Trading Mechanisms, Liquidity Risk And International Equity Market Integration

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Abstract

This study examines whether trading mechanisms or market microstructures of markets have an effect on the integration issue of the international equity market. If the international equity market is integrated, identical stocks listed on different international stock exchanges should have the same rates of return, the same characteristics of stock price behavior and similar distributions of return. If different market microstructures, or trading mechanisms cause differences in characteristics of stock price behavior, those can lead to different rates of return because of different liquidity risk for the same stocks between markets. This study proposes international asset pricing with liquidity risk related to trading mechanisms. Systematic risk by itself cannot predict the sign of expected rate of return difference for the same stocks between international markets. Liquidity risk factors related to market microstructure provide explanations for the sign of rate of return differences between markets. However, liquidity risk factors related to market microstructure do not have a significant effect on the rate of return differences and sensitivity of return differences between markets. Trading mechanisms or market microstructures might not have a significant effect on the interpretation of the international equity market integration studies, if trading volume or other factors are controlled.

1. Introduction

The world-wide stock market crash in October 1987 focused attention on the effect of market structure on security price behavior. One such issue is whether different market structures lead to differences in the characteristics of stock price behavior[1]. Previous empirical tests on this issue focus on volatility or liquidity risk factor related to trading mechanisms. Reinganum(1990)

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[1] 1) Volatility: Amihud and Mendelson(1987) and Stoll and Whaley(1990) mention that volatility of the opening price which is determined through the auction market mechanism is greater than that of the closing price which is determined through the dealer market mechanism on the NYSE. There have been debates over these empirical results. These results may be due to difference in trading mechanisms or due to the overnight trading halt. Later, Amihud and Mendelson (1989,1991) reexamine this issue on the TSE and show that price of mid-day auction mechanism has the least volatility on the TSE. 2) Liquidity: Reinganum(1990) argued that liquidity risk related to market microstructures significantly affect the rate of return differentials between the NYSE (monopolistic dealer market) the NASDAQ(competitive dealers market).

argued that market microstructures significantly affect the rate of return differentials between the NYSE and the NASDAQ. Later, Loughran(1992) argued that 60 percent return differentials of the above empirical results are attributed to IPO effects. The above debate might be attributed to other effects caused by different stocks between different trading mechanisms. Thus, this study focuses on the same stocks traded with the various trading mechanisms, because different stocks have other uncontrolled effects. It is important to select the trading mechanisms which provide a high level of liquidity and efficient price discovery system, because high level of liquidity could reduce the cost of capital.

This study examines whether different market microstructures can affect the characteristics of stock price behavior for the same stocks traded on different international exchanges. This study also examines whether trading mechanisms or market microstructures of markets have an impact on the integration issue[2] of the international equity market. The definition of international equity market integration in this study[3] is that identical securities should have the same rates of return and stock price behavior, even though they are traded on different international stock exchanges. This study examines how or whether different trading mechanisms have an impact on the rates of return and characteristics of stock price behavior for

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[2] Previous studies of international equity market integration focused on testing the significance of domestic or world risk factors, or the risk-return relationship based specifics asset pricing models. Another approach is based upon using event-study methodology around the announcement of the elimination of an international trading barrier. The other recent trend toward the integration issue is related to international equity market linkage using correlation or transmission of price change or volatility between each stock market. However, a definitive empirical study has not been undertaken that determines, whether and to what extent, international equity markets are segmented or integrated.

[3] The definition of international equity market integration is similar to the definition of Garbade and Silber(1977) in the domestic equity market integration. They use dually listed stocks listed on the NYSE and regional stock exchanges and adopt an econometric methodology to test the integration of domestic equity markets. they indicate that the integration hypothesis is not accepted in the short time interval. Lee(1993) examines price execution among NYSE and regional exchanges. He also shows that full integration is difficult since execution price differs systematically depending on the location. Empirical results might be different depending upon the empirical methodology and the time interval.

the same securities. If the international equity market is integrated, identical securities or financial assets should have the same characteristics of stock price behavior, even though they are being traded on different markets.

The sample companies included in this study are traded on the New York Stock Exchange(NYSE), the Tokyo Stock Exchange(TSE) and the London Stock Exchange(LSE). The trading system on the NYSE is a monopolistic dealer market and the NYSE has an active specialist to stabilize market volatility. On the TSE, prices are determined in an auction market. However, on the LSE, prices are determined by a competitive multiple dealer market. Return variance can differ depending on whether market could be controlled by specialist markets or nonspecialist markets. The bid and ask spread can be different between the markets with competing multiple dealers and markets with monopolistic dealers. If there are any differences in stock price behaviors, or different rates of return for the same stocks between international stock markets, these differences may be attributed to liquidity risk related to trading mechanisms, which may have an effect on integration of international equity markets. This study focuses on the main international stock markets, the New York Stock Exchange(NYSE), the Tokyo Stock Exchange(TSE) and the London Stock Exchange(LSE). The U.S.A., Japan and the U.K. have few international trading barriers and hold more than seventy percent of the total world equity capital. They also have different trading mechanisms and market microstructures.

Section 2 describes market microstructure of NYSE, TSE and LSE and discusses liquidity risk factors related to trading mechanisms. Section 3 deals with trading mechanisms, stock price behavior and international equity market integration and proposes international asset pricing model with liquidity risk which might be related to characteristics of stock price behavior. Section 4 provides empirical results and section 6 presents the summary and conclusions of this study.

2. Description of Market Microstructure of NYSE, TSE and LSE and Liquidity Risk Factors

2.1. Market Microstructure of NYSE, TSE and LSE

(1) The New York Stock Exchange(NYSE)

The NYSE represents a combination of both the auction market in the opening price and the continuous dealer market after the opening price. Before opening, there is a flow of orders to buy or to sell a specific quantity of stock at a limit price or a market price. Trading is performed at a single price which clears the market. After the opening price, trading happens continuously by market participants. On the NYSE, specialists have a unique role in the market. They act as auctioneers, dealers and brokers. At the opening, they accumulate orders and determine the opening price, with the assistance of the opening automated reporting system. They act as stabilizers. They minimize the order imbalance by adjusting orders from the crowd trading, or absorb the order imbalance by trading for their own accounts. If a large order imbalance causes the opening price to be significantly different from the previous closing price, specialists may not open the stock market without a floor officials' approval. Specialists act as dealers when they buy or sell for their own accounts. They must trade to minimize order imbalance and to maintain continuity and depth for the orderly and fair market. New York specialists are different from Tokyo's match makers. Specialists actively stabilize the order imbalance, act as auctioneers or dealers and provide the liquidity service.

(2) The Tokyo Stock Exchange (TSE)

The Tokyo stock market is best described as an auction market, where buy or sell orders directly interact with each other. The market microstructure is quite different from that of the NYSE or of the LSE, where there are specialists who act as market makers. On the TSE there are neither designated market makers nor locals who provide liquidity on the short term market movement. All orders are placed by Satori members (Official Order Clerk) who function as

middlemen in the trade. Satori members are neither allowed to trade any listed stocks for their accounts nor accept orders from the investing public. They simply match orders on the order book according to the exchanges rules.

There are two market mechanisms operating in the TSE; the Itayose mechanism, which governs the opening transactions, and the Zaraba mechanism for continuous trading, which also governs the closing transaction.

(3) The London Stock Exchange (LSE)

The trading system on the LSE is a continuous trading system by competitive multiple dealers. London jobbers (market makers) make bid and offer price for stocks they deal with. The jobbers have an obligation to make a continuous bid and ask quotation for the assigned stocks as well as provide customers with liquidity for the stocks. They can make a profit on the bid and ask spread by continuously buying and selling securities without stamp duty or stamp duty reserve tax. The trading structure of the LSE is similar to that of the NASDAQ in the U.S.A. A number of competing dealers offer their firm quotes in large size.

2.1. Market Microstructure and Liquidity Risk

(1) Bid- Ask spread

In the dealer market, market makers match buying and selling trading partners offering bid and ask price. They may eliminate the need for costly search and provide the liquidity service in the market. Bid - ask spread may be the source of revenue to the dealer but it may be the cost to the investor for the liquidity service. The bid and ask spread should be transaction cost and might cause trading friction in dealer markets and might be one of the liquidity risk factors. Amihud and Mendelson (1986, 1989) demonstrate that the expected rate of return has a positive

and concave relation with the bid - ask spread. Several factors[4] may affect the bid - ask spread. Bid- ask spread could be different, depending upon market microstructure. If the actual bid - ask spread is not available or it is costly to obtain it, it can be inferred from the time series stock price. Assuming several assumptions[5], Roll [6](1984) presents a simple method for inferring the implied bid - ask spread from the market transaction price. Since Roll's assumptions may not be realistic, Glosten(1987) and Choi, Salandro and Shastri(1988) extend Roll's model. They argue there may be some bias in Roll's spread. However, this study is related to the relative difference in the spread between market mechanisms. Actual spread data is costly to obtain, so Roll's implied spread is used as one of liquidity risk in this study.

(2) Variance

Levy(1978) demonstrates that in an imperfect capital market, investors invest in only limited securities because of transaction costs. The indivisibility of investment leads to changing

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[4] Several factors may affect the bid - ask spread. These factors can be classified into three approaches. The first approach is related to the economy of scale in order processing and inventory cost. Savings in inventory or transaction cost due to the economy of scale may reduce the bid and ask spread. [Demetz(1968)], Second approach is based upon the information asymmetry or adverse selection problem. Bid - ask spread is the positive function of the level of informed trading activity he perceives in the market. [Copeland and Galai(1983), Glosten and Milgrom(1985) and Kyle(1985)]. Bid - ask spread is the positive function of the level of information asymmetry. The third factor which affects bid - ask spread is related to level of competition between the competing markets or between number of competing dealers. Generally, empirical evidence appears to support the conclusion that competition reduces the bid - ask spread. Several factors are interrelated in the determination of bid - ask spread.

[5] His method requires several assumptions: 1) The market is informationally efficient. 2) Probability distribution of an observed price change is stationary. 3) Probability of market sale of assets is equal to that of market purchase of assets. There is no serial dependence in transaction type. 4) Bid - ask spread is stationary through time.

[6] Roll(1984) presents the implied bid - ask spread from the market transaction price. Serial covariance can be computed from the combined joint distribution of the successive time series price change, assuming bid and ask transaction is equally likely. $Cov(\Delta P_t , \Delta P_{t+1}) = -s^2/4$. So, the implied spread is $S = 2\sqrt{} - Cov(\Delta P_t , \Delta P_{t+1})$. The serial covariance between successive price changes is made because of the presence of the bid - ask spread, not because of the arrival of information.

the efficient set. He shows that variance explains the expected return more significantly than systematic risk. other researchers such as Mayshar(1981) and Constantinedes(1986) argue that variance is related to the expected rate of return and liquidity premium. Variance is positively related to bid-ask spread[7] and could be different depending upon trading mechanisms.

(3) Residual Risk

Previous studies also considered residual risk as a liquidity risk factor. These empirical and theoretical studies focused on the relationship between residual risk and rate of return. In an empirical study, Friend, Westerfield and Graito(1973) found a significant relation between residual risk and expected return. Hirshleifer(1988) argues that future risk premiums can not be expressed solely by systematic risk premium, but also residual risk components have an impact on the risk premium. Merton(1987) demonstrated that the expected rate of return has some relation with the residual risk. Investors hold only securities whose information they are familiar with. His more general asset pricing model of incomplete markets with the imperfect information shows that expected rate of return is an increasing function of systematic risk and residual risk. Residual Risk is positively related to bid-ask spread[8] and could be different from one trading mechanism to another trading mechanism.

(4) Trading Volume

Several researchers use the trading volume as one of the activity variables. The greater

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[7] Several empirical and theoretical studies have shown that bid-ask spreads are positively related to variance. Stoll(1978) proposes that risk averse market makers estimate a higher spread on assets with a higher variance to compensate for the risk of their stocks. Tinic and West(1974), Branch and Freed(1974) and Hamilton(1978) also find that volatility is positively related to the spread.

[8] Bid - ask spread is positively related to residual risk which may serve as another measure of incomplete information. Benston and Hagerman(1974) suggest that residual risk reflects firm specific information or inside information which is positively associated with an insider's opportunity to trade profitably against dealers. Residual risk is related to inside trading opportunity and insufficient diversification due to informational barrier. So, residual risk is positively related to the bid -ask spread. Benston and Hagerman's empirical work shows that residual risk is positively related to bid-ask spread.

the activity, the lower the dealer's inventory cost and the lower the risk, which reduces the bid and ask spread. Thus, trading volume is negatively related to bid-ask spread[9]. Trading volume or transaction rate is one of the liquidity factors.

The above liquidity factors are interrelated and these factors such as the bid - ask spread, total variance of the expected return, residual risk and trading volume could be different from one trading mechanism to another. Competition in the dealer market can reduce the bid - ask spread. So, the bid and ask spread for the same stock may be different between the competing multiple dealers market and the monopolistic dealer market. The active market maker has the role of adjusting the order imbalance and stabilizing market volatility. Volatility may be different depending on the specialist market or the nonspecialist market. Different residual risk or trading volume may be related to other liquidity risk factors.

3. Trading mechanisms, Stock Price Behavior and International Equity Market Integration

In the domestic market, Reinganum (1990) argues that the return differences between NYSE and NASDAQ securities may be partially because of differences in the market microstructures [10] (monopolistic dealer market on the NYSE vs multiple dealers market on the NASDAQ). In the T-bill market, Kamara (1988) says that the Different Trading Structure Hypothesis explains the disparity between future and forward prices. The observed disparities primarily represent the difference in liquidity risk and default risk premium because of the

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[9] Several empirical papers show that trading volume is negatively related to bid-ask spreads, e.g., Tinic(1972), Tinic and West(1972), Barnea and Logue(1975), Cohen et al(1979), Stoll(1979) , Klemkosky and Conroy(1985) and Hamilton (1987). Amihud and Mendelson(1986) show that stocks with lower volume have higher return and higher bid-ask spreads.

[10] Reinganum(1990) found that the average rate of return for NYSE securities is greater than that for NASDAQ securities by six percent per year. He attributes the return differentials to the different market microstructures. Recently Loughran(1992) reports that sixty percent of rate of return differentials may be due to the poor performance of the NASDAQ IPO's. However, forty percent of return differentials may be due to the market microstructure effect.

different trading structures (open out cry auction market in the future vs. secondary OTC dealer market in the forward). The Different Market Microstructure Hypothesis can be also applied to world equity markets. If there are differences in the rates of return for the same stocks on stock market exchanges, omitted liquidity risk factors related to the different market microstructures may explain part of the differences.

Section 3.1 proposes the international asset pricing model in imperfect markets. If there is trading friction or transaction costs, liquidity risk factors should be considered in asset pricing.

Section 3.2 examines the characteristics of stock price behavior related to liquidity risk factors in the different trading mechanisms. Liquidity premium differences are analyzed in relation to liquidity risk factors.

3.1. Imperfect International Asset Pricing Model and Transaction Cost.

Without transaction cost, all individuals could hold a small number of all marketable securities for diversification. In the perfect market approach, the traditional capital asset pricing model predicts that risk premium is proportional to systematic risk (covariance with marker portfolio). With transaction cost and trading friction, individuals may be limited in investing in all securities for diversification. So, the asset pricing model in the imperfect market predicts that risk premium depends not only on covariance but also on other factors. Investors exposed to liquidity risk need a greater risk premium as compensation for the risk. This study proposes that if there is transaction cost or trading friction, there could be also an extra risk premium to compensate for the extra risk in an imperfect international market.

This section proposes the imperfect international asset pricing model[11].

$$E(R_i - R_f) = (AM)Cov(R, R_m) + (A_c - A)\, M_i\, Cov(R_i, R_l) \qquad (3\text{-}1)$$

[11] The derivation procedure is in the appendix. Basic structure is similar to Merton(73) and Errunza and Losq(85) and Alexander, Eun and Janakiramanan(1987)

where A is Risk aversion coefficient, R_m is the rate of return of world market portfolio, M is the total market value, A_c is risk aversion coefficient for the investor in the complete market, and the subscript i means incomplete market. If markets are complete, the above equation can correspond to Sharp - Lintner relationship such as $E(R_i - R_f) = (AM)Cov(R, R_m)$.

The last term in equation, $[(A_c - A) M_i Cov(R_i, R_I)]$, shows that the expected return of a security in an incomplete market needs a greater risk premium than that in a complete market. The expected return of a securities portfolio in an incomplete market (R_I) can be also expressed by the following equation.

$$E(R_I - R_f) = (AM)Cov(R_I, R_m) + (A_c - A) M_I Var(R_I) \quad (3\text{-}2)$$

Jensen(1972) indicated that for the domestic market, a simple version of an asset pricing model could not describe the expected rate of return structure. A simple international version of the asset pricing model could not describe the rate of return behavior in an imperfect world capital market. The first term on the right side of the above equation is related to systematic risk and the second term may be related to other liquidity risk factors which are not captured by systematic risk.

Return variance can be different depending on whether markets are controlled by specialist or nonspecialists. Return variance is also positively related to a bid - ask spread. A bid and ask spread is positively related to residual risk and is negatively related to trading volume. Proxies for the liquidity risk factor such as variance, bid-ask spread, residual risk and trading volume are interrelated.

If international markets are imperfect, systematic risk can not always predict the sign of difference in the rate of return for the same stock on different markets. Other liquidity risk

factors[12] may add an explanation to the difference in the expected rate of return.

Next section discusses characteristics of stock price behavior related to liquidity risk factors.

3.2. Characteristics of Stock Price Behavior and Liquidity Risk Premium

The characteristics of stock price behavior are examined in different exchange markets. These characteristics may lead to different liquidity risk factors, such as the implied bid - ask spread, volatility, residual risk and trading volume.

3.2.1. Liquidity Risk Premium and Implied Bid - Ask Spread

(1) NYSE and TSE(Dealer Market, Auction Market)

The bid - ask spread is usually thought to be a characteristic of the continuous dealer market and a cost of the supplier's immediacy. It can be investigated whether transaction in the auction market takes place at a price that eliminates the bid and ask bound. In a perfectly efficient auction market, the time series of prices should behave as if all the transactions take place at a midpoint price between bid and ask. In a perfectly functioning auction market, Roll's implied spread should be near zero. However, this implied spread can be affected by trading activity, such as trading volume, trading thinness and other trading friction. The implied spread of the U.S. stock listed on the TSE should be near zero on the TSE. So, the implied spread for the same stock should be greater on the NYSE than that on the TSE. If not, the stock price in the auction market[13] is also driven from the true equilibrium price by a temporary order imbalance. This is the case in the existence of the bid and ask spread in the dealer market. The other *potential explanation is that less trading volume and trading thinness may cause more negative

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[12] In the domestic market, several researcher proposes other liquidity factors to explain the rate of return. 1) Variance: Levy(1978), Mayshar(1981), and Constantinedes (1986). Bid - Ask spread: Amihud and Mendelson(1986). 2) Residual risk: Merton (1987) and Hirshleifer (1988).

[13] Haller and Stoll(1989) examine the German Stock Market which operates according to the auction market. The implied spread calculated form the time serial covariance exhibits the similar characteristic as it is in the U.S. dealer market.

autocorrelation, which may lead to the higher implied spread.

(2) NYSE and LSE (Monopolistic Dealer Market, Competitive Dealer Market)

The implied spread may be different between the competitive dealer market and the specialist market with monopoly power. The trading structure of the LSE is similar to that of the NASDAQ in the U.S.. There are a number of competing dealers offering on-line firm quotes in large sizes on the LSE. But the NYSE has specialists to have the monopoly power to gain access to information.

There is conflicting empirical evidence between NASDAQ and NYSE about bid and ask spread.

a) Newton and Quandt(1979) suggest that when similar stocks are compared, the spreads are larger on the NASDAQ, a market with competing dealers, than on the NYSE, a market with the monopolistic specialist. The specialist's quote is frequently on behalf of his book of limit orders, not for his own account. These limit orders act as competing dealers. Limit orders are slow to be changed as market conditions change. So, limit orders periodically may result in much narrower spreads than the specialist would offer for his own account. The other explanation is that the specialist has a greater control over the total order flow and an informational advantage in gaining access to the order flow. Glosten(1989) mentions that the specialist's monopoly power may reduce the asymmetric information.

These conclusions may explain the possible lower spread of the monopolistic dealer market on the NYSE. There is opposite empirical evidence.

b) The other view point is that, as most of empirical results show, competition in multiple dealers market can reduce the spread more than that in the sole monopolistic market maker system. Stoll(1978), Tinic and West(1972, 1974) and Hamilton(1974) show that competition in multiple dealers market, such as the OTC, can reduce the spread. The implied spread is compared as a measure of relative liquidity risk between the NYSE and the LSE. The difference in the spread

between the NYSE and the LSE can be interpreted by the above two opposite explanations. The implied spread of stocks on the LSE may be different from that on the NYSE, not only due to different trading structures but also due to trading thinness. The competitive dealer market may reduce the implied bid - ask spread. Trading thinness on foreign stock exchanges also has an impact on the implied bid and ask spread. Difference in spread may cause liquidity risk difference for the same stocks between markets.

3.2.2. Liquidity Risk Premium and Volatility (Return Variance)

First, Amihud and Mendelson(1987) and Stoll and Whaley(1990) demonstrate that the trading mechanisms have a significant effect on the characteristics of stock price behavior on the NYSE. There have been debates on this issue[14]. The role of market makers also may have an impact on volatility. The NYSE has a specialist to stabilize the stock price but the TSE has only a satori (official order clerk) who is not an active specialist. Trading volume of dually listed stocks in foreign markets is small. Trading thinness can also have an impact on volatility. The above factors can affect the different volatility between markets. Several factors are interrelated in different situations. Volatility may be one of the liquidity risk factors in the imperfect market.

3.2.3. Liquidity Risk Premium and Residual Variance

As Hirshleifer(1988) and Merton(87) demonstrate, residual risk might be one of the omitted liquidity risk factors in the imperfect capital market. Residual risk may be related to the bid and ask spread, as is in the case of Benston and Hagerman(1974). Residual variance can be obtained through the market model based upon the Morgan Stanley Index (as a proxy for the world market Index). Liquidity premium differences are compared based upon residual variance differences.

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[14] There been debates over these empirical results. These results may be due to difference in trading mechanisms or due to the overnight trading halt.

3.2.4. Liquidity Risk Premium and Trading Volume

Trading volume, bid - ask spread and volatility are interrelated. Epps and Epps (1974), Harris(1984), Pfleider(1984) and Rutledge(1984) show that trading volume has a relation with volatility. Several researchers mention that trading volume is negatively related to the bid - ask spread. The trading volume of U.S. stocks listed on the TSE and LSE is small. Thinly trading stocks may have liquidity risk. Trading thinness may cause liquidity cost. Harris(1990) indicates that trading thinness or price discreteness increases the stock price change and return variance. So, trading thinness can cause more negative serial covariance. The liquidity premium is compared in relation to the trading volume.

If international markets are imperfect, systematic risk by itself cannot explains the rate of return. Other liquidity risk factors are considered in imperfect market asset pricing. Higher implied spread, higher variance, higher residual risk and lower trading volume should have the higher liquidity risk and the sign of higher rate of return for the same stocks between markets.

4. Data Description and Empirical Methodology

Dually traded stocks[15] are used in this study. These stocks are traded on the New York Stock Exchange, the Tokyo Stock Exchange and the London Stock Exchange. Weekly closing stock price is used in the calculation of rates of return. Local price is converted to U.S. price. Morgan Stanley world market index (MSCI) is used as a world market index. Variance of daily rate of return is used for volatility. Residual variance is obtained through the market model based upon the MSIC index. The implied spread is calculated based upon the daily data of each stock.

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[15] The information for the NYSE is obtained through the CRSP tape and Nikkei data bank provides the data for the TSE. The source of information of LSE and MSCI world market index is the Data Stream International Ltd. Sample period is from January 1989 to December 1991.

Liquidity premium difference [16] can be defined as the difference in the rate of return between markets for the same stocks. Liquidity premium is compared based not only upon systematic risk, but also upon liquidity risk factors in each market. The proxies for the liquidity risk factors in this study are the implied spread, volatility, residual risk, and trading volume in each market. If liquidity risk factors increase liquidity risk premium and differences between markets is significantly different from zero, significance might have an impact on the international equity market integration. Even though liquidity risk factors affect rates of return, the arbitrage[17] can reduce the return differences for the same stocks traded in various international markets, Thus, the sign of return difference between markets was analyzed related to matching systematic risk and liquidity risk factors.

This study uses a nonparametric sign test to examine whether liquidity risk factors, such as return variance, residual variance, an implied spread, and trading volume, are consistently related to the signs of rate of return differences for the same stocks between markets. If nonparametric sign tests are not significant, it is concluded that liquidity risk factors are not related to rate of return differences between markets and that liquidity risk factors do not have any effect on the rate of return differences between markets. If significant, liquidity risk factors are related to the sign of the rate of return differences. Nonparametric sign tests focus the sign related to factors. However, they do not integrate all factors in the analysis of rate of return

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[16] Reinganum (1990) defines the gross differential liquidity premium(GDLP) as the average rate of return difference between the NYSE and NASDAQ. If portfolios of the equivalent size of firms have the identical risk and identical liquidity risk between the NYSE and the NASDAQ, the model of Amihud and Mendelson(1986) suggests the difference in the average rate of return(GDLP) should be equal to zero. He argues that the GDLP is not equal to zero due to the difference in liquidity risk related to market microstructures. Lee(1993) defines liquidity premium as the absolute difference between the trade price and the mid point of the bid ask spread.

[17] Maldonado and Sander(1983) argue that the law of one price or arbitrage eliminates the price difference between internationally traded stocks.

differences at the same time. Furthermore, the effect of liquidity risk on rates of return can be small. Thus, multiple regression tests are used to examine the sensitivity of the actual rate of return differences related to liquidity risk.

$$R_{US\text{-}JA} = a_1 + b_1 BE_{US\text{-}JA} + c_1 VA_{US\text{-}JA} + d_1 RV_{US\text{-}JA} + e_1 SP_{US\text{-}JA} + f_1 VO_{US\text{-}JA} \quad (3\text{-}4)$$

$$R_{US\text{-}UK} = a_2 + b_2 BE_{US\text{-}UK} + c_2 VA_{US\text{-}UK} + d_2 RV_{US\text{-}UK} + e_2 SP_{US\text{-}UK} \quad (3\text{-}5)$$

Where $R_{US\text{-}JA}$ is the rate of return difference for the same stocks between the NYSE and the TSE; $BE_{US\text{-}JA}$ is the beta difference; $VA_{US\text{-}JA}$ is the return variance difference; $RV_{US\text{-}JA}$ is the residual variance difference; $SP_{US\text{-}JA}$ is the implied spread difference; and $VO_{US\text{-}JA}$ is the difference of the log of trading volume for the same stocks between exchange. Because the trading volume is an extremely large number, trading volume is converted to the log of the trading volume. If the sensitivity coefficient of liquidity risk is not significant, it is confirmed that liquidity risk related to trading mechanisms is not related to rate of return difference between markets.

5. Empirical Results

5.1. Characteristics of stock price behavior and Liquidity Risk

The characteristics of return distributions and stock price behavior is examined, related to liquidity risk factors in the different trading mechanisms. Table 1 shows the names and ticker symbols of sample stocks. Tables 2-4 show vaiance, implied spread and residual variance for the sample stocks in each stock exchange and Table 5 summarizes the statistical significance of differences between markets. Implied spreads are statistically different between the NYSE and the TSE and between the NYSE and the LSE. Variances of returns on the TSE and LSE are consistently higher than on the NYSE. Also, implied spreads of the TSE and the LSE are higher than those on the NYSE. Trading volume of the sample stocks on the TSE and the LSE is substantially lower than that on the NYSE. Higher variance is related to a higher implied spread

Table 1

Sample Stocks listed on the NYSE, TSE and LSE

	COMPANY NAME	TICKER
1	ALLIED SIGNAL	ALD
2	AMER.EXPRESS	AXP
3	AMER.TEL.&TELG	T
4	ANHEUSER-BUSCH	BUD
5	BANKAMERICA	BAC
6	BRUNSWICK	BC
7	CHASE MANHATTAN	CMB
8	CHRYSLER	C
9	CITICORP	CCI
10	DOW CHEMICALS	DOW
11	EXXON	XON
12	FIRST CHICAGO	FNB
13	FPL GROUP	FPL
14	GENERAL ELECTRIC	GE
15	GENERAL MOTORS	GM
16	INTERNATIONAL BUSINESS MACHINES	IBM
17	ITT	ITT
18	J.P. MORGAN	JPM
19	MERRILL LYNCH	MER
20	MOTOROLA	MOT
21	ROCKWELL INTERNATIONAL	ROK
22	TRANSAMERICA	TA
23	WASTE MANAGEMENT	WMX

Table 2

Daily Return Variance

	NYSE	TSE	LSE
ALD	0.032396	0.099902	0.047977
AXP	0.050067	0.056308	0.074687
T	0.023316	0.030366	0.032780
BUD	0.024711	0.032808	0.037994
BAC	0.053638	0.066019	0.065336
BC	0.067703	0.077274	0.099770
CMB	0.056961	0.081846	0.085935
C	0.063057	0.074393	0.083620
CCI	0.062506	0.070951	0.088591
DOW	0.027643	0.046462	0.035556
XON	0.014235	0.022309	0.025794
FNB	0.047687	0.057338	0.061292
FPL	0.007918	0.019665	0.016308
GE	0.020931	0.027675	0.031345
GM	0.032169	0.067024	0.045959
IBM	0.016767	0.021695	0.026480
ITT	0.017671	0.031321	0.035808
JPM	0.029914	0.042056	0.046967
MER	0.049115	0.063422	0.057088
MOT	0.042398	0.046417	0.051407
ROK	0.033341	0.037885	0.043641
TA	0.025755	0.039478	0.034146
WMX	0.032928	0.073871	0.051299
AVG	0.036210	0.051586	0.051295

Table 3

Implied Bid - Ask Spread

	NYSE	TSE	LSE
ALD	0.330125	0.463255	0.700905
AXP	0.055544	0.306947	0.553012
T	0.348667	0.152749	0.562426
BUD	-0.24903	0.426953	0.556421
BAC	-0.53511	-0.46611	-0.20422
BC	0.042548	0.189686	0.277070
CMB	-0.38413	0.377016	-0.15267
C	0.049160	0.298922	0.378696
CCI	0.205634	0.324374	0.344143
DOW	-0.50529	0.693501	0.308489
XON	0.424408	0.750282	0.837355
FNB	-0.45440	-0.08917	0.294819
FPL	-0.12846	0.410377	0.350921
GE	-0.17254	0.346272	0.723079
GM	0.031292	0.382261	0.666
IBM	-0.40397	0.884278	1.171585
ITT	-0.43545	0.204694	0.722985
JPM	-0.49222	0.435312	0.553461
MER	-0.49427	-0.34582	-0.22123
MOT	-0.47054	0.436847	0.258171
ROK	0.236149	0.275927	0.401114
TA	-0.16002	0.266316	0.308035
WMX	-0.03178	0.299062	0.532885
AVG SP	-0.13885	0.305388	0.431454

Table 4

Residual Variance

	NYSE	TSE	LSE
ALD	0.090731	0.141170	0.116834
AXP	0.180946	0.216254	0.164921
T	0.070700	0.080386	0.072205
BUD	0.066022	0.096782	0.087714
BAC	0.234322	0.24426	0.287629
BC	0.183784	0.282766	0.197159
CMB	0.251718	0.227944	0.204972
C	0.218589	0.290683	0.227918
CCI	0.232030	0.210089	0.157226
DOW	0.158729	0.098778	0.157847
XON	0.035424	0.049179	0.050175
FNB	0.251635	0.237931	0.305387
FPL	0.034784	0.045333	0.042062
GE	0.061539	0.063462	0.072182
GM	0.274408	0.124934	0.273116
IBM	0.063488	0.085775	0.078292
ITT	0.056764	0.011111	0.127638
JPM	0.119862	0.150601	0.132349
MER	0.160724	0.186243	0.162244
MOT	4.521392	4.491624	4.499996
ROK	0.116648	0.160852	0.179687
TA	0.090389	0.128128	0.154171
WMX	0.253942	0.134374	0.154171
AVG	0.336373	0.337333	0.343734

Table 5

Comparison of Liquidity Risk factors between Markets

t value for return variance difference between the NYSE and the TSE : 2.6182***

t value for return variance difference between the NYSE and the LSE: 2.5544***

t value for implied spread difference between the NYSE and the TSE : 4.893***

t value for implied spread difference between the NYSE and the LSE: 6.021***

*** : significant at the 1 percent level.

t value for residual variance difference between the NYSE and the TSE : 0.005

t value for residual variance difference between the NYSE and the LSE : 0.028

Table 6

Trading Volume on the NYSE and TSE

(1989-1991)	NYSE	TSE
ALD	234.866	7302
AXP	964.395	115636
T	1320.352	199647
BUD	361.04	39664
BAC	699.324	327632
BC	203.19	11988
CMB	595.806	37617
C	516.668	50932
CCI	1014.233	126399
DOW	507.913	76399
XON	902.731	53723
FNB	175.547	6165
FPL	217.007	4801
GE	1114.668	207075
GM	909.471	64339
IBM	1244.613	293087
ITT	224.711	15976
JPM	391.51	44930
MER	288.215	38971
MOT	435.407	162625
ROK	222.207	1138
TA	97.576	13039
WMX	688.142	364753
Total	13329.594	2263838

Unit:Millions of Shares for NYSE

and also is related to lower trading volume for the sample stocks between markets. Variance of daily rate of return on the TSE and LSE is significantly higher than the variance on the NYSE. There is no bid and ask spread in the auction market on the TSE. The implied spread on the TSE should be near zero. The competitive dealer market should reduce the implied bid and ask spread. However, the empirical results show that the implied spreads on the TSE, an auction market, and the LSE, a competitive dealer market, are much greater than those on the NYSE, a monopolistic dealer market. The implied spreads on the TSE and the LSE are significantly higher than those on the NYSE at the 1 percent level of significance. The trading activity of the dually listed United States firms is high on the NYSE. However, United States securities are not actively traded in foreign markets. The large differences in the implied spread and variance for the same securities between the NYSE and foreign exchanges could be attributed to the effect of the trading thinness on foreign exchanges. Harris(1990) indicates that trading thinness or price discreteness increases the stock price change and return variance. Trading thinness could cause more negative serial covariance, which can further increase the implied spread. Trading volume on the NYSE is much greater than that on the TSE. Different trading volume could lead to different liquidity risk. A significant difference in implied spreads, variance and trading volume can lead to difference in liquidity risk for the same stocks between markets. Residual variance on the TSE and the LSE is higher than that on the NYSE.

5.2 Nonparametric Sign Test and Multiple Regression Test

Table 8 indicates that the rate of return for the sample stocks are not statistically different between the NYSE and the TSE and between the NYSE and the TSE. Even though liquidity risk factors affect rates of return, the arbitrage can reduce the return differences for the same stocks traded in various international markets, Thus, the sign of return difference between markets was analyzed related to matching systematic risk (Table 7) and liquidity risk factors.

Table 7

Beta on the NYSE, TSE and LSE

	NYSE	TSE	LSE
ALD	0.833679	0.775761	0.340445
AXP	1.747397	1.8139	1.852839
T	0.835446	0.656424	0.601696
BUD	1.066549	1.01978	0.799261
BAC	1.584327	1.539939	1.59356
BC	1.792898	1.426216	1.7768
CMB	1.649196	1.784093	1.69281
C	1.2038	1.308880	1.34067
CCI	1.278641	1.326685	1.423196
DOW	1.450354	1.223832	1.03983
XON	0.303804	0.234609	0.143517
FNB	1.610286	1.445567	0.928952
FPL	0.337498	0.37855	0.31128
GE	1.091068	1.213610	1.22825
GM	0.972930	1.295368	1.015514
IBM	0.84404	0.782299	0.842909
ITT	1.155963	1.013056	0.790824
JPM	1.218574	1.053552	1.111061
MER	2.040120	1.793598	1.932380
MOT	0.308072	0.503652	0.541601
ROK	0.933948	1.084727	0.378871
TA	0.936090	0.95052	0.645616
WMX	1.219415	1.128649	0.645616
AVG	1.148438	1.119707	1.007709

Table 8

Weekly Rate of Return on the NYSE TSE and

RETURN	NYSE	TSE	LSE
ALD	0.002006	0.002564	0.002717
AXP	-0.00077	-0.0004	-0.00027
T	0.002929	0.002661	0.002936
BUD	0.004728	0.00472	0.004891
BAC	0.005983	0.006516	0.006261
BC	-0.00088	-0.00049	-0.00042
CMB	-0.00084	-0.00086	-0.00067
C	-0.00399	-0.003	-0.00297
CCI	-0.00412	-0.00381	-0.00405
DOW	-0.00161	-0.00178	0.000628
XON	0.002979	0.002954	0.003169
FNB	0.000935	0.001435	0.000826
FPL	0.002379	0.002434	0.002459
GE	0.003781	0.003825	0.003975
GM	-0.00405	-0.00372	-0.00034
IBM	-0.00098	-0.0008	-0.00085
ITT	0.000938	0.001337	0.001346
JPM	0.005452	0.005673	0.00566
MER	0.006672	0.007004	0.006993
MOT	0.066114	0.066668	0.066512
ROK	0.002395	0.0026	0.002789
TA	0.002052	0.002106	0.002174
WMX	0.0017	0.001744	0.006701
AVG	0.004077	0.004319	0.004801

t value of AVG Difference Between NYSE and TSE: 0.2
t value of AVG Difference Between NYSE and LSE: 0.56

Table 9

Nonparametric Sign Test

Between the NYSE and the TSE

Beta :	-0.208
Implies Bid-Ask Spread:	3.12***
Return Variance:	2.71***
Residual Variance:	1.04
Trading Volume:	2.71***

Between the NYSE and the LSE

Beta :	0.208
Implies Bid-Ask Spread:	4.378***
Return Variance:	4.378***
Residual Variance:	1.458*

* : significant at the 10 percent level.
*** : significant at the 1 percent level.

Table 10

Multiple Regression of the Rate of Return Difference on the Liquidity Difference Between The NYSE and the TSE

$$R_{US\text{-}JA} = a_1 + b_1 B_{US\text{-}JA} + c_1 VA_{US\text{-}JA} + d_1 RV_{US\text{-}JA} + e_1 SP_{US\text{-}JA} + f_1 VO_{US\text{-}JA}$$

a_1	b_1	c_1	d_1	e_1	f_1
-0.00020	0.00037	0.004758	0.00055	-0.000114	-0.00001
(-0.31)	(1.28)	(0.96)	(0.48)	(-0.6)	(-0.1)

Multiple Regression of the Rate of Return Difference on the Liquidity Difference Between The NYSE and the LSE

$$R_{US\text{-}UK} = a_2 + b_2 B_{US\text{-}UK} + c_2\ VA_{US\text{-}UK} + d_2\ RV_{US\text{-}UK} + e_2\ SP_{US\text{-}UK}$$

a_2	b_2	c_2	d_2	e_2
-0.0007045	0.000398	-0.0005829	-0.009724	0.000266
(-0.77)	(0.22)	(-0.14)	(-1.6)	(0.24)

Nonparametric sign tests focus on the sign of the difference and reexamine whether beta and four liquidity risk factors are related to the sign of rate of return differences between the three markets As shown in table 9, the nonparametric sign test shows that beta is not related to the sign of the rate of return difference for the same stocks between imperfect international markets. Thus, systematic risk does not explain the sign of the rate of return difference. Other liquidity risk factors are considered in nonparametric tests. Higher implied spread, higher variance, higher residual risk and lower trading volume should have the higher liquidity risk and the sign of higher rate of return for the same stocks between markets. Generally, nonparametric sign tests for the four liquidity measures are significant. Thus, if international markets are imperfect, systematic risk by itself cannot predict the sign of expected rate of return. Other liquidity risk factors provide explanations for the sign of rate of return differences between markets, as predicted in imperfect international asset pricing model.

Even though nonparametric sign tests for the four liquidity factors are significant, However, nonparametric sign tests do not integrate all factors in the analysis of rate of return performance at the same time. Thus, multiple regression tests are used to examine the sensitivity of the actual rate of return performance, as related to liquidity risk difference. There are small liquidity premium differences between TSE, LSE, and NYSE (Table 8). Furthermore, the sensitivity of liquidity factors to the rate of return difference is not significant, as shown in Table 10. Thus, it is concluded that higher liquidity risk factors related to trading mechanisms do not significantly explain the differences in the rate of return performance between markets.

6. Summary and Conclusions

This study tests to determine whether trading mechanisms or market microstructures have an effect on the integration process. The definition of international equity market integration in this study is that identical securities should have the same rates of return and exhibit the same

stock behavior patterns, even though they are traded in different international stock exchanges. This study proposes the international asset pricing model with liquidity risk factors and examines whether different market microstructures or trading mechanisms have an effect on the characteristics of stock price behavior, which might affect rate of return performance associated liquidity risk. The methodology used to test the liquidity premium hypothesis is based upon multi-liquidity risk factors model which assumes imperfect markets. Even though liquidity risk factors affect rates of return, the arbitrage can reduce the return differences for the same stocks traded in various international markets, Thus, the sign of return difference between markets was analyzed related to matching systematic risk and liquidity risk factors. Empirical results shows that return variance and an implied spread are statistically different between the NYSE and the TSE and between the NYSE and the LSE. It could be attributed to trading mechanisms and trading volume. For the sample stocks, variance of rate of return is consistently related to other liquidity measures such as implied spread and trading volume. Nonparametric sign tests focus on the sign of the difference and reexamine whether beta and four liquidity risk factors are related to the sign of rate of return differences between the three markets. Generally, nonparametric sign tests for the four liquidity measures are significant. Thus, if international markets are imperfect, systematic risk by itself cannot predict the sign of expected rate of return. Other liquidity risk factors provide explanations for the sign of rate of return differences between markets. Nonparametric sign tests do not integrate all factors in the analysis of rate of return performance at the same time. Thus, multiple regression tests are used to examine the sensitivity of the actual rate of return performance, as related to liquidity risk difference. There are small liquidity premium differences between TSE, LSE, and NYSE. Furthermore, the sensitivity of liquidity factors to the rate of return difference is not significant. Thus, higher liquidity risk factors related

to trading mechanisms do not significantly explain the differences in the rate of return performance between markets. Trading mechanisms might not have a significant effect on the issue of international equity market integration.

This study deals with two issues; international equity market integration and market microstructures. The definitive explanation as to what extent international equity markets are segmented or integrated has not been done. Empirical results can be different depending upon time interval and empirical methodology. International equity markets might not be segmented because of different trading mechanisms. Trading mechanisms might not have a significant effect on the issue of international equity market integration between markets, if trading volume or other factors controlled between markets.

Madhavan (1992) also mentioned that with free entry to market making, the continuous dealer market and auction market are equivalent, and the two trading mechanisms coincide if markets is deep.

Appendix

The derivation procedure to eq (3-1) which shows that trading frictions and transaction costs cause the liquidity premium in imperfect international markets.

It is assumed that there are two kind of investors ; a) risk taking unrestricted investors who would invest their assets not only in securities of complete markets without friction but also in securities of incomplete markets with transaction costs and other friction costs, b) risk averse restricted investors who would like to invest in securities of complete markets to avoid transaction costs or friction costs.

A_u : risk aversion coefficient for the unrestricted investors.

A_r : risk aversion coefficient for the investors in complete markets. Capital letter A means the risk aversion coefficient for the aggregate population of investors. The total aggregate population of investors ($A^{-1} = A_u^{-1} + A_r^{-1}$). The greek letter μ is the proportion of restricted investors out of total investors. A / A_r .

Total market value in the world market is expressed by M. The rate of return of the world market portfolio is expressed by R_m. The world market portfolio consists of the market portfolio of securities in complete markets (MC) and those in incomplete markets (MI). The rate of return in complete markets is R_c and the rate of return in incomplete market is R_I

It is assumed that individuals in complete markets are risk averse and maximize utility of wealth at the end of period wealth in a given one period.

Max $EU(W^k_1)$

Subject to $\Sigma x_i = 1$

Where W^k_0 is initial wealth of the individual k. W^k_1 is the end of period wealth of the individual k, and x_i is a fraction of wealth invested in asset i.

W^k_1, end of period wealth can be represented as $(1 + R_o)\ W^k_0$.

Where R_0 is rate of return in one period.

The above equation can be expressed as

$$\text{Max } E\{U[W^k_0(1+R_o) + W^k_0\ x_i\ (R_i - R_o)]\}.$$

The first order condition with respect to x_i

$$E[U'(W^k_1) * W^k_0\ (R_i - R_0)] = 0$$

By taylor expansion of $U'(W_1)$ the above equation is written as

$$E\{\ U' + U''[(W^k_1 - W)(R_i - R_0)]\} = 0$$

$$U'\ E\ (R - R_0) = -U''\ E\{(W-W)(R_i - R_0)\} = 0$$

$$E\ (R - R_0) = -U''/U' * E[(W^k_1 - W)(R_i - R_0)]$$

$$E\ (R - R_0) = -U''/U' * W\ Cov(R_i, R_j)$$

In equilibrium the aggregate demand is equal to aggregate supply and the total wealth is expressed as the market portfolio.

$-U''/U'$ is risk aversion coefficient A .

The above equation will be expressed as

$$E\ (R - R_f) = A\ M\ Cov(R_i, R_m)$$

The rate of return of the world market can be expressed by two portioned vector elements.

$$R = \begin{bmatrix} R_c \\ R_i \end{bmatrix} \qquad V = \begin{bmatrix} V_{cc} & V_{ci} \\ V_{ic} & V_{ii} \end{bmatrix}$$

Where V is variance covariance matrix of expected return in complete markets and incomplete markets.

a) Diversification Portfolio(DP) is defined as the portfolio of

securities in complete markets which is highly correlated with the market portfolio in incomplete

markets. $DP = V^{-1}_{cc} V_{ci} M$

b) The Hedged Portfolio(HP) can be defined as the portfolio of securities which is not correlated with securities in incomplete markets. Hedged portfolios can be created by taking long position in the market portfolio in the incomplete market and by taking short position in the diversification portfolio.

$HP = MI - DP$

The unconstrained investors hold the portfolio $D_u = (1-\mu)WMP + \mu HP$. The restricted investors holds the portfolio to avoid the transaction cost $D_r = \mu (MC + DP)$.

Under the above condition it will be demonstrated that the securities in incomplete markets with transaction costs have additional risk premium above those in complete markets without transaction costs. If there is no excess demand or supply in securities. The aggregate demand has the two parts such as demand in complete markets to avoid market frictions and unconstrained demand to take risk of market frictions. $D_u + D_c = (1-\mu)WMP + \mu(MI - DP + MC + DP) = WMP$

The aggregate supply is WMP. The optimality condition in complete market is

$E(R_c - R_f) = A_r \, Cov(R_c , D_c R)$

$= \mu[M_c \, Cov(R_c, R_{mc}) + V_{cc} V_{cc}^{-1} V_{ci} M] = A/A_r * M \, Cov(R_c R_m)$

By the first order optimality condition in unconstrained demand,

the equation can be written as $E(R_u - R_f) = A_u \, Cov(R , D_u R)$

where $Cov(R_u , D_u R) = (1-\mu) \, Cov(R , MR_m) + \mu \, Cov(R, HP R)$

$1-\mu = A/A_u$. Because $Cov(R_c, HP R)$ is zero by definition of hedging portfolio, the above equation is as follows. $Cov(R , D_u R) = M (A /A_u) * Cov(R , R_m) + \mu \, Cov(R_i, HP R)$

$Cov(R_i, HP R) = Cov(R_i , M_i R_i - M_i V_{ic} V_{cc}^{-1} R_c)$

$= (V_{ii} - V_{ic} V_{cc}^{-1} V_{ei})M_i$ where $\mu = (A_u - A)/A_u$

$A_u Cov(R , D_u R) = (AM)Cov(R , R_m) + (A_u - A) M_i Cov(R, R_i)$

If the above equation is rearranged, $E (R_i - R_f) = (AM)Cov(R , R_m) + (A_u - A) M_i Cov(R, R_i)$

The last term in the above equation shows that the expected return of security in the incomplete market needs more risk premium, compared with that in the complete market.

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