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Capturing the Index Effect via Options

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- We analyze a less-known but profound impact of additions to the S&P 500 – the impact on publicly traded options of the added company. Our analysis sheds new light into the enormous magnitude of index change related price movements in the options market, and provides insights on replicable trading strategies.

- In general, the changes in at-the-money call and put prices are 20 to 30 times higher than changes in the corresponding stock price.

- Comparison between the inter-index transfers and outside additions finds far greater index effect on options prices if the underlying stocks are introduced out of the S&P 1500 index family. Between announcement and effective dates, the median at-the-money call option rises 120% for additions from outside the S&P 1500, and 32% for promotions within the S&P index family.

- While it is not possible to capture most of these price changes because they happen very shortly after the announcement, our study highlights replicable trading strategies with statistically significant returns. Buying at-the-money calls for stocks added to S&P 500 from outside the S&P 1500 on the day after the announcement, and selling the position on the effective date of addition yields returns of 31% on average.

Introduction

The S&P 500 is the most-widely benchmarked index in the world, with more than $1 trillion directly invested in it and several trillions more benchmarked against it. The price changes associated with changes to the S&P 500 are widely known as the "index effect." The index effect has been widely investigated.

In this paper, we analyze a less-known but profound impact of additions to the S&P 500 – the impact on publicly traded options of the added company. To the best of our knowledge, this is the first-ever detailed analysis of the index-effect on the options market. Our analysis sheds new light into the enormous magnitude of index change related price movements in the options market, and provides insights on replicable trading strategies.

Literature Review

The S&P 500 Index Effect

From tests of demand curves of stocks to more recent industry research on "wealth loss" associated with changes to popular stock indices, index effect has been a much-researched topic. The fact that stocks added to a popular index experience excess returns and volumes between the announcement date (AD) and effective date of change (ED), followed by a small post-ED correction has been well documented over the last two decades. Several theories exist to explain this phenomenon.

Dash (2002) summarizes prior studies attributing the index effect to one of five competing hypothesis. According to the *price-pressure hypothesis*, prices will reverse after the index change when heavy index fund trading subsides around the change date. According to the *imperfect substitutes hypothesis*, the price effect is permanent because index fund buying changes the available float of shares. The *liquidity hypothesis* suggests that prices are affected if the liquidity of stocks being deleted is affected. According to *the information content hypothesis*, index addition and deletions have information on firm specific factors that will affect prices of the firm's stock. Also, additions and deletion from the index affect the level of

scrutiny and analyst coverage of the stocks. According to the *selection criteria hypothesis*, evidence of abnormal returns is not robust since the stock selection process followed by index providers itself uses historical prices.

Prior to 1989, it was Standard & Poor's policy to announce and implement changes in the composition of the index simultaneously. Harris and Gurel (1986) and Shleifer (1986) investigated S&P 500 composition changes over the 1976-88 period and found a change-day positive abnormal return of approximately 3% for additions.

Standard & Poor's policy since October 1989, however, has been to pre-announce constituent changes. Lynch and Rendenhall (1997) analyzed price and volume data for firms added to the S&P 500 from March 1990 through April 1995. They found a significant positive cumulative abnormal return of 3.8% over the period starting the day after the announcement that is only partially reversed following additions. Beneish and Whaley (1996) analyzed the effect of changes in S&P 500 index composition from January 1986 to June 1994, a period during which S&P began its practice of pre-announcing changes five days beforehand. They concluded that the new announcement policy had altered the way stock prices react to index changes.

More recently, research has focused on index fund managers and investors. Dash and Blitzer (2004) assert that changing behavior of index fund managers, increase in assets in S&P MidCap 400 from which stocks may be deleted when they are added to the S&P 500, and more competition among arbitrageurs, has led to an overall decline in index effect. Chen, Noronha and Singal (2006) estimate that index fund investors lose $1 to $2 billion dollars a year because of the index effect in S&P 500 and Russell 2000.

Index Changes and Options Prices

While event studies on stock prices are common, event studies on options are less so. In particular, we found one prior literature that studies the impact of index effect on options prices. Dhillon and Johnson (1991) looked at the prices of options for S&P 500 additions with traded options in the 1984-88 period. They observed that call prices increase upon the announcement, and that there is no significant difference between the price rises for stocks

that do and do not have traded options. Because the call prices could have increased due to an increase in variance, they also looked at put prices. They observed that put prices decline, which is inconsistent with a variance increase.

Research Methodology

Data

The study includes all S&P 500 new additions with exchange traded options between February 2002 and December 2007. Both transfers within the S&P index family and addition from outside are included. We exclude those added companies whose origins are mergers, restructuring or recapitalization. This leads to a sample of 93 stocks, 54 internal transfers and 39 outside additions, respectively.

The stock options data come from DeltaNeutral, an online provider of historical option data and trading software. We use their commercially available files on stock options data in the U.S. from February 2002 to December 2007. The data fields include date, underlying cash symbol, underlying cash price, option type, expiration, strike, last price, bid price, ask price, volume, and open interest.

We usually take the last trading price as the close of the day on each option. However, if the last trading price is missing, or if the last is lower than the bid (or higher than the ask), we use the mid price calculated from bid and ask instead. Our options data do not have the open price or intra-day price of the options. Therefore, we limit our research to daily price changes at the most granular level.

Methodology

Assuming that the new additions usually experience abnormal upward price shock upon addition to the S&P 500, we test both a long-call strategy and short-put strategy. We use the near-term at-the-money (ATM) options, as they are usually the most liquid options traded in the market and most affected by the underlying price shock. We test six holding periods of the option positions, as illustrated in Exhibit 1.

Exhibit 1: Holding Periods Tested

Period	Holding Period	Start Date	End Date
1	AD to AD + 1	Announcement Day	The Day After Announcement
2	AD to ED	Announcement Day	Effective Day
3	AD + 1 to ED	The Day After Announcement	Effective Day
4	ED - 1 to ED	The Day Before Effective Day	Effective Day
5	ED to ED + 1	Effective Day	One Day After Effective Day
6	ED to ED + 3	Effective Day	Three Days After Effective Day

AD: Announcement day

ED: Effective day

AD + 1: The next trading day after announcement

ED – 1: The next trading day before effective day

ED + 1: One day after effective day

ED + 3: Three days after effective day

Source: Standard & Poor's.

For long call positions, holding period returns are calculated as:

$$r_{long\ call} = \frac{C_{end} - C_{start}}{C_{start}}$$

where *Cstart, Cend* are the closes of the call option on the start day and end day of the period.

For short put positions, holding period returns are calculated as:

$$r_{short\ put} = \frac{P_{start} - P_{end}}{P_{start}}$$

where *Pstart, Pend* are the closes of the put option on the start day and end day of the period.

In addition, we run regression of the option returns on the following factors: stock beta in the past year, company market capitalization, and option premium. The purpose of our regression is to identify the main driving forces of the positive option strategy return.
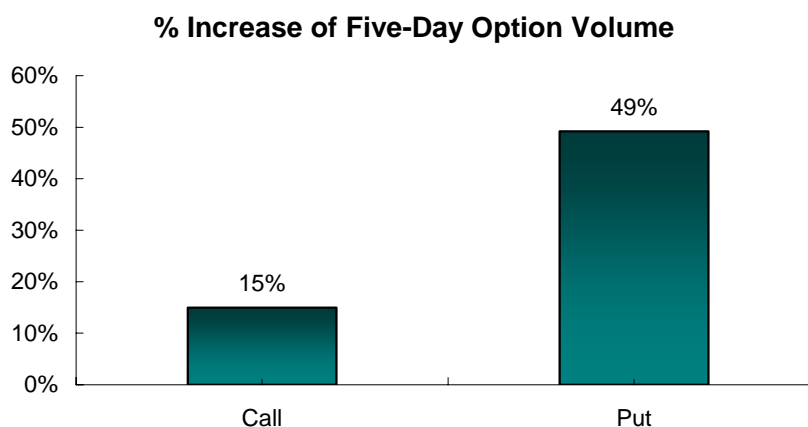
Results

We evaluate index effect on options among three different dimensions:

- Impact on option trading volumes

- Impact on option prices

- Transfers vs. Outsiders

Impact on option trading volumes. As expected, option trading volume surges after the announcement. The five-day average trading volume of near term ATM calls increases from 2223 contracts to 2557 (a 15% increase), and the five-day average trading volume of near term ATM puts increases from 1666 to 2486 (a 49% increase).

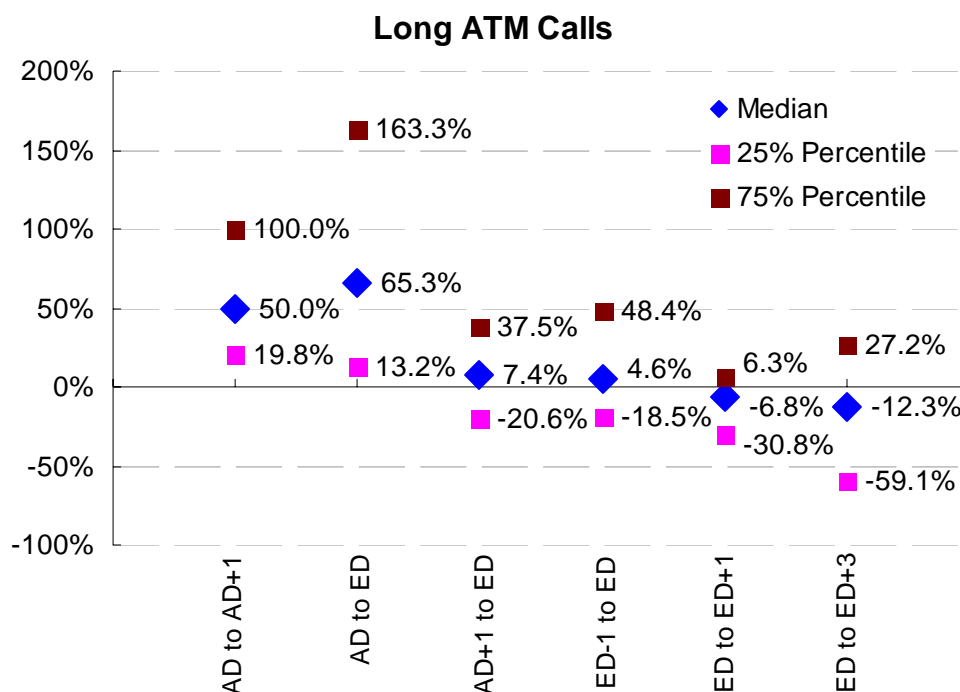**Exhibit 2: Impact on Option Trading Volume**

% Increase of Five-Day Option Volume

Source: Standard & Poor's.

Impact on option prices. Exhibit 3 shows the holding period return of long call options of all 93 stocks. The abnormal positive return of underlying stocks right after the announcement was amplified through option trading. The median of the option return on the immediate trading day after announcement is about 50%. The median of the holding period return between the announcement day and the effective day is around 65%. This implies that most option price surge occurs immediately after the announcement. In contrast, entering a long call position on the effective day does not render a positive return. The call price does not

move much on the effective day, and tends to go down afterwards. This could be explained by the partial reversal of the underlying stock price or by the drop in implied volatilities.

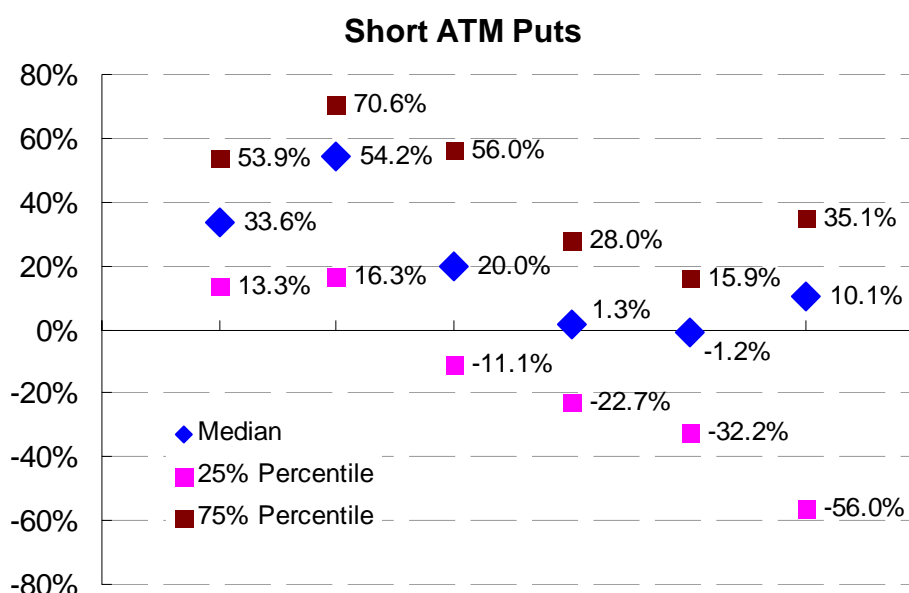**Exhibit 3: Holding Period Return of All Additions - Long Calls**

Long ATM Calls

	Underlying Stock Price Return	Long Call Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	3.01%	83.87%	7.74	0.00%
AD to ED	4.04%	109.11%	5.90	0.00%
AD + 1 to ED	1.27%	16.90%	2.32	2.28%
ED - 1 to ED	1.10%	45.43%	2.57	1.17%
ED to ED + 1	-0.52%	-5.28%	0.85	39.57%
ED to ED + 3	-0.48%	-11.20%	1.91	5.94%

Source: Standard & Poor's.

To isolate the effect of the underlying price and the volatility, we turn to the price move of put options. We exam another bullish option trading strategy, shorting puts, in the same set of stocks. If the return of call options comes from the move of volatilities, we expect the put options to move in the same direction of calls, hence, shorting puts shall give a reverse pattern of returns. If it is the underlying price shock that drives the call option prices, shorting puts shall follow the same pattern of returns.

The holding period return of long call options of all 93 stocks is illustrated in Exhibit 4. The similar pattern of returns confirms that, option returns, from both long call and short put positions, come from the abnormal move of underlying stock prices.

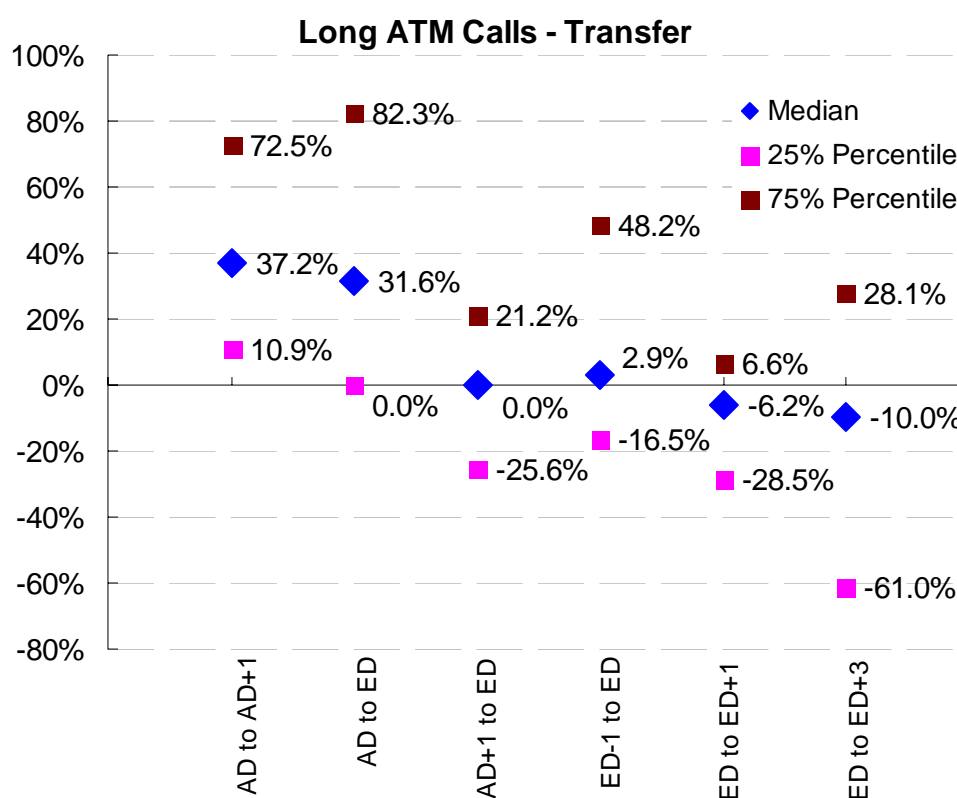**Exhibit 4: Holding Period Return of All Additions - Short Puts**

	Underlying Stock Price Return	Short Put Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	3.01%	34.75%	12.30	0.00%
AD to ED	4.04%	37.80%	5.30	0.00%
AD + 1 to ED	1.27%	8.03%	0.42	67.46%
ED - 1 to ED	1.10%	0.86%	0.04	97.00%
ED to ED + 1	-0.52%	-17.38%	2.57	1.17%
ED to ED + 3	-0.48%	-18.01%	1.94	5.50%

Source: Standard & Poor's.

We take one further look at the relationship between option returns and the underlying returns. Although driven by the underlying price move, right after the announcement, the returns from long calls and short puts are significantly different from, in this case, larger than the stock returns. It seems that the stock price move brings an extraordinary shock in the option market.

Transfers vs. Outsiders: Dash and Blitzer (2004) show that additions caused by inter-index transfers (deletion from one component of the S&P Composite 1500 and addition to another) have a less pronounced index effect on stock price because of offsetting buy and sell requirements of different index funds. This difference in underlying stock return is also reflected in the option trading strategies we test. Exhibit 5 and Exhibit 6 show the holding period returns coming from inter-index transfers and those that come from outside the 1500, if a long ATM call position is established.
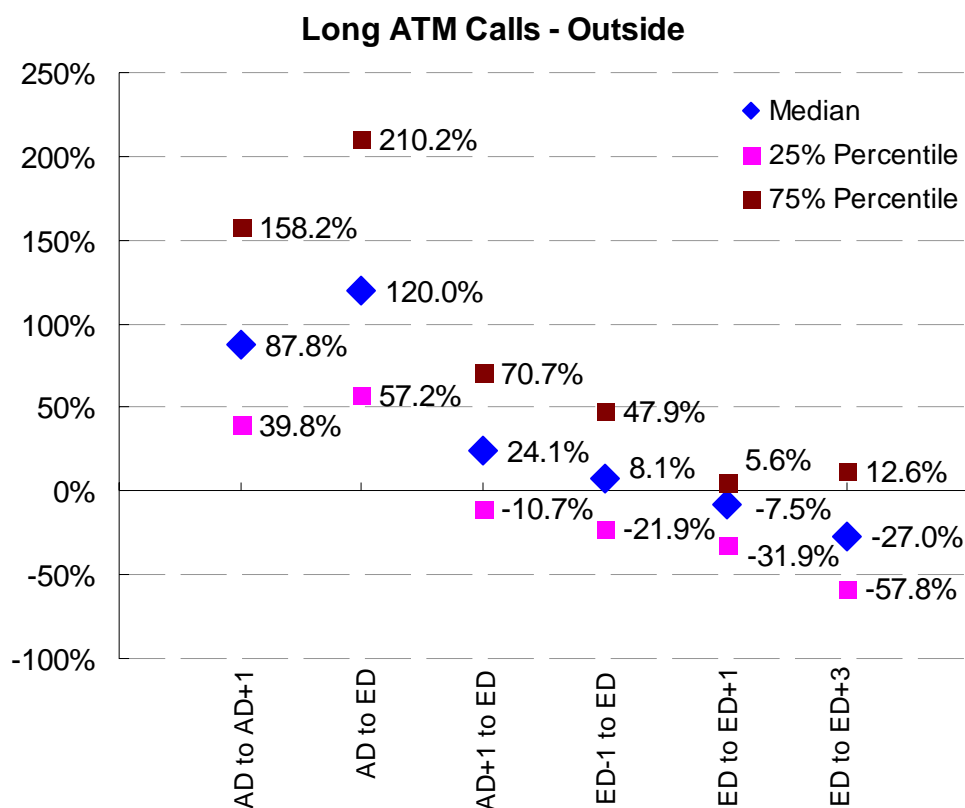
Exhibit 5: Holding Period Return of Inter-Index Transfers - Long Calls

	Underlying Stock Price Return	Long Call Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	2.09%	55.69%	5.29	0.00%
AD to ED	1.96%	56.67%	4.48	0.00%
AD + 1 to ED	-0.04%	5.06%	0.46	64.48%
ED - 1 to ED	0.38%	36.96%	1.99	5.17%
ED to ED + 1	-0.21%	-0.73%	0.06	95.19%
ED to ED + 3	-0.10%	-10.29%	1.39	16.95%

Source: Standard & Poor's.

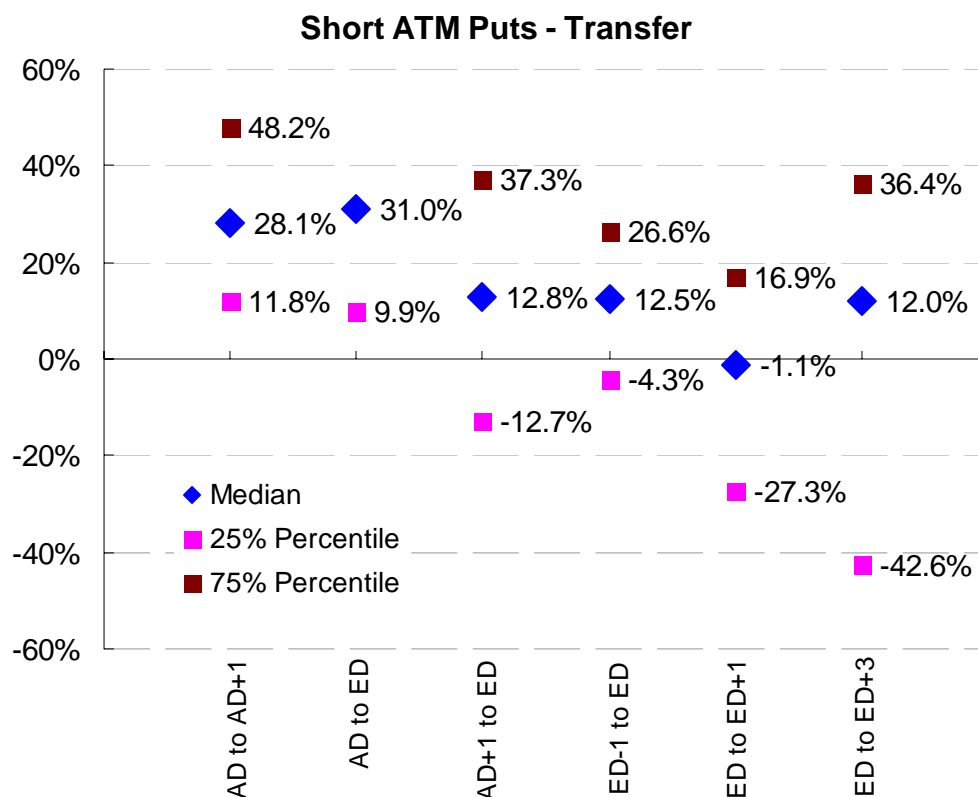**Exhibit 6: Holding Period Return of Outsiders - Long Calls**

Long ATM Calls - Outside

	Underlying Stock Price Return	Long Call Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	4.28%	122.88%	6.19	0.00%
AD to ED	6.92%	181.71%	4.80	0.00%
AD + 1 to ED	2.92%	31.88%	2.81	0.79%
ED - 1 to ED	2.10%	57.47%	1.69	9.97%
ED to ED + 1	-0.95%	-11.73%	1.91	6.40%
ED to ED + 3	-1.01%	-12.49%	1.29	20.41%

Source: Standard & Poor's.

Exhibit 7 and Exhibit 8 show the holding period returns coming from inter-index transfers and those that come from outside the 1500, if a short ATM put position is established.
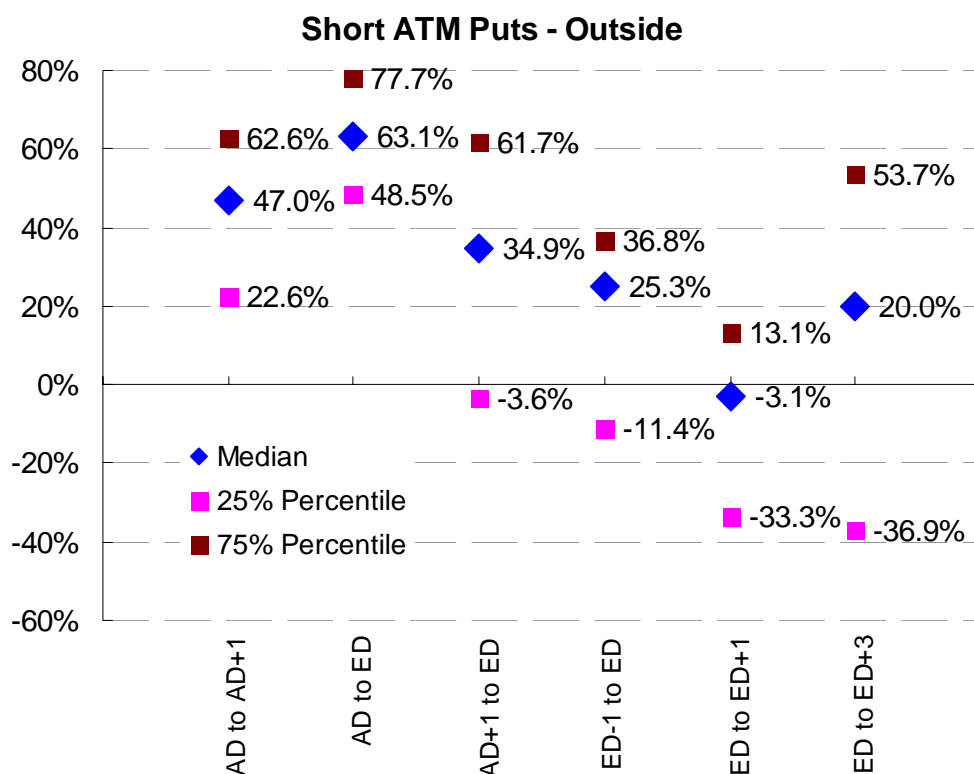
Exhibit 7: Holding Period Return of Inter-Index Transfers – Short Puts

	Underlying Stock Price Return	Short Put Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	2.09%	29.92%	8.50	0.00%
AD to ED	1.96%	33.22%	6.21	0.00%
AD + 1 to ED	-0.04%	9.88%	1.29	20.32%
ED - 1 to ED	0.38%	10.01%	2.74	0.83%
ED to ED + 1	-0.21%	-12.45%	1.86	6.82%
ED to ED + 3	-0.10%	-8.63%	0.83	41.26%

Source: Standard & Poor's.

Exhibit 8: Holding Period Return of All Outsiders – Short Puts

Short ATM Puts - Outside

	Underlying Stock Price Return	Short Put Price Return		
	Mean	Mean	T Statistics	P Value
AD to AD + 1	4.28%	41.43%	9.17	0.00%
AD to ED	6.92%	44.14%	2.74	0.93%
AD + 1 to ED	2.92%	5.70%	0.08	93.92%
ED - 1 to ED	2.10%	7.28%	0.71	48.49%
ED to ED + 1	-0.95%	-24.39%	1.82	7.69%
ED to ED + 3	-1.01%	17.93%	1.11	27.45%

Source: Standard & Poor's.

From above, we clearly see that the excess movement in the underlying stock price of the outsiders is further magnified by the use of option strategies. If we enter a long call position on an addition from outside S&P composite on AD, we will get a 122.88% return the next day on average, which doubles the average return of a long call position on an upgrade within the S&P index family.

What catches our attention is that, if the underlying stock is an intra-index transfer, most option return seems to be realized right between AD and AD+1. If we enter the long call

position on AD+1, only 5.06% return is left by the effective day. However, if the underlying stock is added from outside the S&P family, on average, we reap a 31.88% return between the AD+1 and ED. This seems to be a more executable trade in reality.

What Explains The Returns of Options?

To find out the driving forces behind the return of options, we regress the cross-sectional holding period returns of option trading between the announcement day and the effective day on three factors: beta of the underlying stock, market value of the company, and the option premia (as percentage on the underlying stock price).

The linear model we want to evaluate is:

$$r = \beta_1 * S + \beta_2 * MV + \beta_3 * OP + \varepsilon$$

where

r = option strategy holding period return

S = underlying stock 1-year beta

MV = market value of the company

OP = option premium

$\beta_1, \beta_2, \beta_3$ are regression coefficients

The holding period yield of the long call strategy between the announcement day and the effective day seems to be partially related to the three factors we tested, with an adjusted R-square of about 26%. The F statistic confirms that the variables as a whole have significance. High-beta stocks tend to have high returns from the long call position. Not surprisingly, the call premium has a negative impact on returns while the other two factors have a positive impact. Exhibit 9 shows the regression results.

Exhibit 9: Regression: Long Call

Coefficient	Value	T Statistics	P Value
β1	1.28	3.99	0.00
β2	2.53×10^{-5}	1.71	0.09
β3	-21.37	-2.47	0.02

Multiple R-Squared: 0.283,   Adjusted R-squared: 0.2577
F-statistic: 11.18 on 3 and 85 DF, p-value: 2.942×10^{-6}

Source: Standard & Poor's.

Exhibit 10 shows the regression results on the holding period yield of the short put strategy between the announcement day and the effective day. Beta still tends to be a major factor in option returns, however, the market value and the put premium lose their significance.

Exhibit 10: Regression: Short Put

Coefficient	Value	T Statistics	P Value
β1	0.20	1.76	0.08
β2	5.29×10^{-6}	0.98	0.33
β3	2.94	0.82	0.41

Multiple R-Squared: 0.2731,   Adjusted R-squared: 0.2474
F-statistic: 10.64 on 3 and 85 DF, p-value: 5.177×10^{-6}

Source: Standard & Poor's.

We further compare the regression results between the inter-index transfers and the outside additions. Regression results of long call positions are listed in Exhibit 11 and Exhibit 12. Interestingly, beta of the underlying stocks does not have as profound effect on the holding period returns on inter-index transfers as on the outside additions. Instead, market value plays a much more significant role. We also note that the linear model has a better fit for outside additions than for inter-index transfers.

Exhibit 11: Regression: Long Calls - Transfers

Coefficient	Value	T Statistics	P Value
β1	-4.41×10^{-2}	-0.13	0.90
β2	1.08×10^{-4}	2.37	0.02
β3	-11.20	-1.70	0.09

Multiple R-Squared: 0.2832,   Adjusted R-squared: 0.2374
F-statistic: 6.19 on 3 and 47 DF, p-value: 1.242×10^{-3}

Source: Standard & Poor's.

Exhibit 12: Regression: Long Calls - Outsiders

Coefficient	Value	T Statistics	P Value
β1	2.54	4.17	0.00
β2	1.59×10^{-5}	0.81	0.42
β3	-0.36	-2.36	0.02

Multiple R-Squared: 0.4356,   Adjusted R-squared: 0.3872
F-statistic: 9.00 on 3 and 35 DF, p-value: 1.48×10^{-4}

Source: Standard & Poor's.

We also compare the regression results on the short put strategies on inter-index transfers and outside additions. Summaries are listed in Exhibit 13 and Exhibit 14 for summary. The regression on the inter-index transfers has a much better fit than on the outside transfers. Beta, market value and put premiums can explain 44% of the short put position returns on the transfers. Market value seems to be a driving force. However, this linear regression does not see significant driving forces on the outside additions.

Exhibit 13: Regression: Short Puts - Transfers

Coefficient	Value	T Statistics	P Value
β1	-0.14	-0.98	0.33
β2	6.51×10^{-5}	3.27	0.00
β3	-2.10	-0.80	0.43

Multiple R-Squared: 0.4741,   Adjusted R-squared: 0.4406
F-statistic: 14.12 on 3 and 47 DF, p-value: 1.079×10^{-6}

Source: Standard & Poor's.

Exhibit 14: Regression: Short Puts - Outsiders

Coefficient	Value	T Statistics	P Value
β1	0.10	0.33	0.75
β2	1.24×10^{-6}	0.16	0.87
β3	9.86	1.02	0.31

Multiple R-Squared: 0.2617,   Adjusted R-squared: 0.1984
F-statistic: 4.136 on 3 and 35 DF, p-value: 1.31×10^{-2}

Source: Standard & Poor's.

Conclusions and Areas For Further Research

There is a sharp change in volumes and prices of stocks options following the announcement of their addition to the S&P 500. In general, the changes in at-the-money call and put prices are twenty to thirty times higher than changes in the corresponding stock price. Trading volumes increase by 15% to 49%.

Comparison between the inter-index transfers and outside additions finds more profound index effect on options prices if the underlying stocks are introduced out of the S&P 1500 index family. Between announcement and effective dates, the median at-the-money call option rises 120% for additions from outside the S&P 1500, and 32% for promotions within the S&P index family. The median at-the-money put option falls 63% for additions from outside the S&P 1500, and 31% for promotions within the S&P index family.

It is not possible to capture most of these price changes because they happen very shortly after the announcement. Our study shows two executable strategies that have delivered statistically significant returns at the 5% confidence level:

1. Buying at-the-money calls for stocks added to S&P 500 from outside the S&P 1500 on the day after the announcement date, and selling the position on the effective date. This strategy yields returns of 31% on average.

2. Selling at-the-money puts for stocks added to S&P 500 from inside the S&P 1500 on the day before the effective date, and selling the position on the effective date. This strategy yields returns of 10% on average.

We also regress the option holding period returns on three factors in order to find the driving forces. Beta of the underlying stocks plays the most significant role in the options returns. High beta stocks tend to have high returns from the bullish option trading strategies, whether it's a long call or a short put. Option premiums and market value affect the option returns as well, but they seem to lose their statistical significance on the short put strategy. However, these three factors work differently on inter-index transfers and outside additions. Long call returns on inter-index transfers are almost immune to the beta factor; they are more sensitive to the market value and option premium instead. If the underlying is an outside addition, however, the call return will be driven by the beta and the call premium.

There are several areas of research that can be pursued in the area of index effect on options prices. First, given the rapidity with which options prices react to index change announcements, it would be useful to do our analysis with data of greater frequency than the end-of-day data that we have. Second, for liquidity reasons we have limited our research to at-the-money options. There are stocks with depth in options volumes for strikes farther than at-the-money, and it would be interesting to study the impact of index changes on those options.

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