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Cross-listing of Swedish stocks in London and New York

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Abstract

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- Keywords:** Cross-listing, market integration, market fragmentation, information linkages between countries, volatility, liquidity
- Purpose:** In this study we seek to examine whether the Swedish firms on SSE with a cross-listing in London or New York exhibit any differences in volatility and liquidity after the listing date. Based on this, we further make an inference regarding the presence of integration between these markets.
- Methodology:** The effect of cross-listing on volatility and liquidity is examined through a multivariate regression analysis. We also examine the change in volatility and liquidity one by one by performing descriptive statistics on each of the variables.
- Theoretical perspective:** The theoretical section consists of theories and earlier research concerning cross-listing, market integration and volatility and liquidity of stocks.
- Empirical foundation:** Results of the regression analysis and descriptive statistics are presented in this section. Further, these results are analyzed with regard to theories and earlier studies in this area.
- Conclusions:** When examining volatility and liquidity individually, we find no general change in the former but we find a general increase in the latter for the investigated stocks. This implies there is some order inflow to the Stockholm stock exchange after the listing in London or New York and that information is freely available between these markets. Further, when jointly testing for changes in volatility and liquidity in a multivariate analysis we intend to capture the relationship between these two variables. The insufficient number of significant coefficients of these variables prohibits us from making generalizations concerning the Swedish stock market as a whole. Therefore we can not conclude whether the Swedish market is integrated with London and New York and whether information is freely available between these markets.

CONTENTS

1. INTRODUCTION	5
1.1 Background	5
1.2 Problem Discussion	7
1.3 Research question	9
1.4 Purpose	9
1.5 Delimitation	10
1.6 Target Group	10
2. FINANCIAL MARKETS	11
2.1 Short facts about the Stock Exchanges	11
2.1.1 Stockholm stock exchange and the OMX	11
2.1.2 NASDAQ (The National Association of Securities Dealers Automated Quotations)	12
2.1.3 New York Stock Exchange	12
2.1.4 American Stock Exchange	12
2.1.5 London Stock Exchange	13
2.2 American Depositary Receipt (ADR)	13
3. THEORY	15
3.1 Benefits of cross-border listings	15
3.2 Volatility	16
3.3 Liquidity	17
3.4 Market integration	18
3.5 Key articles	19
3.5.1 Domowitz, Glen & Madhavan (1998)	19
3.5.2 Bayar and Önder (2005)	20
3.5.3 Werner and Kleidon (1996)	21
4. RESEARCH METHOD	23
4.1 Method	23
4.2 Data collection	23
4.3 The sample	24
4.4 The model	26

4.4.1 Descriptive statistics	26
4.4.2 Multivariate analysis	27
4.5 Practical implications	29
5. EMPIRICAL RESULTS AND ANALYSIS	31
5.1 Introduction	31
5.2 Descriptive statistics	32
5.3 The model	34
6. CONCLUSION AND FURTHER RESEARCH	39
6.1 Conclusion	39
6.2 Further research	40
7. REFERENCES	41
7.1 Articles	41
7.2 Books	44
7.3 Electronic sources	44

1. Introduction

1.1 Background

The question of foreign listings has been a burning topic in recent years. International stock trading is gaining importance and firms are increasingly interested in cross-listing their stock in order to broaden their shareholder base and raise new capital. Some even argue that foreign listings can result in a lower cost of capital (Karolyi (1998), Stulz (1999)).

The main focus of the current studies, in this field, lies on the question of whether the benefits of international listings really do exceed the substantial costs attached to it. Researchers are interested in investigating whether the domestic market in fact gains from the foreign listings and what effects this has on an individual stock. An important aspect discussed in the literature is the degree of market integration (see Domowitz et al. (1997), Domowitz et al (1998), Oxelheim (2001)). Domowitz et al. (1998) claim that freely available information on the foreign market leads to an increase in quality of the domestic market. This further results in greater market integration between the foreign and domestic markets. On the contrary, if the markets are segmented, the domestic market quality worsens as a result of poor intermarket informational linkages. The costs of international listings are primarily defined as transparency costs, that is, costs associated with the disclosure requirements of the foreign market. If the information is available to the foreign market, it is reflected in the prices of stocks, resulting in decreased volatility and increased liquidity. However, the results of this study exhibit a decrease in liquidity and an increase in volatility, meaning that the examined U.S. and Mexican markets are not integrated.

Apart from the question of market integration, the academic debate also sheds light on several other benefits of cross-listings. Diversification opportunities are of course present, as firms gain access to new markets and new investors, thus

expanding their shareholder base and ultimately possible sources of capital. This logic seems to be the general perception of the practitioners as well, at least when consulting the survey presented by Mittoo (1992). The Canadian corporate managers taking part in this study distinguish the liquidity to be the main reason for listing abroad. In addition they believe that publicity is another important benefit, resulting in greater awareness of the firm for foreign investors. Similar conclusions are drawn by Fanto and Karmel (1997). In his review of the current literature, Karolyi (1998) finds that the cost of equity declines after a cross-listing due to a decline in the domestic market betas. Stulz (1999) also documents a decrease in the cost of capital after an international listing. The globalization, he argues, provides two reasons for this. First, investors require a smaller risk premium and secondly, the agency costs of raising new capital become less important.

As already mentioned, various studies focus on the issue of liquidity in the aftermath of a foreign listing. Korczak and Bohl (2005) investigate the effects of cross-listing on the newly-established capital markets in Central and Eastern Europe. The study finds that the companies that list abroad significantly improve their home market liquidity and that the stock pricing efficiency increases. In contrast to thier study, Bayar & Önder (2005) examine the change in volatility and liquidity of French stocks after their cross-listing on the German market, the Xetra. The study also tests the degree of integration between the Paris Bourse and the Xetra and finds that trading and non-trading hour's volatility is affected by cross-listing. In their investigation the authors adopt the methodology of the previously mentioned Domowitz et al. (1998) study. The results show there is an increase in volatility and a decrease in liquidity after cross-listing for many of the tested stocks, meaning that the two markets are not fully integrated. Noronha et al. (1996) find, in their study of 126 U.S. listings in London and Tokyo, that liquidity, measured as the bid-ask spread, does not change significantly.

Analysis of the bid-ask spread and the volatility are also performed by Chan et al. (1996), where the authors compare European and Japanese cross-listed stocks on the NYSE and AMEX with similar American stocks. Here they examine the stocks during a 24 hour period to determine whether any deviations arise. The results show that the intraday patterns of these stocks are fairly similar despite the

fact that public information flows differ for all of the stocks during the trading day.

The intraday pattern of British firms that cross-list in the U.S. is examined by Werner and Kleidon (1996) and is further compared to the pattern of non cross-listed firms. Their study involves an examination of volatility, volume and spreads and aims to find out whether trading in multiple markets significantly affects information flow, trading patterns and dealer competition respectively. The conclusion is that the intraday patterns for British cross-listed stocks are similar to the patterns of non-cross-listed stocks.

Further one article examining the intraday prices of stocks is written by Lowengrub and Melvin (2002). They examine volatility and volume of German firms that cross-list in the U.S. The general results of their research are that the intradaily volume and volatility curves flatten after cross-listing which points towards an integrated global trading environment rather than two segmented markets.

As presented in this section, numerous studies examine the changes in volatility and liquidity when examining the effect of cross-listing. According to Werner and Kleidon (1996), previous empirical findings establish that volatility and liquidity¹ have a reversed relation, meaning that more liquid stocks are associated with lower volatility and vice versa. Further one general thought is when the bid-ask spread decreases liquidity increases. Having this in mind one can use volume to measure liquidity. The reasoning behind this is that volume and bid-ask spread also have an inverse relationship, meaning when volume increases, bid-ask spread decreases, which in turn results in an increase in liquidity.

1.2 Problem Discussion

In reviewing the existing research in the field of cross-listing, we find that much of the discussion focuses on the possibility of improving liquidity and volatility of stocks. Some studies examine the effects of foreign listings on the emerging markets of the world while others look at the bigger markets. Nearly all studies

¹ Liquidity is often measured through the bid-ask spread or through change in trading volume in relation to volatility. For further information on liquidity, see section 3.3.

focus on cross-listing in the U.K. and U.S. equity markets (i.e. LSE, NYSE, NASDAQ and AMEX) and on the issuance of ADRs on the US market, as these markets are considered to be the largest and most important in the world (Miller, 1999).

Stock performance is one of the most important features of a firm's operations. Thus it is not surprising that the volatility and liquidity aspect of cross-listing is an object of extensive research.

In the literature, it is hypothesized that the world markets are not perfectly integrated, which gives firms an opportunity to improve the volatility and liquidity of their share by listing on a foreign market. This is especially the case if the domestic market is a small emerging market (Domowitz et al., 1998; Korczak and Bohl, 2005). Market integration is also directly related to the question of international capital structure, which arises through a foreign listing. In his review of the current literature, Karolyi (1998) finds that a cross-listing can induce systematic changes in a stock; giving rise to a change in a firm's cost of equity capital. This occurs as a result of the risk exposure that the company faces, not only on the domestic, but also on the foreign market. In segmented markets where companies face relatively high investment barriers for foreign investors, the market risk is higher resulting in a higher cost of capital. Listing their share abroad, gives these companies an opportunity to attract foreign investors on their own market, leading to a decrease in market risk and thus also in the cost of capital. From this perspective, cross-listing is beneficial only when markets are segmented.

Market segmentation can however be measured using other theoretical implications, other than those of capital structure discussed above. Domowitz et al., (1998) develop a theoretical model in order to examine whether the U.S. market and the Mexican market are integrated. In their model, the intermarket informational linkages are a central concept when determining the degree of integration between two markets. Integration is assumed to hold if the volatility of an individual stock declines and liquidity increases after the cross-listing of the share. The opposite case suggests that the markets in question are segmented. Studies performed on the Swedish market similar to those discussed above, to our knowledge, are virtually non existent. The only study we find is that of Gårdängen (2005), which examines the pre and after effects of foreign listings on liquidity of

Swedish cross-listed stocks between years 1989-2000. In her study, the author specifically examines whether listing on a major foreign stock exchange decreases the bid-ask spread of the listing securities in the home market.

The shortage of studies performed on the Swedish market, referring to the question of volatility and liquidity effects on individual stocks after a foreign listing does, in our opinion, impose a need to address this particular research question. Not in the least considering the fact that a lot of research on other markets, as discussed previously, shows that cross-listing can result in certain benefits for individual firms. In addition, as some studies point out, the size of the benefits depends on the degree of market integration between the domestic and the foreign markets.

In light of these presented arguments we, in the following paper, investigate the effects of foreign listings on volatility and liquidity of individual Swedish stocks, cross-listed in London and New York. In contrast to Gårdängen (2005), we follow the reasoning and the methodology of the previously mentioned Domowitz et al. (1998) study, which has an additional implication for our analysis. The purpose of our paper becomes not only to investigate the mentioned effects on volatility and liquidity, but also to, through these results, establish whether the Swedish and the U.K. and the U.S. markets are integrated or segmented.

1.3 Research question

From the discussion above, the following question arises: is there a significant change in volatility and liquidity, for Swedish stocks listed on the Stockholm Stock Exchange (SSE), after a cross-listing in London or New York.

1.4 Purpose

In this study we seek to examine whether Swedish firms on the SSE with a cross-listing in London or New York exhibit any differences in volatility and liquidity after the listing date. Based on this, we further make an inference regarding the presence of integration between these markets.

1.5 Delimitation

The following study examines a sample of 19 Swedish stocks, listed on the Stockholm Stock Exchange, with foreign listings on the London Stock Exchange, the New York Stock Exchange, NASDAQ and with issued ADRs in the United States. The examination period is between 1989 and 2004, and the core reason for this choice is the data availability.² In addition, this period of 15 years provides us with sufficient data in order to conduct the study, though it is not overly extensive.

1.6 Target Group

The target group of this paper is anyone taking interest in the world of finance and financial markets. Some basic knowledge of financial and econometrical relationships is however necessary.

² Both regarding the foreign listing date and the data on individual stocks.

2. Financial markets

2.1 Short facts about the Stock Exchanges

The main task of stock exchanges is to create liquidity for sellers and buyers. The exchange does not own the shares that are traded; instead it is only a place where buyers and sellers meet. Stock exchanges can either be order driven or quote driven. In an order driven market all of the orders of both buyers and sellers are available. In a quote driven market, only the bid and ask offers of market makers are available. One benefit of a quote driven market is the certain execution of trades, while there is no execution guarantee on an order driven market.³ To get an overall picture of the exchanges that are relevant for this study, a quick presentation is in order.

2.1.1 Stockholm stock exchange and the OMX

Stockholm stock exchange is, since 1998, owned by the OMX Group, which is a privately owned, profit-driven, electronic exchange. Since 2006, OMX includes three exchanges on the Nordic market – Stockholm, Copenhagen and Helsinki, and three Baltic exchanges – Tallinn, Riga and Vilnius. Stockholm Stock Exchange (SSE) is an order-driven continuous auction market with a computerized trading system – SAXESS. Only members of the SSE, who are primarily banks and stockbrokerage firms, have access to the system. Through the SAXESS, bids and offers are entered into the open order book, and trades are automatically executed when prices, volumes and other conditions are met. The SSE also offers an off-exchange registration process, where the counterparts agree terms over the phone.⁴

³ Investopedia (<http://www.investopedia.com/ask/answers/06/quoteorderdrivenmarket.asp>)

⁴ OMX (http://omxgroup.com/nordicexchange/omhandeln/handel/handla_aktier_elektroniskt/)

2.1.2 NASDAQ (The National Association of Securities Dealers Automated Quotations)

NASDAQ is an American electronic stock exchange, established in 1971 and at that time the first of its kind. Today it is the largest electronic equity market in the United States, listing approximately 3,300 companies and trading more shares, on average, than any other US market. The NASDAQ is a dealer's market, where the participants are buying and selling from a market maker over a network of computers and telephones.⁵

2.1.3 New York Stock Exchange

The New York Stock Exchange (NYSE) is the largest stock exchange in the world as regards volume in dollars and second largest by number of companies listed. The foundation of NYSE goes back to year 1792 when a couple of stock brokers signed the Buttonwood Agreement. The trade on NYSE is floor driven (order driven market) while the trade on many other exchanges is computer driven. The trade is done through specialists who act as auctioneers in an open auction market, bringing buyers and sellers together. Each specialist is responsible for a particular number of stocks. When exchange members, i.e. those that act on behalf of investors, want to trade they gather around one particular specialist who in turn will match the buyers and sellers and make the auction go through.⁶

2.1.4 American Stock Exchange

The American Stock exchange (AMEX) is, just like NYSE, an auction based exchange. This exchange has merged with NASDAQ and most of its trading is in small-cap stocks, exchange-traded funds and derivatives.⁷

⁵ Wikipedia homepage (<http://en.wikipedia.org/wiki/Nasdaq>)

⁶ NYSE homepage (<http://www.nyse.com/about/history/1022221392987.html>), Wikipedia homepage (http://en.wikipedia.org/wiki/New_York_Stock_Exchange)

⁷ Investopedia homepage (<http://www.investopedia.com/terms/a/amex.asp>)

2.1.5 London Stock Exchange

The London Stock Exchange (LSE), founded in 1801, is one of the oldest exchanges in the world, and the largest in Europe. It lists over 2,700 firms and consists of the Main Market, Alternative Investments Market (AIM) and EDX London (market for derivatives). LSE is a dealer's market using dealer quotes in order to establish fair trade prices. The Stock Exchange Automated Quotation (SEAQ) is one of the several computerized systems which provides the market with bid and ask quotes. The largest companies on the LSE are traded on the Stock Exchange Trading Service (SETS), which automatically matches buyers and sellers. Except for these quote-driven systems, LSE also has a hybrid system (SETSm), for market users that prefer trading both electronically and through a market making system.⁸

2.2 American Depositary Receipt (ADR)

American Depositary Receipt (ADR) is a negotiable instrument which facilitates for American investors to invest in securities of non U.S. companies and attain an international equity exposure. As regards the foreign issuers, ADRs help them to gain a broader global shareholder base and to raise capital from U.S. investors. These instruments also help foreign companies to improve communication with shareholders in the U.S. Investors that choose to invest in these instruments do not have to worry about the complex and expensive cross-border transactions that often occur in connection with foreign investment.

These instruments are considered to be the U.S. instruments; they follow the U.S. market regulation and are traded in U.S. dollars. When dividends are paid out on the underlying instrument, ADRs convert and pay out these in U.S. dollars. ADRs are issued by U.S. banks. Therefore one can say that U.S. banks function as depositary and issuing agents. For each ADR there is a specified number of or a fraction of local shares that back the ADR up, the so called ADR ratio. Through

⁸Wikipedia homepage (http://en.wikipedia.org/wiki/Alternative_Investments_Market), (http://en.wikipedia.org/wiki/London_Stock_Exchange), and London Stock Exchange homepage (<http://www.londonstockexchange.com/en-gb/about/cooverview/whatwedo/tradingservices.htm>)

this, one can set a price of ADRs which lies in the price range of the competitive U.S. shares.⁹

ADRs can be divided in unsponsored and sponsored ADR programs. Unsponsored are issued by the depositary bank, and the companies whose stocks are the underlying instrument are not involved in the issuance. Here investors are responsible for the cost of the depositary's services. In sponsored ADR programs, companies whose stocks are the underlying instruments are involved in the issuance. These shares possess all the rights of a common share, for example the voting rights. Sponsored ADRs can in turn be divided in Level I Over the counter, Level II Exchange listed, Level III Public offering and Rule 144A Private placement.

Level I is the most basic form compared to the three remaining sponsored ADRs and it is traded over the counter. Using this form of ADR the issuer does not have to adapt its accounting to U.S. Generally Accepted Accounting Principles (GAAP). These programs also have the lowest cost to enter a market and are simple to execute. On the other hand these programs have limited visibility in the U.S. since they are traded over the counter. Level II and III ADR's are listed on U.S. securities exchanges or quoted on NASDAQ. Thus, these ADRs are more visible on the U.S. market; they have a higher trading volume and thus higher liquidity potential compared to Level I ADRs. The issuer must in these cases fulfil the U.S. GAAP-rules. In the fourth program the issuer wants to raise capital in the U.S. private markets. This is done by issuing restricted securities or as it also is called, Rule 144A ADRs which are sold to qualified institutional buyers. Thus, these ADRs are not listed or publicly available and have a limited liquidity in U.S. In this case the ADRs do not have to fulfil the GAAP rules.¹⁰

⁹ (JPMorgan ADR Group, 2005)
http://www.adr.com/pdf/ADR_Reference_Guide.pdf#search=%22jp%20morgan%20adr%20group%2B%20adr%20reference%20guide%22

¹⁰ Bank of New York (http://www.adrbny.com/dr_edu_basics_and_benefits.jsp#l2dr)

3. Theory

3.1 Benefits of cross-border listings

With the intention of giving the reader a chance of better understanding cross-listing as a phenomenon, we present an article by Karolyi (1998), where the author surveys the literature on foreign listings. In his paper, nearly all researched aspects of cross-listing are incorporated, including the one examined in our thesis. The article concludes the following:

- ◆ The share price reacts positively to foreign listings in the first month after listing. The most evident results are observed for non-U.S. firms listing in the U.S., which on average, exhibit an annualized 12% return in the first week;
- ◆ The price performance up to one year following the listing varies between different firms due to the home and the foreign market, the capitalization degree, capital-raising needs and other company specific factors;
- ◆ The post-listing trading volume increases on average, and in most cases, the trading volume on the domestic market also increases, which leads to a significant decrease in domestic market spreads. The main reason behind these effects is the competition from the new market;
- ◆ Share liquidity improves overall; however, this depends on the increase in total trading volume, where the foreign-listing occurs, and the degree of foreign ownership restrictions in the home market;
- ◆ The domestic market risk of the listed shares significantly reduces. There is instead a slight increase in the exposure to global market risk and foreign exchange risk. These factors result in a net reduction in the cost of equity capital of 114 basis points on average;

- ◆ Surveys show that managerial reasons behind the corporate cross-listing decision are primarily benefits of an expanded shareholder base, increased liquidity and potentially lower cost of capital;
- ◆ American Depositary Receipts serve as an effective means of diversifying globally;
- ◆ Rigid disclosure requirements impose the largest barrier to cross-border listings.

3.2 Volatility

Volatility can be defined as the degree to which the price of a security, commodity or market rises or falls within a short-term period. It is the amount of uncertainty or risk about the size of changes in a security's value. Therefore, the higher the volatility the riskier is the security. One can also say that high volatility means that one predicts the price of a security to vary in a larger interval of values compared to securities with low volatility.¹¹

Volatility in stock prices can be caused by different factors, such as arbitrage, technology improvement and an increasing number of financial instruments. Due to arbitrage, prices adjust more quickly to the information in the market, and thus cause volatility in securities. Improvement in the technology enhances the distribution of information, which in turn makes it possible for the markets to react quicker to both negative and positive news. The increasing number of financial instruments gives the investors an opportunity to move their money between more kinds of investment positions.¹²

Measuring volatility can for example be done with standard deviation and implied volatility. When performing this study we use variance (squared standard deviation) as a measure on volatility. But instead of calculating variance in the traditional way¹³ we use squared price changes as a proxy for the same. This lies in line with the study performed by Domowitz et al. (1998) and the one performed by Bayar and Önder (2005). Domowitz states that “when the number of traders is

¹¹ <http://www.investopedia.com/terms/v/volatility.asp>

¹² http://www.uwsp.edu/business/cwerb/3rdQtr00/SpecialReportQtr3_00.htm

¹³ http://www.uwsp.edu/business/cwerb/3rdQtr00/SpecialReportQtr3_00.htm

large, the cumulative price movements are approximately normal and the expected absolute daily price change is proportional to the standard deviation of daily price changes”.

3.3 Liquidity

In the world of finance, liquidity is an important concept. Liquidity is the degree to which an asset or security can be bought or sold in the market without affecting the asset's price. Further, it also can be described as the ability to convert an asset into money quickly.¹⁴

In the academic literature, liquidity is defined in several different ways. Coppejans et al. (2000) study liquidity dynamics using Swedish stock index futures contracts. In their paper liquidity is characterized by depth of market at different ticks away from the quote midpoint. The price of liquidity, or illiquidity of an asset, can also be measured through the size of the bid-ask spread, which seems to be the case in many studies (see for example Tinic and West, 1974; Kyle, 1985; Noronha et al., 1996; Gårdängen, 2005). The bid-ask spread involves three cost components, namely order processing, inventory and information asymmetry components (Stoll, 1989; Huang & Stoll, 1997). The extent of these costs, and thus the degree of illiquidity, is very much affected by the market structure, i.e. whether the market is order-driven or quote-driven. In quote-driven markets, the investor pays the bid-ask spread to the market maker or specialist. In purely order-driven markets, buyers and sellers deal directly with one another (Gårdängen, 2005), which ultimately might narrow spreads.

Another way of measuring liquidity is through trading volume, as performed by Admati and Pfleiderer (1988); Domowitz et al. (1998) and Bayar and Önder (2005). In these articles, liquidity is measured by the degree of sensitivity of price variability to volume. When this sensitivity increases, there is a reduction in liquidity and vice versa. Based on the findings of e.g. Demsetz (1968), Benston and Hagerman (1974) and Tinic (1972), Conroy et al. (1990) argue that it is empirically motivated to use volume as a measure of liquidity, because of the negative relationship between volume and spread.

¹⁴ Investopedia homepage (<http://www.investopedia.com/terms/l/liquidity.asp>)

3.4 Market integration

National markets are more and more becoming a part of a global equity market. (Oxelheim, 2001; Errunza & Miller, 2003; Foerster & Karolyi, 1998). Although, one can say that markets are not completely integrated. According to Oxelheim (2001), perfect market integration is characterized by the lack of cross-border barriers to equity activities, lack of internal barriers of distorting tax incentives and lack of cross-border information asymmetries. If markets were completely integrated this would mean that a dual listing on a foreign market would not have a significant effect on the price of share (Alexander et. al., 1988). Many studies have been made concerning market integration and according to Oxelheim (2001) many of these have a starting-point in the Law of One Price theory, which states that if two or more markets are integrated then identical securities should be priced identically in these markets.

If markets are segmented this means there are several barriers, such as ownership restrictions, different tax regimes and information asymmetry for foreign investors, which create restrictions to capital flow between domestic and foreign markets. Investors in different markets face different opportunity sets for investment in domestic and foreign securities (Alexander et al. 1988), which in turn affects the pricing of securities. This argumentation is also supported by Foerster & Karolyi (1993), who state that when markets are segmented the expected return on securities in the domestic market will differ from that of securities in the foreign market with comparable risk.

Segmentation of capital markets forces firms to search for different alternatives to reduce the negative effects associated with segmentation. One of these alternatives is cross-listing of stocks that allow foreign investors to trade the stock in their own currency. Thus foreign investors avoid transaction costs and any existing foreign exchange regulations that usually appear when trading in a foreign currency. If the firm is required to disclose more information or if security analysts produce more information in connection with the cross-listing, this introduction can in turn lead to a decrease in information costs (Alexander et. al., 1988).

3.5 Key articles

In the following we are in more detail explaining three articles, which we consider relevant for our study. These articles provide us with additional information concerning market integration - segmentation, but also with the theoretical implications that they are build on. The first article described here is also the one providing the basis for our paper.

3.5.1 Domowitz, Glen & Madhavan (1998)

In their study from 1998, Domowitz et al. develop a theoretical model in order to examine the liquidity and the volatility of 25 Mexican stocks, cross-listed in the United States. The study focuses on the importance of costly intermarket information linkages, or transparency, when determining the impact of cross-listing on spread and volatility.

The theoretical model developed in this study rests on the hypothesis that cross-listing has a positive effect on domestic market liquidity if the intermarket price information is freely available at all times. This is due to the fact that when incorporation of information into prices is fast on the foreign market, foreign investors start to trade, which in turn leads to an increase in the total number of traders and a decline in spreads. The model thus implicitly suggests that the post foreign listing spread is negatively related to the frequency of trading, which increases with new trader arrivals. Further, they claim that an entry of new investors is likely to reduce volatility. Thus, perfect information linkages between markets, along with new investor entry following a cross-listing, yield improvements in both of these mentioned measures of market quality, in both the foreign and domestic markets. In contrast, if the markets are not integrated, they are not informationally linked and cross-listing results in the opposite effect i.e. decreased liquidity and increased volatility on the domestic market. In this market situation, cross-listing results in a migration of investors away from the domestic market since the investors face higher cost of entering the domestic market after the foreign listing, as opposed to the costs prior to the listing. This suggests that

the trading volume in the domestic market decreases, leading to an increase in spreads. In addition trader migration increases the volatility. The model also considers a situation where markets can neither be described as integrated nor fragmented. Rather, the imperfect information flows on the market lead to a partial fragmentation state, where the effects of cross-listing are concentrated in some parts of the market. This situation can occur for example due to ownership restrictions in the domestic equity market.

This theoretical model is tested through a set of time series regressions, where the authors test each firms' liquidity and volatility separately. Two components of volatility are tested, base-level volatility and transitory volatility. The first captures the volatility over time, induced by imperfect public information. The second component captures the sensitivity of current volatility to past volatility shocks. The methodology of this study is discussed in Chapter 4.

The results of the Domowitz et al. (1998) study show that the impact of cross-listing is complex and do not provide the authors with unambiguous conclusions. Instead, the results show signs of both costs in forms of order flow fragmentation and benefits relating to increased intermarket competition. In the series open to foreign ownership, liquidity tends to decrease and price volatility increases, which is consistent with the migration of foreign investors. However, the overall conclusion of the study is that the U.S. and Mexican markets are not found to be fully integrated.

3.5.2 Bayar and Önder (2005)

Bayar and Önder (2005) examine the volatility and liquidity of French stocks before and after cross-listing on the German Stock Exchange, Xetra. The study also involves testing the integration of the Paris Bourse and the Xetra and identification of how trading and non-trading hour volatility is affected by cross-listing. The study is based on French stocks since there are more French companies listing on the German market compared to the number of German companies listing on the French market. This decision is also based on a research made by Pagano et al. (2001) which states that European companies prefer to cross-list on more liquid and larger markets and on markets with more investor

protection and more efficient legal systems. Since there are many other factors besides cross-listing that can affect volatility and liquidity of stocks several restrictions are made in order to adjust for these. For example, in order to eliminate the effect of cross-listing on other stock markets, the stocks that are listed on other markets within a range of 100 days before and 50 days after cross-listing are excluded from the sample. Also stocks that have paid out dividends within 5 days before and 10 days after their cross-listing are excluded. The reason behind this is that investors tend to reinvest their dividend income in the stock. The results show there is an increase in volatility in many stocks during trading and non-trading hours after cross-listing. Also when controlling for the impact of market volatility, the results show an increase in volatility after cross-listing. Finally the stocks liquidity is found to decline for many stocks, which implies that investors tend to migrate to the Xetra after the cross-listing. Based on these results, the authors draw the conclusion that there is a lack of integration between the French and the German capital markets.

3.5.3 Werner and Kleidon (1996)

The article written by Werner & Kleidon (1996) examines the intraday patterns of U.K. and U.S. trading of British cross-listed stocks. They study volatility, volume and spreads of these stocks in order to find out if trading in multiple markets significantly affects information flow, trading patterns and dealer competition respectively. The results are then compared with analysis of domestic stocks.

The authors argue that there are several reasons why trading of cross-listed British stocks on the London and New York market have the potential of being integrated but also why these markets might not be integrated. The fact that both London and New York are open trading markets with complete access for foreign investors and that there are no regulatory constraints preventing cross-border arbitrage in cross-listed stocks, provide some reasons why these markets should be seen as integrated. Further reasons are that British cross-listed stocks are liquid in both London and New York trading and that dealers in these stocks potentially face cross-Atlantic competition for order flow since the cross-listed stocks are traded simultaneously on both markets for 2 hours each day. On the contrary,

since the British cross-listed stocks are traded through American Depositary Receipts in the U.S., the two securities might not be perfect substitutes for all investors. Thus there is a reason to believe that these markets are not fully integrated after all. Also, the costs associated with cross-border arbitrage, strengthens this argumentation.

In their article ordinary least square regressions are used to analyze the intraday patterns. The models used are expressing intraday patterns as deviations from a benchmark level and are corrected for firm-specific effects. The authors find that British cross-listed stocks and non-cross-listed stocks have similar intraday patterns. The shorter non-trading period, which is due to the fact that British stocks continue to trade in New York after the closing in London, does not affect the intraday pattern. Also the intraday pattern of British ADRs is not affected by the fact that the stocks have been trading in London before the trading in New York has opened. Apart from this the authors also find an increase in trading volume during the two hours that stocks are traded on both markets. They find that the largest amount of the total daily volatility and trading volume of cross-listed stocks occurs during these two overlapping hours. Further they state that morning volatility from New York spills over to the London market. However, London dealers do not raise their spreads; instead spreads in London are lower for cross-listed stocks compared to that of non-cross-listed, during the overlap of trading. Finally the spreads of ADRs are similar to those of other NYSE/AMEX-listed stocks. On the whole one can say that the order flow for British securities, cross-listed on the U.S. capital market, is segmented.

4. Research Method

4.1 Method

Earlier studies concerning the impact of cross-listing on the value of a company have mainly focused on movements in stock prices. In our study we use a quantitative approach in order to examine the fluctuations in volatility and liquidity of Swedish stocks during a certain time period before and after cross-listing on the U.S. and U.K. markets. The methodology part is mainly based on the article by Domowitz et al. (1998).

4.2 Data collection

Performing our study we start by collecting the relevant literature. The literature consists mainly of published articles received from the electronic database of Lund University (ELIN). One other important source is Internet research. In order to maintain the reliability of the research we only use reliable internet sources such as the homepages for respective Stock Exchanges and Investopedia, the online financial dictionary.

The information regarding which Swedish companies that have cross-listed during the chosen examination period we receive from several different sources. For the years 1989 to 2000, the information is gathered from the Stockholm Stock Exchange Fact Book (1990 to 2001). For the remaining time period, years 2001 to 2004, there where no such compiled information available, which forces us to look for alternative ways of collecting this particular information. We start by looking at Dagens Industri homepage¹⁵ in order to find out which Swedish

¹⁵ Dagens Industri, Stock Watch (www.dagensindustri.se/stockwatch)

companies that are listed on the Stockholm Stock Exchange. Continuing, we search on the homepages and in annual reports of respective firm to discover whether these are cross-listed on NYSE, NASDAQ or LSE. Thus, for period 2001-2004 there is a potential risk that we have missed some firms that are relevant for our study. It is possible that some firms have been introduced on the Swedish market and also on one of the two foreign markets in question and later delisted from both of these markets during years 2001 to 2004. Such firms are rather impossible for us to trace, and thus a risk of survival bias appears. However, to reduce this risk we in addition turn to the homepage of The Bank of New York for current and terminated Swedish ADRs in the U.S.¹⁶

Information on listing dates for the companies in question is received from their homepages, annual reports and The Bank of New York's previously mentioned homepage. Daily closing prices and daily trading volumes for respective firm is gathered from the financial database SixTrust.

4.3 The sample

As mentioned above, the examination period of this study is year 1989 to 2004, meaning that in order for a firm to be included in our sample the introduction on the U.K. or the U.S. market has to occur during this time period. The main reason for choosing this time period is the availability of data. Going even further back in time would make it very hard for us to gather the information that is needed in order to perform this study. Considering all this, we end up with a sample of 19 Swedish companies that for the first time have cross-listed in U.S. or U.K. during the examined time period. Thus, we only consider when the first foreign listing occurs, i.e. the firms do not have to be cross-listed on both markets at the same time in order to be included. The reason for this is that both the U.S. and the U.K. markets are large markets, and the effects of listing on both are not considerably more beneficial than listing on only one of these markets.

¹⁶ Bank of New York homepage (http://www.adrbny.com/dr_directory.jsp) and http://www.adrbny.com/terminated_dr_directory.jsp

In order to perform the regressions for each of the 19 firms in our sample we collect daily stock prices and daily trading volume for each of these. For all except two of the firms we use ± 250 days starting from the cross-listing date. This period is consistent with the examination period of Bayar & Önder (2005). For the two remaining companies, TeliaSonera and Securitas, which have been introduced both on the home and the foreign market in a range of less than 250 days, we incorporate a shorter time period. For these two firms we use the number of days that we have data for prior to the cross-listing and 250 days following the listing, as in the previous cases. Thus, the smallest number of daily observations used in our study is -171 for TeliaSonera and -180 for Securitas. By using a minimum of -171 to a maximum of +250 daily observations we manage to capture both the short term and the long term effects of cross-listing. We select a maximum of ± 250 daily observations since having a longer time period can lead to a higher risk of including effects that are not connected to the cross-listing. Table (1) below provides an overview of the firms included in our sample.

Table 1 – Overview of companies in the sample

Company name	Listing date	Foreign Listing	Sample period
Atlas Copco	1990-12-10	London	± 250 days
Avesta Sheffield	1994-03-18	London	± 250 days
Billerud	2003-01-07	ADR	± 250 days
Föreningsparbanken	1998-02-02	ADR	± 250 days
Handelsbanken	1994-03-29	London	± 250 days
Hennes & Mauritz	1991-05-14	London	± 250 days
Investor	1992-06-02	London	± 250 days
Kinnevik	2000-03-15	Nasdaq	± 250 days
Lundin Oil	1998-01-21	Nasdaq	± 250 days
MoDo	1994-09-29	London	± 250 days
Pharmacia (Procordia)	1991-05-16	London	± 250 days
Pricer	1998-03-01	ADR	± 250 days
SE Banken	1993-08-24	London	± 250 days
Securitas	1992-03-26	London	-180/+250 days
Skandia	1990-10-04	London	± 250 days
Stora	1989-11-07	London	± 250 days
TeliaSonera	2002-12-09	Nasdaq	± 250 days
Tele2	1997-01-22	Nasdaq	-171/+250 days
Trelleborg	1994-12-30	London	± 250 days

4.4 The model

In order to answer the research question of this thesis we, as mentioned, adopt the methodology of Domowitz et al. (1998) study. A model similar to this is also utilised in the previously mentioned Bayar & Önder (2005) study.

During the course of our research, we find that many studies, referring to the issue of volatility and liquidity following a cross border listing, define their model in accordance to the Domowitz et al. (1998) study (e.g. Bayar and Önder, 2005; Admati and Pfleiderer, 1988; Werner and Kleidon, 1996; amongst others). Here, volatility is measured as the square of the price change and liquidity is measured through the use of daily trading volume. Werner and Kleidon (1996) state that a number of empirical findings (e.g. Amihud and Mendelson, 1987; Biais, 1993; Easley et al., 1996; Ho and Stoll, 1981 etc.) demonstrate that more liquid stocks are associated with lower volatility and lower spreads. As we mention in section 3.2, trading volume and spread also exhibit a negative relationship. This implicitly suggests that liquidity and trading volume (per se) have a positive relationship. Given these facts, in addition to the discussion throughout Chapter 1 and 3, we believe that it is highly motivated to examine the effects of cross-listing on both volatility and liquidity jointly.

4.4.1 Descriptive statistics

In order to examine the change in volatility and liquidity separately we perform descriptive statistics for every company and on each of the mentioned variables individually. Here, we calculate the mean value and standard deviation for volatility before and after the cross-listing respectively, for all of the 19 companies. The calculation is based on squared daily price changes before and after cross-listing (± 171 to ± 250 days). In order to see whether the change in volatility is significant we run a paired Student's t-test for each company. The paired Student's t-test is a statistic for measuring the significance in the average difference of paired values.¹⁷ As concerns the change in liquidity we use daily

¹⁷ (<http://www.ruf.rice.edu/~bioslabs/tools/stats/pairedttest.html>)

trading volume before and after the cross-listing for the calculation of descriptive statistics. Thus our null-hypothesis and the alternative hypothesis for the t-test are:

H₀: There is no significant change in volatility before and after cross-listing.

H₁: There is a significant change in volatility before and after cross-listing.

H₀: There is no significant change in liquidity before and after cross-listing.

H₁: There is a significant change in liquidity before and after cross-listing.

The descriptive statistics approach is based on the research by Bayar and Önder (2005). In their article, the authors test all the stocks in the sample simultaneously to examine whether there is any significant change in volatility and liquidity subsequent to the cross border listing. Our study differs from Bayar and Önder (2005) in the sense that we choose to examine volatility and liquidity for each stock separately. The reason behind this choice is that we believe there is a risk that much of the relevant information can be lost by performing the paired t-test on the mean values of volatility and liquidity for all firms simultaneously.

In the analysis, we further compare the results of this approach with the results of the time-series regressions (performed on each stock individually). In that way, we hope to gain more solid conclusions about the research question.

4.4.2 Multivariate analysis

The aim of this analysis is to simultaneously examine the changes in volatility and liquidity caused by the cross-listing of stocks, according to the Domowitz et al. (1998) model. Equation (1) is performed individually on all 19 stocks in the sample using the OLS estimation technique, in contrast to Domowitz et al. (1998) Generalized Method of Moments technique. The obtained estimated models are subsequently tested to establish whether they hold for the underlying OLS

assumptions. If detected, standard errors are corrected for heteroskedasticity and autocorrelation (Newey & West, 1987). There is also a possibility that some of the errors are not normally distributed; however given the large sample size, a violation of the normality assumption is nearly insignificant (Brooks, 2002, p. 182).

When specifying the time-series regressions, we divide the volatility into two components: (i) base-level volatility arising from imperfect public information, and (ii) transitory volatility arising from trading frictions and information asymmetry. Hence, it is a product of trading volume during the day and it is inversely related to market liquidity. This reasoning is based on Domowitz et al., (1998). The reason for including both (i) and (ii) is that both are a reflection of stock price movements. The squared price change $(\Delta P_t)^2$ is used to proxy for the price variance in the model. Thus, the estimated model looks as follows:

$$(\Delta P_t)^2 = \gamma_0 + \gamma_1 D_t + \delta_0 (\Delta P_{t-1})^2 + \delta_1 (\Delta P_{t-1})^2 D_t + \lambda_0 V_t + \lambda_1 V_t D_t + \varepsilon_t \quad (1)$$

where P denotes the closing price of the stock on day t in Swedish Krona, V_t is the trading volume on day t , D_t is a dummy variable assuming the value of 1 after the cross-listing date, and 0 otherwise, and ε is the error term. The coefficients γ_0 and γ_1 represent the base-level volatility and the change in base-level volatility after the cross-listing respectively, δ_0 represents the transitory volatility, i.e. the effect of the previous day's volatility on today's volatility and δ_1 represents this effect following the cross-listing. The coefficients λ_0 and λ_1 denote the inverse of market liquidity prior and subsequent to the cross-listing.¹⁸ In other words, these last coefficients measure the sensitivity of price to volume, i.e. the liquidity of the stock.

When interpreting the results from the regressions, in order to determine whether there is a significant change in volatility and liquidity after the cross-listing, we set up the following null-hypotheses and alternative hypothesis:

H_0 : There is no significant change in volatility before and after cross-listing.

¹⁸ For explanation on this relationship, see section 3.3

H₁: There is a significant change in volatility before and after cross-listing.

H₀: There is no significant change in liquidity before and after cross-listing.

H₁: There is a significant change in liquidity before and after cross-listing.

Provided that market integration holds, cross-listing increases the information flow, leading to a decline in price volatility and an increase in market liquidity. Hence the coefficients γ_1 and λ_1 are both expected to be negative. If instead the market is fragmented, resulting in higher volatility and decreased liquidity, the opposite case is expected, i.e. γ_1 and λ_1 are positive. Since price volatility today is affected by past volatility, δ_0 is expected to be positive. As we describe in Chapter 3, Domowitz et al (1998) additionally investigate a third state, namely the partial fragmentation state. We do not consider this form in this thesis, since we assume that all Swedish equities are equally open to foreign ownership, without ownership restrictions.

4.5 Practical implications

When specifying a model as $Y=\alpha+\beta X+\varepsilon$ we implicitly assume that X causes Y. Looking at equation (1) we can see that $\gamma_1 D_t$ is a function of closing stock prices. Thus in this regression there is also a chance for reversed causation to appear. By ignoring this simultaneity there is a chance that our estimates become somewhat biased and inconsistent (Ramanathan, 2002, p. 113).

The results of our regressions, performed on each company separately, might show relatively low adjusted R-squared values, which can be seen as a weakness of the model. Since the aim of this study is not to identify all the variables that have an impact on volatility we should be careful with the interpretation of the low R-squared values. The aim of this study is as we already have mentioned only

to see what effects cross-listing has on volatility and liquidity. Thus in our study we are excluding all other variables that could have an impact on volatility.

According to the theory of econometrics, when testing the hypothesis in a study there is a risk for appearance of type I and type II errors (Brooks, 2002, p.78).¹⁹ There is always a direct trade-off between these two, when choosing a significance level. This means when decreasing the size of the test (e.g. from a 5% test to a 1% test) one reduces the chance of appearance of type I error and increases the chance for type II error and vice a verse. In order to reduce the chance of both these errors we choose to have a relatively large sample size, (i.e. min -250 days to max +250 days counting from the day of introduction on the foreign market).

As already mentioned above, survivorship bias, i.e. the tendency for failed companies to be excluded from the study, can also affect the reliability of our study. There is a risk that we have missed some companies, which have delisted their shares from the foreign market, since these are hard to trace. We are also aware of that there is a possibility that the sources from which we collect our data are not a 100% reliable. In order to eliminate the effect of these inaccuracies we are collecting our information from several sources and comparing the information.

The obstacles mentioned above often arise in econometric models and are hard to completely eliminate. This in turn affects the reliability of our results and forces us to interpret the results with some caution.

¹⁹ Type I error is the possibility to reject H₀ when it was really true and type II error is the possibility to not reject H₀ when it was in fact false

5. Empirical results and analysis

5.1 Introduction

Following the Domowitz et al. (1998) study we, in this paper, examine the effects of cross border listings on volatility and liquidity of individual Swedish stocks, listed on the SSE. More specifically, the paper investigates how listing Swedish stocks on the LSE, NYSE and NASDAQ effects their volatility and liquidity on the domestic market.

A theoretical model developed by Domowitz et al. (1998) is adopted in our investigation, and it highlights the importance of intermarket information linkages. Specifically, if intermarket price information is freely available, cross-listing results in an improvement in market quality. With transparency, trading increases and narrows spreads, which in turn increases liquidity in both markets. This state is defined as perfect market integration. In the opposite case, where intermarket information linkages are poor, cross-listing reduces liquidity and increases volatility. Thus, market quality worsens, inducing a state of market fragmentation. As we present in section 3.5, market integration can be viewed from other perspectives than that of Domowitz et al. (1998), which we also bring up in the analysis.

Analysis of the model (equation (1)), described in section 4.4.2, which simultaneously measures both pre and after volatility and liquidity of Swedish cross-listed stocks, is presented below. Since we are interested in establishing whether there is a significant change in the two variables subsequent to the listing, we use dummy variables to separate the before and after measures of volatility and liquidity, so that we can easily extract results for both of these states. The results of the coefficients, from the regressions, take into account all independent variables in the specified model, which is why it is hard to say anything about the

change in one single variable alone. Thus, to test the two variables in isolation, and distinguish whether there is a significant change in their measures after the cross-listing for each individual firm, we use the paired Student's t-test. We also present descriptive statistics for each variable.

5.2 Descriptive statistics

Descriptive statistics, along with the results from the t-test for volatility and liquidity measures are presented in Table 2 and 3. Starting with the before and after mean values of the volatility measure, it is found that volatility is lower in 10 cases out of 19 in the post listing period. However, as can be seen from Table 2, only 6 of these are statistically significant. Considering that 12 firms in total exhibit significant change in volatility after the cross-listing, we are left with 6 cases of increasing volatility that are statistically significant. Based on these results, we cannot, with any certainty, conclude that volatility is significantly decreasing for Swedish cross-listed stocks in general. Even though the mean values exhibit more cases of decreases than increases for individual stocks subsequent to the listing, they are not statistically meaningful. Thus, according to the t-tests, Swedish stocks listed in London or New York, generally exhibit both increases and decreases in volatility following the international listing, providing us with somewhat ambiguous answers.

Table 2 –Descriptive statistics of measure of volatility before and after cross-listing

Company name	Mean Volatility prior	Standard deviation	Mean Volatility after	Standard deviation	t-statistics probability
Atlas Copco	0,0006	0,0011	0,0005	0,0011	0,2345
Avesta	0,0007	0,0013	0,0003	0,0005	0,0000***
Billerud	0,0005	0,0007	0,0003	0,0005	0,0018***
FSB	0,0006	0,0017	0,0007	0,0011	0,2996
HB	0,0029	0,0295	-0,0011	0,0212	0,1067
H&M	0,0004	0,0014	0,0003	0,0016	0,4474
Investor	0,0004	0,0007	0,0011	0,0037	0,0017***
Kinnevik	0,0008	0,0018	0,0010	0,0019	0,1500
Lundin Oil	0,0009	0,0026	0,0017	0,0040	0,0121**
Modo	0,0004	0,0008	0,0002	0,0004	0,0016***
Pharmacia	0,0005	0,0013	0,0003	0,0007	0,0131**
Pricer	0,0013	0,0047	0,0059	0,0180	0,0001***
SEB	0,0064	0,0164	0,0006	0,0010	0,0000***
Securitas	0,0002	0,0006	0,0003	0,0007	0,0984*
Skandia	0,0003	0,0007	0,0005	0,0012	0,0410**

Stora	0,0002	0,0008	0,0006	0,0013	0,0005***
Tele2	0,0004	0,0008	0,0005	0,0012	0,8468
TeliaSonera	0,0014	0,0032	0,0006	0,0012	0,0004***
Trelleborg	0,0004	0,0006	0,0004	0,0006	0,3044

Note: ***,** and * indicate significance at the 1%, 5% and 10% levels respectively

Going over to Table 3 and the results of the measure of liquidity, we observe quite different results, than the previous. Here, we observe that volume increases in 15 out of 19 cases following the listing, 13 of these being statistically significant. The remaining 4 cases demonstrate a decrease in volume, only two of these being significant. According to the discussion in section 3.3 and 4.4 on the relationship between volume and liquidity, we can thus say that, in general, liquidity increases for Swedish stocks after the listing in London or New York. The results on liquidity are consistent with Gårdängen (2005) study, which examines the same domestic and foreign markets as this paper.

Table 3 –Descriptive statistics of measure of liquidity before and after cross-listing

Company name	Mean Volume prior	Standard deviation	Mean Volume after	Standard deviation	t-statistics probability
Atlas Copco	153569	386769	513026	772226	0,0000***
Avesta	232276	262067	469301	952773	0,0002***
Billerud	309979	362263	275608	243820	0,2135
FSB	759721	621727	1047803	634741	0,0000***
HB	130582	129576	131929	245374	0,9359
H&M	222814	657582	930964	1637033	0,0000***
Investor	224039	366953	843537	762416	0,0000***
Kinnevik	68087	126588	21617	31794	0,0000***
Lundin Oil	147176	211141	316022	252133	0,0000***
Modo	193415	181479	326198	277016	0,0000***
Pharmacia	16933	26088	35169	56128	0,0000***
Pricer	359793	691980	551638	780617	0,0000***
SEB	2177757	2791629	1760706	1057431	0,0385**
Securitas	22871	51588	215458	253948	0,0000***
Skandia	336808	409778	495626	436491	0,0000***
Stora	61145	117475	49713	70123	0,1897
Tele2	1112057	1061704	1208026	1099526	0,4064
TeliaSonera	6770461	5391903	10662026	6576980	0,0000***
Trelleborg	578409	317513	691958	518250	0,0000***

Note: ***,** and * indicate significance at the 1%, 5% and 10% levels respectively

5.3 The model

After looking at the descriptive statistics, we now turn to the results and analysis of equation (1). As described in Chapter 4, we perform time-series regressions on each of the 19 examined stocks individually, in order to establish whether any changes in volatility and liquidity occur following a cross border listing.

Before proceeding with the interpretation, the regressions are tested for the underlying OLS assumptions. In some cases heteroskedasticity and autocorrelation are detected, which we correct for by using the Newey-West adjustment. The adjusted R^2 values are low for majority of the nineteen regressions. This implies that the included independent variables are not sufficient to explain the variation in the dependent variable. However, the purpose of this study is not to capture all relevant variables that explain the dependent variable, i.e. volatility. Instead we seek to investigate two predetermined variables and capture the change in volatility and liquidity in association with cross border listings. Therefore, other important variables that explain volatility might be omitted.

Returning to the Domowitz et al (1998) theory, cross-listing should decrease volatility and increase liquidity if market integration holds. Thus, the coefficients γ_1 and λ_1 , from the regressions, are both expected to be negative. This state would suggest some inflow of trading to the Stockholm Stock Exchange (SSE). In the opposite case, a migration of order flow from the SSE to the foreign market is likely. The coefficients are expected to be positive, further implying that the markets in question are fragmented.

Looking at our results from the regressions (table (4)), we find that the coefficients on base-level volatility (γ_0) are positive for all companies and show a high statistical significance in all cases but one. Further, the coefficients on volume (λ_0) are positive for eighteen companies, implying that trading increases volatility. Ten of these are statistically significant. The fact that both γ_0 and λ_0 are positive provides support for the definition of the theoretical model, meaning that volatility and liquidity are exhibiting a negative relationship, as confirmed by previous studies (e.g. Amihud and Mendelson, 1987; Biais, 1993; Easley et al., 1995; Ho and Stoll, 1981 etc.).²⁰ The coefficients for transitory volatility (δ_0),

²⁰ For explanation on the coefficients, see section 4.5.2

which represent the impact of past volatility on the current volatility, are positive in sixteen cases. This lies in line with the expectations for this coefficient, since current price volatility is affected by past volatility (Domowitz et al, 1998). Eight of these are significant.

Further support for the model is provided by coefficients γ_1 and λ_1 . Both of these are negative, meaning that volatility and liquidity move in opposite direction from each other. In particular, for the base-level volatility coefficients before and after cross listing, we receive mean values of 0,085 and -0,020 respectively (i.e. for coefficients γ_0 and γ_1). This implies an average decrease in base-level volatility after cross listing. More specifically, eleven of the nineteen studied companies exhibit a decrease in base-level volatility after listing in London or New York, however, only eight of these being significant. This decrease can be explained by freely available information or transparency between the markets.

Table 4 – Results of the time-series regressions (in percent)

Firm	γ_0	γ_1	δ_0	δ_1	λ_0	λ_1
Atlas	0.054 (0.008)***	-0.011 (0.011)	13.889 (6.546)**	-8.992 (9.251)	-0.001 (0.004)	0.003 (0.006)
Avesta	0.067 (0.008)***	-0.035 (0.009)***	9.993 (7.089)	-2.303 (11.172)	0.026 (0.010)**	-0.012 (0.011)
Billerud	0.050 (0.005)***	-0.014 (0.007)**	5.763 (5.616)	-9.036 (9.286)	0.010 (0.005)**	0.030 (0.007)
Förenings- Sparbanken H&M	0.052 (0.007)***	0.011 (0.011)	-5.326 (7.087)	17.703 (9.119)**	0.015 (0.010)	0.015 (0.015)
Investor	0.063 (0.022)***	-0.031 (0.026)	-0.190 (7.240)	3.973 (8.011)	0.001 (0.002)	-0.002 (0.002)
Kinnevik	0.032 (0.006)***	0.047 (0.020)**	13.993 (13.251)	6.030 (23.791)	0.000 (0.001)	0.016 (0.025)
Lundin Oil	0.056 (0.010)***	0.015 (0.015)	27.531 (14.040)**	1.673 (18.345)	0.011 (0.009)	-0.012 (0.012)
Modo	0.079 (0.018)***	0.053 (0.034)	11.518 (9.985)	10.130 (12.376)	0.166 (0.065)**	-0.019 (0.081)
Pricer	0.034 (0.006)***	-0.015 (0.006)**	14.375 (6.306)**	1.001 (9.576)	0.011 (0.006)*	-0.000 (0.007)
Stora	0.095 (0.026)***	0.422 (0.132)***	26.462 (10.223)***	-13.129 (12.862)	0.078 (0.048)	0.876 (0.306)***
Pharmacia	0.021 (0.006)***	0.023 (0.012)*	-0.842 (1.248)	27.871 (12.514)**	0.005 (0.004)	0.002 (0.005)
SEB	0.051 (0.007)***	-0.021 (0.010)**	0.854 (4.931)	7.565 (10.522)	0.004 (0.003)	0.002 (0.006)
Skandia	0.444 (0.104)***	-0.390 (0.104)***	30.276 (7.153)***	-18.472 (12.289)	0.745 (0.225)***	-0.718 (0.225)***
Handels- banken Securitas	0.033 (0.007)***	0.016 (0.010)	7.560 (8.683)	0.383 (10.206)	0.001 (0.006)	0.009 (0.009)
Tele2	0.279 (0.188)	-0.388 (0.232)*	6.584 (6.658)	-9.154 (9.467)	0.466 (0.179)***	-0.409 (0.224)*
TeliaSonera	0.030 (0.008)***	0.000 (0.009)	19.567 (10.640)*	-7.310 (12.642)	0.018 (0.009)*	-0.014 (0.009)
Trelleborg	0.035 (0.006)***	-0.006 (0.007)	6.702 (3.978)*	14.202 (9.493)	0.038 (0.012)***	-0.010 (0.014)
	0.095 (0.016)***	-0.049 (0.017)***	30.314 (10.332)***	-7.700 (14.496)	0.138 (0.046)***	-0.053 (0.051)
	0.038 (0.004)***	-0.011 (0.006)*	9.310 (5.463)*	16.000 (11.137)	0.024 (0.008)***	0.003 (0.012)

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively

The corresponding mean values for volume coefficients λ_0 and λ_1 are 0,092 and -0,015 respectively, implying a decrease in price sensitivity to volume after cross listing. When price is less sensitive to trading volume, liquidity of the stock increases.²¹ Looking at individual stocks, we observe 10 exhibiting an increase in liquidity following the cross-listing; however, only two of these are statistically significant. The fact that volatility and liquidity are found to have a negative relationship in the specified model is consistent with previous research, discussed above. However, the lack of a sufficient number of statistically significant coefficients prohibits us from making inferences about market integration in general. Thus, we cannot, with statistical meaning state whether the Swedish stock market is integrated with the London and New York stock markets, according to the Domowitz et al. (1998) theory. These results are consistent with Bayar and Önder (2005) results for the French and German market, before adjusting their initial model by including several other variables.

Comparing the results from the regressions with results from the t-test, we observe similar results for volatility. In the first we have 8 significant decreases following the cross-listing, while the t-test provides us with 6 statistically significant decreases. The t-test also exhibits 6 significant increases in volatility, whereas the regressions exhibit 3. Neither of these results is sufficient to make generalizations about the Swedish market. As regards liquidity, the tests display rather different results. The regressions suggest virtually no statistically significant changes in liquidity after the cross border listing, whereas the t-test implies significant increases in liquidity in 13 cases out of 19. Only 2 decreases are observed. This result is more adequate as basis for generalizations about the market. The increase in liquidity, according to this test, is consistent with Gårdängen (2005) results of decreasing spreads for cross-listed Swedish stocks.

In general, however, the results of the performed tests in this paper are not consistent enough to make inferences about the level of integration between the Swedish, U.K. and U.S. markets, as defined in this thesis. Hence we cannot, with strong statistical inference, conclude whether there is enough information flow, or transparency between these markets. We can only look at individual stocks and their behaviour after the listing abroad, with respect to volatility and liquidity.

²¹ See section 3.3 and 4.4

However, for individual stocks, changes in these two variables may be random and caused by some firm-specific factors. Again, this is not sufficient to draw conclusions about the market at large.

As discussed in previous chapters, market integration can be defined in several ways and during our research we find a great number of studies measuring market integration between countries. The large interest in this research area has also led to a variation in research methods. Domowitz et al (1998) and Bayar and Önder (2005) state that markets are integrated when volatility decreases and liquidity increases after cross-listing. Contrary to this view on market integration other authors (e.g. Alexander et. al., 1988; Foerster & Karolyi, 1993) state that if markets are integrated, cross-listing on foreign markets would not have a significant effect on the price of shares. Looking at the results from our regressions we find that, in 11 of the studied stocks, volatility has a significant impact on price change and liquidity has a significant impact on price change in 3 of the cases, following the cross-listing. This implies that, despite the continuous process of integration between markets, the Swedish stock market is not completely integrated with the London and New York stock markets. Within this view of market integration, the values for the change in volatility and liquidity following the listing (i.e. γ_1 and λ_1), should not exhibit any significance, since a change in these variables also leads to a change in price.

According to Pagano et al. (2001) European firms prefer to cross-list on more liquid and larger markets. Comparing the Swedish stock market to the London and New York markets one can say that the Swedish market is relatively small, as regards volume traded and the number of companies listed,²² hence the Swedish market should benefit from listing on these markets. Based on our results from the regressions we cannot state that the Swedish market either benefits or loses from being listed in London or New York. On the other hand, the t-test demonstrates an improvement in liquidity following the listing, which could imply some signs of benefits for the cross-listed stocks.

Apart from the volatility and liquidity effects of cross-listing, examined in this paper there are many other potential benefits that might inspire Swedish firms to cross-list. As discussed in previous chapters, some possible explanations are that

²² See Chapter 2

firms hope to gain a decrease in domestic market risk of the listed shares, a reduction in cost of capital, due to managerial benefits and diversification effects.

6. Conclusion and further research

6.1 Conclusion

The research concerning the issue of cross-listing has been vastly researched, as presented in this paper. Not in the least the volatility and liquidity aspect of cross-listing.

The purpose of this paper is to examine whether there is a change in volatility and liquidity in Swedish stocks after their listing in London and New York. We base our methodology on Domowitz et al. (1998) theoretical model, which highlights the importance of freely available information between markets. The model suggests that market integration arises when there is free information flow between markets, resulting in lower volatility and higher liquidity on the domestic market. In addition we interpret our results in accordance to other theories concerning market integration which are presented in Chapter 3.

In order to reach any conclusions we use two different techniques (i.e. t-test and time-series regression) to test whether any changes occur in volatility and liquidity after cross-listing. As regards the results of the t-tests for volatility we find no significant changes for the market in general. Further, for the liquidity measure we find significant increases in majority of the stocks. Thus, looking on the variables individually we observe a general increase in liquidity for the investigated stocks, which implies that there is some order inflow to the Stockholm stock exchange after the listing in London or New York. Further, this implies that the information is freely available between these markets. However, in order to investigate the movements in volatility and liquidity jointly in one model, and to capture the relationship between these two variables, we perform time-series regressions. From these results we only can make inferences

concerning changes in volatility and liquidity for individual stocks. The insufficient number of significant coefficients of these variables prohibits us from making generalizations concerning the Swedish stock market as a whole. Therefore we can not, with statistical significance, conclude whether the Swedish market is integrated with London and New York and whether the information is freely available between these markets.

6.2 Further research

The effects on volatility and liquidity due to a foreign listing have been investigated in several ways. Nevertheless, there are not many studies in this research field performed on the Swedish market. The large number of research methods within this area motivates further testing of the Swedish market. Not in the least considering the fact that we receive inconclusive results in this study. By adopting a different model and defining the variables for volatility and liquidity in another way might give more consistent results. Liquidity can for example be defined through the changes in the bid-ask spread. Another way of measuring the effect of cross-listing on volatility and liquidity is using the GMM method (used by Domowitz et al. (1998)), which includes identifying relevant instrumental variables. This method is more extensive than the OLS method and captures more detailed information, which might provide more reliable results.

7. References

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