showed, there is the intuitive, albeit overlooked, argument concerning differences in rules governing revisions and membership eligibility across indices. The amount of *new* or *unexpected* information contained in each rebalancing decision is to a large extent dependent on the degree to which the index selection rules are objective (subjective), transparent (opaque) and thus predictable (unpredictable). Similarly, it is likely that differences in frequency of rebalancing and time interval (in days) between the announcement and implementation dates of the changes, across indices, may impact prices (and trading volume) differently. More research is required to provide richer contexts for these empirical questions.

Third, a survey of the literature suggests that richer hypotheses with stronger theoretical foundations need to be developed to advance research in this field. So far, there has been little effort to formulate or offer theoretical perspectives on the subject. Hence a promising area for future work is developing theoretical models and advancing discussions in the theoretical realm.

Fourth, there is need for more research linking the literature on the index effect with other streams of the wider finance literature. Specifically, it would be beneficial to see studies attempting to establish a link between the index premia and the wider literature on (i) investor sentiment, and cultural factors as variously discussed by Baker and Wurgler (2006), Lemmon and Portniaguina (2006), Baker and Wurgler (2007), Schmeling (2009), Chui et al. (2010) and Stambaugh et al. (2012) and (ii) corporate governance and stock returns as discussed by Gompers et al. (2003) and Core et al. (2006).

Fifth, regarding research on the long-term impact of index revisions and the well-documented inferential and statistical caveats especially associated with long-horizon tests, future research could examine the long-term impact of the revisions using more robust econometric and statistical techniques. Evidence about how revisions to an index affect firms' long-term

performance and shareholder value should be of interest to traditional buy-and-hold investors such as pension funds, sovereign wealth funds and insurance companies. Furthermore, future studies could employ multiple abnormal return computation methods. This will not only improve the robustness of the results of individual studies, but may also facilitate cross-study comparisons of results. In view of the possible bias in estimating the model parameters from a historical period, future efforts could also revisit the literature by using more robust procedures. This way, spurious inferences can be avoided and, at the same time, differences in the estimates obtained using different procedures can help in quantifying the bias.

Finally, as our survey reveals and as Petajisto (2008) correctly noted, research on the index effect has been approached mainly from the perspective of the information content of the revisions, efficiency of the market and how short-term investors and arbitrageurs can exploit any observed mispricing induced by the index revisions. Very little attention has been paid to the potential impact on index-tracking funds themselves who, in a bid to minimize their tracking error, usually buy (sell) the new additions from (deletions to) arbitrageurs at significant markup (discount) on the effective date. The few available studies all examine the impact on funds tracking the S&P 500 index. Future research could perhaps examine how and to what extent the activities of arbitrageurs around the index revision dates affect the competitiveness and performance of tracker funds indexed to popular non-US indices such as the FTSE 100 (London) and Nikkei 225 (Tokyo). Moreover, undertaking this task can shed some light on the extent to which differences in rebalancing policy, selection criteria and value of index-linked assets, across indices, affect the performance/profitability of tracker funds.

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Table 1: Summary of selected (recent) studies that examine the effects of changes in index composition

Author(s)	Focus of Investigation	Index/Country/ Sample Period	No. of Events/Sample size	Findings/Explanations
Liu (2000)	Price and volume effects	Nikkei 500 (Japan); 1991- 1999	92 additions; 86 deletions	Imperfect substitute hypothesis (Downward sloping demand hypothesis)
Masse et al. (2000)	Price effects	TSE 300 (Canada); 1984-1994	134 additions; 109 deletions 18 additions; 21 deletions	Price pressure hypothesis
Rigamonti & Barontini (2000)	Price and volume effects	Mib30, Midex (Italy); 1995 -1999	(Mib30) 14 additions; 16 deletions (Midex)	Information hypothesis/Liquidity hypothesis; Price pressure hypothesis
Deininger et al. (2000)	Price and volume effects	DAX, MDAX (Germany); 1988 -1998	4 additions; 4 deletions (DAX) 16 additions; 18 deletions (MDAX)	Imperfect substitute hypothesis; Liquidity hypothesis; Price pressure hypothesis
Wurgler & Zhuravskaya (2002)	Price effects (additions only)	S&P 500 (US); 1976 - 1989	259 additions	Imperfect substitute hypothesis
Denis et al. (2003)	Earnings forecasts and realized earnings (additions)	S&P 500 (US); 1987 - 1999	236 additions	Imperfect substitute hypothesis; information effect
Hanaeda & Sarita (2003)	Price and volume effects	Nikkei 225 (Japan); April 2000	30 additions; 30 deletions	Imperfect substitute hypothesis

Benchmann (2004)	Price and volume effects	KFX (Denmark); 1989 – 2001	52 additions; 52 deletions	Imperfect substitute hypothesis; information/liquidity hypothesis; selection criteria hypothesis
Biktimirov et al. (2004)	Price, volume and institutional ownership effects	Russell 2000 (US); 1991 – 2000	4231 additions; 3092 deletions	Price pressure hypothesis
Chen et al. (2004)	Price and volume effects	S&P 500 (U.S) 1962 – 2000	760 additions; 235 deletions	Investor awareness hypothesis
Chakrabati et al. (2005)	Price and volume effects	MSCI (Multi-country); 1998 – 2001	455 additions and deletions	Imperfect substitute hypothesis
Becker-Blease & Paul (2006)	Liquidity effects (additions only)	S&P 500 (US); 1980 – 2000	185 additions	Liquidity hypothesis
Chen et al. (2006)	Index-tracking funds	S&P 500 (US), 1989 – 2002; Russell 2000 (US), 1990 – 2002	263 additions; 72 deletions 7244 additions; 4969 deletions	Loss to index funds
Gregoriou & Ioannidis (2006)	Price and volume effects	FTSE 100(UK); 1984 – 2001	258 additions; 258 deletions	Information/liquidity hypothesis
Okada et al. (2006)	Price and volume effects (additions only)	Nikkei 225 (Japan); 1991 – 2002	69 additions	Price pressure hypothesis
Mase (2006)	Price effects	FTSE 100 (UK); 1992 – 1999	85 additions; 72 deletions	Investor awareness hypothesis
Shankar & Miller (2006)	Price, volume and institutional ownership effects	S&P 600 (SmallCap)	504 additions; 112 deletions	Price pressure hypothesis

Vespro (2006)	Price and volume effects	CAC 40, SBF 120 (France); FTSE 100 (UK); 1997 – 2001	24 additions; 14 deletions (CAC 40 & SBF 120) 23 additions; 28 deletions (FTSE 100)	Price pressure hypothesis
Liu (2006)	Price and volume effects	Nikkei 225 (Japan); 1970 – 2002	105 additions; 48 deletions	Imperfect substitute hypothesis
Pullen & Gannon (2007)	Price and volume effects	S&P/ASX 200 (Australia); 2000 – 2001	51 additions; 48 deletions	Price pressure hypothesis
Hacibedel & Bommel (2007)	Price and volume effects	MSCI (Multi-country); 1996 – 2004	269 additions; 262 deletions	Investor awareness hypothesis
Mazouz & Saadouni (2007)	Price and volume effects	FTSE 100 (UK); 1984 – 2003	190 additions; 187 deletions	Price pressure hypothesis
Mase (2007)	Price and volume effects	FTSE 100 (UK); 1992 – 2005	132 additions and deletions	Price pressure hypothesis
Cai & Houge (2008)	Price effects	Russell 2000 (US); 1979 – 2004	865 additions and deletions	Imperfect substitute hypothesis
Gygax & Otchere (2010)	Price and information effects (Incumbents)	S&P 500(US); 1978 – 2006	183,734 non-industry peer sample; 20,460 same industry peer sample	Price pressure and information hypotheses
Daya et al. (2012)	Informational Efficiency effects	FTSE 100 (UK); 1984 – 2009	212 additions; 210 deletions	Investor awareness hypothesis
Chan et al. (2013)	Liquidity, institutional ownership &	S&P 500 (US); 1962 – 2003	788 additions; 244 deletions	Imperfect substitute, liquidity and information hypotheses

	operating performance			
Biktimirov & Li (2014)	Price and volume effects	FTSE SmallCap (UK) 1998 – 2008	672 additions; 532 deletions	Liquidity and price pressure hypotheses
Kamal (2014)	Price and volume effects (Deletions only)	S&P 500 (US); 1989 – 2011	115 deletions	Liquidity hypothesis
Miller & Ward (2015)	Price effects	FTSE/JSE Indices (South Africa) 2002 – 2011	113 additions and 116 deletions across 4 Indices	Price pressure hypothesis
Wang et al. (2015)	Price and volume effects	CSI 300 (China) 2005 – 2012	266 additions; 314 deletions	Price pressure hypothesis
Li & Tan (2015)	Corporate Governance changes (additions)	S&P 500 (US) 1994 – 2007	393 additions	Governance effects
Fernandes & Mergulhao (2016)	Price and volume effects	FTSE 100 (UK) 1992 – 2010	138 additions; 146 deletions	Imperfect substitute hypothesis

Table 2: Index Revision Policies and Membership Criteria for Selected Indices

Index	Replacement Pool	Scheduled Changes/Frequency	Inclusion Criteria	Transparency Level
S&P 500	Undisclosed	No/As-needed	Various; incl. market cap, financial viability, reasonable price	Low
Nikkei 225	Disclosed	Yes/Annually†	Liquidity, sector balance	Moderately High
TOPIX	Disclosed	Yes/Annually	Change in listed Section to 1st Section from Mothers, JASDAQ and the 2nd Section	High
Russell 2000	Disclosed	Yes/Annually	Market cap, liquidity, free float (no. of tradeable shares)	High
FTSE 100	Disclosed	Yes/Quarterly	Market cap	High
MSCI Indices	Disclosed	Yes/Quarterly; Semi-Annually	Various; incl. liquidity, free float, market cap, industry group	High

† "extraordinary replacements" (or unscheduled changes) may also be implemented on an as-needed basis

Table 3: Value of Index-linked Investments for Selected Indices

Index	Assets invested (USD trillion)
S&P 500	2.2
Nikkei 225	0.084
TOPIX	0.060
Russell 2000	0.041
MSCI Indices†	0.473
FTSE Indices*	3.0

Source: S&P Dow Jones Indices, Bloomberg, Morningstar, MSCI, London Stock Exchange Group

† comprises of the MSCI World index plus about 160,000 other individual MSCI indices

* comprises of the FTSE 100 plus over 100,000 other individual FTSE indices