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THE EFFECT OF DOW JONES INDUSTRIAL AVERAGE INDEX COMPONENT CHANGES ON STOCK RETURNS AND TRADING VOLUMES

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ABSTRACT

This study examines the impact of index membership changes in Dow Jones Industrial Average (DJIA) Index on the return and trading volume of the affected stock. We make two key contributions to the literature. First, we employ a robust event study methodology based on Fama-French Momentum Model with EGARCH to explore the price/volume dynamics associated with DJIA Index additions and deletions. Second, we extend earlier work by incorporating all index reconstitution announcements after Dow Jones & Company began preannouncing index changes in 1990. Our results show that index additions (deletions) experience temporary increases (decreases) in stock prices following the announcement. The abnormal returns surrounding the announcements are economically and statistically significant. In addition, both inclusions and removals lead to temporary abnormal trading volume increases in the post-announcement period. However, the stock prices and trading volumes revert within a few trading days. Our findings are consistent with the price pressure hypothesis as the documented abnormal returns and trading volumes are not permanent.

JEL: G12, G14

KEYWORDS: Dow Jones, Event Study, Index Reconstitution; Fama-French Momentum Model, Abnormal Return and Volume

INTRODUCTION

The Dow Jones Industrial Average (hereafter DJIA) Index is one of the best-known stock market indices in the world. It is often referred to as simply the "Dow." The index consists of thirty 'blue-chip' large market capitalization stocks that serve as gauge of the US stock market and economy. The DJIA Index has been in existence since 1896 and continues to play important roles as a global stock market index leader and a leading indicator of the U.S. economy. It is widely followed by investors throughout the world. In recent decades, financial institutions began to offer investment products that derive from the value of the DJIA Index. These financial instruments include but are not limited to Dow Jones index funds, exchange-traded funds (ETFs) and index futures and options contracts. In addition, there are currently index trading strategies that are based on the DJIA that perform program trading, index hedging and other actively traded risk management programs. The offering of these index financial instruments demonstrates the importance and practical applications of the DJIA Index and how investors utilize the market index in portfolio management, risk management and other financial trading programs.

From time to time, a Dow company may be replaced due to corporate events such as name change, merger and acquisition. The Standard and Poor's (S&P) Dow Jones Index Committee is responsible for overseeing the DJIA Index and deciding on index membership changes. In this study, we investigate the impact of DJIA Index changes on the prices and trading volumes of the affected stocks. Given that DJIA is a stock market index of vast investor interest worldwide and its linkage with popular index trading strategies, it is

critical to determine the effect of Dow Index changes on the stocks that are added to and deleted from the Index. Earlier studies that focus on DJIA Index component changes find mixed results. The pioneering work of Varela and Chandy (1989) illustrate that there is no significant change in stock prices when a stock is added to or removed from the DJIA Index. Polonchek and Krehbiel (1994) document positive significant abnormal returns and trading volumes for newly listed DJIA companies but find no significant changes in returns and volumes for stocks removed from the Index. In the contrary, Beneish and Gardner (1995) show that DJIA Index additions are not associated with changes in stock prices or trading volumes.

The primary objective of this study is to examine further the impact of DJIA Index changes. We make the following two main contributions to existing literature. First, we extend the index component changes sample of Polonchek and Krehbiel (1994) and Beneish and Gardner (1995) to include the time period where S&P began to pre-announce index changes several days prior to the actual effective inclusion/removal. This allows us to study the impact of index changes around the announcement and the effective dates. Moreover, we gather close to 30 years of (post-crash) DJIA Index changes data to coincide on the growth of DJIA Index trading instruments and strategies. In addition, we employ more sophisticated econometrics techniques like the Fama-French Momentum approach [see Fama and French (2012)] and EGARCH model to investigate the event of index component changes. These techniques provide us with additional insights with regard to robustness of the empirical analysis.

Our results indicate, in general, that in the more recent decades, newly included (excluded) DJIA stocks experience positive (negative) significant abnormal returns. The abnormal returns around announcement dates are more pronounced than around the actual inclusion/removal dates. However, the observed abnormal returns are only temporary and revert within a few trading days. Both additions and deletions experience significant increases in trading volumes. Again, changes in trading volumes are more noticeable surrounding the announcement date than the actual effective date. We also find that the changes in trading volumes are temporary which further support the price pressure hypothesis. Furthermore, the results are robust and are not dependent on event study stock return-adjustment techniques and model estimation approaches. The results are consistent with other index reconstitution studies that examine indices such as the S&P 500 Index [see Chen, Noronha and Singal (2004)]. This study offers additional insights as to how a stock reacts when it is added to or deleted from the DJIA Index. We contend that the results support the price pressure hypothesis and are correlated with the growth of financial assets and instruments based on the DJIA Index. Finally, we conclude that DJIA index component changes are associated with short-term demand curve changes and thus rule out effect of new information, stock liquidity and shadow cost (i.e., asymmetric information). The rest of the paper is organized as follows. The next two sections provide background of DJIA index component changes, literature review and development of hypotheses. We then discuss data/methodology and presents the empirical results. The final section concludes.

DJIA Index Changes

Following the 2012 merger of McGraw-Hill Companies and CME Group, the parent companies of Standard and Poor's (S&P) and Dow Jones & Company, respectively The Dow Jones Industrial Average (DJIA) Index is currently maintained by the Standard and Poor's Index Committee of S&P Dow Jones Indices, LLC. The committee is in charge of the DJIA Index component changes. The selection criteria, according to the S&P Dow Jones, include sector balance, sustained growth, wide investor interest, excellent reputation and blue-chip company. DJIA Index changes can result from corporate events such as name changes as well as mergers & acquisitions. Prior to 1990, DJIA index changes are announced one day before the actual effective change. For instance, Chicago Tribune reports that Dow Jones announces on Wednesday, March 11, 1987 that Boeing and Coca-Cola (Owens-Illinois and Inco Ltd.) are to be included in (dropped from) the DJIA Index, effective Thursday, March 12, 1987. After 1990, Dow Jones makes 'pre-announcement' of DJIA index changes and the announcement date usually precedes the effective date by several trading days. For example, the Apple Inc. inclusion (and AT&T removal) was announced on Friday, March 6, 2015

and the actual effective date of the inclusion/deletion was on Thursday, March 19, 2015 at the market open. Chen et al. (2004) reports that to ease order imbalances arising from corresponding index trading programs/strategies, Standard and Poor's started to preannounce S&P 500 Index changes from October 1989 onward. Therefore, the reason Dow Jones' decided to preannounce DJIA Index changes may be similar to that for the S&P 500 Index, given the growth of index funds and index program trading in the late 80's. To further understand the effect of DJIA Index changes, this study specifically explores DJIA Index changes after the implementation of the 'pre-announcement' policy since earlier studies did not include such index changes data. This allows us to compare the results to previous work that may yield additional insights on DJIA Index listings and de-listings.

LITERATURE AND DEVELOPMENT OF HYPOTHESES

Previous research studies have examined stock index composition changes and contend that the index changes are related to temporary downward sloping demand curves (price pressure), long-run downward-sloping demand curves (i.e., imperfect substitutes), liquidity costs, information content/environment, and investor recognition/shadow costs. The price pressure hypothesis suggests that index composition changes are associated with temporary order imbalances. Significant order flows generated by short-term change in security demands can result in temporary stock price deviation from its equilibrium level. However, in a semi-strong efficient stock market, the effect of such demand "shocks" should be absorbed quickly and should not cause long-term changes in the level of the stock prices. As a result, the price pressure hypothesis predicts only short-run changes in share prices and trading volumes of added (deleted) stocks. Harris and Gurel (1986) and Lynch and Mendenhall (1997) documents evidence showing temporary changes in stock prices following the S&P 500 Index changes announcements. The changes in prices are non-permanent and revert to pre-inclusion (or pre-deletion) levels.

Shleifer (1986) and Kaul, Mehrotra, and Morck (2000) find that the event time excess returns associated with index changes are not temporary. The abnormal returns documented following index component changes do not revert and stock prices move to a higher (lower) level for index additions (deletions) on a permanent basis. Shleifer (1986) attributes the long-term changes in security prices to permanent changes in the demand for the stock once it enters or exist the S&P 500 Index. Further, Wurgler and Zhuravskaya (2002) contend that security arbitrage risk is an important factor that determines excess returns observed when a stock is added to or deleted from a market index. In other words, a stock with high arbitrage risk should experience strong demand shock since it does not have 'perfect' substitute. The abnormal return around the demand shift would therefore be more pronounced for stocks with high arbitrage risks because arbitragers are less likely to transact those shares in the marketplace.

Amihud and Mendelson (1986) contend that the required rate of return for a stock is reduced when the trading liquidity measured by the bid-ask spreads of the stock become lower. The liquidity costs argument suggests a permanent stock price increases (decreases) for index additions (deletions). Beneish and Gardner (1995) study DJIA index composition changes over the period 1929-1988 and show that the event period abnormal returns and trading volumes are due to information cost/liquidity of the affected stocks. Furthermore, Beneish and Whaley (1996) present evidence of decline in security trading costs (i.e., liquidity) after a firm is added to a stock market index. Moreover, Hedge and McDermott (2003) find that permanent changes in security liquidity costs are directly related to event period cumulative abnormal returns. In this study, we do not consider liquidity costs since companies in the Dow Jones Industrial Average Index are already highly liquid and the stocks are traded globally in various stock exchanges around the world.

Denis, McConnell, Ovtchinnikov, and Yu (2003) and Chen et al. (2004) contend that index inclusions may signal the future prospect of a company and as a result, the permanent changes in share prices after an inclusion may simply reflect new information. Jain (1987) provides evidence that information content may be attributed to the observed excess returns. Furthermore, Dhillon and Johnson (1991) study options and

bond prices of companies that are being added to the S&P 500 Index. They show that call option prices and corporate bond prices respond to index inclusion announcements. Denis et al. (2003) and Zhang, Lin and Shin (2010) document results that S&P 500 Index additions and deletions lead to changes in analyst earnings estimates. They conclude that the event period abnormal returns are related to the changes in information environment of the firms.

The seminal work of Merton (1987) illustrates how a "neglected" stock can be linked to higher idiosyncratic risk (i.e., shadow cost) and this, an investor would require a risk premium for holding such stock. Merton's market segmentation model contends that a reduction in shadow costs corresponds to a lower required rate of return for the security invested. In other words, if index membership affects shadow costs of a firm, it may explain why a stock being included into a market index can experience significantly positive abnormal returns that are permanent. Polonchek and Krehbiel (1994) examine the DJIA roster changes over the period 1962 through 1991 and contend that the observed positive abnormal returns and higher trading volumes associated with Dow additions are due to the attention effect consistent with Merton's (1987) framework. Moreover, Chen et al. (2004) provide novel evidence that market reactions to index additions and deletions are not symmetric. In fact, Chen et al. (2004) show permanent price increases in stocks that are added to the S&P 500 Index but only short-term price declines in the sample of deleted firms. They attribute the asymmetric response to the changes in investor recognition/shadow costs of the affected stocks. Lastly, Elliott and Warr (2006) present new evidence that the event period abnormal returns associated with index additions and deletions are related to a firm's measures of investor awareness. They contend that the excess returns are partially determined by changes in investor recognition following a firm's index membership changes. We focus on the price pressure hypothesis for the DJIA Index changes under investigation as our initial empirical analysis determines whether (1) DJIA Index additions and deletions experience abnormal returns and trading volumes around the announcement and effective dates and (2) any abnormal returns and/or trading volumes are temporary (reverting). We test the following (null) hypotheses:

HO1: There is no abnormal return following a firm's inclusion to or removal from the DJIA Index

HO2: There is no abnormal trading volume after a company is added to or excluded from the DJIA Index

HO3: The post-event cumulative abnormal returns are not significantly different from zero

HO4: The post-event cumulative abnormal trading volumes are not significantly different from zero

The price pressures hypothesis predicts that index additions (deletions) experience short-term positive (negative) returns and significant increases in trading volumes. We expect that if price pressures exist surrounding the DJIA Index changes, a company that is added to (removed from) the Index would experience temporary positive (negative) abnormal returns. Moreover, we expect short-term significantly higher trading volumes for both the additions and deletions. Lastly, we expect that post-event abnormal returns and/or trading volumes to be temporary and do not persist.

DATA AND METHODOLOGY

Composition changes in the Dow Jones Industrial Average (DJIA) are available on the Standard and Poor's (S&P) Dow Jones Indices website. We gather a list of all DJIA Index component changes after the year 1990 when S&P/Dow Jones began to 'pre-announce' index changes. Unlike earlier studies, we focus on the post-1990 period because it also corresponds to substantial growth in index-based investment assets such as index funds, exchange-traded funds (ETFs) and index options/futures contracts. Our sample includes all DJIA index additions and deletions from 1990 through 2015. The last DJIA Index change occurred in March 2015 when Apple Inc. replaces AT&T. There are no additional index changes after that.

There are a total of 48 component changes (evenly divided between inclusions and removals) occurred during the sample period. Table 1 provides a complete list of the 48 DJIA Index composition changes.

Table 1: Sample of the Dow Jones Industrial Average Index Additions and Deletions (1990 Present)

Additions	Deletions	Announcement	Effective
Apple Inc.	AT&T	3/6/15	3/19/15
Goldman Sachs Group	Alcoa Corp.	9/10/13	9/23/13
Nike Inc.	Hewlett Packard	9/10/13	9/23/13
Visa Inc.	Bank of America	9/10/13	9/23/13
United Healthcare	Kraft Foods	9/14/12	9/24/12
Cisco Systems	Citigroup	6/1/09	6/8/09
Travelers Co.	General Motors	6/1/09	6/8/09
Kraft Foods	AIG	9/18/08	9/22/08
Bank of America	Altria Group Inc.	2/11/08	2/19/08
Chevron Corp.	Honeywell	2/11/08	2/19/08
AIG	AT&T	4/1/04	4/8/04
Pfizer Inc.	Eastman Kodak Co.	4/1/04	4/8/04
Verizon Communications	International Paper	4/1/04	4/8/04
The Home Depot Inc.	Chevron Corp.	10/26/99	11/1/99
Intel Corp.	Goodyear Co.	10/26/99	11/1/99
Microsoft Corp.	Sears Holdings Corp.	10/26/99	11/1/99
SBC Corp.	Union Carbide Corp.	10/26/99	11/1/99
Hewlett Packard	Bethlehem Steel Corp.	3/13/97	3/17/97
Johnson & Johnson	Texaco Inc.	3/13/97	3/17/97
Travelers Co.	Westinghouse Electric	3/13/97	3/17/97
Wal-Mart Stores Inc.	F. W. Woolworth Co.	3/13/97	3/17/97
Caterpillar Inc.	Navistar International	5/2/91	5/6/91
Walt Disney Company	Primerica Inc.	5/2/91	5/6/91
J. P. Morgan	U.S. Steel	5/2/91	5/6/91

The table lists all of the DJIA additions and deletions in the sample. The list of DJIA index changes are available on the S&P/Dow Jones Indices website (http://us.spindices.com/indexology/djia-and-sp-500/the-changing-djia). Announcement date is the Wall Street Journal reporting date of the DJIA Index addition or deletion and the effective date is the actual trading date when the addition or deletion actually occurs.

We use daily stock return and trading volume data from the Center for Research in Security Prices (CRSP) database to perform event studies to analyze market reaction to DJIA component changes. We employ the Fama-French three-factor model with momentum adjustment, a robust econometrics technique to perform the event studies. The event study analysis is to determine whether there is significant abnormal return/trading volume surrounding the event a stock is added to or deleted from the DJIA Index. We employ the event study method with the Fama-French three-factor model [See Fama and French (2012)] as follows:

$$R_{it} - R_f = \alpha_i + \beta_m\left(R_{mkt} - R_f\right) + \beta_h HML + \beta_s SMB + \beta_u UMD + \varepsilon_{it} \quad (1)$$

, where *Rit* is the ith stock return on day t and *Rmkt* represents the CRSP Equally-weighted market index portfolio on day t. εit is a random error term for stock i on day t, and the αi and β's parameters are regression parameters to be estimated. Rmkt-Rf is the market risk premium; that is, the market rate of return earned above the risk-free rate. The risk-free rate is the three-month Treasury bill rate. HML, SMB and UMD are the Fama-French stock-specific variables – book-to-market, company size factor and the momentum factor, respectively. The event study estimation period is the 120-day trading period beginning 46 days prior to the DJIA index addition or deletion. We estimate the market model using the exponential generalized autoregressive conditional heteroscedastic (EGARCH) model. The EGARCH model is more robust than the ordinary least squares (OLS) approach as well as the other more basic ARCH models since "a typical characteristic of asset returns is volatility clustering where one period of high volatility is followed by more of the same and then successive periods of low volatility ensue" [see Bollerslev (1986)].

We measure abnormal return of the ith stock on day t (*ARit)* by subtracting the EGARCH estimated return ($\alpha\,\hat{\imath} + \beta\,\hat{\imath}\,Rmkt$) from the actual stock return of the ith stock in the event period.

$$AR_{it} = R_{it} - \hat{\alpha}_i + \hat{\beta}_i R_{mkt} \quad (2)$$

where $\hat{\alpha}i$ and $\hat{\beta}$ are estimates of the true parameters obtained via the EGARCH analysis. After we compute the abnormal return of a single stock on day t, we continue the process to calculate the average abnormal return across all firms in the sample on day t over the period under investigation:

$$\overline{AR}\text{s} = {\sum_{i=1}^{Ns} ARit}/{Ns} \quad (3)$$

where $\overline{AR}$s is the average abnormal return across the stocks in the sample (s). Ns is the number of stocks in the sample of additions or deletions. We use equation (3) to test whether abnormal return on the event date exists when a company enters or exits the DJIA Index. To detect possible price reversals, we examine cumulative average abnormal returns (CAARs) of the additions and deletions in the event window. Cumulative average abnormal return (CAAR) over a given event period from day *t1* to day *t2* is computed as follows:

$$CAAR(t1, t2) = \sum_{t1}^{t2} \overline{AR}s \quad (4)$$

If the price pressure hypothesis holds, we expect to find that the CAAR in post-inclusion (post-deletion) period to be close to or equal to zero as prices revert. Finally, we examine the other effect of price pressure – abnormal trading volume when a company is newly included in or removed from the DJIA Index. The analysis of abnormal trading volume is based on the event study approach referenced above (see Cowan, 2007), except that log-transformed relative volume replaces the return. The computation of log-transformed relative volume employed in the volume event study follows Campbell and Wasley (1996). We use 120-day trading volume data, beginning 46 days prior to the announcement/effective date, to perform the volume event study estimations. The event period begins ten days before the announcement/effective date and ends ten days after that date. We use the parameter estimates from the estimation window to examine whether abnormal trading volumes exist in the event period.

RESULTS

The results of the event study analysis reveal a significant short-term increase in stock prices and trading volumes when a company enters the DJIA Index. On the other hand, when a company is deleted from the Index, the stock prices temporarily decrease and the trading volumes move higher in the few trading days after the removal. Table 2 shows that on the announcement date (event day 0), an addition experiences positive abnormal return of 1.26% (*p*-value = 0.0001). The abnormal returns on the next three trading days (days 1, 2 and 3) are not significantly different from zero. This suggests that the documented abnormal return is only temporary. There appears to be marginal buying pressure around the announcement date as the mean cumulative abnormal returns for the event windows (-1, +2) and (0, +1) are 1.14% (p-value = 0.0516) and 1.19% (p-value = 0.0080), respectively. However, the buying pressure dissipates shortly since the immediate-term event window of (0, +10) is associated statistically insignificant abnormal return of 1.31% (p-value = 0.1293). The results further confirm the short-term price behavior of the included shares. For the deleted stocks, we find similar results as shown in the event study analysis for the added stocks (see Table 3). In general, we discover significantly negative abnormal returns around the event dates when a company is dropped from the DJIA Index. In fact, there is a pattern of gradual price declines prior to and immediately after an index removal announcement as the S&P/Dow Jones typically removes Dow companies under financial distress and bottom performing firms that no longer represent the US economy. For instance, American International Group (AIG), Bank of America, Citigroup and General Motors were

deleted from the index during the 2008-2009 Great Recession period. From event days -6 to 0, index deletions are associated with negative abnormal returns.

Table 2: Announcement and Effective Date Event Study, Additions Sample (N=24)

	Announcement Date		Effective Date	
	Mean		Mean	
Day	Abnormal Return	P-Value	Abnormal Return	P-Value
-10	-0.15%	0.3321	-0.24%	0.2141
-9	-0.04%	0.4502	-0.33%	0.1433
-8	0.03%	0.4673	0.04%	0.4485
-7	-0.13%	0.3581	0.26%	0.196
-6	-0.26%	0.2303	-0.37%	0.112
-5	-0.57%*	0.0512	0.53%**	0.0422
-4	-0.26%	0.2257	0.50%*	0.0506
-3	0.13%	0.3502	-0.08%	0.3946
-2	-0.03%	0.4608	0.74%***	0.0078
-1	-0.06%	0.4341	0.24%	0.2157
0	1.26%***	0.0001	-0.03%	0.4595
1	-0.08%	0.4136	0.18%	0.2801
2	0.01%	0.4924	-0.23%	0.2247
3	0.33%	0.1704	-0.18%	0.274
4	0.48%*	0.0826	-0.17%	0.2837
5	0.08%	0.4085	-0.28%	0.1769
6	-0.15%	0.3345	-0.24%	0.2181
7	0.06%	0.4265	-0.41%*	0.0891
8	-0.10%	0.3924	0.27%	0.1855
9	-0.46%*	0.0918	-1.11%***	0.0001
10	-0.14%	0.3426	-0.26%	0.1937

*Note: The abnormal returns are computed using standard event study methodology based on the Fama-French with Momentum Model. We estimate the market model using the exponential generalized autoregressive conditional heteroscedastic (EGARCH) model. The CRSP equally-weighted portfolio is the market benchmark index. The 120-day estimation period begins 46 trading days prior to the actual event date of index addition. *, **, *** indicate significance at the 10, 5 and 1 percent levels, respectively.*

Table 3: Announcement and Effective Date Event Study, Deletions Sample (N=24)

	Announcement Date		Effective Date	
	Mean		Mean	
Day	Abnormal Return	P-Value	Abnormal Return	P-Value
-10	-0.36%	0.2905	-0.62%	0.1471
-9	-0.08%	0.4502	-0.10%	0.4349
-8	-0.35%	0.2951	0.63%	0.142
-7	0.29%	0.3268	-0.09%	0.4421
-6	1.67%***	0.0054	-1.71%***	0.0018
-5	-0.99%*	0.0648	-2.51%***	<.0001
-4	-1.16%**	0.0378	-1.50%***	0.0053
-3	-2.60%***	<.0001	-1.26%**	0.0163
-2	-1.39%**	0.0167	0.48%	0.2052
-1	-2.76%***	<.0001	1.20%**	0.0202
0	-0.28%	0.3339	0.93%*	0.0562
1	1.06%*	0.0527	0.32%	0.2939
2	1.25%**	0.0281	-1.07%**	0.0347
3	0.35%	0.2957	-1.03%**	0.0403
4	-1.75%***	0.0037	-0.08%	0.4475
5	-0.85%*	0.0977	0.49%	0.2002
6	0.44%	0.2493	1.45%***	0.0068
7	-0.07%	0.4572	0.78%*	0.0933
8	0.69%	0.1445	0.57%	0.1681
9	0.69%	0.1449	0.69%	0.1186
10	1.05%*	0.0552	0.57%	0.1662

*Momentum Model. We estimate the market model using the exponential generalized autoregressive conditional heteroscedastic (EGARCH) model. The CRSP equally-weighted portfolio is the market benchmark index. The 120-day estimation period begins 46 trading days prior to the actual event date of index deletion. *, **, *** indicate significance at the 10, 5 and 1 percent levels, respectively.*

The cumulative abnormal returns analysis presented in Panel A of Table 4 indicates reversal of the stock prices following the actual inclusion of the stocks. In fact, the mean cumulative abnormal return over the event period, days 0 to day 10 [i.e., (0, +10)] is significantly negative and erases earlier price gains from the inclusion announcements. Thus, the price effect of DJIA Index inclusion announcements appear to be temporary and does not persist. The findings are consistent with the price pressure hypothesis. However, Panel B of Table 4 reveals a quick reversal of share prices following the announcement and effective dates of DJIA Index deletions. Although prices of the deleted stocks experience significant declines preceding the announcement and immediately after the announcements, the prices of such stocks appear to turn positive following the deletion announcements and on the actual removal dates (i.e., the effective date). On the announcement date, there is a mean abnormal return of -0.28% for the deleted stocks, but share prices over the next 3 trading days are all positive. Furthermore, on the effective dates, a deleted company actually experiences positive abnormal returns of 0.93% and over the event window (-1, +1) the cumulative abnormal returns are +2.46% (*p*-value = 0.0079). The results again support the price pressure hypothesis since the general pattern of stocks prices around the event dates shows temporary price declines and immediate price reversions. The findings for the index deletions may be surprising at the first glance; however, it suggests that investors seeking 'value' stocks may turn to these shares as the recently deleted Dow stocks (still well-established) may still provide significant dividend yields and opportunity to regain prices in the future. The price reversals may be related to bargain hunting as well as arbitrage trades.

Table 4: Event Period Cumulative Abnormal Return Analysis

Panel A (Additions Sample; N=24)				
	Announcement		**Effective**	
Event Window	**CAR**	**P-value**	**CAR**	**P-value**
(-1,+2)	1.14%*	0.0516	0.16%	0.3991
(-1,0)	1.21%***	0.0072	0.21%	0.3141
(-1,+1)	1.13%**	0.0307	0.39%	0.2321
(0,+1)	1.19%***	0.008	0.15%	0.3669
(0,+10)	1.31%	0.1293	-2.47%***	0.0073
Panel B (Deletions Sample; N=24)				
(-1,+2)	-0.82%	0.2646	1.39%	0.1187
(-1,0)	-3.04%***	0.0005	2.14%***	0.0051
(-1,+1)	-2.02%**	0.0373	2.46%***	0.0079
(0,+1)	0.73%	0.2138	1.25%*	0.066
(0,+10)	2.47%	0.1281	3.63%**	0.0312

*Cumulative abnormal return (CAR) is the event study abnormal return over a specific event period. For instance, in table 4A, the additions CAR is 1.19% (p-value = 0.008) for the period (0, 1) indicates that over the event date and the day following the event date, a DJIA firm experiences a positive cumulative abnormal return of 1.19% that is statistically significant. *, **, *** indicate significance at the 10, 5 and 1 percent levels, respectively.*

Following the analysis of event period abnormal return analysis, we turn our attention to the other aspect of the price pressure hypothesis – trading volume changes around the announcement and effective dates of DJIA Index composition changes. Tables 5 and 6 show the results of the abnormal trading volume analysis. The daily trading volume increases on the inclusion announcement date and the actual inclusion date are 44.35% (p-value < 0.0001) and 18.21% (p-value = 0.0176), respectively. However, the abnormal trading volumes decrease every single trading days afterwards. By the fifth trading day after the announcement and effective dates, the abnormal trading volumes are 12.05% (p-value = 0.0583) and 3.86% (p-value = 0.3278), respectively. Neither is statistically different from zero and this indicates that the increases in trading volume after a company is included in the DJIA Index is merely a short-term change reflecting temporary transaction pressure. Finally, in both samples of index additions and deletions (see Tables 5 and 6), we find that there are less abnormal trading volumes around the effective dates than those around the announcement dates. This suggests that market participants respond more to the announcements of index component changes than to the actual inclusion/removal events.

Table 5: Announcement and Effective Date Volume Event Study, Additions Sample (N=24)

	Announcement Date		Effective Date	
	Mean Abnormal		Mean Abnormal	
Day	Relative Volume	P-Value	Relative Volume	P-Value
-10	12.56%*	0.0509	-0.17%	0.4922
-9	13.78%**	0.0364	11.47%*	0.0924
-8	2.53%	0.371	0.87%	0.4601
-7	1.91%	0.402	4.08%	0.3185
-6	5.92%	0.2205	3.70%	0.3342
-5	5.48%	0.2376	5.36%	0.2677
-4	3.77%	0.3116	4.52%	0.3006
-3	-4.27%	0.289	4.83%	0.2884
-2	-12.29%*	0.0548	26.09%***	0.0013
-1	-7.31%	0.1706	63.31%***	<.0001
0	44.35%***	<.0001	18.21%**	0.0176
1	20.44%***	0.0039	4.70%	0.2933
2	21.75%***	0.0023	5.72%	0.2543
3	16.21%**	0.0174	-1.59%	0.427
4	28.11%***	0.0001	7.57%	0.1907
5	12.05%*	0.0583	3.86%	0.3278
6	-3.21%	0.3378	-3.89%	0.3266
7	4.18%	0.2931	-3.49%	0.3434
8	15.49%**	0.0218	-0.57%	0.4737
9	6.74%	0.1899	4.80%	0.2894
10	1.72%	0.4116	-8.07%	0.1754

*Note: We follow Cowan (2007)'s standard event study methodology to determine abnormal trading volume. In the volume event study, the log-transformed relative monthly volume is used. We use 120 days of trading volume data, beginning 46 days prior to the announcement/effective date, to calculate the volume event study estimations. The event period begins 10 days before the announcement/effective date and ends 10 days after that date. *, **, *** indicate significance at the 10, 5 and 1 percent levels, respectively.*

Table 6: Announcement and effective Date Volume Event Study, Deletions Sample (N=24)

	Announcement Date		Effective Date	
	Mean Abnormal		Mean Abnormal	
Day	Relative Volume	P-Value	Relative Volume	P-Value
-10	8.59%	0.2078	7.60%	0.2522
-9	19.08%**	0.0353	10.49%	0.1785
-8	14.86%*	0.0795	-4.52%	0.3457
-7	19.87%**	0.0298	9.59%	0.1999
-6	13.45%	0.1011	15.12%*	0.0922
-5	19.10%**	0.0351	20.20%**	0.0381
-4	30.97%***	0.0017	41.95%***	0.0001
-3	14.93%*	0.0786	27.53%***	0.0078
-2	30.48%***	0.0019	30.90%***	0.0033
-1	25.18%***	0.0085	66.62%***	<.0001
0	59.75%***	<.0001	28.39%***	0.0063
1	22.11%**	0.0181	20.82%**	0.0337
2	21.99%**	0.0186	17.62%*	0.0609
3	33.52%***	0.0007	11.32%	0.1601
4	54.90%***	<.0001	5.75%	0.3069
5	30.24%***	0.0021	10.11%	0.1873
6	10.45%	0.161	3.90%	0.3661
7	5.34%	0.3064	5.98%	0.2996
8	20.94%**	0.0236	17.83%*	0.0587
9	-1.40%	0.4472	5.83%	0.3042
10	7.34%	0.2432	14.98%*	0.0942

*Note: We follow Cowan (2007)'s standard event study methodology to determine abnormal trading volume. In the volume event study, the log-transformed relative monthly volume is used. We use 120 days of trading volume data, beginning 46 days prior to the announcement/effective date, to calculate the volume event study estimations. The event period begins 10 days before the announcement/effective date and ends 10 days after that date. *, **, *** indicate significance at the 10, 5 and 1 percent levels, respectively.*

In short, we document that DJIA Index additions (deletions) experience non-permanent increases (decreases) in share prices following the index composition change announcements. The abnormal returns surrounding

the announcements are economically and statistically significant. Both inclusions and removals lead to temporary abnormal trading volume increases in the post-announcement period. In fact, the stock prices and trading volumes revert within a few trading days. Our findings are consistent with the price pressure hypothesis as the documented abnormal returns and trading volumes are temporary and do not persist. Moreover, we find less pronounced price effects surrounding the effective dates. Investors appear to react more to the announcement than to the actual inclusion/deletion. This finding is consistent with the efficient market hypothesis as the announcement contains more information that were not available to the market and the event study window results support the notion that in an efficient market, investors respond quickly as additional information arrives and become available.

CONCLUSIONS

In this study, we examine the prices pressure hypothesis utilizing a comprehensive list of the Dow Jones Industrial Average (DJIA) Index additions and deletions. We perform event study on stock prices and trading volumes surrounding the announcement and effective dates of the Index component changes. Our study attempts to shed additional lights on the impact of index trading strategies (e.g. program trading, index funds, ETFs and index options/futures contracts) on the companies that enter and exit the DJIA Index. Our empirical analysis focuses on the time period (post-1990 period) following the Standard and Poor's/DJ Company's 'pre-announcement' policy on index composition changes. This particular time period also corresponds to the substantial growth of index trading strategies and related investment products and allows us to determine how investors respond to DJIA Index additions and deletions in light of these additional index trading and transactions. Our results show that index additions (deletions) experience temporary increases (decreases) in stock prices following the announcement. The abnormal returns surrounding the announcements are economically significant. Both inclusions and removals lead to temporary abnormal trading volume increases in the post-announcement period. In fact, the stock prices and trading volumes revert within a few trading days. Our findings are consistent with the price pressure hypothesis as the documented abnormal returns and trading volumes are not permanent. Future research may extend the impact of prices pressure on index inclusions and removals by incorporating intra-day data to determine the dynamics of the market response. Because of the growth in high-frequency trading, the 'second-by-second' prices and trading volumes of the companies added to and deleted from the DJIA may yield additional insights about how markets behave and how new information are incorporated into share prices in an efficient market. Such research would be of interest to both individual and institutional investors.

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