“Convergence to market efficiency for Taiwan 50 index added stocks”

AUTHORS	Han-Ching Huang Pei-Shan Tung

ARTICLE INFO	Han-Ching Huang and Pei-Shan Tung (2011). Convergence to market efficiency for Taiwan 50 index added stocks. *Investment Management and Financial Innovations*, *8*(2)
RELEASED ON	Friday, 24 June 2011
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	**0**	**0**

Han-Ching Huang (Taiwan), Pei-Shan Tung (Taiwan)

Convergence to market efficiency for Taiwan 50 index added stocks

Abstract

This study examines the inclusion effect and the convergence to market efficiency for stocks added to the Taiwan 50 index. We find that there is no abnormal trading volume prior to the announcement day. That is to say, the transparency of the Taiwan 50 index is good. Even without trading costs, we can not make a profit based on the "Taiwan 50 game" strategy. Besides, there is no change in the efficiency situation around the announcement day. Therefore, there is no significant change in weak- (strong-) form efficiency when a stock is included in the Taiwan 50 index. These added stocks achieve weak-form efficiency in 1.5-minute time periods and achieve strong-form efficiency in 5-minute time periods. As a result, the arbitrage activity takes about 5 minutes.

Keywords: index effect, market efficiency, Taiwan 50 index, S&P 500 index, addition.
JEL Classification: G10, G14.

Introduction

Over the past two decades, there have been many studies concerning index additions. Most of the literature has focused on the S&P 500 index, whereas a few studies[1] have examined the Russell 1000 index. Compared with S&P 500 index additions, the Russell 1000 index reconstitutions are more transparent. Empirical results about the index addition effects indicate differences between them. The index addition effect of the Taiwan 50 index[2], with a selection process similar to Russell 1000 reconstitutions, has hardly been explored in the literature[3]. We examine the effect on the Taiwan 50 index to explore the differences. Moreover, most of the literature uses daily data to detect the index addition effect; we examine the intraday market microstructure of index added stocks[4]. Further, we use daily and intraday data from the Taiwan 50 index added stocks around the announcement day to explore the inclusion effect and the convergence to market efficiency for stocks added to the Taiwan 50 index.

Of the studies on index added stocks, many of them (e.g., Beneish and Whaley, 1996; Kappou et al., 2010) that examine the stocks included in the Standard & Poor's (S&P) 500 index have documented the positive average price change. There are two main reasons for explaining the price change. First, the reaction is due to the demand for index funds (e.g., Beneish and Whaley, 1996; Okada et al., 2006). The index funds are usually evaluated by the tracking error, the difference between the fund's return and the return on the index. This assumes that index additions are information-free[5]. Wurgler and Zhuravskaya (2002) show that abnormal returns are related to the difficulty in finding perfect substitutes for the added firms. Okada et al. (2006) document that the excess demand of index arbitrageurs for shares of newly added firms is the main source of the temporary stock price increase. Second, according to the efficient markets hypothesis, the stock price adjusts to reflect new information which the S&P 500 index additions convey (e.g., Denis et al., 2003; Kalpathy and Santhanakrishnan, 2008). Denis et al. (2003) find that there are significant increases in EPS (earnings per share) forecasts and significant improvements in realized earnings in the newly-added firms, which indicate that S&P index inclusion is not an information-free event. Although an information-free event states that new information does not cause index inclusion, the index inclusion could lead to an improvement in the future performance of included stocks since index inclusion could result in greater scrutiny of management by investors[6]. Kalpathy and Santhanakrishnan (2008) examine Russell 1000 reconstitutions, which are purely based on transparent and objective rules[7], and com-

[1] See Chen (2006), Carino and Pritamani (2007), and Kalpathy and Santhanakrishnan (2008).

[2] In June 2003, the Taiwan stock exchange (TSE) introduced the first Taiwanese exchange-traded fund (ETF), the Taiwan top 50 tracker fund (TTT). According to research on the Asia Pacific ETF market, performed by Deutsche Bank, there are 240 ETFs in the Asia Pacific region and the Asia Pacific ETF market grew to US$77.7 billion in assets by the end of October 2010. The assets of TTT have grown from $0.13 billion in June 2003 to $1.65 billion in October 2010, making it the 15th largest ETF in the Asia Pacific region based on total assets as of the end of October 2010. Owing to the growing importance of the TTT, we examine the index addition effect of Taiwan 50 index.

[3] For example, Lin and Chiang (2005) find that the volatility of component stocks increase following the establishment of TTT.

[4] Kappou et al. (2010) examine the tick-by-tick stock price performances and trading volumes of the added stocks for the first time.

[5] In 2002, S&P made an affirmative claim: "Company additions to and deletions from an S&P equity index do not in any way reflect an opinion on the investment merits of the company." The above remarks confirm that the inclusion in the index is an information-free event, which means that S&P does not claim that inclusion represents an endorsement of the newly-included stock's future prospects.

[6] According to Huberman and Regev (2001), even though there is in essence no new information, the stock price might have significantly changed as a result of enthusiastic public attention.

[7] The Russell 1000 is strictly constituted by market capitalization. Specifically, firms traded on all major stock exchangrs are sorted on market capitalization at the end of May every year and the top 1000 firms are assigned membership to the Russell 1000 index. A preliminary list of constituents is announced in the second week of June, the final reconstituted list is proclaimed in the four week of June, and the index changes are effective at the end of June.

pare them with S&P 500 additions, which are made by an S&P index committee. They find that S&P 500 firms exhibit a permanent upward shift in stock prices in the two years following index additions, while Russell 1000 firms witness complete reversal of stock returns following reconstitutions. These results are consistent with S&P 500 index additions conveying new information to the market.

The traditional index effect literature always focuses on close-to-close returns. The price change due to new information is measured by the close-to-close return following the announcement. If the close-to-close return is largely driven by the close-to-open price movement, the efficiency of the market is supported. If the close-to-close return is largely driven by the open-to-close price movement on the day following the announcement, market inefficiency could be concluded. Beneish and Whaley (1996) use the stocks included in S&P 500 index during the period from 1989 to 1994 as a sample and find that the close-to-open return is statistically significant, whereas the open-to-close return is insignificant, which implies that the market is efficient[1]. Kappou et al. (2010) find similar results for the S&P 500 added stocks for the period of 1993-2002. We also check the close-to-open returns to explore whether the market is efficient in regard to Taiwan 50 added firms.

Although index returns are independent from day to day[2], the same could not be said from trade to trade. Some time is needed for smart investors to explore what happens in order imbalances, to make sure whether there is new information regarding values, and to remove any serial dependence remaining after prices adjust to new equilibrium levels. Chordia et al. (2005) propose examining how long it takes the market to achieve weak-form efficiency, i.e., how long it takes to remove return dependence. Besides, they explore whether lagged order imbalances are significant predictors of future returns over short intervals to check the strong-form efficiency. Strong-form efficiency is the appropriate criterion because agents away from the exchange cannot easily and immediately observe order imbalances, only the insiders, i.e., NYSE (New York stock exchange) market makers and perhaps astute floor traders, could obtain the information on order imbalances instantly. By using intraday returns for 150 NYSE stocks during the calendar years 1996, 1999, and 2002, they find that weak-form efficiency appears to prevail over intervals from five minutes to one day. Nonetheless, the market is not characterized by strong-form efficient over short intervals of a few minutes since order imbalances could just predict future returns over a very short period. Unlike Chordia et al. (2005) examine the ordinary period, Patell and Wolfson (1984) explore the dividend and earning announcements event and find that the announcements interrupt the usual pattern of return serial dependence for at least fifteen minutes. They indicates that the activities of arbitrageurs who offset the impulsive reactions of naive investors to corporate announcements. In the announcements of index additions, Beneish and Whaley (1996) also find that there are many arbitrageurs to trade added stocks to make profit. Nevertheless, they do not focus on the market efficiency of added stocks. Therefore, following Chordia et al. (2005), we use intraday data explore whether there is significant change in weak-strong-form efficiency when a stock is included in the Taiwan 50 index.

The price change due to the demand for index funds is measured by the returns between the announcement day and effective day. Since many index funds are not rebalanced until the effective day, risk arbitrageurs can buy the shares of the stock ahead of the index funds and sell them after the funds are satisfied (Beneish and Whaley (1996) refer to it as a S&P game[3]). Beneish and Whaley (2002) find that, by shorting the deleted stock and hedging using a long position in SPDRs (standart and poor's depository receipts), a simulation of the new game in town earns a mean abnormal risk-adjusted return of over 8% on average. Kappou et al. (2010) use a similar strategy[4] and obtain a 5.10% net return after considering trading costs. We attempt to examine whether there is an "S&P game" for the Taiwan 50 index (or "Taiwan 50 game").

The main empirical results of our paper are as follows. First, Beneish and Whaley (1996) find that trading

[1] Cusick (2002) uses a different definition for an efficient market. Using the firms added to the S&P 500 from 1990 to 2000, he finds that there is a 5.45% average abnormal return of added stocks from the close of the day after the announcement to the close of the effective day, implying a violation of a semi-strong efficient market. Nonetheless, there is an increase in market efficiency over time since the proxy for investor interest has increased significantly over time and the trading profit available to investors has fallen.

[2] Chordia et al. (2002) find that the market order imbalances, defined as aggregated daily market buy orders less than sell orders for stocks in the S&P 500 index, are highly predictable from day to day. This implies that investors continue to buy and sell for a long time, they are splitting large orders over days or they are herding. Notwithstanding the persistence in order imbalances, the S&P 500 index exhibits almost a random walk over a horizon of one day. This indicates that some sophisticated investors might correctly predict continued price pressure by order imbalances and conduct countervailing trades within the first day. Thus, all serial dependence in returns is removed.

[3] Using data from October 1989 to January 1994, they find that the average abnormal return is 4.011 percent (t = 4.15) and the one-way trading cost is less than $0.80 per share (the average price of included stocks is about $40 per share). Therefore, even after accounting for reasonable trading costs, the abnormal return remains positive on average and provides the motivation for the S&P game.

[4] The strategy is slightly more complex than that of Beneish and Whaley (1996) and Cusick (2002). The strategy involves three basic steps. First, short the added stock from the open of the first day after the announcement until the close. Second, reverse the position until the close of the event date. The third step is to short the stock again from the close of the event date until the close of the third day after the event.

volume on the announcement day of the S&P 500 index change is nearly 40 percent larger than normal. Since the announcement takes place after the close, the abnormal volume implies that news of the identity and the timing of the change have leaked out prior to the formal announcement. Therefore, we use the case of the Taiwan 50 index change and find that trading volume is normal as usual on the announcement day, indicating that the public news of the identity and the timing of the change have fully leaked out prior to the formal announcement. That is to say, the transparency of the Taiwan 50 index is better than that of the S&P 500 index. Second, the S&P game worked well during the period from October 1989 to January 1994, and Beneish and Whaley (1996) expected the S&P game to disappear. We examine whether there is an "S&P game" for the Taiwan 50 index (or "Taiwan 50 game"). The average abnormal return of the strategy of buying the stock and short selling the Taiwan 50 futures at the open on the day after the announcement and closing the position at the close on the effective day is insignificantly negative. Therefore, even without trading costs, we can not make a profit by adopting the "Taiwan 50 game" strategy. Third, Beneish and Whaley (1996) use the close-to-close return following the announcement to test for efficiency. We use the concept of Chordia et al. (2005) to explore whether there is a significant change in weak-strong-form efficiency when a stock is included in the Taiwan 50 index. The lagged returns are not significant predictors of future returns in all the periods, i.e., these added stocks achieve weak-form efficiency in 1.5-minute time period. Moreover, the lagged order imbalances are not significant predictors of future returns until the 5-minute time period, i.e., these added stocks achieve strong-form efficiency only after 5 minutes. Therefore, the arbitrage activity takes about 5 minutes.

The contributions of this paper are as follows. First, past studies usually use daily data to discuss whether there is a significant change in added stock. To our knowledge, we first use the intraday data to explore the speed of convergence for the added stock. Second, the transparency of the Taiwan 50 index is better than that of the S&P 500 index. Therefore, it is an interesting issue to explore whether the arbitrage opportunity of the "S&P game" exist in the Taiwan 50 index.

The remainder of this study is organized as follows. Section 1 describes the data and methodology. Our empirical results are presented in Section 2 and the last Section concludes.

1. Data and methodology

The most common reason for a stock's addition or deletion is that it merges with or is acquired by another firm. In these cases, the timing of the stock's removal is close to the tender offer expiration date or to the shareholder vote date. Corporate restructuring (e.g., a spin-off) and bankruptcy could also result in the stock's removal. A firm would be deleted when it no longer meets the criteria[1] for inclusion in the S&P 500 index. As in past studies, we do not examine the behavior of stocks deleted from the Taiwan 50 index since the deleted stocks are either not traded after the index change or the announcement of the removal is confounded by the firm-specific information.

We analyze firms included in the Taiwan 50 index for the period from January 2003 through July 2008. Over this period, there are seventeen stocks included. The number of days between the announcement day and effective day for index changes is about six days. The transaction price, volume data and bid/ask quotes are taken from the Taiwan Economic Journal (TEJ) data base.

According to the ground rules for the management of the Taiwan 50 index, the quarterly reviews of the Taiwan 50 index constituents take place on the Thursday after the first Friday of January, April, July and October using data from the close of the last business day in March, June, September and December. Any constituent changes will be implemented on the next trading day following the third Friday of the same month of the review meeting. The rules for inserting and deleting companies at the quarterly review are designed to provide stability in the selection of constituents of the Taiwan 50 index, while ensuring that the index continues to be representative of the market by including those companies which have risen significantly. A company will be inserted at the periodic review if it rises to 40th or above. The secretary to the Advisory Committee is responsible for publishing the 5 highest ranking non-constituents of the Taiwan 50 index following each quarterly review. This reserve list will be used in the event that one or more constituents are deleted from the Taiwan 50 index during the period up to the next quarterly review of the index. When a constituent is removed from the list, it will be replaced by the highest ranking company by full market capitalization eligible on the reserve list as at the close of the index calculation two days prior to the deletion.

[1] Since the primary objective of the S&P 500 to be the performance benchmark for the U.S. equity markets, the criteria for inclusion in the index include: (1) industry representation – the firm must be from an important (or emerging) U.S. industry segment; (2) firm size – the firm usually has the highest market value within its industry; (3) number of shareholders – the firm's shares must be widely-held to avoid adverse effects of market illiquidity; (4) trading volume – the greater is the trading activity of the firm's shares, the more efficient is their pricing and the more timely is the movement in the index; (5) financial soundness – the firm's financial and operating conditions are rigorously analyzed to ensure that included firms will have longevity.

The daily data are divided into two parts: (1) a benchmark period, which extends from sixty days before the announcement day to one day before the announcement day; and (2) a testing period, which extends from the announcement day to sixty days after the effective day. We analyze the trading activity of Taiwan 50 additions using the following indicators. We use three kinds of spread and depth to represent liquidity. That is:

$$\textit{Relative quoted spread} = (P_a - P_b)/\ ((P_a + P_b)/2), \quad (1)$$

$$\textit{Effective spread} = 2\times|P - (P_a + P_b)/2|, \quad (2)$$

$$\textit{Depth} = \textit{Volume at } P_a + \textit{Volume at } P_b, \quad (3)$$

where P_a is the lowest ask price, P_b is the highest bid price, and P is the transaction price.

We divide the daily data into two parts to distinguish whether the abnormal return on the day following the announcement is ascribed to the overnight price movement or price movement during the following day. There is a problem in measuring abnormal returns by using intraday data. The market return is usually proxied by using the return on the cash index such as the Taiwan 50 index. Measuring the overnight return based on the cash index is not reasonable. The cash index is based almost entirely on the prices of a stock's previous day's close when the cash index is reported for the first time at the beginning of the day. To circumvent this problem, this paper use returns on the nearby Taiwan 50 index futures contract. Therefore, abnormal return is defined as the stock return over the indicated interval less the nearby Taiwan 50 index futures return over the corresponding interval.

By using a futures-based approach to compute the abnormal return, we can measure the return on a viable strategy, which is to buy the included stock and to sell an appropriate number of Taiwan 50 index futures. The return based on the strategy in the holding period is:

$$\textit{Abnormal return}_i =$$

$$= \left(\prod_{t_i=1}^{T}(1+R_{m,t_i})-1\right) - \left(\prod_{t_i=1}^{T}(1+R_{m,t_i})-1\right), \quad (4)$$

where R_i and R_m are the return on stock i and the Taiwan 50 index futures, respectively, and T is the length of the trading interval.

Chordia et al. (2005) explore whether lagged returns are significant predictors of future returns over short intervals to check the weak-form efficiency:

$$R_{it} = \alpha_0 + \alpha_1 R_{it\text{-}1}, \quad (5)$$

where R_{it} is the return on stock i in period t, defined as $\ln(P_{it}/P_{it\text{-}1})$, P_{it} is the mid-quote price.

If α_1 is significantly different from zero, we could conclude that the stock does not achieve weak-form efficiency.

Moreover, we divide the intraday period into three parts: a period from announcement day -5 to the announcement day, a period from announcement day +1 to the effective day, and a period from effective day +1 to effective day +5. The time intervals are from 1.5 to 60 minutes. For each stock, we define the order imbalance as OIN, which is the number of buyer-initiated trades[1] minus that of seller-initiated trades.

Chordia et al. (2005) explore whether lagged order imbalances are significant predictors of future returns over short intervals to check the strong-form efficiency[2].

$$R_{it} = \beta_0 + \beta_1\ OIN_{it\text{-}1}, \quad (6)$$

where R_{it} is the return on stock i in period t, defined as $\ln(P_{it}/P_{it\text{-}1})$, P_{it} is the mid-quote price, and $OIN_{it\text{-}1}$ is the order imbalance of stock i in period $t - 1$.

If β_1 is significantly different from zero, we could conclude that the stock does not achieve strong-form efficiency.

2. Empirical results

2.1. Trading volume. To separate abnormal trading volume in the days after the announcement day, we compute the ratio of daily trading volume to average daily trading volume over the sixty trading days prior to the announcement day. If the daily volume on or after the announcement day is greater (less) than normal, the ratio is greater (less) than one.

Panel A of Table 1 indicates that trading volume is 0.949 times normal (with a t-ratio of -0.228) on the announcement day, which is normal as usual. This indicates that the public news of the identity and the timing of the change have fully leaked out prior to the formal announcement. That is to say, the transparency of the Taiwan 50 index is better than that of the S&P 500 index since trading volume on the announcement day of the S&P 500 index change is nearly 40 percent greater than normal (Beneish and Whaley, 1996). Furthermore, we use intraday data on the announcement day to check the information leakage. According to the volume presented in Figure 1, high trading activity occurs at the close[3]. Moreover, Figure 2 shows that

[1] We then sign trades using Lee and Ready (1991) rule: if a transaction occurs above (under) the prevailing quote midpoint, it is regarded as a buy (sell) order. If a transaction occurs exactly at the quote midpoint, it is signed using the previous transaction price according to the tick test (i.e., buys if the sign of the last non-zero price change is positive and vice versa).

[2] Although the strong form of efficient market hypothesis predicts that stock price reflects all information, strong-form efficiency is still the appropriate criterion because investors who are not at the exchange cannot observe order imbalances immediately; only the market makers and perhaps astute floor traders can inspect order imbalances promptly.

[3] In Taiwan stock market, the market opens at 9:00 a.m. and closes at 1:30 p.m.

most of the trades are sell-initiated. Thus, a higher volume at the close is just a "smile pattern" instead of buying pressure from informed traders, which confirms the better transparency of Taiwan 50 index.

Table 1. Abnormal trading volume and abnormal trade size of added stocks

Interval			
From	Until	Mean	T-value
Panel A. Abnormal trading volume			
Ann. day		0.949	-0.228
Ann. day +1		1.339	1.098
Ann. day+1	Eff. day	1.440	1.422
Eff. day		1.191	0.705
Eff. day +1		1.013	0.109
Eff. day +2	Eff. day +10	1.162	0.868
Eff. day +10	Eff. day +20	1.080	0.522
Eff. day +20	Eff. day +40	1.303	0.684
Eff. day +40	Eff. day +60	1.668	0.909
Panel B. Abnormal trade size			
Ann. day		0.934	-1.483
Ann. day +1		0.961	-0.964
Ann. day+1	Eff. day	1.009	0.263
Eff. day		0.905	-2.180**
Eff. day +1		0.878	-4.649***
Eff. day +2	Eff. day +10	0.919	-2.704**
Eff. day +10	Eff. day +20	0.947	-1.122
Eff. day +20	Eff. day +40	0.956	-0.742
Eff. day +40	Eff. day +60	0.948	-1.214

Note: ***, **, and * denote significance at 1%, 5%, and 10% level. Ann. day and Eff. day represent announcement day and effective day respectively.

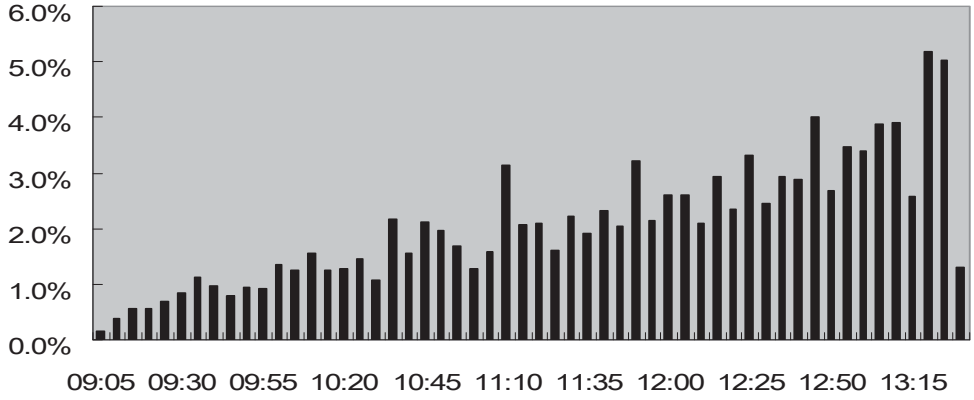

Fig. 1. Number of shares traded over each 5-min interval expressed as a percentage of the total daily volume of the added stock on the announcement day

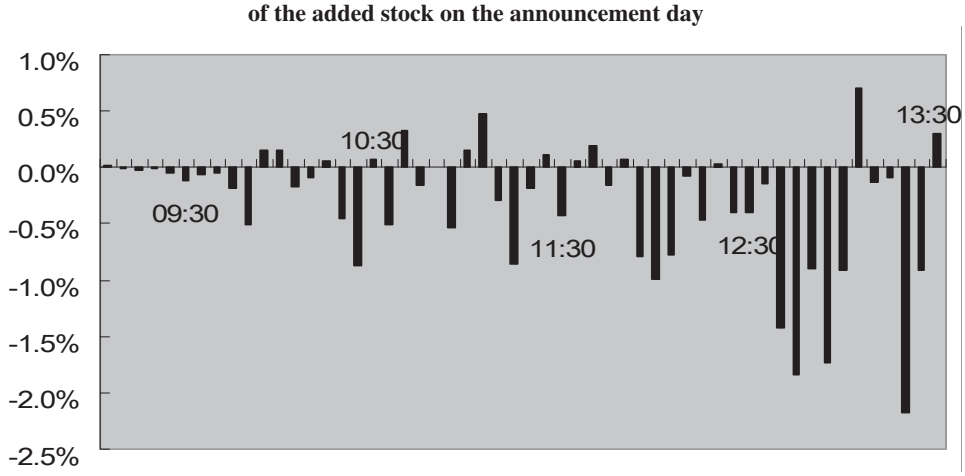

Fig. 2. Order imbalance traded over each 5-min interval expressed as a percentage of the total daily volume of the added stock on the announcement day

The trading volume is 1.339 times normal (with a t-ratio of 1.098) on the day after the announcement, 1.440 times normal (with a t-ratio of 1.422) across all days between the announcement day and the effective day, and 1.191 times normal (with a t-ratio of 0.705) on the effective day. The overall abnormal trading volume from the day after the announcement to the effective day has increased. The evidence implies that many index funds rebalance their portfolios and a great number of arbitrageurs seek to make profits in this period. Furthermore, we use intraday data on the effective day to examine the behavior of index funds and arbitrageurs. According to the volume presented in Figure 3, high trading activity occurs at the close. Moreover, Figure 4 shows that most of the trades are buyer-initiated through the day. The strong buying pressure implies that there are many index funds buying the added stocks during the day to minimize the tracking error, whereas there are few arbitrageurs seek to sell stocks to make profits on the effective day.

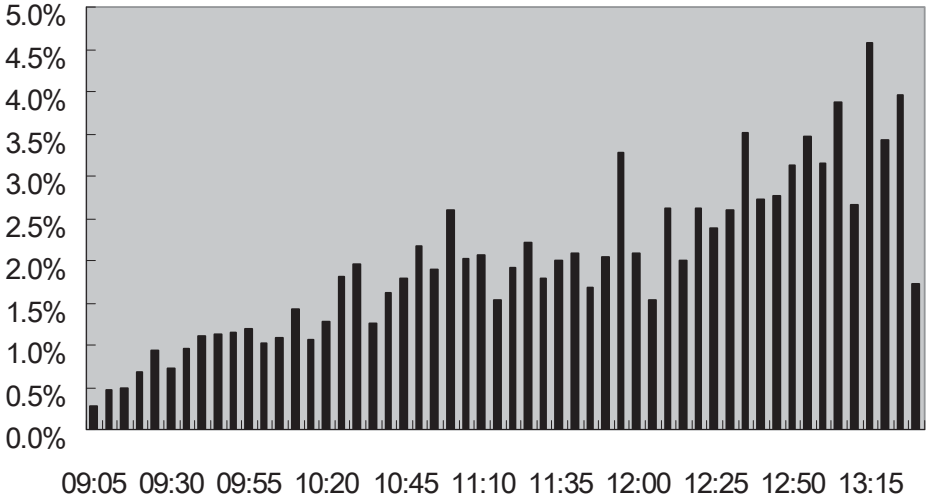

Fig. 3. Number of shares traded over each 5-min interval expressed as a percentage of the total daily volume of the added stock on the effective day

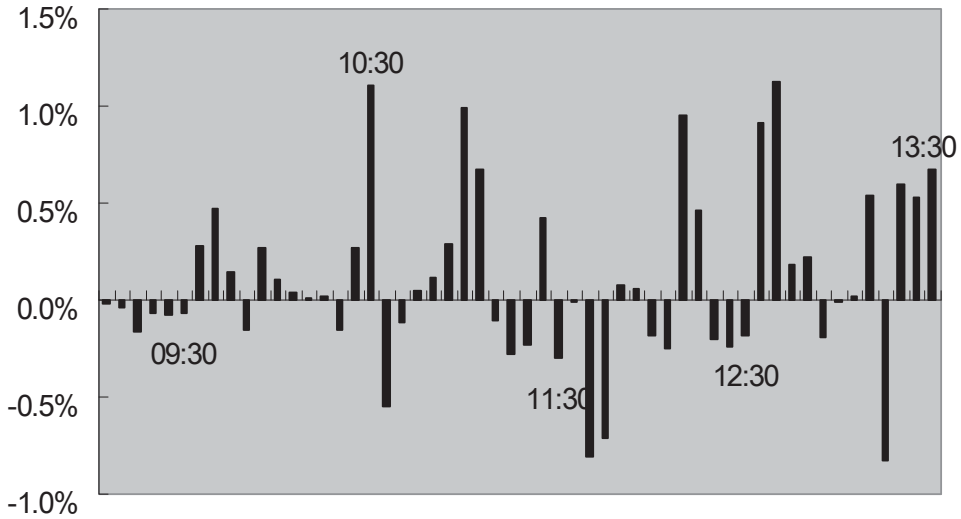

Fig. 4. Order imbalance traded over each 5-min interval expressed as a percentage of the total daily volume of the added stock on the effective day

The abnormal volume ratio is 19.1 percent higher than normal in the first ten days after the addition and 30.3 percent higher than normal in days 21 through 40. Furthermore, this ratio remains more than 66 percent above normal as far as 60 days after the effective day. Obviously, the trading volume is influenced permanently by the addition to the Taiwan 50 index. The main potential explanation is that the added stocks become more liquid since they are scrutinized more fully by investors, institutions, and analysts. Another possible explanation might be that index arbitrageurs with Taiwan 50 futures and options increase the trading volume of the added stocks since they are part of the Taiwan 50 index basket.

2.2. Trade size. To isolate abnormal trade size in the days after the announcement day, we compute the ratio of daily trade size to average daily trade size over the sixty trading days prior to the announcement day. If the daily trade size on or after the announcement day is greater (less) than normal, the ratio is greater (less) than one. Panel B of Table 1 shows that the average trade size is 0.905 times normal (with a t-ratio of -2.180) on the effective day, 0.878 times normal (with a t-ratio of -4.649) on the effective day +1, and 0.919 times normal (with a t-ratio of -2.704) on the effective day +2 through effective day +10. Furthermore, it remains about five percent less than normal as far as 60 days after the effective day. According to Sofianos (1993) and Beneish and Whaley (1996), the average trade size of the stocks used in S&P 500 index arbitrage is significantly less than the average trade size of the stocks in their sample before they are added to the S&P 500. Therefore, in our sample, we could conclude that index arbitrage prevails after the effective day. Moreover, Chen et al. (2004) find that there is the increased investor awareness for added stocks as investors learn about it. Elliott et al. (2006) document that increased investor awareness is the pri-

mary factor behind the cross-section of abnormal announcement returns. Compared with the institution investors, the individual investors are more affected by investor awareness effect. The individual investors would pay more attention to the added stocks and trade them more. Since the majority of their trade size is small, the average trade sizes of the added stocks decrease after announcement day, especially after effective day.

2.3. Spread and depth. After considering the trading volume and trade size, we examine the changes in the spread (depth) by computing the ratio of the average bid/ask spread (depth) across all quotes on a particular day to the average of the average daily bid/ask spread (depth) during the sixty trading days before the announcement.

The relative quoted spread results, reported in Panel A of Table 2, are more distinct than those reported for the absolute quoted spread[1]. The relative quoted spread is 0.917 times normal (with a t-ratio of -4.183) on the day after the announcement, 0.906 times normal (with a t-ratio of -3.673) across all days between the announcement day and the effective day and 0.888 times normal (with a t-ratio of -4.359) on the effective day. The overall abnormal relative quoted spread from the day after the announcement to the effective day has decreased. The temporary decrease in the relative quoted spread implies that the index funds might use limit orders to rebalance their portfolios in this period. By using the limit order to buy the added stocks at a price higher than the market maker's bid price (lower than the ask price), the index funds tighten the spread.

The relative quoted spread is 0.903 times normal (with a t-ratio of -3.176) on the effective day +1, and 0.913 times normal (with a t-ratio of -3.629) on the effective day +2 through effective day +10. Furthermore, it remains about ten percent less than normal as far as 60 days after the effective day. The permanent decrease in the relative quoted spread implies that added stocks become more liquid since they are scrutinized more fully by investors, institutions, and analysts.

Panels B and C of Table 2 indicate that the results for the abnormal effective spread and abnormal depth are all insignificant. There is neither a temporary nor a permanent reduction in the abnormal effective spread and abnormal depth.

[1] The untabulated results indicate that the abnormal absolute quoted spread results are all insignificant. There is neither a temporary nor a permanent reduction in the absolute quoted spread.

Table 2. Abnormal relative quoted/effective bid/ask spread, and abnormal depth of added stocks

Interval			
From	Until	Mean	T-value
Panel A. Abnormal relative bid/ask spread			
Ann. day		0.935	-1.766*
Ann. day +1		0.917	-4.183***
Ann. day+1	Eff. day	0.906	-3.673***
Eff. day		0.888	-4.359***
Eff. day +1		0.903	-3.176***
Eff. day +2	Eff. day +10	0.913	-3.629***
Eff. day +10	Eff. day +20	0.922	-3.078***
Eff. day +20	Eff. day +40	0.919	-2.175**
Eff. day +40	Eff. day +60	0.909	-1.879*
Panel B. Abnormal effective bid/ask spread			
Ann. day		1.021	0.574
Ann. day +1		1.009	0.340
Ann. day+1	Eff. day	1.010	0.394
Eff. day		1.008	0.229
Eff. day +1		1.019	0.620
Eff. day +2	Eff. day +10	1.007	0.194
Eff. day +10	Eff. day +20	0.998	-0.069
Eff. day +20	Eff. day +40	0.975	-0.644
Eff. day +40	Eff. day +60	0.963	-0.959
Panel C. Abnormal depth			
Ann. day		1.092	0.494
Ann. day +1		1.303	0.929
Ann. day+1	Eff. day	1.125	0.661
Eff. day		0.950	-0.213
Eff. day +1		1.017	0.072
Eff. day +2	Eff. day +10	1.197	0.835
Eff. day +10	Eff. day +20	0.998	-0.013
Eff. day +20	Eff. day +40	1.058	0.301
Eff. day +40	Eff. day +60	1.148	0.754

Note: ***, **, and * denote significance at 1%, 5%, and 10% level. Ann. day and Eff. day represent announcement day and effective day respectively.

2.4. Abnormal return. The close-to-close returns are reported in Panel A of Table 3. The abnormal return from the announcement day close until the effective day close is 3.8 percent with a t-ratio of 1.503. It could be the index fund investment. Over the period as a whole, average abnormal returns are insignificantly different from zero.

Average abnormal returns for different overnight and intraday intervals are reported in Panel B of Table 3. The average abnormal return from the announcement day close until the announcement day +1 open is 4.5 percent with a t-ratio of 1.541, while the average abnormal return from the open of the announcement day +1 to the close of the effective day is-2.7 percent with a t-ratio of -1.126. Therefore, we can not conclude that the close-to-close return is driven by the overnight or intraday return. Whether the market is efficient in Taiwan 50 added firms can not be judged by checking the close-to-open returns.

We focus on the profitability of risk arbitrage. Buying the added stocks at the open after the announcement day and selling them at the close on the effective day is referred to as the "Taiwan 50 game" strategy. The average abnormal return of the strategy of buying the stock and short selling the Taiwan 50 futures at the open on the day after the announcement and closing the position at the close on the effective day is -4.60 percent (with a t-ratio of -1.090). Therefore, even without trading costs, we can not make a profit by adopting the "Taiwan 50 game" strategy. This conclusion is not consistent with Beneish and Whaley (1996), whose abnormal return is 4.011 percent (with a t-ratio of 4.15). It might be that the transparency of the Taiwan 50 index is better than that of the S&P 500 index, and there is no room for investors to arbitrage. Moreover, Fama (1998) documents that even if anomalies existed in the past, once the anomalies are detected and made public, they will disappear since investors will try to take advantage of them.

The abnormal return from the announcement day close until the effective day + 60 close is negative and insignificant, and does not exhibit the reversal of stock returns in Russell 1000 reconstitutions.

Table 3. Average abnormal return of added stocks

Interval			
From	Until	Mean	T-value
Panel A. Close-to-close return			
Ann. day -1 close	Ann. day close	0.001	0.147
Ann. day close	Eff. day close	0.038	1.503
Ann. day close	Eff. day +1 close	0.033	1.390
Ann. day close	Eff. day +10 close	0.002	0.068
Ann. day close	Eff. day +20 close	-0.020	-0.819
Ann. day close	Eff. day +40 close	-0.017	-0.463
Ann. day close	Eff. day +60 close	-0.009	-0.198
Panel B. Returns between ann. and eff. days			
Ann. day close	Ann. day +1 open	0.045	1.541
Ann. day +1 open	Ann. day +1 close	-0.027	-1.126
Ann. day +1 close	Eff. day close	0.044	2.129**
Eff. day -1 close	Eff. day open	0.031	0.995
Eff. day open	Eff. day close	-0.028	-1.008
Eff. day close	Eff. day +1 open	0.037	1.223
Eff. day +1 open	Eff. day +1 close	-0.014	-2.319**
Panel C. Open-to-close returns			
Ann. day +1 open	Eff. day close	-0.046	-1.090
Ann. day open	Eff. day close	0.007	0.209
Ann. day open	Eff. day +10 close	-0.024	-0.567
Ann. day open	Eff. day +20 close	-0.046	-1.576
Ann. day open	Eff. day +40 close	-0.044	-1.138
Ann. day open	Eff. day +60 close	0.077	0.700

Note: ***, **, and * denote significance at 1%, 5%, and 10% level. Ann. day and Eff. day represent announcement day and effective day, respectively.

2.5. Efficiency. Table 4 reports serial regressions for returns and univariate regressions of returns on lagged order imbalances[1]. We calculate returns by the mid-quote price. The results show that lagged returns are not significant predictors of future returns in a period, i.e., these added stocks achieve weak-form efficiency in a 1.5-minute time period. Besides, there is no difference in the efficiency situation between three periods. Therefore, there is insignificant change in weak-form efficiency when a stock is included in the Taiwan 50 index. Table 4 also shows that lagged order imbalances are significant predictors of future returns in a 1.5-minute time period, i.e., these added stocks achieve strong-form efficiency only after 5 minutes[2]. The above results seem reasonable, for in a 1.5-minute time period, these stocks do not achieve strong-form efficiency but achieve weak-form efficiency, which is consistent with the efficient markets hypothesis.

Overall, order imbalances might arise from traders who have a demand for informational or liquidity needs. Market makers react to order imbalances by quotes from their fundamental values to control inventory. Finally, arbitrageurs intervene to increase market-making capacity by guiding countervailing trades in the direction opposite to the initial order imbalances. Based on the above findings that these added stocks do not achieve strong-form efficiency until 5 minutes, this arbitrage activity takes about five minutes.

Table 4. Univariate regressions predicting returns of added stocks

Explanatory var.	Return interval (minutes)				
	1.5	5	10	15	30
	From ann. day -5 to ann. day				
Return $t-1$	0.009 (0.248)	-0.081 (-1.310)	-0.069 (-0.799)	-0.068 (-0.644)	-0.075 (-0.531)
OIN $t-1$	0.001 (3.821***)	0.000 (1.582)	-0.000 (0.059)	0.000 (0.395)	0.000 (-0.011)
	From ann. day +1 to eff. day				
Return $t-1$	-0.002 (0.0136)	-0.062 (-1.129)	-0.020 (-0.280)	-0.050 (-0.555)	-0.056 (-0.433)
OIN $t-1$	0.001 (4.166***)	0.001 (1.508)	0.000 (0.181)	0.001 (-0.122)	0.001 (0.108)
	From eff. day +1 to eff. day +5				
Return $t-1$	-0.019 (-0.408)	-0.093 (-1.523)	-0.075 (-0.882)	-0.023 (-0.235)	-0.048 (-0.363)
OIN $t-1$	0.001 (3.670***)	0.000 (1.636)	0.000 (0.659)	0.000 (0.556)	0.000 (0.556)

Note: ***, **, and * denote significant at 1%, 5%, and 10% level. Ann. day and Eff. day represent announcement day and effective day, respectively.

[1] We obtain similar results by means of multiple regressions of returns with both lagged returns and lagged OIN as predictors.

[2] Using data for 150 NYSE stocks during 2002, Chordia et al. (2005) find that stocks achieve strong-form efficiency only after 10 minutes, which is slower than added stocks. Since the added stocks are of more concern to the public, the convergence to efficiency should be more rapid.

Conclusion

This study examines the index addition effect of Taiwan 50 index for the period from January 2003 through July 2008. We find that trading volume is normal as usual on the announcement day, indicating that the public news of the identity and the timing of the change have fully leaked out prior to the formal announcement. That is to say, the transparency of the Taiwan 50 index is better than that of the S&P 500 index. The average abnormal return of the strategy of buying the stock and short selling the Taiwan 50 futures at the open on the day after the announcement and closing the position at the close on the effective day is insignificantly negative. Therefore, even without trading costs, we can not make a profit by adopting the "Taiwan 50 game" strategy. The lagged returns are not significant predictors of future returns in all the periods, i.e., these added stocks achieve weak-form efficiency in 1.5-minute time period. Moreover, the lagged order imbalances are not significant predictors of future returns until the 5-minute time period, i.e., these added stocks achieve strong-form efficiency only after 5 minutes. Therefore, the arbitrage activity takes about 5 minutes. Besides, there is no difference in the efficiency situation between the three periods. Therefore, there is insignificant change in weak-strong-form efficiency when a stock is included in the Taiwan 50 index.

References

1. Brown, P., D. Walsh, A. Yuen. The Interaction between Order Imbalance and Stock Price // *Pacific-Basin Finance Journal*, 1997. – № 5. – pp. 539-557.
2. Beneish, M.D., R.E. Whaley. An anatomy of the S&P game: the effects of changing the rules // *The Journal of Finance*, 1996. – № 51. – pp. 1909-1930.
3. Beneish, M.D., R.E. Whaley. S&P 500 index replacements // *The Journal of Portfolio Management*, 2002. – № 28. – pp. 51-60.
4. Carino, D.R., M. Pritamani. Price pressure at Russell index reconstitution // Working Paper, 2007. Russell Investment Group.
5. Chen, H. On Russell index reconstitution // *Review of Quantitative Finance and Accounting*, 2006. – № 26. – pp. 409-430.
6. Chordia, T., R. Roll, A. Subrahmanyam. Order imbalance, liquidity and market returns // *Journal of Financial Economics*, 2002. – № 65. – pp. 111-130.
7. Chordia, T., R. Roll, A. Subrahmanyam. Evidence on the speed of convergence to market efficiency // *Journal of Financial Economics*, 2005. – № 76. – pp. 271-292.
8. Cusick, P. Price effects of addition or deletion from the standard and poor's 500 index: evidence of increasing market efficiency // *Financial Markets, Institutions and Instruments*, 2002. – № 11. – pp. 349–383.
9. Denis, D.K., J.J. McConnell, A.V. Ovtchinnikov, Y. Yu. S&P 500 index additions and earnings expectations // *The Journal of Finance*, 2003. – № 58. – pp. 1821-1840.
10. Elliott, W.B., B.F. Van Ness, M.D. Walker, R.S. Warr. What drives the S&P 500 inclusion effect? An Analytical Survey // *Financial Management*, 2006. – № 35. – pp. 31-48.
11. Fama, E. Market efficiency, long-term returns, and behavioral finance // *Journal of Financial Economics*, 1998. – № 49. – pp. 283-306.
12. Huberman, G., T. Regev. Contagious speculation and a cure for cancer: a nonevent that made stock prices soar // *The Journal of Finance*, 2001. – № 56. – pp. 387-396.
13. Kalpathy, S., M. Santhanakrishnan. Information content of S&P 500 index additions: a reexamination using Russell 1000 reconstitutions // Working Paper, 2008. Washington State University.
14. Kappou, K., C. Brooks, C. Ward. The S&P 500 index effect reconsidered: evidence from overnight and intraday stock price performance and volume // *Journal of Banking and Finance*, 2010. – № 34. – pp. 116-126.
15. Lee, C., M. Ready. Inferring trade direction from intra-day data // *Journal of Finance*, 1991. – № 46. – pp. 733-747.
16. Lin, C.C., M.H. Chiang. Volatility effect of ETFs on the constituents of the underlying Taiwan 50 Index // *Applied Financial Economics*, 2005. – № 15. – pp. 1315-1322.
17. Okada, K., N. Isagawa, K. Fujiwara. Addition to the Nikkei 225 index and Japanese market response: temporary demand effect of index arbitrageurs // *Pacific-Basin Finance Journal*, 2006. – № 14. – pp. 395-409.
18. Patell, J., M. Wolfson. The intra-day speed of adjustment of stock prices to earnings and dividend announcements // *Journal of Financial Economics*, 1984. – № 13. – pp. 223-252.
19. Wurgler, J., E. Zhuravskaya. Does arbitrage flatten demand curves for stocks? // *The Journal of Business*, 2002. – № 75. – pp. 583-608.