1 Introduction

Financial innovations during the last decades have led to a large number of commercial products. Basket securities or index-linked securities are securities whose values are aggregate of existing securities. One of the recent innovations in basket securities is exchange-traded fund (ETF) also called Index Participation Units (IPUs). ETF has been a popular composite security since its first introduction to markets. The first ETF, Toronto Index Participation Units (TIPs) was introduced in Canada in 1990. Created by the Toronto Stock Exchange (TSE), TIPs tracked the Toronto-35 Index. In 1993, the American Stock Exchange then launched its first ETFs, Standard and Poor's Depository Receipts (SPDR) tracking the Standard and Poor's 500 (S&P 500) Index. Due to the success of SPDR, other ETFs were introduced to markets in the following. For instance, the Diamonds tracks the Dow Jones Industrial Average (DJIA), the Cubes (QQQ) tracks the NASDAQ 100 Index, iShares tracks the Morgan Stanley Capital International Indexes (MSCI), and the like. In the past 12 years, ETFs have experienced a rapid growth globally. The asset under management has increased from $800 million in January, 1993 to $359.8 billion in September, 2005. 400 ETFs are listed in global markets as of the end of September, 2005 with an average daily dollar volume of $17.5 billion in 2005.[1]

The creation of ETFs gives investors an investing vehicle to trade a portfolio of securities in one transaction; hence, risk diversification can be easily realized with a low transaction cost. Moreover, ETFs are index-tracking securities; therefore, they also function well as hedging tools. For arbitrageurs, the launch of ETFs facilitates the arbitrage tradings between benchmark index and component stocks. Undoubtedly,

[1] Source: the official website of Polaris International Securities Investment Trust Co., Ltd.

they are of great significance in terms of the risk diversification and market liquidity. Subrahmanyam (1991) proposes that as information asymmetry exists, basket securities may provide liquidity traders with a low cost alternative to direct investment in their underlying stocks. Thus, the introduction of exchange-traded funds has important implications for the microstructure of underlying stocks. However, there is little empirical evidence about the impact of ETFs trading on the market liquidity of underlying stocks. The introduction of Taiwan Top 50 Tracker Fund (TTT), the first exchange-traded fund in Taiwan security market launched on June 30, 2003, gives us an opportunity to address this critical issue.

To what extent do basket securities affect the market liquidity of underlying stocks? The introduction of basket securities can give rise to two possible effects. The adverse selection theories suggest that the liquidity of underlying stocks might become worse due to an increase in the adverse selection cost. On the contrary, the index arbitrage theories propose an opposite conclusion. They suggest that the liquidity of underlying stocks might become better because the index arbitrage between markets can eliminate information asymmetry. We explain the two propositions in the following.

Subrahmanyam (1991) formulates a model to demonstrate the impact of the creation of basket securities. He concludes that liquidity traders prefer a basket security to its component stocks as the trading instrument. The reason is that the security-specific information could be diversified in the basket security. Risk diversification could result in an improvement in the adverse selection problem of basket securities. In other words, the creation of composite securities improves the welfare of liquidity traders because the composite securities minimize liquidity traders' trading losses to informed traders. Moreover, he suggests that upon the introduction of a basket security, there will be deterioration of the adverse selection

problem for underlying stocks. The deteriorated adverse selection problem for underlying stocks results from the migration of liquidity traders to the market of the basket security because of its low transaction cost (i.e. low adverse selection costs). The migration of liquidity traders to the market of basket securities raises the proportion of informed traders in the market of underlying stocks. Therefore, the adverse selection risk increases the underlying stocks and consequently, the liquidity of underlying stocks worsens. Similar conclusions can be found in Gorton and Pennacchi (1993) and Gammill and Perold (1989).

However, the index arbitrage theories suggest a different proposition. The trading of index-linked securities will increase arbitrage tradings and is likely to lower the adverse selection risk in the underlying securities markets. Arbitrageurs profit from tracking error, or mispricing between the index and the component stocks. The inter-market arbitrage will correct the information asymmetry between the index security and the corresponding constituents. Thus, the market liquidity of component stocks will improve. Fremault (1991) discusses the role of index arbitrage between index futures and their underlying stocks. She concludes that index arbitrage provides buying support as well as selling support to correct temporary order imbalances across markets. Furthermore, index arbitrage transmits information from one market to the other and reduces information asymmetries across markets. These two functions of index arbitrage imply the improvement in market liquidity. Similar results can be found in Kumar and Seppi (1994).

Based on theoretical models, some empirical researches subsequently examine the market liquidity effects of the introduction of basket securities although the available empirical evidence is limited. Hedge and McDermott (2004) investigate the market liquidity effects of the introduction of Diamonds for the Dow Jones Industrial Average and QQQ for the NASDAQ 100 index. They conclude that after the trading

of the exchange-traded fund, the liquidity of the underlying DJIA 30 index stocks improves. This improvement in liquidity results primarily from a decline in the adverse selection cost of the component stocks. Similar result is found in the component stocks of the NASDAQ 100 index; however, the evidence is weak in comparison with the analysis result of the Diamonds. Furthermore, Hedge and McDermott (2004) examine the trading costs of the Diamonds and QQQ compared with their underlying baskets of stocks respectively. They show that the Diamonds has lower transaction costs compared with the portfolio of the DJIA 30 stocks and weak evidence implies that the QQQ is more liquid compared with the basket of its component stocks.

Van Ness et al. (2005) examine the impact of the listing of the Diamond Index securities. Their study shows that the bid-ask spreads of the Dow 30 stocks increase relative to that of the matching stocks because the Dow 30 stocks exhibit a smaller decline in spreads compared with the matched control group. However, they do not find a consistent change in the adverse selection components. Instead, the change of bid-ask spreads of Dow 30 stocks are caused by another spread component, the inventory holding costs. This finding is different from that of Hedge and McDermott (2004). Additionally, van Ness et al. (2005) examine the overall trading costs of the Diamonds contract compared with the portfolio of its component stocks and find that the trading costs of the Diamonds are significantly lower than that of the portfolio.

Richie and Madura (2005) look into the Nasdaq-100 Index tracking security to determine whether the creation of QQQ affects the liquidity, pricing efficiency, and risk of the underlying stocks. They conclude that the pricing efficiency of the component stocks improves and the systematic risk of the component stocks reduces. As for liquidity effect, their analysis of depths and effective spread shows that the market liquidity improves following the introduction of the QQQ while their analysis

of quoted spread does not show a consistent result. Additionally, they find that the reduction in spreads of heavily weighted stocks is less pronounced than that of those stocks with smaller weights in the post-QQQ market.

Small (2004) examines the liquidity and the adverse selection costs of exchange traded funds (ETFs) by using a matched sample of equity securities and equity ETFs. He concludes that the exchange traded funds exhibit higher level of liquidity and smaller adverse selection costs than the matched control sample.

In addition to ETFs markets, the liquidity effects of basket security trading are tested in other financial markets, for example, mutual funds markets and futures markets. Clark and Shastri (2001) compare the liquidity and adverse selection costs of closed-end funds and a control sample of stocks of similar size and trading volume. They find strong evidence that domestic and international equity funds exhibit greater liquidity and lower adverse selection costs than the corresponding portfolios of underlying stocks. Jegadeesh and Subrahmanyam (1993) investigate the liquidity effects on the underlying stock market around the introduction of the S&P 500 index futures contract. Using monthly data, they analyze the liquidity measures of the S&P 500 component stocks and the control sample of non-S&P 500 stocks. Their analysis suggests that the liquidity of the underlying stocks worsens because the spreads for the sample of S&P 500 stocks increase significantly following the introduction of the futures contract. They also find weak evidence that adverse selection components increase in the post futures period. Edward (1988) tests the effects of S&P 500 futures trading on cash market liquidity. His result does not indicate that the introduction of futures trading caused an increase in the stock price volatility. Instead, the market volatility was greater in the pre-futures period. In contrast, Harris (1989) finds a small increase in volatility for the S&P 500 stocks following the introduction of the S&P 500 futures contract; however, the increase is insignificant.

As we addressed above, there is much attention to the market liquidity effects of basket securities in developed markets. However, few studies attempted to address this issue in emerging markets which are characterized by volatility. Following previous literature, we extend the research to the Taiwan stock market. The objective of this paper is to present a comprehensive analysis of the market liquidity effects of the introduction of TTT on its underlying stocks. We compare the changing patterns of liquidity proxies before and after the launch of TTT. We find that some liquidity proxies, for instance, trading volume, trade frequency and trade size, increase in the post-introduction period. However, after we take the market-wide factor into consideration, the standardized volume decreases after the trading of TTT and it implies that the liquidity of underlying stocks seems worse. The significantly increased volatility of daily returns also suggests deterioration of liquidity. As for the analysis of spreads, our results are inconsistent when we consider different possible influential factors. Both the quoted and effective spread increase significantly while the percentage quoted and effective spread experience a small decline. However, we find no significant difference in the spread in terms of the number of ticks. We then follow Lin et al. (1995) to conduct spread decomposition and find that the widening effective spread is mainly caused by an increase in the adverse selection component. It leads to the conclusion that the liquidity of the Taiwan 50 underlying stocks deteriorates because the adverse selection risk significantly increases in the post-listing period. This finding is consistent with the predictions of Subrahmanyam (1991) and Gorton and Pennacchi (1993).

The remainder of this article is organized as follows. Section 2 briefly introduces the product characteristics of ETFs, TTT, and the Taiwan 50 index components. Section 3 describes the data and methodology used in this research. Section 4 presents the empirical results. Section 5 concludes.