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RELATIONSHIP BETWEEN VOLATILITY AND MULTILISTING: EVIDENCE FROM THE FINNISH STOCK MARKET*

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The purpose of this paper is to provide an additional insight into the stock price volatility of all Finnish companies that are listed on foreign stock exchanges through studying permanent changes to the stock price volatility brought by trading on many markets. We find that the variances of both restricted and unrestricted stocks are slightly lower during the post-listing period. (JEL: G14, G15)

1. Introduction

Stapleton and Subrahmanyam (1977) and Yagil and Forshner (1991) showed that in a situation characterised by segmented markets, the negative impacts of segmentation can be reduced through international portfolio investments, through direct investments in assets or through listing of the shares of the company in new stock exchanges. The purpose of this paper is to provide additional insight into the stock price volatility of the Finnish companies that are listed on foreign stock exchanges. We aim to investigate whether listings on multiple exchanges have permanently affected the nature of stock price volatility of the Finnish companies through employing parametric and non-parametric techniques. This question is interesting since theoretical work done by e.g. Black (1986) suggests, that due to the overreaction hypothesis of the traders, listing on multiple exchanges should lead to an increase in variance.[1] The recent empirical evidence, however, is very ambiguous on the issue. For example, Foerster and Karolyi (1993) reports no significant increase in variance for Canadian firms listed on the New York Stock Exchange, but e.g. Chan et. al. (1996) finds higher opening volatility for foreign stocks listed at the NYSE.

This study is based on Finnish data. The Finnish market offers an interesting setting because the local legal characteristics limited the Finnish investor's ability to diversify internationally but did not fully restrict the foreign investor to invest in Finland. The legislation led to a partial segmentation of the Finnish market (Hietala 1989), but stepwise liberalisation of the legislation has nowadays led to full liberalisation of the Finnish capital markets (see Appendix I). These facts enable the research work to

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[1] *Shiller (1981), French and Roll (1986) and Summers (1986) have also argued, that increase in variance on dually listed securities is due to overreaction of traders who follow each others trades.*

be done in a unique way because of the late liberalisation and the relatively small size of the Finnish stock market. These local characteristics enable us to conduct the research in a way which is not possible for other, larger markets because complete data sets for all companies are available and all international listings are recorded accurately in a chronological order.

Before 1986 the Finnish and the foreign investors were not equally treated in terms of investment opportunities because the Finnish legislation restricted the Finnish investors from investing in foreign securities.[2] On the other hand, the foreign investors were allowed to own up to 20% of the shares of the Finnish companies. By the end of March 1987, the 20% rule was eased to concern only the voting power; otherwise the maximum amount of foreign ownership was raised to 40%.[3] The main intention of these restrictions was to limit the foreign ownership of Finnish resources in the forest or in the mining industries as well as in strategically important companies in publishing, telecommunication and energy production. However, those restrictions did not prevent foreign listing as long as the 20% rule in voting power was respected. In fact some stocks were actually listed on foreign stock markets before 1986 (see Appendix II). Foreign investors became interested in the Scandinavian markets during the year 1982 which resulted in a soar in the price of unrestricted shares that were quoted equally with restricted ones. The excess demand of the free shares led to special arrangements. Brokers developed an unofficial market to trade the free shares because the values of the free shares were significantly higher than the markets prices of restricted shares. This arrangement was later abandoned because Helsinki Stock Exchange (henceforth HeSE) started the separate listing of the free and the restricted shares from the beginning of January 1984 (Hietala 1988, 1989).

As a result of the Finnish legislation, Finnish investors had less interest to follow international development or to include extensive foreign information into their evaluation of the Finnish securities before 1989. A logical consequence was that foreign institutional investors or banks lacked the interest to locate personnel or to open branches in Finland because the only products they could sell – because of the legislation – were the free shares of companies that investors could only own up to a certain limit. The lack of presence of foreign investors before the changes in the legislation reduced the ability of security analysts to correctly follow the development of the relatively small and closed Finnish security market. This implies that the Finnish securities would be expected to be efficiently priced mainly in terms of the local information. However, it does not imply that the Finnish shares were necessarily correctly priced in the sense of the hypothesis of efficient markets, if the sum of the information mass gathered by Finnish and foreign investors had been used to price Finnish securities.[4] Since 1986 the restrictions concerning the capital markets have been gradually eased and finally on July 1st 1990 all restrictions concerning investments made by the Finnish investors abroad were totally relaxed. The final step in the liberalisation of Finnish stock markets occurred in January 1st 1992 when the division of shares with respect to foreign ownership was released.

The organization of the paper is the following. After the introduction, the literature review and the limitations of the study the focus is moved to the empirical issues. In Chapter 2, the methodological issues, the assumptions and the test-hypotheses are presented. The data and descriptive statistics are described in Chapter 3. Chapter 4 reports the results from the hypotheses tests.

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[2] *From December 1st 1984 banks received expanded authorities in foreign lending and to trade with foreign securities, especially with stocks.*

[3] *Actually, the legislation had some exceptions. Insurance companies were free from the 20% rule alike companies established by foreigners which did not have right to own or to enter strategically important sectors like forest or mining industries.*

[4] *In the beginning of the 1980's e.g. the regulation of the Danish equity markets resembled the Finnish legislation. Stonehill and Dullum (1982) discussed the impact of the Danish legislation and concluded that it could lead to a situation where different investors do not posses same information mass.*

1.1 Literature review

What kind of an effect can multilisting on foreign exchanges have for the stock return volatility? We will start by briefly discussing some of the theories and practical policy implications of the impact of multilisting.

1.1.1 Impact of multilisting on liquidity

The proponents for multimarket trading claim that enhanced competition between exchanges is beneficial for the stock. They base their argument on the notion that the needs and the wants of the traders are different and thus a single market can not optimally serve the best interest of the different market participants. Johnsen (1991) claims that international listing on foreign exchanges would decrease the cost of capital of multilisting companies and provide better international diversification benefits for both local and foreign investors. In practice, the U.S. lawmakers and the regulators share the view that multilisting is beneficial because it may increase inter-market competition. In addition, it has been argued that the SEAQ market has become the leading European market because of lower regulatory rules and greater anonymity to large investors.

An opposite view to multimarket trading is provided by Amihud and Mendelson (1995) who point out that multimarket trading may fragment the markets and the order flow. They argue that it is the issuer's role to determine which stock exchange or multimarket trading on several exchanges would best serve the marketability and the liquidity of the shares. Management's interest is to ensure good liquidity because high liquidity increases the value of the shares (Amihud and Mendelson, (1986)) and lowers the company's cost of capital which in turn increases the value of the stocks.

1.1.2 Link between information and volatility

As we have seen multilisting can affect the variance and the liquidity in two possible, but opposite, ways. Information arrival theories have tried to explain the link between information and stock return variances. Kyle's (1985) model describes a situation where seemingly continuous trading is actually a series of sequential auctions between three groups of traders. A single insider has access to unique private information on the ex. post liquidation value of the risky asset. The model also includes uninformed noise traders who in general act randomly and earn negative profits on the cost of an insider, and market makers who have access to conditional information about the volumes traded by the two other groups. By definition, market makers earn zero profits because they do not have sufficient information to distinguish the trading of the two other groups. Kyle's model assumes that the insider's problem is to choose correct trading volume with respect to the insider's quadratic profit function and the depth of the market, which is defined as the market's ability to absorb quantities without having large deviations on price of the security. Admati and Pfleiderer (1988) extend Kyle's model to include discretionary liquidity traders (noise traders) who have discretion about the timing of their trades but have no access to private information.

Black (1986) discussed the nature of noise in his almost philosophical article from 1986 and concluded:

> "The more noise trading there is, the more liquid the markets will be, in the sense of having frequent traders that allow us to observe prices. But noise trading actually puts noise into prices. The price of a stock reflects both the information that information traders trade on and the noise traders trade on."

The basic idea of Black's model is that variance is caused by the overreaction of traders to each other's trades. The same conclusion was also reach by Shiller (1981), French and Roll (1986) and by Summers (1986), who all argued that increase in variance is due to overreaction of traders who follow each other's trades. A common characteristic of Kyle's 1985 and Black 1986 models is that increase in trading volume is also positively related to trade price volatility.

1.1.3 Link between private- and public information and volatility

In the framework developed by French and Roll (1986) volatility over a trading session is caused by public information, private information and pricing errors.

The public information hypothesis states that information that becomes known at the same time would affect the stock prices. As examples they suggest macroeconomic data released by U.S. authorities, Supreme Court decisions and corporate announcements.[5] They, however, reject the public information as the source of stock return variation in a study which examines the two-day return variance over stock exchange holidays when businesses are open. The same conclusion is also reached by Barclay, Litzenberger and Warner (1990).

As Kyle did in his 1985 model French and Roll (1986) hypothesised that the main source of volatility is private information. However, there is a distinction between Kyle's and French and Roll's models regarding the way information is incorporated into prices. French and Roll claim that an important component of volatility is trading time but not volume. Private information differs from public information because private information is incorporated into prices through trading. Public information affects prices too, but so fast that no one can trade on it. As we can see, division of information into two classes is artificial and most information drops in continuum between private and public information.

1.1.4 Empirical evidence

Empirical research has studied the impact multilisting on volume and on volatility to some extent. Increased volume due to multilisting has been reported by e.g. Foerster and Karolyi (1993) for Canadian stocks listed in the NYSE, NASDAQ and AMEX, and by Barclay, Litzenberger and Warner (1988) for U.S. stocks listed in the Tokyo exchange. Makhija and Nachtmann (1990), Howe, Mandura and Tucker (1993), Jayaraman, Shastri and Tandon (1993) report increased stock volatility due to listing on multiple exchanges. Chan, Fong, Kho and Stulz (1996) find higher opening volatility as well as opening spreads for foreign stocks on the NYSE and AMEX markets as compared to local stocks. On the other hand, no significant risk increases due to multilisting has been found by Barclay, Litzenberger and Warner (1990) on volatility in general, and on the intraday / close-to-close volatility ratio, and by Howe and Mandura (1990) on covariance risk and by Foerster and Karolyi (1993) on volatility and beta. Increased spreads are also found by Noronha, Sarin and Saudagaran (1996) for NYSE and AMEX stocks listed on the Tokyo Stock Exchange.

2. Purpose and research hypotheses

The purpose of this paper is to provide an additional insight into the stock price volatility of all Finnish companies that are listed on foreign stock exchanges by studying permanent changes to the stock price volatility brought by trading on many markets.

We think that it is interesting to study what happens to the Finnish companies in a situation when stocks have earlier been traded solely in the home market, but then begin to trade in other international exchanges. The previous section and the models of e.g. Kyle (1985) and Black (1986) assumed that volatility is a constant because information is incorporated at a constant rate into prices which at the end of the continuous auction reflect all information. In other words, volatility is determined by noise traders in a way that increased trading volume leads to a higher level of noise, i.e. volatility. The model of French and Roll (1986), on the other hand, assumes that the trading time and the stock return volatility are positively related. Empirical papers have pointed out that in many cases multilisting leads to increased trading volume and extended trading time.[6] We

[5] *Empirical evidence is provided by Harvey and Huang (1991), who study the foreign exchange market. They conclude that the release of U.S. macroeconomic news increases volatility of the foreign exchange market, which is open around the clock.*

[6] *See e.g. Foerster & Karolyi (1993), Barclay & Litzenberger & Warner (1990).*

know, that in general, trading volumes at the HeSE have increased throughout our study period. However, Pursiainen (1997) reports that listing on multiple exchanges has decreased the mean trading volumes in 67% of the sample which consisted of Finnish multilisted firms. The impact of multilisting on trading time depends on the region where Finnish companies are multilisted. Roughly speaking, we can divide our sample into three groups. Group one consists of listings in the continental Europe. In this group multilisting extends the trading time roughly one hour mainly because of the different time zones. The second group consists of listings in LSE and in SEAQ because trading time is extended by two hours. The final group consists of NYSE and NASDAQ listed firms because these firms have almost undisrupted trading which moves from Finland when HeSE closes to the United States where NYSE opens only 30 minutes after HeSE closes.[7]

In addition to the information arrival theories which link the stock market volatility and the information together, there are also alternative theories which try to explain why multilisting would affect volatility. Foerster and Karolyi (1993) point out that it is intuitively appealing to think that the first international listings would occur on smaller international markets which are similar to the home stock market or within closely related trading blocks. If we develop information arrival theories further by assuming that firms tend to list their shares on "the familiar foreign stock markets", it could be concluded that the variance of returns on a stock should sufficiently increase if the equity is first listed on a small international market but is later introduced to the larger investor community through listing on a major international exchange. Even noise and information asymmetries should be lower during the first listing. The amount of traders does not dramatically increase and the markets are physically located so that trading time is not extended much and therefore possibilities for creating new information when the home market is closed is limited. This extension of the information arrival theory can be empirically investigated through studying the Finnish stocks. The evidence supports the thinking of dominant–satellite relationship because the Finnish companies have started the internationalisation of the equity on the European exchanges and especially in Sweden. There are several reason for this, perhaps the most obvious are the historical or the geographical reasons and the mental closeness of these markets. After the development process of the companies have gone far enough listing in other, more stringent exchanges has been more appropriate.

As we have seen, various reasons may affect the stock return volatility of multilisted companies. Therefore, it is interesting to study whether multilistings on international stock exchanges impact on the volatility of the Finnish multilisted stocks. The first hypothesis test whether the population variances of internationally listed companies have changed on the pre- and the post-listing periods. This hypothesis can be formulated as:

(1) $H_0: \sigma^2_{bl} = \sigma^2_{al}$
$H_1: \sigma^2_{bl} \neq \sigma^2_{al}$
where;
σ^2_{bl} = *before listing*
σ^2_{al} = *after listing*

The null hypothesis is that no shift in variances has occurred due to listings on multiple exchanges. Because changes in variances may have been caused by e.g. changes in trading volume or in time, we have also grouped our sample by stock exchange. This procedure enables us to study the impact of the lengthening of trading time across exchanges because listing in different exchanges has various effects on trading time.

The second hypothesis tests whether the variances of restricted and unrestricted series of stocks with respect to the foreign ownership are similar. This hypothesis relates back to Stapleton and Subrahmanyam (1977) or to Pagano (1985). Stapleton et al. demonstrated through examples that the share prices of stocks in a

[7] *During our sample period U.S. listed Finnish companies did not have undisrupted trading from the HeSE close to the NYSE/NASDAQ open. The opening of HeSE was moved and lengthened by 30 minutes from the beginning of January 1996 to cover the previous 30 minutes long non-overlapping time period from the HeSE close to the NYSE open.*

country with restrictions in foreign ownership leads to lower stock prices in the country with imposed restrictions. Therefore it is possible to assume, that even the variances of different classes of stocks might not be the same.[8] The same methodology is employed empirically by Berglund & Liljeblom (1990). We can also assume that restricted stocks are close substitutes to unrestricted stocks (under the assumption of same voting power) but that unrestricted stocks are more interesting to foreign investors because these stocks can be included in international portfolios. Therefore, the variance effects between different classes of stocks would be different because trading volume and especially trading time would not be the same. Kyle in his model from 1985 and Black from 1986 pointed that increased trading volume would increase volatility. French and Roll (1986) came to the same conclusion, but they claimed that trading time is the factor which explains volatility. Because the trading time of the multilisted free shares has changed, we can assume that even the volatility would have changed because according to French and Roll (1986) trading time and volatility are positively related.

We test the second hypothesis in three different ways. First, we study whether the pre- and the post-listing variances of restricted stocks are unchanged. Second, we test if the variances of restricted stocks are different from the variances of unrestricted stocks on the pre-listing period. Third, we test if post-listing variances of unrestricted stocks are different from the variances of restricted stocks.

We are also concerned whether the distributions of stock returns have changed due to listing on multiple exchanges. The question can be tested by several non-parametric tests. A common character of the Mann-Whitney test is that only two samples or populations can be tested simultaneously. Therefore, for stocks listed in more than one exchange a series of tests will be executed after the following principle: In the first test, distributions between the first and the second foreign listing will be studied. In the second test, distributions between the second- and the third foreign exchange listing will be tested, and so forth. Kruskal-Wallis test will be used to test samples k of all stock exchanges simultaneously.

Finally, a sub-group of new international listings after January 1st 1992 is formed. This group consists of companies that were listed after the regulation concerning the restricted and the unrestricted shares with respect to foreign ownership were abandoned. The purpose of this group is to provide us an additional insight into the effects of the multilisting process and whether it has changed due to the changes in the legal environment. Therefore all hypothesis tests and descriptive statistics are also executed for this sub-group consisting of a total of 7 listings since 1992.

In order to estimate a true change in the volatility of multilisted stocks, several control procedures are established. In this paper, the mostly used benchmark for the change in volatility or distributional characteristics of stocks is the HEX-index and the WI-index prior to 1990. The

(2)

Hypothesis 2.1	Hypothesis 2.2	Hypothesis 2.3
H_0:$\sigma^2_{r,b} = \sigma^2_{r,a}$	H_0:$\sigma^2_{ur,b} = \sigma^2_{r,b}$	H_0:$\sigma^2_{ur,a} = \sigma^2_{r,a}$
H_1:$\sigma^2_{r,b} \neq \sigma^2_{r,a}$	H_1:$\sigma^2_{ur,b} \neq \sigma^2_{r,b}$	H_1:$\sigma^2_{ur,a} \neq \sigma^2_{r,a}$
where;	*where;*	*where;*
$\sigma^2_{r,b}$ = *restricted, before*	$\sigma^2_{ur,b}$ = *unrestricted, before*	$\sigma^2_{ur,a}$ = *unrestricted, after*
$\sigma^2_{r,a}$ = *restricted, after*	$\sigma^2_{r,b}$ = *restricted, before*	$\sigma^2_{r,a}$ = *restricted, after*

[8] *Pagano suggested that unrestricted shares might in fact be more volatile than restricted shares. Unrestricted shares are actively traded by few foreign traders and are therefore exposed to larger shifts in demand than unrestricted shares because a sole foreign trader can cause larger idiosyncratic demand shifts than a local broker with restricted shares would do.*

control index is created by using the HEX- or the WI- index for the same time 105 weeks long time period as has been done for the stocks and then by doing all tests jointly both with the multilisted stocks and with the control. This test, however, may have some statistical shortcomings because an index may have different statistical properties as an individual stock. Therefore we also create an additional control group consisting of stocks which are not multilisted, but which otherwise are as similar as possible with our real multilisted sample when variables like industry or size are considered. Even if, in general, trading volumes have increased during our study period, we have noticed that trading volumes were very low (in average less than 1000 million Finnish Markkas a day) before 1987 and also during the deepest economic recession years 1991–92. Because infrequent trading may also induce volatility, we have also divided sample into two groups – the high- and the low volume samples- in order to test whether volatilities of multilisted companies would be different during the high- and the low volume periods.

In other tests, the primary methodology employed is the market model technique studied e.g. in Brown and Warner (1980, 1985). The residuals from the equation are employed to measure the magnitude and the timing of the volatility caused by listing on multiple exchanges. By using the market model, we can explicitly control for a specific stock's relation to the market and isolate the stocks specific error term, which we will focus on. Moreover, if the market model is estimated separately for the pre- and the post-listing periods, the model takes into account that listing may cause changes in expected returns and betas. Therefore, we also control for the possibility that betas would have changed through employing the paired t-test, which examines whether the pre- and the post-listing betas are different in a statistically significant way.

The limitations of the study are closely related to the availability of the reliable stock market data. We have defined the day when the stocks or the ADRs became available to all investors as the event day of the study.[9] Other alternatives could be when the company announced that it will apply for a membership on a foreign stock exchange or when the Finnish company applied for the membership in the foreign stock market or when the foreign exchange approved the application of the membership. It is also normal that large financial institutions begin unofficial trading before the official listing day on a broker's list.

The reason why we have chosen the first official trading day as the starting point of this research is the reliability of the data because all definitions of the event-day are defective. Because of the differences in the policy of information releasing between the individual companies and the stock exchanges the time from the announcement of possible listing to actual listing is not constant over time to all companies or to stock exchanges. Few companies or exchanges may not even release the information in advance and therefore finding the correct event-day is difficult ex post. The first trade is not a reliable starting point for the study because the first trades before the official listing are often between large investors or between the arrangers of the listing or between the market quarantines. Therefore, these trades can be classified as outside the capacity of the "small-investor" and the trading can also be infrequent.

The strength of defining the actual listing day as the event-day is that we have an unambiguous date. The weakness of the definition may be that the listing information may be outdated and already partially incorporated into the stock prices. However, because the aim of this paper is not to study the immediate price reaction to the listing event, but of the more permanent changes to the stock price volatility brought by physical trading on many markets, the choice of the listing date as event-day should not cause statistical problems.

3. Data and descriptive statistics

The data used in this study covers all foreign listings of Finnish companies during the period

[9] *The same definition has been employed in e.g. Howe & Kelm (1987), Jaynaram et al. (1993) and in Varela & Lee (1993).*

from 1982 (when the first listing occurred) to the end of 1995. A complete list of Finnish companies listed on foreign exchanges is provided in Appendix II. This study employs 105 weeks long period for each company around the foreign listing date so that weeks –52 to –1 are weeks before listing and similarly weeks +1 to +52 describe the period after listing, zero denotes the actual listing week. The change in the value of the shares is estimated through calculating weekly returns (Wednesday to Wednesday) in logarithmic form for each class of multilisted stocks. All calculated returns are corrected for stock splits, rights issues and dividends by reinvesting the proceeds into the stock. We will report averages over individual stocks (e.g. average pre- post variance ratios) with an indication of the number of significant individual changes observed. Each stock is paired with simultaneous values with the control index (the market return)[10], i.e. the same statistics as for the stocks (e.g. variance ratios) are computed for the control index's using the same time period as for the stock itself. Similarly as for the individual stocks, we will report averages of the control index statistics, as well as numbers of significant observations detected.

Because of the data requirements, some companies are excluded totally from the study. In some tests, only a limited population of companies is included on the data set. The reasons for these decisions were various; in two cases an exact listing day could not be defined accurately or the equity issue was directed to foreign investors only by the creation of a new stock series, which was not listed in Finland. Even the requirement of data 52 weeks prior to the international listing proved to be a tricky prerequisite for some companies that had, unfortunately, to be excluded from the study. In order to test the second hypothesis concerning the difference in restricted versus unrestricted shares, a comparable restricted share had to be found. Such a class of shares did not exist for all companies which unavoidably limited the test to some extent.

Tables 1 and 2 show where and when the Finnish companies have been listed. In terms of number of listings, London seems to be by far the most popular financial center for the Finnish companies, because four companies are listed on the LSE and another 17 at the SEAQ. The U.S. market comes in second place, even if only

Table 1. Frequency distribution of listings of Finnish companies in different exchanges. Table 1 reports where and in which extent Finnish companies have listed on foreign exchanges during the period 1982–95. London (LSE and SEAQ) has been the most frequently listed market followed by the New York Stock Exchange and the Stockholm Stock Exchange.

Exchange	Number
SEAQ	17
ADR	7
LSE	4
StSE	3
FRU	2
PAR	1
NASDAQ	1

Notes:
ADR denotes stocks listed by the American depositary receipts program at the New York Stock exchange, **LSE** denotes the Stock Exchange of Great Britain and Ireland and **SEAQ** denotes the electronic list at the same exchange, **NASDAQ** denotes shares listed on the OTC market in the USA, **StSE** is the Stockholm Stock Exchange, **PAR** denotes the Paris Stock Exchange and **FRU** is the Frankfurt Stock Exchange.

Table 2. Frequency distribution of listings of Finnish companies by year. The table reports three periods since 1982 characterized by high international listing activity and by the booming Finnish markets.

Year	Number
1982	1
1983	3
1984	2
1985	1
1986	–
1987	3
1988	5
1989	6
1990	2
1991	2
1992	–
1993	2
1994	5
1995	3

[10] *The market return prior to 1990 is WI-index computed at the Swedish School of Economics and Business Administration and the HEX-index measuring total returns thereafter.*

three companies (Nokia, Rauma and Valmet) are fully listed on the NYSE list. The StSE has been important for the Finnish companies although it comes only in the fourth place in the ranking by frequency. The reason is that the first companies started the internationalising of their equity on the Swedish market. A possible reason for firms decision to list in StSE may have been that both the legislation and the accounting standards are relatively similar in Finland and in Sweden. This tendency supports the idea presented in Forester and Karolyi (1993) in a sense that the Finnish companies began from markets that are easy to entry and familiar to the companies. The Swedish stock market has functioned as a feasible market for internationalising Finnish companies because StSE is larger than HeSE and so listing in Sweden introduces the firms to a larger investor community. There may also exist factors, like the mental closeness of the Nordic countries and common language which may have eased communication between participants and thus reduced the barriers to list on a foreign market on a way which is not possible to quantify.

From Table 2 it can be seen, that there have actually been three periods characterised by high listing activity. The first period started on September 13th 1982 when Kone B shares were listed on StSE. Another six listings occurred on NASDAQ, LSE, SEAQ and StSE. These listings were accompanied by simultaneous strong growth of the Swedish market. Hietala (1988) reports the same results and explains the strong growth of the Swedish and Finnish markets as a result of increased foreign demand but does not give any explanations why foreign investors became interested in these two Nordic markets simultaneously. This research provides three explanations why the multilisting activity increased so dramatically in the beginning of the 1980's. First, the soaring Nordic markets offered an lucrative opportunity for Finnish companies to raise capital from equity markets. Secondly, many Finnish firms had expanded on foreign markets and thus wanted more publicity provided by listing on foreign exchanges. Finally, the example of other successfully dually listed Nordic companies like e.g. Novo increased interest on international equity markets.

The second period of foreign listings took place at the end of the 1980's. The main economic reason lies on the favorable development of the world economy. In spite of the October crash in 1987 the financial markets grew fast in Finland and economic activity was on a high level. In this environment companies were able to show strongly improving results which led to management's belief that multilisting would have favorable consequences on the value of the firms.

The third peak in foreign listing activity was in 1994. It is remarkable to notice that no Finnish company did list its shares on foreign exchanges in 1992, when the law of foreign ownership was released in Finland and only two listings were recorded in the following year. Possible explanations for these phenomena are twofold. First, Finland, like all other industrialized nations, was in a deep recession and thus foreign capital markets did not appear to be very lucrative for new listings. Second, the abandonment of the law of foreign ownership reduced the initiative of financially distressed Finnish firms to seek new capital from new stock markets because foreign investors could now easily come to the Finnish market. These findings are an analogy to some degree to results reported by e.g. Lucas & McDonald (1990) and Bayless & Chaplinsky (1996) who found that equity issues are likely to come in bullish markets when even the negative price reaction tends to be significantly lower.

4. Results

Table 3 reveals results from the first hypothesis. The third column for stocks and the sixth column for control reveal results that can be interpreted in two ways. First, it reports the ratio of post- to pre-listing variances. Secondly, this variance ratio can be interpreted as an F-test for the equality of the two variances. I.e., the test statistic is the ratio of the sample variances

(3) $F = \frac{\sigma_{al}^2}{\sigma_{bl}^2} \sim F(51,51)$ and the hypothesis are:

$H_0: \sigma_{bl}^2 = \sigma_{al}^2$

$H_1: \sigma_{bl}^2 \neq \sigma_{al}^2$

In general, the variances of the Finnish stocks listed on foreign exchanges have slightly decreased due to the multilisting event. This can be seen from Table 3 which reports that multiple listings on the foreign exchanges are associated with a decrease in the post-listing variance of returns in 58% (14/24) of the listings of which seven listings are statistically significant. Decreasing post-listing variances are also evident for the stocks listed after 1992. In all listings after 1992 the variances have actually dropped on the post-listing period. Possible reasons for this tendency could be that multilisting actually has a decreasing effect on the variance or that the change in the legislation may have affected the results.[11] However, Table 3 also reports five significant increases in the post-listing variances for the stocks. When results for the control are being studied we can see a different pattern, in 63% (15/24) of the cases, the post-listing variance is higher than the pre-listing variance, of which 50% are significant.

As an additional control measure, we have also created a sample consisting of companies which match with the actual multilisted companies as well as possible when variables like size or industry class are considered. In other words, we have created an index consisting of 24 non-multilisted companies during the same time interval as actual listings happened. The results can be seen on Table 3 below the column Matched Sample. We can see that when we employ an index, variances have significantly dropped during the post-listing period. When results from non-multilisted companies are studied individually company by company (not reported on Table 3) we get a result which is different from the previous result. In total 50% (12/24) of the matched companies experience an increase in post-listing variance during the same time period when the actual company multilisted. The proportion of significant F-statistics, however, is lower being only 25% of the total sample. We see this result as an additional support to our original results for stocks which show a slight tendency of decreasing post-listing variances because both the control- and the matched samples show increasing post-listing variances which is an opposite result.

Finally, we have also controlled that changing market conditions, like e.g. infrequent trading caused by low trading volumes, would have affected our results. These results can be found from Table 3 under the column Trading Volumes. The low volume period refers to the years before 1987 and during 1991–92 when volumes were under 1000 million Finnish Markkas a day. The results reveal that volatilities on average have been on a higher level during the low trading volume periods than during the high trading volume periods. This result gives support to findings that low trading volumes and infrequent trading may induce volatility. Our finding that the post-listing volatilites are on a lower level is an expected result because the sample employed in this additional control procedure consists of actual listings which have already proven to generate lower post-listing variances. However, this result increases the robustness of our results because our results show decreasing post-listing variances no matter whether the low or the high period is in question.

As an alternative to comparing the international listings to the control index, we can try to control for market effects by the estimation of a market model for each stock. Residuals from this model should measure effects not related to either a change in market volatility or stock beta. The market model is estimated separately for the pre- and the post-listing periods in order to allow for a change in β_i.[12, 13] The last

[11] *Of course, hypothesis of $F < 1$ are impossible to test when only the critical values of the right-hand tail of the F-distribution are employed. The numerator and the denominator have not been replaced in Table 3 (or in forthcoming Tables 4 and 5) because the aim of the Table is to report results concerning a proportional change in the variance. When reporting results in the tests of significance have, however, been conducted as two-way tests, i.e. inverting the ratio when needed.*

[12] *E.g. Lau et al. (1994) employ the market model separately for the pre- and the post listings periods.*

[13] *We have also controlled for the possibility that multilisting might affect β coefficients. The impact of the multilisting on the β coefficients is inconclusive because in 50% of the listings the post-listing β is larger than the pre-listing β. In addition, we have also conducted a paired t-test to test whether the means of 24 pre- and post-listing β co-*

Table 3. Comparison of variances before and after the listing event. The first two columns for the individual stocks respectively for the control index and for the market model residuals report the pre- and the post-listing variances. The third column for each group reports the ratio of the pre- to the post-listing variances, which also can be interpreted as F-test for the equality of two variances. The last column reveals a similar F-test for the market model residuals. The market model is estimated for each stock separately for the pre- and the post-listing periods in order to allow for a change in β_i. Rows which concern groups of stocks, such as the rows "All" and each row for the each market, average variances for all the stocks in the group are reported.

	Stocks			Control			Market model residual		
Company	Pre-listing variance	Post-listing variance	F-test	Pre-listing variance	Post-listing variance	F-test	Pre-listing variance	Post-listing variance	F-test
All	0,0024	0,0025		0,0006	0,0006		0,0017	0,0018	
LSE	0,0021	0,0019		0,0005	0,0004		0,0014	0,0012	
Amer	0,0029	0,0013	**0,439**	0,0005	0,0001	**0,258**	0,0024	0,0012	**0,482**
Enso	0,0013	0,0024	**1,868**	0,0002	0,0004	**1,696**	0,0010	0,0021	**2,152**
Kymmene	0,0022	0,0007	**0,314**	0,0007	0,0003	**0,447**	0,0008	0,0002	**0,281**
Nokia	0,0020	0,0031	1,551	0,0004	0,0008	**2,229**	0,0013	0,0015	1,131
SEAQ	0,0026	0,0034		0,0006	0,0006		0,0021	0,0026	
Amer	0,0011	0,0044	**3,928**	0,0003	0,0005	**1,692**	0,0008	0,0030	**3,887**
Enso	0,0018	0,0018	0,993	0,0003	0,0004	1,457	0,0015	0,0016	1,017
Huhtamäki	0,0023	0,0026	1,132	0,0005	0,0008	**1,796**	0,0021	0,0022	1,055
Kop	0,0004	0,0009	**1,955**	0,0003	0,0005	**1,689**	0,0002	0,0004	**1,949**
Metsä-Serla	0,0036	0,0014	**0,396**	0,0021	0,0011	**0,535**	0,0021	0,0006	**0,292**
Pohjola	0,0043	0,0067	1,546	0,0004	0,0007	**1,693**	0,0043	0,0058	1,346
Rauma-Repola	0,0048	0,0111	**2,285**	0,0001	0,0004	**3,555**	0,0048	0,0105	**2,198**
Repola Yhtymä	0,0052	0,0043	0,830	0,0004	0,0007	1,664	0,0040	0,0026	0,637
Sampo	0,0030	0,0029	0,980	0,0012	0,0009	0,718	0,0018	0,0013	0,702
Unitas	0,0008	0,0007	0,921	0,0003	0,0005	**1,689**	0,0005	0,0005	1,001
Wärtsilä	0,0012	0,0008	0,651	0,0005	0,0001	**0,256**	0,0011	0,0007	0,634
ADR	0,0023	0,0018		0,0010	0,0008		0,0011	0,0010	
Amer	0,0009	0,0015	1,627	0,0005	0,0008	**1,842**	0,0005	0,0009	**1,851**
Nokia	0,0040	0,0021	**0,527**	0,0013	0,0007	**0,564**	0,0020	0,0015	0,762
Repola Yhtymä	0,0021	0,0019	0,923	0,0012	0,0009	0,737	0,0009	0,0005	0,605
StSE	0,0015	0,0012		0,0002	0,0004		0,0012	0,0009	
Kone	0,0014	0,0016	1,141	0,0001	0,0002	1,610	0,0013	0,0012	0,893
Nokia	0,0018	0,0007	**0,381**	0,0002	0,0005	**2,520**	0,0014	0,0004	**0,300**
Wärtsilä	0,0012	0,0012	0,982	0,0002	0,0005	**2,553**	0,0009	0,0010	1,228
FRU	0,0027	0,0027		0,0007	0,0004		0,0016	0,0013	
Nokia	0,0031	0,0012	**0,376**	0,0008	0,0003	**0,318**	0,0015	0,0010	0,708
Yhtyneet	0,0023	0,0042	**1,813**	0,0004	0,0008	**2,035**	0,0017	0,0016	0,970
PAR									
Nokia	0,0031	0,0012	**0,375**	0,0008	0,0003	**0,315**	0,0015	0,0010	0,708
Group-1992	0,0030	0,0029		0,0014	0,0009		0,0017	0,0010	
Metsä-Serla	0,0036	0,0014	**0,396**	0,0021	0,0011	**0,535**	0,0021	0,0006	**0,292**
Nokia	0,0040	0,0021	**0,527**	0,0013	0,0007	**0,564**	0,0020	0,0015	0,762
Repola Yhtymä	0,0021	0,0019	0,923	0,0012	0,0009	0,737	0,0009	0,0005	0,605
Sampo	0,0030	0,0029	0,980	0,0012	0,0009	0,718	0,0018	0,0013	0,702
Matched Sample									
All		0,0002	0,0001	**0,418**					
Trading volumes									
Low period		0,0002	0,0000	1,5289	0,0003	0,0001	1,597		
High period		0,0001	0,0000	1,4644	0,0002	0,0000	1,158		

Notes:

* As an additional control measure, we have also calculated a portfolio index consisting of companies which are not multi-listed. All 24 non-multilisted companies which are included in the index match as well as possible with multi-listed companies in relation to such criterias as industry and size.

** We have also controlled for a possibility that changes in average trading volumes at HeSE would also have affected the volatilites of the multilisted companies. Therefore, we have also split our sample into two groups where a portfolio index is formed. The first portfolio; Low period, consists of companies listed before 1987 and during 1991–92. The second portfolio; High period, consists of companies listed 1988–90 and 1993–95.

column reveals results from the F-test for market model residuals. The residuals have been estimated through using equation $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$. This type of test studies whether the variance of ε is unchanged and is derived from hypothesis test about $\sigma^2_{\varepsilon,bl}$ and $\sigma^2_{\varepsilon,al}$.

(4) $H_0: \sigma^2_{\varepsilon,bl} = \sigma^2_{\varepsilon,al}$
$H_1: \sigma^2_{\varepsilon,bl} \neq \sigma^2_{\varepsilon,al}$

That means, that the test statistic is the ratio of the sample variances of the residuals in the market model equation. The results are similar to the stocks indicating that a very slight decrease on the variances has occurred on the post-listing period. We can also see that variances have dropped on the post-listing period for all group-1992 stocks. This indicates that the changes in the legislation may have had impact on the variances of listing companies. This indicates that results have similarity to e.g. Barclay, Litzenberger and Warner (1990 and to Foerster and Karolyi (1993) who report unchanged or decreased volatilities on the post-listing period.

We are also concerned to study whether the stock return distributions of multilisted companies would have changed.[14] Therefore, we have also employed non-parametric Mann-Whitney test in order to test whether the two random samples have been drawn from the same population distribution or not. The Mann-Whitney test has lower power than the parametric tests reported in Table 3 because the test does not require that the difference between the two sample means is normally distributed. Results (not reported) show, that it has not been possible to reject the null-hypothesis of the same population distribution in any of the cases.[15] This implies that we can not draw the conclusion that a statistically significant change has occurred for the listing data and it is possible that observations both before and after the listing have been drawn from the same population.

We have also employed the non-parametric Kruskal-Wallis test, which is an extension of the Mann-Whitney test when there are $k>2$ populations. These qualities of the test give us tools to study whether the k population distributions are equal. This is very powerful result, because it gives us tools to study the hypothesis of growing importance of listing in larger exchanges by studying all distributions simultaneously. The null-hypothesis in this test is the following: The random samples k of multilisted stocks have been drawn from the same population distribution, when a 105 weeks long research period is used. If results in Kruskal-Wallis test are significant, it implies that multiple listings in larger exchanges affect the distribution of returns of internationally listed shares. Results (not reported) do not support the hypothesis of the larger stock markets dominance. Especially interesting are results from the by far

efficients would be statistically different. The t-statistic, however, is insignificant indicating that multilisting does not affect market model β coefficients. This result is in contrast to e.g. Foerster and Karolyi (1998) who report lower post-listing betas for companies from Asia, Australia, Canada and Europe that listed their stocks in the U.S. between 1976–92.

[14] In general, we have been concerned over the statistical properties of the data we employed in the study. We have estimated the autocorrelation and the partial autocorrelation coefficients for the pre- and the post-listing periods and for the whole 105 weeks long period. Results indicate that we do not have systematic autocorrelation pattern and only few significant autocorrelation coefficients are measured randomly both for the stocks and for the control.

In earlier versions of the paper, we were concerned over the heteroscedasticy of the data. However, heteroscedasticy seems not to be a problem because we have employed weekly logarithmic data which seems not to be so sensitive to problems like heteroscedasticy or autocorrelation as the data with higher frequency (daily, intraday) would be. In addition, we also tried to model volatility with various kinds of ARCH and GARCH models but we did not find any model which would converge in more than perhaps one or two of the 24 listings. Probably the main cause to weak ARCH effect is both the length and the frequency of the data we use. Our view is that our time period (one year pre, one year post, two years total) and also the time interval (one week) are too short that any ARCH effect would be possible to find. Probably a data set consisting of monthly or even quartile observations from longer time period than two years would be more suitable for the research which would study the ARCH effect. However, the problem of a data set of that kind would be that it would no longer study the impact of multilistings on volatility because from such a data set it would be hard to determine whether it is multilisting or other reasons which have affected volatility of a specific stock.

[15] The market model residuals employed in the Mann-Whitney test are estimated separately both for the pre- and the post-listing periods.

most internationalized company – Nokia – because statistics show that the subsequent listings do not affect the stock return variability. This result gives weak support for the theory that listing in larger and dominant markets would have greater impact on stock return variability than listing in smaller international markets which companies tend to do in the beginning of the internationalization process. Therefore, it can be claimed that when several k samples are tested, statistics do not show a higher level of significance compared with 2 samples tests. This implies that multiple listings should be seen as subsequent events which do not affect the return distribution of shares to a statistically significant extent.

To sum up, we can see that the trading of Finnish stocks in different geographic regions with or without overlapping trading time between the HeSE and another foreign stock exchange do not generate distinctive volatility patterns. For example, listing in the LSE, on average, tends to decrease volatility but the effect of multilisting is opposite for the SEAQ where volatility has increased during the post-listing period. Both exchanges, however, are located in the same city and in the same time zone. Therefore, we reject hypotheses of Black (1986) and Kyle (1985) who claim that increased trading volume would generate volatility. We also reject the hypothesis of French and Roll (1986) because the evidence from e.g. NYSE listed stocks shows that increased trading time does not induce volatility. On the other hand, results give support to theories (like Johnsen (1991) which claim that multimarket trading increases competition between exchanges which in turn generates more trading and price stability.

Table 4 reveals results for the second hypothesis. The third column for stocks and the sixth column for control reveal results that can be interpreted either as a ratio of the post- to the pre-listing variances or as the F-test for the equality of the two variances. We can see that the results are in line with the results reported in Table 3 for unrestricted stocks. In 66% (9/16) of the listings, the variance has decreased during the post-listing period. Therefore, we conclude that the effect of multilisting seems to be similar across dual classes of stocks. On the other hand, our empirical evidence does not support theories which claim that multilisting would be harmful to a stock or lead to increased volatility mainly due to increased trading time and volatility. However, the control index shows, that the post-listing variance is higher than the pre-listing variance in 63% of the cases of which 44% are statistically significant at $\alpha = 5\%$. The variances of the group consisting of stocks listed after 1992 appears to have decreased during the post-listing period due to the multilisting event because only in the group-1992 the variances of even restricted stocks appear to be lower after the listing. However, the group-1992 consists only of two companies (Metsä-Serla and Nokia) so any general conclusions concerning the impact law changes on variance can not be inferred.

Table 5 reports results from the hypotheses 2.2 and 2.3. In other words, we test if the variances of restricted stocks are different from the variances of unrestricted stocks on the pre-listing period versus on the post-listing period. The composition of the test statistics is otherwise similar to statistics shown on the previous tables.

From Table 5 it can be seen that during the pre-listing period the variances of the unrestricted shares have been on a lower level than the restricted shares have been only in four cases. The results from the post-listing period are also in line with the results from the pre-listing period. We can see that the difference in variances between restricted and unrestricted stocks is large for Rauma-Repola stocks in SEAQ. Even if the difference in variances is statistically significant only in few cases, we can see that unrestricted stocks have larger weekly variance than restricted stocks. Results from stocks listed after 1992 are unambiguous because Metsä-Serla's restricted stocks have larger variance than the unrestricted stocks but results are opposite for Nokia during both periods. Results, in general, are similar to Berglund & Liljeblom (1990) who reported that average standard deviations of unrestricted shares is higher than restricted ones and that the average standard deviations have increased through time. These results give additional support to Pagano (1985) who claimed that unrestricted stocks can be

Table 4. Comparison of variances of restricted stocks before and after the listing event. The first two columns for the individual stocks respectively for the control group report the pre- and the post-listing variances. The third column reveals results from a F-test which is conducted by estimating the ratio of post- to pre-listing variances. This type of test studies whether the variances have changed between two periods.

	Restricted stocks			Control		
Company	pre-listing variance	post-listing variance	F-test	pre-listing variance	post-listing variance	F-test
All	0,0020	0,0016		0,0006	0,0005	
LSE	0,0018	0,0017		0,0005	0,0005	
Enso	0,0009	0,0023	**2,614**	0,0002	0,0004	**1,696**
Kymmene	0,0016	0,0007	**0,419**	0,0007	0,0003	**0,447**
Nokia	0,0029	0,0021	0,733	0,0004	0,0008	**2,229**
SEAQ	0,0020	0,0016		0,0006	0,0006	
Enso R	0,0013	0,0019	1,395	0,0003	0,0004	1,457
Huhtamäki	0,0010	0,0010	1,023	0,0005	0,0008	**1,796**
Metsä-Serla	0,0045	0,0016	**0,365**	0,0021	0,0011	**0,535**
Rauma-Repola	0,0011	0,0013	1,205	0,0001	0,0004	**3,555**
Repola Yhtymä	0,0037	0,0039	1,050	0,0004	0,0007	1,664
Unitas	0,0008	0,0007	0,938	0,0003	0,0005	**1,689**
Wärtsilä	0,0014	0,0009	0,637	0,0005	0,0001	**0,256**
ADR						
Nokia	0,0036	0,0020	**0,541**	0,0013	0,0007	**0,564**
StSE	0,0010	0,0009		0,0002	0,0005	
Nokia	0,0009	0,0006	0,633	0,0002	0,0005	**2,520**
Wärtsilä	0,0011	0,0013	1,144	0,0002	0,0005	**2,553**
FRU	0,0027	0,0019		0,0006	0,0005	
Nokia	0,0027	0,0011	**0,417**	0,0006	0,0003	**0,454**
Yhtyneet	0,0027	0,0027	1,001	0,0006	0,0008	1,321
PAR						
Nokia	0,0021	0,0011	**0,544**	0,0008	0,0003	**0,315**
Group-1992						
Metsä-Serla	0,0045	0,0016	**0,365**	0,0021	0,0011	**0,535**
Nokia	0,0036	0,0020	**0,541**	0,0013	0,0007	**0,564**

Notes:
Statistically significant values at $\alpha = 0{,}05$ are marked bold.

more volatile than restricted shares. Variances can be larger for unrestricted stocks due to larger idiosyncratic demand shifts caused by foreign traders.

5. *Summary*

This paper focuses on the relationship between volatility and listing of shares on multiple exchanges. The small number of internationally multilisted shares and the legislational characteristics of the Finnish stock market have led to relatively late and well-documented international listing activity. These characteristics make it possible to study the relationship between volatility and multilisting through employing full sample of all companies which would not be possible for other larger markets.

An extensive sample of Finnish companies shows, that there exists a tendency to expand first to close markets with low information releasing requirements and first after international success or recognition to newer more demanding markets. However, the results from Kruskal-Wallis test give weak support for the theory that listings in larger and dominant markets would have greater impact on stock return variability than listings in smaller international markets which companies tend to do in the beginning of the internationalization process. Thus the market has similar appreciation for

Table 5. Results from the comparison between restricted and unrestricted stocks on the pre- and the post-listing periods. The first column reports the variance of restricted shares on the 52 weeks long pre-listing period. The second column reports the variance of unrestricted shares on the 52 weeks long post-listing period. The third column reports the ratio of pre-listing unrestricted to restricted stocks variances, which also can be interpreted as F-test for the equality of two variances. The following columns report similar test statistics for the post-listing period. The aim of the tests is to study whether the variances are similar between dual classes of stocks on the pre- and the post-listing periods.

	Stocks pre-listing period			Stocks post-listing period		
Company	unrestricted variance	restricted variance	F-test	unrestricted variance	restricted variance	F-test
All	0,0025	0,0020		0,0024	0,0016	
LSE	0,0018	0,0018		0,0021	0,0017	
Enso R	0,0013	0,0009	1,468	0,0024	0,0023	1,049
Kymmene	0,0022	0,0016	1,366	0,0007	0,0007	1,024
Nokia	0,0020	0,0029	0,702	0,0031	0,0021	1,486
SEAQ	0,0028	0,0020		0,0033	0,0016	
Enso R	0,0018	0,0013	1,388	0,0018	0,0019	0,988
Huhtamäki	0,0023	0,0010	**2,334**	0,0026	0,0010	**2,584**
Metsä-Serla	0,0036	0,0045	0,791	0,0014	0,0016	0,857
Rauma-Repola	0,0048	0,0011	**4,553**	0,0111	0,0013	**8,638**
Repola Yhtymä	0,0052	0,0037	1,412	0,0043	0,0039	1,117
Unitas	0,0008	0,0008	1,016	0,0007	0,0007	0,997
Wärtsilä	0,0012	0,0014	0,906	0,0008	0,0009	0,926
ADR						
Nokia	0,0040	0,0036	1,093	0,0021	0,0020	1,065
StSE	0,0015	0,0010		0,0009	0,0009	
Nokia	0,0018	0,0009	**1,881**	0,0007	0,0006	1,133
Wärtsilä	0,0012	0,0011	1,099	0,0012	0,0013	0,944
FRU	0,0027	0,0027		0,0027	0,0019	
Nokia	0,0031	0,0027	1,157	0,0012	0,0011	1,042
Yhtyneet	0,0023	0,0027	0,854	0,0042	0,0027	1,546
PAR						
Nokia	0,0031	0,0021	1,510	0,0012	0,0011	1,042
Group-1992	0,0038	0,0041		0,0017	0,0018	
Metsä-Serla	0,0036	0,0045	0,791	0,0014	0,0016	0,857
Nokia	0,0040	0,0036	1,093	0,0021	0,0020	1,065

Notes:
Statistically significant values at $\alpha = 0{,}05$ are marked bold.

different exchanges and therefore international listings should be seen as subsequent events which do not affect the stock return distribution to a statistically significant extent.

We find that, in general, the variances of the multilisted stocks have slightly decreased during the post-listing period. However, when the residuals from the market model equation are used in non-parametric Mann-Whitney U test we can not find that return distributions would have changed on the pre- and the post-listing periods. In addition, all multilistings that occurred after the law change in 1992 concerning the foreign ownership of shares have also resulted in decreased variances on the post-listing period.

Results from the unrestricted stocks also apply for the restricted stocks because we find that the post-listing variance is lower than the pre-listing variance even for the restricted stocks. We find also that in roughly 70% of the listings, unrestricted stocks have larger variance than the restricted stocks have.

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Appendix I: A short history of the liberalization of the Finnish capital markets

1984 December	Banks received expanded authorities in foreign lending and to trade with foreign securities, especially with stocks.
1985 March	Dividend gains from foreign investors could be removed abroad without the permission of Bank of Finland.
1986 January	Investments in foreign stocks allowed, maximum investment amount 10 000 mk/year per person.
1987 June	Direct investments up to 30 000 000 mk allowed and the limit for investments in foreign stocks was set up to 50 000 mk.
1988 August	The limit for investments in foreign stocks was set up to 300 000 mk/year per person
1989 1st June	The regulations concerning direct investments abroad were totally released for the investment- and insurance sectors.
1989 1st September	Ownership of apartments and real estate were released. Investments in foreign securities, accounts and goods allowed without the permission of the Bank of Finland. Most of the direct investments made by foreigners in Finland were freed from the regulation of the Bank of Finland.
1990 February	Finnish companies had no longer to ask the permission from the Bank of Finland for raising equity abroad. Foreign investors were released from obligation to buy Finnish shares from Finland.
1990 1st July	Private investments abroad were totally released.
1990 1st September	Derivatives for bounded shares were allowed for foreign investors.
1992 January	Division of shares with respect to foreign ownership was released.
1993 January	The law concerning foreign ownership in Finland was released.

Appendix II: Foreign listings during the period 1982–1995

Companies or listings in parentheses are not included in the survey. The reasons are that the exact listing dates are not identified (Finnair, the 1st listing of Huhtamäki) or the equity issue is restricted to foreign investors only (Instrumentarium) or it is a question of an IPO (Kemira, Metra, Rauma, Valmet). We have treated Rauma-Repola, Repola and Rauma as separate companies. The reason for this choice is that the line of business of companies that were one unity until 31.12.90 has changed remarkably. Yhtyneet Paperitehtaat and Repola were forest companies (a new company named UPM-Kymmene was created through merger of Yhtyneet and Repola on the 1st of May 1996) and Rauma is a steel company. We can see that some listings are overlapping (e.g. Nokia in both LSE and SEAQ) or there are listings where different series of stocks (Pohjola) are listed to the same exchange. In these cases we have excluded stocks listed on the smaller exchanges or less liquid stocks from the study. We have, however, tried to collect an extensive sample of Finnish companies for the study because otherwise the sample size would be too small. We have estimated that 24 listings fulfil our criteria to be included in the survey. Most tables include individual test statistics for all 24 listings included in the survey so that a critical reader can form his or her own view over the impact of multilisting on specific Finnish firms. Due to the identification problems or merges of

companies we have even conducted tests with smaller sample sizes than 24. The results are, as expected, in line with the full sample so results consisting of 24 listings are reported throughout the paper.

Company	Stock	Exchange and Date
Amer Yhtymä Oy	A-series	LSE 29.5.1984 ADR 6.4.1987 SEAQ 11.12.1989
Enso-Qutzeit Oy	A-series free R-series free	LSE 19.6.1989 LSE 19.6.1989 SEAQ 22.2.1989
Finnair Oy		[SEAQ January 1995]
Huhtamäki Oy	I-series free	SEAQ 14.8.1990 [ADR April 1990]
[Instrumentarium Oy	B-series	NASDAQ 18.8.1983]
Kansallis-Osake-Pankki		SEAQ 16.1.1989
[Kemira Oy	A-series	SEAQ 10.11.1994] [ADS 10.11.1994]
Kone	B-series free	StSE 13.9.1982
Kymmene Oy	free free	LSE 20.6.1988 SEAQ 20.6.1988
[Metra Oy AB	B-series free	SEAQ 25.3.1991]
Metsä-Serla Oy	B-series	SEAQ 22.3.1993
Nokia -Yhtymä	A-series free	StSE 23.6.1983 LSE 15.5.1987 [SEAQ 15.5.1987] FRU 20.5.1988 PAR 27.5.1988 ADR 1.7.1994
[Outokumpu		SEAQ 11.6.1993]
Pohjola	A-series free B-series free	SEAQ 27.12.1989 SEAQ 27.12.1989
[Rauma Oy		ADR 22.6.1995] SEAQ 22.6.1995]
Rauma-Repola	I-series free	SEAQ 19.6.1985
Repola Yhtymä	free	SEAQ 2.1.1991 ADR 16.5.1994
Sampo	A-series	SEAQ 3.5.1994
Unitas Oy	A-series	SEAQ 16.1.1989
[Valmet Oy	A-series	SEAQ 24.10.1988] [ADR 24.10.1988]
Wärtsilä	II-series free	StSE 30.6.1983 SEAQ 26.4.1984
Yhtyneet paperitehtaat	pref. free	FRU 17.7.1987

Appendix III

Panels A, B and C reveal some statistical properties of the time-series data. Panel A covers the whole 105 weeks long study period and Panels B and C cover the period 52 weeks before respectively after the international listing. The higher moments of distributions are reported as well as Lilliefors-t statistic, which is a test of normality.

Panel A shows us that the null-hypothesis of normally distributed returns is rejected in 16 listings for the stocks and in 10 observations for the control. In addition, the sub-sample consisting of firms listed after 1992 shows that in two listings the return distribution has not been normally distributed when the p-values of the Lilliefors-t test are studied. In general there exists a difference between the stocks and the control index if the moments are studied. We can see that in 10 listings, the return distribution is significantly skewed but the control index reports only 4 significant observations. Both the share and the control groups report high significant kurtosis values in several cases.

From Panel B it can be seen, that at the pre-listing period the return distributions of the internationally listed companies have been significantly non-normal in 58% of all listings. However, the control group reports only four cases where the normality assumption can be rejected. Differences in return distributions can also be seen when skewness and kurtosis values are being studied. We can also see that the weekly returns of shares are more skewed than the control index.

Panel C reveals that the return distributions of multilisted shares appears to be more normally distributed on the post-listing period because only three companies report significant Lilliefors t-test p-values.

In general, the common property of Panels A, B and C is that the standard deviations of multilisted stocks is higher for all listings at all exchanges than for the control index. This is an expected result because the control index is a value-weighted portfolio of all Finnish stocks (first the WI-index then the HEX-index in its total return form). According to the theory a well-diversified portfolio will generally have a smaller standard deviation than single stocks, or less well-diversified portfolios averages of single stocks.

PANELS A, B, C
Descriptive Statistics for the period 1982–95

Panel reports the average parameter values (standard deviation, skewness, kurtosis) of the return distributions for individual stocks as well as the average parameter values of the return distributions for the control variable. The control variable employed in this study is the total market return, which is a value weighted index of all stock returns listed at HeSE. Lilliefors-t test of normality is conducted for the return distributions of individual stocks and for the control indexes in order to study whether return distributions are normally distributed. The time period used in panel A of Table 3 covers the Finnish stocks listed at different exchanges during the period 1982–95 for 105 weeks period which includes the pre-listing period, listing week and the post-listing period. Panel B covers the pre-listing period and Panel C the post-listing period.

Panel A, The Pre- and the Post-listing periods

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
All	24	0,047	0,127	10	3,024	20	0,074		24	0,023	–0,288	4	2,296	18	0,262	10
LSE	4	0,044	–0,038	1	4,042	4	0,078	Amer, Kymmene	4	0,021	–0,593	1	3,508	4	0,114	3
SEAQ	11	0,052	0,060	5	1,892	9	0,060	Amer, Huhtamäki, Kop, Metsä-Serla, Rauma-Repola, Sampo, Wärtsilä	11	0,024	–0,036	2	1,286	7	0,328	2
ADR	3	0,045	0,301	2	0,400	1	0,267	Amer	3	0,030	–0,293	0	1,349	1	0,652	1
StSE	3	0,036	0,830	2	6,611	3	0,001	Kone, Nokia, Wärtsilä	3	0,016	0,308	1	2,091	3	0,034	3
FRU	2	0,052	–0,350	0	5,082	2	0,001	Nokia, Yhtyneet	2	0,024	–1,390	0	5,457	2	0,065	0
PAR	1	0,046	–0,149	0	4,408	1	0,002	Nokia	1	0,023	–1,411	0	5,695	1	0,047	1

Subsample of companies listed after 1992

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
	4	0,051	0,403	3	0,580	3	0,210	Metsä-Serla, Sampo	4	0,034	0,039	0	0,129	1	0,780	0

Panel B, The Pre-listing period

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
All	24	0,047	0,383	13	2,991	16	0,139		24	0,022	–0,167	4	1,291	10	0,402	4
LSE	4	0,045	0,091	2	2,736	3	0,337	Amer, Kymmene	4	0,021	–0,365	0	1,988	2	0,522	0
SEAQ	11	0,048	0,178	6	1,588	6	0,087	Amer, Enso, Metsä-Serla, Rauma-Repola, Sampo, Wärtsilä	11	0,022	–0,179	1	0,772	4	0,430	1
ADR	3	0,046	0,449	2	0,652	1	0,192	Amer	3	0,030	0,151	1	0,516	1	0,651	0
StSE	3	0,038	1,695	2	10,476	3	0,000	Kone, Nokia, Wärtsilä	3	0,013	0,634	2	1,493	1	0,093	2
FRU	2	0,052	0,449	1	3,128	2	0,116	Yhtyneet	2	0,024	–0,678	0	1,971	1	0,282	0
PAR	1	0,056	–0,453	1	3,739	1	0,213		1	0,029	–1,576	1	4,574	1	0,041	1

Subsample of companies listed after 1992

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
	4	0,056	0,435	3	0,436	1	0,151	Metsä-Serla, Sampo	4	0,038	–0,002	0	0,117	1	0,370	1

Panel C, The Post-listing period

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
All	24	0,047	0,067	7	1,862	14	0,338		24	0,023	–0,213	3	1,250	12	0,419	2
LSE	4	0,042	–0,119	1	2,691	3	0,389		4	0,020	–0,501	1	2,069	3	0,356	0
SEAQ	11	0,054	0,015	2	1,573	6	0,353	Amer	11	0,024	–0,050	2	5,000	1	0,346	0
ADR	3	0,043	0,419	1	0,463	1	0,410	Nokia	3	0,028	–0,472	0	1,344	1	0,513	1
StSE	3	0,034	0,299	1	1,678	1	0,366	Kone	3	0,019	0,172	0	1,451	2	0,427	0
FRU	2	0,049	–0,349	1	3,926	2	0,118		2	0,022	–0,870	0	2,816	1	0,505	1
PAR	1	0,034	0,465	1	2,347	1	0,112		1	0,016	0,080	0	0,276	0	0,981	0

Subsample of companies listed after 1992

	Average of parameters for shares								Average of parameters for control							
Market	no. of obs.	stdev.	skewness	no. of sign. companies	kurtosis	no. of sign. companies	Lilliefors-t p-value	Companies significant at $\alpha = 5\%$	no. of obs.	stdev.	skewness	no. of sign. obs.	kurtosis	no. of sign. obs.	Lilliefors-t p-value	no. of sign. obs.
	4	0,045	0,308	1	0,266	1	0,438	Nokia	4	0,030	–0,026	0	–0,355	0	0,544	0