

# Stock Exchange Merger and Liquidity

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## Abstract

The paper empirically investigates the effects of the Euronext stock exchange merger on listed firms. Specifically, it examines how consolidation has affected stock liquidity and how the effect varies with firm type. The results show asymmetric liquidity gains from the stock exchange merger, where the positive effects are concentrated among big firms and firms with foreign sales. There is no systematic pattern found across industries or listing locations beyond size and foreign exposure effects. Competitive effects of the merger are also analyzed, i.e. the merger effect on relative market shares (share of trading) of European exchanges. The merger is associated with an increase in Euronext's market share, where the increase is drawn from the London Stock Exchange.

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# 1 Introduction

The business environment of European stock exchanges has changed considerably in the last decade. Technology improvements and globalization trends of the 1990's have increased competition among European stock exchanges, which no longer serve merely a national appetite but offer world-wide menus. Furthermore, the government or member owned, national stock exchanges - much as the notion of national airlines - are gradually being replaced by for-profit, publicly listed exchanges. These exchanges have a clear objective of maximizing shareholders' wealth and are less focused on serving either members' or national interests. The transition has been swift, with 69% of exchanges in the World Federation of Stock Exchanges being for-profit entities in 2004, compared to only 38% in 1998 (World Federation of Exchanges, 2004).

The change in ownership structure of stock exchanges has been accompanied by an immense increase in international stock exchange integration and co-operation. For example, stock exchanges have established strong operational ties with the usage of joint trading systems and the harmonization of regulations. This increased level of integration has recently taken a new turn as stock exchanges have sought partners to create fully merged identities. The most noteworthy merger activities include the Euronext merger, the OMX merger, ongoing consolidation between NYSE and Euronext, and NASDAQ's keen interest in the London Stock Exchange.<sup>1</sup>

This paper empirically investigates the effects of the Euronext stock exchange merger on listed firms, i.e. the merger of the stock exchanges of Amsterdam, Brussels, Lisbon and Paris. There are many aspects of interest in such an analysis, both economic and regulatory issues which affect investors, firms, financial intermediaries and the overall economy. Thus, any profound study of the effect of stock exchange merger is bound to be selective and incomplete in its coverage. This paper narrows the focus by examining how consolidation of exchanges has affected the market liquidity of traded stocks. In particular, which types of firms have gained the most from merger in terms of stock liquidity? Does it depend on firm size, industry, location or any other characteristics? In addition to such a heterogeneity

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<sup>1</sup> Euronext is the merged stock exchange of former national exchanges of Belgium, France, Netherlands and Portugal. OMX owns and operates 7 exchanges based in the Nordic and Baltic countries. NYSE and NASDAQ are American stock exchanges with headquarters in New York.

analysis, the paper also attempts to measure the competitive effects on neighboring markets, such as the effect on relative market shares of European exchanges.

The main motivation for studying liquidity is that it ultimately affects the cost of capital. For example, if trading volume of a particular stock is low, then the stock is harder to sell (e.g. in bear markets) and the bid-ask spread is typically high. This makes the stock less desirable, which is reflected in price. Amihud and Mendelson (1986) estimate that the most illiquid stocks could gain 50% in value if, all else equal, liquidity would be raised to the level of the most liquid stocks. Brennan and Subrahmanyam (1996) and Datar et al. (1998) also find that stock returns are a decreasing function of various measures of liquidity - such as turnover, which is the liquidity measure used in this paper (see further section 4). Liquidity is therefore of concern to both firms and the exchanges that serve them.

The purpose of the study is to shed light on not only whether a stock exchange merger is beneficial to firms, but also how the gains may be distributed among market players. Answering how liquidity has changed – and for which firms – is a valuable contribution to evaluating possible motives for stock exchange mergers and whether such mergers are advisable. A further motivation is to provide evidence on how a stock exchange merger may influence the competitive market environment, i.e. whether it proves to be an effective means of competition. In particular, it is of interest to explore whether merged exchanges attract market shares (share of trading) from other exchanges as a result of the merger - and if so, from which competing exchanges the additional order flow has been drawn. Such competitive effects have largely been left unexplored in Europe.

The results indicate that the gains from the Euronext stock exchange merger have been unevenly allocated. The increase in liquidity is concentrated among big firms and firms with foreign exposure. A plausible explanation is that these firms are more visible and familiar to new foreign investors that enter the market following the merger. If the merger effect is broken up across the four key merger events of the Euronext consolidation process, the results indicate that all four events had a significant effect on stock liquidity. Further analysis shows that there is no systematic pattern found across industries or listing locations beyond size and foreign exposure effects. The analysis of the competitive effects of the merger indicates that trading activity has drifted from the London exchange to Europe's mainland exchanges, where Euronext's market share has risen by 2.23% (in terms of value of trading

volume). There is however no evidence of Euronext's enhancing its competitive stand in terms of attracting new firm listings.

The paper proceeds by reviewing existing literature and outlining the paper's contributions. Section 3 presents competing hypotheses on potential merger effects and section 4 describes the Euronext merger process and the data. The methodology is introduced in section 5 and empirical results follow. Section 7 concludes.

## **2 Literature review and contribution**

The analysis of stock exchange merger is related to several categories of the economics literature. First, financial time series analyses have established that international stock markets are becoming more interdependent, e.g. in terms of price convergence (e.g., Taylor and Tonks, 1989; Corhay et al., 1993; Fraser and Oyefeso, 2005; Chelley-Steeley et al., 1998; Kim et al., 2005). Although this has been incident to increased stock exchange cooperation, a causal relationship has not been established. In fact, Nielsson (2007) finds little interdependence and no convergence among the Nordic and Baltic stock markets, in spite of increased merger activity among the exchanges in the region. Second, stock exchange mergers are related to cross-listings of firms and stock market liberalizations, since all of these events relate to increased market size (number of potential investors). The cross-listing literature finds that firms tend to cross-list on markets more liquid than their own (Pagano et al., 2001), thus improving the overall liquidity of the firm. But there is less agreement on which types of firms benefit relatively more from cross-listing. For example, Halling et al. (2006) show that domestic turnover increases among European firms that cross-list in the U.S., while Levine and Schmukler (2006) demonstrate that the opposite holds true for firms from emerging economies, i.e. domestic trading decreases when firms cross-list. Also, cross-listing firms are typically relatively big firms, so any observed evidence of liquidity gains from the cross-listing literature only applies to big firms. But interestingly, Halling et al. (2006) find a negative firm size effect, i.e. the ratio of foreign to domestic trading volume is higher among the relatively small firms that cross-list. In contrast, Wójcik (2002) studies the ownership structure of big European firms and concludes that foreigners do not invest depending on firm size, but rather based on firm location (country). Analyzing spillover effects of cross-

listing, Karolyi (2004) and Levine and Schmukler (2006) show that firm migration from emerging markets is negatively related to the liquidity of the remaining firms in the home market, i.e. the trading activity falls among firms that remain in the domestic market. Finally, in the stock market liberalization literature the general result of increased trading activity with bigger market size also holds true (e.g. Kim and Singal, 2000). Here there is also evidence of firm heterogeneity, e.g. Dahlquist and Robertsson (2004) find, in contrast to Halling et al. (2006) and Wójcik (2002), that foreign investors seem to prefer large and well-known firms, and thus these firms realize the largest reduction in capital costs.

The empirical literature listed above merely gives a quick glimpse at the numerous studies that analyze the effect of increased market size on liquidity. But direct work on stock exchange mergers is far more limited in scope as there are still only a handful of realized mergers to be analyzed empirically. The studies have therefore mostly been restricted to theoretical analyses or estimation of cost functions of exchanges. Among the latter are studies by Malkamäki (1999) and Schmiedel (2001), who argue that there are substantial economies of scale from integrating operations and eliminating duplication of fixed costs. Schmiedel et al. (2002) extend this analysis to show scale economies in the settlement procedure, i.e. stock market integration should lead to higher trading volume which increases efficiency in the clearing and settlement mechanism. Theoretical papers include work by Santos and Scheinkman (2001) who present a model illustrating that competition among financial intermediaries will not lead to excessively low standards and may in some cases lead to better outcomes than monopoly. In contrast, Noia (2001) presents a model that demonstrates that mergers among exchanges are more efficient than competition, e.g. due to network externalities.

There are only a few empirical papers that directly relate liquidity to stock exchange structure. First, Jain (2003) examines 51 stock exchanges to pinpoint which institutional features are associated with higher liquidity. He finds that hybrid systems and pure electronic limit order books have better liquidity outcomes than e.g. pure dealer systems.<sup>2</sup> Second, Arnold et al. (1999) analyze the effect of three U.S. regional

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<sup>2</sup> A limit order market is a market where orders (which specify direction, quantity and acceptable price of trade) are compared to orders already held in the system (the book) and execution of trade takes place if there is a match between buy and sell orders. A dealer system is a market where an intermediary (the dealer) acts as a counterparty for the trades of his customer. A hybrid system is a combination of these two market systems.

stock exchange mergers on liquidity and market share of exchanges. They find that merged stock exchanges provide narrower bid-ask spreads and attract market share from other exchanges. Their paper provides no heterogeneity analysis, but it applies the same econometric framework as used here for analyzing competitive effects of merger. Third, a study by Padilla and Pagano (2005) analyses the effect of harmonization of clearing systems in the Euronext exchanges and find that liquidity among the largest 100 stocks rose substantially. Their paper relates most closely to this study, but several improvements and extensions are made. The empirical methodology is different as e.g. more key merger events are used (to be clarified in section 4), which provides a more detailed and comprehensive analysis. Also, this paper introduces a richer dataset and extends into analyses of firm heterogeneity and competitive merger effects.

The Euronext merger provides a case study of an exogenous policy shock that allows causal interpretation of econometric results. Thus it offers a more direct and reliable investigation of stock exchange merger than e.g. predicting merger outcomes from cost function estimation. Also, unlike the cross-listing literature, the study of stock exchange merger allows for analyzing the effect of an increase in market size for all firms listed, rather than an increase for one firm only. This implies that selection issues, such as firms cross-listing because they are of a particular type, are avoided. Another contribution of the paper relates to the introduction of a comprehensive dataset including all firms listed on the four Euronext exchanges in 1996-2006. Having the whole population of firms offers a more complete picture of merger effects than studies limited to analyzing only a fraction of firms, typically the largest and most liquid ones. The data richness also makes it possible to examine the potential heterogeneous outcomes of listed firms, which has not been viable in former studies with a non-random subsample of firms. This paper is therefore a first step towards filling that gap by providing a far more direct and detailed analysis than previously offered. In other words, the heterogeneity analysis offers insight to which types of firms benefit from merger, depending on characteristics such as firm size, industry, foreign exposure and location. Finally, the dataset also includes firms from a handful of other European exchanges. This allows for the usage of control groups and the study of competitive effects that the Euronext merger. Such a competitive analysis, i.e. the effect of stock exchange integration on non-merging markets, has not been carried out with European data.

### 3 Hypotheses on merger effects

There is a vast theoretical literature which examines the effects of market integration, e.g. monopoly, on various market outcomes. But this literature is limited to the theory of the firm; much less work exists on integration of financial intermediaries which serve those firms. Also, several theoretical models exist that deal with investment and security *holding*. But few theoretical models predict *trading* decisions after market consolidation. However, several arguments and hypotheses can nonetheless be presented that predict liquidity outcomes of stock exchange merger. It is then up to empirics to shed light on which of these competing hypotheses hold true.

There are several reasons why firms may gain in terms of stock liquidity following a stock exchange merger. First, the market may become broader, in the sense that there are more market participants trading in listed firms. This means that the firm faces a bigger pool of investors from which it can raise funds. Second, the market may deepen, meaning that larger quantities are available at a price marginally above and below the prevailing market price. This makes the market more liquid in the sense that large, individual trades are less likely to drive price movements.<sup>3</sup> Third, there are various cost channels through which liquidity may increase after stock exchange merger. These include lower information and indirect (non-monetary) transactions costs, such as ease of transaction due to unification of trading and clearing systems. A stock exchange merger may also lower direct transactions costs, thereby inducing higher trading volume. This may especially be important in Europe where transaction costs are far higher than in the U.S. For example, clearing and settlement costs for European transactions are 9 times higher than for U.S. transactions, and the costs of cross-border transactions in Europe can be as much as 46 times higher than in the U.S. (London Stock Exchange, 2001). These kind of pricing schedules are very likely to affect trading volume, with volume finding shelter where prices are low. The European Commission predicts that the bulk of the 2-5 billion Euros spent on trading, clearing and settlement can be saved by consolidating

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<sup>3</sup> Pagano (1989) offers an elegant model capturing this idea, i.e. that “a higher number of market participants implies lower price sensitivity to a trader’s net demand, and thus increased liquidity.” This feature is also referred to as liquidity externality, i.e. there are lower costs with more market participants, which favors market consolidation.

exchanges within Europe (*Economist*, 2006c). In short, lower transactions costs due to stock exchange mergers are likely to lead to increased trading volume.

There are fewer convincing arguments of why firms in general may experience lower stock liquidity after stock exchange merger. The main concern is potential monopolistic behavior by the newly merged exchange. For example, *The Economist* (2006a) reported that “[m]ore than a few investment bankers were furious ... when Euronext announced that it was returning 1 billion euros to shareholders, without cutting trading fees”, despite Euronext’s objective of “offering participants increased liquidity and lower transactions costs” (Euronext, 2007). On the other hand, it can also be argued that there is still active competition in the current European system, e.g. through competition from quasi-exchanges, like automated trading systems or electronic communication networks. Also, although fees may not have decreased after the Euronext merger, they have remained fairly stable. This study takes no stand on the potential monopolistic effects of the Euronext merger, other than analyzing changes in market shares and examining whether Euronext has attracted volume from other European exchanges.

Given these arguments it may seem likely that liquidity should increase following a stock exchange merger. However, the liquidity benefits may still be asymmetrically allocated among firms. To investigate whether this is the case, the paper examines how potential liquidity gains differ depending on firm’s characteristics, such as firm size, foreign exposure, industry or listing location. Liquidity is measured by turnover, where turnover is defined as number of shares traded in a particular firm relative to the number of outstanding shares (see further section 4).

#### *A. Foreign Exposure*

The Euronext cross-border merger increased the potential investor base, i.e. stocks listed on individual national stock exchanges became more accessible to foreign investors. But the trading pattern of these foreign investors is potentially concentrated on certain types of stocks. In particular, firms with high visibility outside their domestic market may receive more interest from foreign traders. For example, firms which operate abroad or offer their products outside their home market may enjoy higher visibility to foreign investors, who in turn may be more inclined to trade in those companies. Also, investors may prefer trading in stocks of recognizable,

household brands since it may involve lower information and indirect transaction costs. Therefore, firms that have foreign sales or foreign assets in the market into which they are merging, may be better known to foreign investors and enjoy more visibility, resulting in relatively higher post-merger trading. Hence, this supports the idea that turnover increases relatively more for firms *with* foreign exposure.

However, higher visibility of firms with foreign exposure could also imply that those firms will fare relatively worse. If firms are household names outside their home market, it may imply that foreign investors are already trading relatively more in those firms, compared to the less known firms. Thus the merger may not have a sizeable effect on trading volume in recognizable firms which foreign investors are already tracking. In contrast, the merger should primarily benefit firms that experience the relatively highest increase in visibility to foreign investors. The firms that gain the relatively most visibility experience a greater boost in attention than firms that are already well known to foreign investors. The firms that investors were not familiar with previous to the merger are likely to be those without foreign exposure (foreign sales/assets), which are therefore the ones that should experience the greatest fall in indirect transaction costs and the relatively highest increase in trading volume. In other words, turnover may therefore increase relatively more for firms *without* foreign exposure.

Finally, foreign exposure might not matter at all. What investors really trade on might only be financially relevant information, such as profits per share, dividend payments and expected future prospects.<sup>4</sup> Foreign sales or assets may therefore be irrelevant in determining turnover.

### *B. Size*

The argument that firms with foreign exposure may enjoy higher visibility to foreign investors - thereby leading to relatively higher post-merger liquidity - can also be applied to big firms. That is, people may be more familiar with big, salient firms and therefore be more inclined to trade in those. Big firms are typically also better covered by analysts and therefore expected to feature lower informational asymmetries. Thus, stock exchange merger might primarily affect trading in big firms.

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<sup>4</sup> It should, however, be noted that these variables intuitively relate to security *holdings*, not necessarily trading volume.

Also, smaller firms may become relatively tiny once the markets have merged. In other words, they may be likelier to disappear in the crowd and as a result get less attention from investors than before. This reasoning implies that it may be better to be a small firm on a small market, than a tiny firm on a big market. Finally, even if visibility of small firms increases, it may not matter to big and influential investors (such as hedge funds) since they often trade primarily in the biggest companies anyway. These arguments support that turnover increases relatively more for *big* firms.

Imitating the arguments presented for foreign exposure, it might also be that foreign investors are already trading relatively more in big firms. Therefore the primary increase in trading volume should occur among small firms. Furthermore, big domestic firms need no longer be relatively big on the newly merged market. Therefore investors' attention may shift away from those firms to the ones that are still big on an international scale. In other words, it may be better to be a relatively big firm on a small market, than relatively small on a big market. For example, a big firm that qualifies for inclusion in the domestic market index may not qualify for a big-cap market index on the merged market. Therefore investors may now devote less attention to it as they shift their focus to the new market index. In contrast, a small firm, which did not qualify for the domestic market index in the first place, is not adversely affected to the same extent. For these reasons, bigger firms may experience a relatively lower increase (or greater decrease) in trading volume than smaller firms. Equivalently, turnover may increase relatively more for *small* firms.

A case can also be made for size not mattering for trading decisions. This is in line with the previously mentioned conclusion of Wójcik (2002) who finds that people pick securities depending on country, not firm size. This is a reasonable argument if firms of different size categories are otherwise the same. Thus, turnover may be unaffected by firm size.

### *C. Industry*

Industry patterns may follow the arguments above, e.g. the industries with the biggest and most internationally exposed firms may gain relatively more from merger. For example, if firms with foreign exposure tend to gain more from merger, then firms in the service sector may gain relatively less since they are not export oriented

(with exceptions, such as banks and travel agencies). Also, industries that require international cooperation or compete internationally may do better since these industries are better known among foreign investors and thus present themselves as more appealing trading choices.<sup>5</sup>

Again, this argument can be flipped upside-down. That is, if foreigners are already trading in these familiar industries, the biggest increase in trading volume should occur in other industries than the most placeable ones. Finally it is plausible that there is no heterogeneity across industries. In particular, after controlling for foreign exposure and size effects (and thereby for the bulk of “firm familiarity”), it is tricky to present convincing arguments of why one industry might enjoy a higher increase in liquidity than another.

#### *D. Location*

Location data of this study is restricted to the primary exchange of the each observed firm. The study therefore examines heterogeneous outcomes of firms listed in Amsterdam, Brussels, Lisbon and Paris. It is hard to predict which of these exchanges should gain the most liquidity. But there are nonetheless some general arguments that can be presented.

First, the market with the relatively biggest increase in its potential investor base can be expected to enjoy the highest relative increase in liquidity. Here Lisbon or Brussels (country population 10 mill.) should thus gain relatively most whereas the increase in Paris’s investor base is relatively small and thus should have a more limited effect. Second, if the merger breaks down on restrictions and red-tape, the market with the strictest pre-merger regulations and the most unfavorable business environment might enjoy a relatively greater rise in the trading volume. In particular, the market where foreign access was relatively cumbersome prior to the merger (e.g. through fees or restrictive regulations) might experience a relatively larger rise in the number of market participants and trading volume. In sum, turnover may increase relatively more for firms listed in exchanges that originally are small and more regulated (restrictive).

In contrast, investors may also escape markets which historically have provided a relatively unfavorable trading environment. In other words, firms listed on the most

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<sup>5</sup> For example, Icelanders might be more inclined to trade in Norwegian fisheries (an industry they know well) than the Norwegian oil industry (an industry that is non-existent in Iceland).

attractive exchange before the merger may be the firms which attract the highest share of foreign trading. Also, there may be a flight to liquidity in the sense that trading may now concentrate on one market, i.e. the one which enjoyed the highest pre-merger liquidity. This is consistent with Pagano (1989) and Chowdhry and Nanda (1991), who present a theory of clustering of trading volume in markets, i.e. they argue that if transaction costs are limited, then liquidity will concentrate on a few markets. Furthermore, Portes and Rey (2005) demonstrate that the key determinant of asset flow is market size (measured as equity market capitalization). Therefore one can argue that trading may concentrate on the biggest market among Euronext's exchanges, namely Paris. This supports that the turnover increases relatively more for firms listed in exchanges that originally are large, liquid and less regulated (restrictive).

Lastly, it has been established that investors are generally infected by home bias. This means that investors prefer investing domestically and thereby forego potentially large gains from international diversification.<sup>6</sup> Moreover, investors may prefer investing in their home market to support domestic businesses, e.g. in order to keep profits (and taxes thereof) within their own country. Thus, although stock exchange mergers may facilitate cross-border transactions, e.g. by alleviating asymmetric information, it may not be enough to significantly induce cross-border transactions. Thus, post-merger turnover across exchanges may be unchanged from the pre-merger level.

## **4 Data and background information**

The pan-European exchange, named Euronext, was formed in September 2000 when the exchanges of Amsterdam, Brussels and Paris merged. Two years later the Lisbon exchange also merged into Euronext. The Euronext merger meant that members of each local exchange automatically became members of the other exchanges as well, which gave members access to the entire trading platform. Other

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<sup>6</sup> Admittedly, this argument (and the next one) may not necessarily go through in this setting since it relates to security holdings, not trading volume. See e.g. Gehrig (1993) and Tesar and Werner (1995) for evidence on home bias. One possible explanation for home bias that there is an informational barrier that makes foreign trading less profitable (Hau, 2001), which may imply that a stock exchange merger can increase cross-border trading if it successfully increases the information flow.

key events followed, i.e. events that further integrated and unified the markets. First, the trading platform was unified, which involved introducing the same technical system (NSC) and introducing a single set of trading rules. This implied that cross-border trading became easier as the markets became accessible by both local and remote members through any of the four gateways. Second, Euronext introduced a common clearing platform (Clearing 21), which meant that the whole clearing framework became harmonized. Therefore the users of the trading platform would not need to deal with separate clearing systems and thus this event further integrated the markets. Lastly, in 2005 all shares listed on the four local exchanges were moved to a single, regulated market, named the Eurolist. This is a single list which encompasses all Euronext's regulated national markets, with stocks classified in alphabetical order (not geographical). The list was introduced to increase simplicity and transparency on the consolidated market.

The dates of these key events in the merger process of Euronext are listed in table 1. Although various other important steps were taken towards unification of the national stock exchanges, these are the ones identified as being the principal integration events. Thus, these 4 mergers events - occurring at 11 different dates for the 4 national exchanges - will be utilized in the empirical merger analysis that follows.

The main dataset of the paper is provided by Thomson One Banker and consists of a panel of monthly observations on all listed firms on Euronext from Sept. 1996 to Sept. 2006. This amounts to 1,506 firms, where the majority of firms, or 70%, is listed in Paris, while 25% are listed in Amsterdam or Brussels, and the remaining in Lisbon. The dataset also includes data on firms listed outside Euronext, which is useful for comparison purposes and for creating control groups. These are firms listed on stock exchanges in Frankfurt, London and Spain (BME).<sup>7</sup> This adds another 4,240 firms to the dataset. Summary statistics are given in table 2.

Liquidity, the outcome variable of interest, can be measured in various ways. One simple measure is trading volume, i.e. the number of shares traded in a firm over e.g. one month. A better measure is turnover, which is the measure used in the paper. It is

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<sup>7</sup> The Spanish stock exchanges of Madrid, Barcelona, Bilbao and Valencia go under the name of the company that integrates the exchanges, i.e. "Bolsas y Mercados Españoles" (BME). Note that the dataset only includes the largest 137 of BME listed firms, whereas it covers all the Frankfurt and London listed firms. Frankfurt exchange also goes under the name of "Deutsche Börse" and is the largest of 8 German exchanges.

defined as the number of shares traded (in a particular firm) relative to the number of outstanding shares. This corrects the volume measure by taking into account that a single share represents a different proportion of firm ownership depending on the total number of outstanding shares. Other possible measures, which are less feasible to use here, include bid-ask spreads, value of volume, number of days in which trading occurs and other various measures introduced by e.g. Roll (1984), Lesmond (1999) and Amihud (2002).<sup>8</sup>

The dataset offers a number of firm variables that make it possible to investigate whether the effect of the stock exchange merger differs depending on firm type. These variables represent the firm characteristics described in section 3, namely foreign exposure, firm size, industry and exchange location. More specifically, foreign exposure is captured by foreign sales or foreign assets, size is proxied by firm market value and the industry specification is provided by the Thomson database.

Lastly, an additional dataset is provided by the Federation of European Securities Exchanges (FESE), which consists of monthly observations from January 2000 to August 2006. The data consists of the Euro value of volume for 6 major exchanges in Europe, namely Euronext, Frankfurt, London, BME (Spain), Milan and the consolidated OMX exchange.<sup>9</sup> The data is aggregated on the stock exchange level (so firm heterogeneity cannot be explored) and is used for examining how the Euronext merger has affected the market shares of European exchanges (section 6.3).

## 5 Methodology

To analyze heterogeneous effects of the Euronext stock exchange merger on stock liquidity, the empirical analysis employs a fixed effects regression with dummy variables capturing the key event dates. The model is

$$T_{it} = \alpha + \beta D_{it}^{events} + \gamma X_i^1 D_{it}^{events} + \theta X_i^2 D_{it}^{events} + \delta X_i^1 X_i^2 D_{it}^{events} + \lambda Z_{it} + \pi D_t^{month} + c_i + \varepsilon \quad (1)$$

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<sup>8</sup> The analysis uses monthly data which makes e.g. bid-ask spreads, Roll's and Amihud's measures unattractive alternatives to turnover. Value of volume is an undesirable measure since it includes market price, which can be influenced by many unexplained factors (such as investor sentiment) and therefore the outcome variable will be correlated with anything that affects stock price. Lastly, number of days in which trading occurs is a better liquidity indicator in less developed financial markets.

<sup>9</sup> Value of volume is the sum of both electronic order book transactions and negotiated deals. The Milan exchange represents the Italian stock exchange, named Borsa Italiana, which is based in Milan. The data on OMX includes the stock exchanges of Copenhagen, Stockholm, Helsinki and Vilnius. It therefore excludes the national stock exchanges of Iceland, Latvia and Estonia.

where the subscripts refer to firm  $i$  and time  $t$ . Liquidity, the outcome variable of interest, is measured by turnover,  $T_{it}$ . The four merger events (see table 1) are represented by a  $T \times 4$  matrix of dummy variables,  $D^{events}$ . The empirical analysis includes two different specifications of the event dummies. First, each event dummy takes value 0 before the relevant merger event, but value 1 at the date of occurrence and until the final sample date. This specification will give coefficient estimates that measure the effect of each individual event. Second, the dummy specification can also be such that the value 1 is assigned only at occurrence and up until the date of the next merger event. In this case the dummy coefficients will measure the cumulative effect of the events to date. The coefficient on the last event dummy will therefore give the overall effect of the merger process, which is of primary interest.<sup>10</sup>

To measure the heterogeneous effects that the merger may have on firms, the regression equation must include variables on firm characteristics. Equation (1) represents the case where two measures of firm characteristics are included in the model, namely  $X^1$  and  $X^2$  (e.g. firm size and foreign sales). The firm characteristics are interacted with the merger events to measure the heterogeneous effects of the merger. The coefficients on these interaction terms ( $\gamma$  and  $\theta$ ) therefore measure the incremental merger effect on stock liquidity for different types of firms (incremental to effect  $\beta$ ). These firm characteristics are also jointly interacted with the merger events in order to measure the incremental merger effect on firms that possess both characteristics (e.g. big firms with foreign sales may experience a greater post-merger liquidity than purely domestically operating big firms). Thus, the coefficients  $\gamma$ ,  $\theta$  and  $\delta$  are the heterogeneous merger effects of interest in the study.

Regressions of the type presented in Equation (1) generally require that firm characteristics are also added as control variables, i.e. without interacting them with merger events. But in the empirical analysis that follows these firm characteristics are time constant. Thus, they are effectively included in  $c_i$ , which is a vector of fixed

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<sup>10</sup> Equivalently, one can run the first specification and add up the coefficient estimates. Note that each event does not occur simultaneously in every exchange and that the events are sufficiently far apart for liquidity changes to materialize before the next event occurs. Also note that in both specifications the event dummy takes value 1 only when an event has occurred in at least two exchanges so the impact of consolidation can realize. For example, the trading event dummy does not take value 1 for firms listed in Paris until in May 2001 when the Brussels exchange joins the platform. One exception to this rule is the Eurolist event for Parisian firms since in February 2005 the three main markets of Paris (Premier Marché, Second Marché and the Nouveau Marché) merged into one, which formed the foundation of the Eurolist which was launched two months later (70% of firms are listed in Paris).

effects that takes out any (unobserved) time-constant firm specific characteristic which may explain variation in liquidity. Hence only time-varying explanatory variables need to be included in the regression model. Time-variant control variables are represented by  $Z_{it}$ , i.e. variables that may influence liquidity but are independent of the process of integration. For example, GDP per capita in each of the four Euronext countries is unrelated to the merger but may influence trading volume (there is typically more stock market activity in economic upturns). The model also includes monthly dummies which filter out average monthly changes in liquidity across all firms. In other words, the coefficients of interest will measure variation beyond the average variation in liquidity for every month. The monthly dummies can therefore be thought of as a time trend in the most flexible format available, which is desirable because trading volume is typically a very volatile series. Also note that these monthly dummies are not collinear with the event dummies since no merger event occurs simultaneously across all exchanges.

The last section of the paper analyses the competitive effects of the Euronext merger. The methodology used in that section of the paper examines if the market share of Euronext (i.e. share of trading) has increased - and if so, from which exchange(s) has the increase been drawn. In other words, has the merger proved to enhance the competitive stand of Euronext? The methodology, which originates to Zellner (1962) and is typically referred to as SURE (seemingly unrelated regressions), involves estimating a simultaneous equation system where the dependent variable in each equation is the market share of a particular exchange and explanatory variables are merger event dummies and various controls. This allows for testing not only whether the merger had a statistically significant effect on Euronext's market share, but also examines from which non-merging markets the additional market share was drawn. It is the potential existence of a common explanatory factor of market shares of all exchanges that necessitates the joint estimation of the equation system. Specifically, such a factor would induce contemporaneous correlation between error terms across separate exchange regressions, which would not be accounted for by running OLS on each equation separately.

## 6 Empirical results

### 6.1 Firm heterogeneity

There are four dimensions of firm heterogeneity that this section examines; namely foreign exposure, firm size, industry and listing location (exchange). The heterogeneous effects across firm size and foreign exposure are captured using interaction terms, whereas separate regressions are run for each industry and listing location (exchange).<sup>11</sup> First the focus of the analysis is on firm size and foreign exposure (tables 3 and 4) and industry and exchange effects are dealt with separately (tables 5 and 6).

Table 3 reports the cumulative effect of the merger on stock turnover. The columns represent fixed effects regressions including nearly 1,200 firms listed in Euronext in the sample period 1996-2006.<sup>12</sup> Column (1) reports the cumulative effect of the four merger events, controlling for gross domestic product (GDP) per capita and including monthly dummies. Interestingly, the effect of merger on stock turnover is non-significant. Therefore the merger has *not* increased liquidity of the average firm. The coefficient on GDP per capita is positively significant, which is what one would expect given that trading volume is generally higher in economic upturns.<sup>13</sup>

The remaining regressions reported in table 3 analyze whether the merger effect is different for big/small firms or firms with/without foreign exposure. A firm is considered big if its market value lies in the top 10% across all firms at the outset of the merger process (January 2000). Likewise, small firms are defined as those in the bottom 10% in terms of market value. This definition leads to a similar subsample of big firms as used in Pagano and Padilla (2005), i.e. their study consists of 104 large caps included in the main indexes of the four national exchanges. Thus the results of the two studies are directly comparable. Foreign exposure is defined either in terms of

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<sup>11</sup> This approach is used since introducing location dummies (i.e. Amsterdam, Brussels, Lisbon and Paris dummies) and interacting each of those with a particular merger event will lead to collinearity, i.e. the sum of the interaction terms (location\*event) will equal the event dummy. Also, the industry classification involves 7 different sectors, so including interaction terms for every industry when also controlling for both size and foreign exposure is impractical as it implies adding 144 interaction terms to the model.

<sup>12</sup> This is down from the approximately 1,500 Euronext firms in the dataset since some of these firms are automatically excluded due to incomplete data reports.

<sup>13</sup> It should be noted that throughout the paper the R-squared is very low, but that is not unexpected since stock turnover is generally a highly volatile series. Also note that if a firm dummy is included for every firm to pick up any individual firm specific effect, then the R-squared would increase dramatically (but the coefficient estimates would of course not change, since this is effectively the same as running a fixed effects regression).

foreign sales or foreign assets. Each of these two measures of foreign exposure takes the form of a dummy with value 1 if the firm had foreign sales/assets at the outset of the merger process. Thus the size and foreign exposure variables are time constant dummies, which implies that they are automatically dropped from the fixed effects regressions. But recall that the objects of primary interest are the interaction terms of these firm characteristics with the merger events.

Regression (2) in table 3 adds the interaction of merger events with foreign exposure, where foreign exposure is measured by foreign sales. The merger variable is again non-significant, which indicates that firms without foreign sales were unaffected by the merger. However, the interaction term of merger events and foreign sales returns a positive and significant coefficient. This implies that although firms in general do not benefit from merger in terms of liquidity, those firms which have foreign sales do relatively better than other firms.<sup>14</sup> This supports the idea that foreign investors prefer to invest in firms in which they have an informational advantage. Regression (3) controls both for size and foreign exposure, so the non-significant coefficient on the merger variable now implies that medium sized firms without foreign sales were unaffected by the merger. The coefficient on foreign sales is still positively significant and there is also a large and highly significant effect for big firms. In other words, the turnover of big firms increases by 0.13% more than for the medium sized firm with no foreign sales.<sup>15</sup> These significant responses of big firms and firms with foreign sales are of real economic significance since the average monthly turnover for Euronext firms is 0.14% in the sample period. In contrast, regression (3) reports no merger effect for small firms. This implies that the conclusions of Padilla and Pagano (2005) of higher post-merger liquidity are restricted to their specific sample of big firms, i.e. small or medium sized firms do not enjoy the same benefits from merger. Finally, there is no significant incremental effect of both having foreign sales and being big (or small), as indicated by the last two interaction terms in regression (3).

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<sup>14</sup> Also, the absolute effect of the merger on firms with foreign sales (not relative to other firms) is 0.07 (0.03), which is significant at the 5% level.

<sup>15</sup> The absolute effect of the merger on big firms in general is 0.15%, which is statistically significant at the 1% level. This number is obtained by adding up i) the effect on the medium sized firm without foreign exposure (-0.01), ii) the effect on big firm (0.13) and iii) the incremental effect if the firm is both big and has foreign sales, which is the interacted effect (0.05) times the proportion of firms with foreign sales (0.46).

Regression (4) in table 3 repeats the analysis of regression (3), but now using foreign assets as a measure of foreign exposure. This leads to very similar results, except the big firm effect is now even larger. However, including both foreign sales and foreign assets (column 5) makes all estimates insignificant, which reflects that the two foreign exposure measures are capturing the same variation (correlation between the measures is 0.54). The analysis proceeds using foreign sales as the measure of foreign exposure, since it gives more conservative estimates.

Overall, the results are in harmony with those of Kang and Stulz (1997) who find a similar pattern of foreign investment in Japanese stocks, i.e. foreign investment tends to be concentrated in large, export-oriented firms that are presumably more familiar to foreign investors. Also, Pagano et al. (2002) find that foreign sales and firm size have the largest impact on a firm's decision to list abroad, allowing it to capitalize on reputation acquired in foreign markets.

Table 4 reports more detailed results where the merger effect is broken up across the four integration events. When pooling all firms, the results indicate that the trading and clearing unifications had the largest net effect, whereas the member access event and the introduction of Eurolist are on average non-significant. Regression (2) breaks these results up across firm types. The results indicate that all four events had an effect, i.e. the trading platform unification benefits medium sized firms without foreign sales, the Eurolist event benefits firms with foreign sales relatively more and the member accessibility and the clearing system unification events benefit big firms relatively more. None of the events have a significant effect on small firms.

Intuitively, the Eurolist event, which primarily involves increased visibility of foreign firms, benefits firms with foreign sales. The significance of this event also suggests that the increased post-merger liquidity is not merely cost driven (cf. trading and clearing unification), but there is also a behavioral, demand driven aspect to the merger effect. Existing theoretical literature has however mainly focused on the cost side in determining the level and direction of trading volume in a multimarket setting.<sup>16</sup>

To examine whether some industries have gained relatively more liquidity than others following the merger, the sample is split into 7 different industry groups. The

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<sup>16</sup> For example Pagano (1989) and Chowdhry and Nanda (1991). Note, however, that if transactions costs are defined more broadly, they could of course include visibility of firms.

industry groups, as classified by the Thomson One Banker database, are industrial firms (metal producers, oil, construction, textiles, etc.), technical manufacturing (machinery, cars, aerospace, etc.), physical consumption goods (food, beverage, apparel, retail, etc.), services (transport, recreation, utilities), electronics and electrical products, financial services (commercial banks, investment companies, insurance, brokerage firms, etc.) and everything else is grouped into “miscellaneous”.

The industry analysis is reported in table 5, where a separate regression is given for each industry, controlling for firm size and foreign exposure. Again the results show that the merger did not increase liquidity of medium sized firms without foreign sales. Foreign sales turn up positively significant for 5 out of the 7 industries. Firms in services with foreign sales do not enjoy higher liquidity, which is intuitive since they provide an output which is typically not very export oriented or visible outside the firm’s primary area of operation. The other industry for which foreign exposure is not significant is electronics, but there the interaction of foreign sales with both small and big sized firms is highly positive. The firm size effect is fairly consistent with earlier results, i.e. small firms do not enjoy relatively higher liquidity for any industry, whereas there is a strong big firm effect in 3 cases. Finally, somewhat puzzlingly there is a significant negative effect of being both large and having foreign sales in two cases. One possible explanation is that foreign investors are already investing in those industries and thus these industries gain relatively less. This is plausible given that the two industries in question provide consumption goods and financial services, which typically are fairly visible, recognizable sectors to investors.

Besides the firm size and foreign sales effects across industries, the results do not show any clear indication of heterogeneous industry effects. The merger has not had a significant effect on any industry after controlling for size and foreign exposure, i.e. the average firm (medium sized without foreign sales) in one industry did not enjoy relatively higher liquidity than the average firm in another industry. Thus there are no signs of pure industry effects beyond the different size and foreign sales effects.

Lastly, examining which exchange has gained relatively most in terms of liquidity of listed firms is tricky. First, running a separate regression for each exchange results in collinearity between the event dummies and monthly dummies. Therefore the monthly dummies are replaced by a flexible time trend, i.e. a fifth order polynomial. Admittedly, this will not be as effective in controlling for random shocks unrelated to the merger, in particular given the high volatility of turnover. To partly address this it

is desirable to control for non-merger related events that may generally affect stock liquidity in world markets. The average monthly turnover of London listed firms is included for this purpose, which should capture such world market events. Second, the firm size variables are defined over the whole sample, so when the sample is divided across listing locations, few big (small) firms remain in some subsamples. For example, among the smallest 10% of firms (based on market value), there are only 6 small firms that originally were listed in Amsterdam. Also, nothing is gained by redefining firm size within each exchange separately, since it leads to even fewer firms in some subsamples (8 small Lisbon firms instead of 15). Moreover, redefining firm size within each exchange is problematic because e.g. a big firm within a particular exchange may no longer fulfill the definition of being big on the new, post-merger market. Third, comparing the merger effect across exchanges is tricky because it is difficult to interpret results in accordance to the hypotheses put forward in section 3. Specifically, it demands partial judgment by the observer to declare which exchange had the most restrictive regulatory framework before the merger.

For these reasons the results (reported in table 6) should be interpreted with care. The estimates show that medium sized firms without foreign sales listed in Brussels experienced a significantly positive merger effect, which is consistent with the hypothesis that the exchange with the smallest domestic investor base should experience the highest gains. With regards to firm heterogeneity, there is a strong positive size effect for both Brussels and Paris listed firms. However, there is only a significantly positive foreign sales effect for Paris listed firms. Interestingly, the merger has not benefited any types of firms originally listed in Lisbon and the effect is even negative for large firms, which is similar to results of Padilla and Pagano (2005) where the Euronext merger was found to have the weakest effect on Lisbon listed firms. However, it is questionable how much can be deduced from the results in terms of firm size, given the small subsamples. Finally, turnover in each exchange is non-surprisingly positively related to turnover in London.

To supplement the results reported in table 6, it is informative to plot the evolution of cross-border trading over the merger period. Figure 1 shows the fraction of cross-border trading within the Euronext market, i.e. the share of value of volume on each Euronext marketplace originating from other Euronext members not located in the corresponding country. For example, the share of total trading in Amsterdam listed firms by members of other Euronext exchanges rose from 19% to 56%, i.e. it tripled

in 2001-04. For Brussels and Lisbon the cross-border trading nearly rose five-fold and for Paris the increase was seven fold (from 1% to 7%). Although no causation is established, figure 1 suggests that the merger has successfully facilitated cross-border trading among the Euronext exchanges.

## 6.2 Robustness

A sensitivity analysis of the main heterogeneity results is carried out in table 7. First, using monthly dummies may be excessively restrictive since it takes out the bulk of the variation in turnover, i.e. it filters out average monthly changes in turnover across all firms. In particular, in cases where a merger event happens simultaneously in two or more exchanges, the monthly dummy for that particular month may absorb most of the merger effect. If this is the case, the effect of the merger event will primarily consist of the reaction of firms listed in the other (one or two) exchanges where the event occurs in different months.<sup>17</sup> Thus, regression (1) of table 7 drops the monthly coefficients and instead includes a flexible time trend, namely a fifth order polynomial. Also, the average monthly turnover for London listed firms is added to further control for non-merger related events that may affect stock liquidity in world markets. The results are virtually unchanged from the base model presented in table 3, with big firms and firms with foreign sales enjoying relatively higher post-merger stock liquidity compared to other firms.

Second, the choice of the 10% cutoff level when defining small and big firms is somewhat arbitrary. Thus regression (2) in table 7 defines big (small) firms as those who have market values in the top (bottom) 20% across all firms at outset of the merger. The relative merger effect on big firms is still significant, but becomes lower as big firms are on average smaller in size.

Third, measuring firm size with market value may be problematic since anything that affects stock prices will affect market value. Therefore the dummy size definition

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<sup>17</sup> For example, for the Eurolist event the monthly dummy of April 2005 is likely to capture most of the Eurolist effect since the event happens simultaneously in three of the four exchanges. Thus the Eurolist effect could be identified primarily by the reaction of Paris listed firms in February 2005. Moreover, even if the monthly dummy of April 2005 is insignificant, this does not guarantee that the dummy is not absorbing most of the Eurolist effect. It may still be that there is a positive (negative) merger effect which is cancelled out by a random, negative (positive) shock that takes place in the three exchanges (thus resulting in a non-significant monthly dummy and event coefficient). These two effects will not be adequately separated if there is not a corresponding negative (positive) shock in the Paris exchange in April 2005, which the monthly dummy would capture and represent.

can indirectly be influenced by various economic variables or investor sentiment. The third regression in table 7 attempts to address this concern by defining firm size in terms of domestic asset value reported in the firms' accounts. Big (small) firms are now defined as those in the top (bottom) 10% in terms of asset value. The results are very similar; there is still a positive and significant firm size and foreign exposure effect. The big firm effect is smaller, but now the interaction of being both big and having foreign sales is significantly positive.

Another possible specification is to use the actual market values and foreign sales figures (instead of using dummy variables) when defining firm size and foreign exposure. Using the actual values may be advantageous to using dummy values as it mitigates the possibility of discarding relevant information in defining firm size and foreign exposure. This specification is reported in regression (4) in table 7, where the dummy specification for foreign sales has been replaced by log of foreign sales at the outset of the merger process (January 2000).<sup>18</sup> Regression (5) repeats regression (4), but now the dummy definitions for size are also replaced by logs of actual market values. The estimates verify earlier results, with big firms and firms with foreign sales enjoying relatively higher post-merger stock liquidity. Specifically, converting the coefficient estimates of regression (5) indicates that an average firm with foreign sales enjoyed 0.06% higher post-merger liquidity compared to medium sized firms without foreign sales, while for big firms the relative gain is 0.09%.<sup>19</sup> These results are interesting in comparison to the results of Halling et. al (2006), who in contrast find negative size effect when using a log specification.<sup>20</sup>

Finally, a fruitful way to investigate whether other events than those related to the merger are driving the results, is to compare the outcomes of Euronext listed firms to outcomes of firms listed elsewhere around the merger events. For example, if the merger events are truly influential, one should expect Euronext listed firms to react more strongly to the events than, say, Frankfurt listed firms. To investigate this, the

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<sup>18</sup> Note that firm characteristics still drop out of the regression (when not interacted with the merger events) because the variables are still time constant, taking their Euro values in January 2000. Using a log specification mitigates the effect of large numerical values.

<sup>19</sup> Since the relationship between firm characteristics and turnover is non-linear when using the log specification, the interpretation of the estimates is less straightforward than previously. These numbers are obtained by noting that average foreign sales in January 2000 are 1,680 mill. EUR, which implies that the average firm with foreign sales experienced a  $0.003 \cdot \ln(1680 \text{mill})$  higher post-merger turnover (which equals 0.06). Similarly, big firms had on average 17 bill. EUR higher market value at the outset of the merger, which is associated with  $0.004 \cdot \ln(17 \text{bill})$  higher post-merger turnover.

<sup>20</sup> Halling et al. (2006) use log assets as a measure of firm size, whereas here we use log market value. However, rerunning regression (5) using log assets produces the same results.

exchange in which a firm is listed is represented as a firm characteristic in the regression model. The results of the analysis are reported in column 6 of table 7, using Frankfurt listed and BME listed firms as control groups. Using firms listed in e.g. Germany or Spain as control groups eliminates concerns such as whether the Euro or EU integration (but not stock exchange merger) is driving liquidity variation. The results show that both Frankfurt listed and BME listed firms fare relatively worse than Euronext listed firms around the merger dates, which is consistent with the merger benefiting only participating exchanges.

### **6.3 Competitive effect of merger**

The Euronext merger has increased trading activity in big firms and those with foreign sales, which amounts to about half of the sample firms. Thus it is natural to ask whether this increase in trading on Euronext has affected trading activity in other European exchanges. That is, has Euronext attracted order flow from other exchanges, thereby improving its market share compared to non-merging exchanges? To analyze whether the merger has proved to be an effective means of competition, a simultaneous equation system is estimated where the dependent variable in each equation is the market share of a particular stock exchange. Market share is measured as the fraction of the Euro value of volume across European exchanges. For exchanges involved in mergers, the pre-merger values are summed market shares of the merging exchanges. The explanatory variables of interest are merger event dummies, which in each equation (i.e. for each exchange) capture the change in market share associated with the Euronext merger. Variables which control for other market influences are a flexible time trend (5<sup>th</sup> order polynomial) and GDP per capita in the country of the relevant exchange. Also, because market share is analyzed, the data effectively controls for overall changes that are common to all stock exchanges (e.g. general rise in value of volume).

The results are reported in table 8. The data consists of monthly observations from January 2000 to August 2006, where market share is reported in percentage units (i.e. multiplied by 100). The analysis covers six major stock exchanges in Europe, which together hold more than 90% of the European market share. The six exchange regressions (columns) are estimated simultaneously using the seemingly unrelated regression methodology (SURE). First, panel A reports that the merger is associated

with a 2.18% increase in Euronext's market share (the market share was 20.5% at the outset of the merger process). The results also indicate that this increase is drawn from the London Stock Exchange, which has experienced a substantial loss in market share. Interestingly, the London exchange is the only exchange which has lost significant market share, which suggests that the merger is associated with trading activity drifting from London towards Europe's mainland exchanges. Overall, four out of the six exchanges have increased their market shares, but the increase is only significant for Euronext and (surprisingly) the Milan exchange. Thus the merger has enhanced the competitive stand of Euronext.

Theoretical papers that partly relate to competitive effects of stock exchange mergers include early papers by Pagano (1989) and Chowdry and Nanda (1991). They present a theory of clustering of trading volume, i.e. they argue that if transaction costs are limited then liquidity will concentrate on a few markets. Portes and Rey (2005) also demonstrate theoretically that the asset flow is determined by market size. Thus one would expect a bigger exchange, namely the merged Euronext exchange, to attract further market share. The results reported in table 8 thus support these theoretical arguments. On the empirical side, Arnold et al. (1999) study the effect of three U.S. regional stock exchange mergers on market share, using the same framework as applied here. They find that two out of the three mergers had a positive effect on the market share of the merging exchange. For the non-effective merger, Arnold et al. (1999) argue that the lack of significance may be due to limited competition among particular exchanges, e.g. due to being in different time zones. One might thus expect that the Euronext merger would not significantly affect market shares since cross-border competition is likely to be more limited than regional competition. However, the results in table 8 indicate that cross-border exchanges are affected by the merger, with Euronext attracting market share from the London exchange.

Panel B in table 8 repeats the estimation of panel A, but estimating each equation separately (OLS). The results are almost unchanged, which implies that there is little evidence of a common explanatory factor inducing contemporaneous correlation between error terms across separate exchange regressions. Lastly, there are 480 observations in the simultaneous estimation of the six regression equations, which may raise concerns of small sample size. Thus panel C reports estimation results

where small sample adjustments are made (to panel A) in calculating standard errors.<sup>21</sup> This does not have a significant effect on the estimates.

Lastly, to further explore the changes in the competitive environment of European stock exchanges, it is informative to graph the evolution of market capitalization for the major European exchanges. Figure 2 indicates that market capitalization is in most cases around the same level as in 2000. After market capitalization was at a historic high in 2000, stock prices plummeted, which explains the low values in 2003. Therefore the market capitalization is comparatively high in 2006, in particular among exchanges where the number of listed firms has decreased over the same period. This includes Euronext, where approximately 400 firms either went bankrupt, delisted or merged (see figure 3).<sup>22</sup>

Another indicator of the competitive standing of European exchanges is how well they have managed to attract new listings. The evolution of the number of new firms listed is graphed in figure 4. Euronext has experienced a decline in the number of new listings in the merger period, while three of the other four exchanges have experienced a rise. However, this comparison may be questionable as firms typically tend to list in their home countries due to costs of listing abroad, such as complying with foreign regulations and operating in a different language. Thus it is informative to see where foreign listings are concentrated, i.e. in which exchange firms decide to list provided that they choose to list abroad. This is shown in figure 5. The number of foreign firms listing in Euronext is fairly stable in the merger period and there is no clear indication of Euronext outperforming other exchanges in terms of attracting foreign listings.

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<sup>21</sup> This implies using an alternative divisor in computing the covariance matrix for the equation residuals, i.e. the asymptotically justified estimator that uses sample observations ( $n$ ) is replaced by  $\sqrt{(n-k_i)(n-k_j)}$ , where  $k_i$  and  $k_j$  are the number of parameters in equations  $i$  and  $j$ .

<sup>22</sup> BME is excluded from figures 3-5 due to limited data availability on number of firms listed. Also, only the main market of the London Stock Exchange is included in figures 3-5. In particular, the figures do not include firms listed on AIM, which is a growth market for smaller companies where firms do not need a particular financial track record or trading history to list, nor is there a minimum requirement in terms of size or number of shareholders. The AIM market has grown fast in recent years and had 1,634 firms listed in 2006 (462 new listings in 2006, thereof 124 foreign firms).

## 7 Concluding remarks

To conclude, stock exchange mergers may not be in the interest of all firms. However, although the liquidity gains are restricted to particular types of firms, namely big firms and those with foreign exposure, there are two things to note. First, the foreign sales effect applies to a large fraction of firms since in the Euronext sample almost every other firm has foreign sales. Second, there is no clear evidence that the Euronext merger led to decreased liquidity for any types of firms, which suggests that the merger may still be Pareto improving.

Nonetheless, the asymmetric distribution of gains is still a concern which is worth contemplating for prospective stock exchange partners. As Magnus Bocker, chief executive of OMX, remarks: “Everyone is starting to see the opportunities that a larger market creates”, while noting that “[a] merger built solely on shareholder value and cost issues will fail” (*Economist*, 2006c&d).

With regards to future work, a similar framework as is applied here may be used to examine the effects of other stock exchange interactions. For example, the OMX merger between the Nordic and Baltic stock exchanges is an interesting case, where the level of cooperation has followed a similar process as the one for Euronext. Outside Europe there are further interesting, unexplored examples of increased merger activity. Besides ongoing transatlantic consolidation of the NYSE and Euronext, takeover attempts for the London Stock Exchange, various flirting with the Tokyo exchange and Indian stock exchanges, etc., many within country mergers have taken place, e.g. in Colombia, Japan and India.

Finally, there are of course various complications and practical issues that this study has set aside. For example, changes in the regulatory environment of stock exchanges will be an important concern in the near future. Above all is the “Market in Financial Instrument Directive” (MiFID) that comes into play in November 2007, which is an EU directive that aims to make cross-border trading in securities in Europe simpler and promote competition between trading venues. This entails breaking up trading monopolies by removing rules that deter competition and promoting new types of trading venues that can be offered by other financial intermediaries, such as banks. But even though a legislative fragmentation of liquidity

may make stock exchange mergers more difficult in practice, it might also make exchange consolidations more beneficial and attractive.

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**Table 1. Dates of Merger Events**

	Members' access to all Euronext securities	Trading system (NSC)	Clearing system (Clearing 21)	Eurolist
Amsterdam	Sept. 2000	Oct. 2001	Oct. 2002	Apr. 2005
Brussels	Sept. 2000	May 2001	Mar. 2002	Apr. 2005
Lisbon	Sept. 2002	Nov. 2003	Nov. 2003	Apr. 2005
Paris	Sept. 2000	Already in place	Jan. 2001	Feb. 2005

Source: Euronext Annual Reports

**Table 2. Summary Statistics**

All figures in the table are from the Thomson One Banker dataset. Panel A reports total figures and panel B reports means, with standard deviations in parenthesis. Non-Euronext firms are firms from the exchanges of Frankfurt (1188 firms), London (2915) and BME (137). Turnover is reported in percentages (multiplied by 100). Foreign sales and domestic assets are average annual figures (not monthly). GDP per capita is average quarterly GDP (billions of EUR) as a proportion of the population (millions) of the country where the exchange is located. GDP per capita for non-Euronext firms consists of GDP of Britain, Germany and Spain. Monthly data on the value of traded shares is provided by the Federation of European Securities Exchanges (not reported in table), where the mean value of volume is 189 (42) bill. EUR for Euronext and 701 (152) for other exchanges.

	Amsterdam	Brussels	Lisbon	Paris	Euronext	Non-Euronext
Panel A: Total figures						
Number of firms	174	204	79	1,049	1,506	4,240
Number of firms w/ for.sales	122	68	30	462	682	1,496
Number of firms w/ for.assets	85	43	15	154	297	995
Proportion of Euronext firms	12%	14%	5%	70%	100%	0%
Prop. of firms in exchange w/for.sales	70%	33%	38%	44%	45%	29%
Prop. of firms in exchange w/for.assets	49%	21%	19%	15%	20%	19%
Panel B: Means (st.dev.)						
Turnover	0.26 (0.45)	0.08 (0.21)	0.16 (0.63)	0.13 (0.48)	0.14 (0.46)	0.23 (0.48)
Foreign sales (mill. EUR)	3,240 (11,300)	913 (2,333)	425 (741)	1,610 (6,180)	1,790 (7,120)	917 (5,940)
Domestic assets (mill. EUR)	3,760 (22,000)	3,760 (14,200)	2,040 (7,980)	2,480 (7,410)	2,910 (13,000)	3,600 (25,200)
Market value (mill. EUR)	3,370 (1,170)	1,260 (5,940)	797 (1,980)	1,480 (7,150)	1,660 (7,610)	1,290 (7,580)
GDP per capita	6.72 (0.90)	6.33 (0.65)	3.08 (0.38)	6.28 (0.59)	6.16 (1.00)	6.72 (0.90)

**Table 3. Merger Effect on Turnover**

The merger dummy shows the combined effect of all four merger events on turnover. Firm size and foreign sales/assets are dummies indicating whether the firm was big/small (in terms of market value) or had foreign sales/assets at the outset of the merger period. Turnover is measured in percentages (multiplied by 100). The average turnover is 0.14 for all firms, 0.09 for small firms, 0.34 for big firms, 0.18 for firms with foreign sales and 0.21 for firms with foreign assets. All regressions include firm fixed effects and monthly dummies. Robust standard errors are reported in parenthesis, clustered by security to allow for heterogeneity and autocorrelation within securities. Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

Turnover	(1)	(2)	(3)	(4)	(5)
Merger	0.04 (0.03)	-0.00 (0.03)	-0.01 (0.03)	0.01 (0.03)	-0.01 (0.03)
For.sales * Merger		0.07*** (0.02)	0.05*** (0.02)		0.04** (0.02)
Small * Merger			0.00 (0.02)	-0.01 (0.02)	0.00 (0.02)
Big * Merger			0.13*** (0.04)	0.19*** (0.06)	0.13*** (0.04)
For.sales * Small * Merger			-0.07 (0.05)		0.00 (0.03)
For.sales * Big * Merger			0.05 (0.06)		0.08 (0.08)
For.assets * Merger				0.05*** (0.02)	0.03 (0.02)
For.assets * Small * Merger				-0.19 (0.13)	-0.19 (0.13)
For.assets * Big * Merger				-0.04 (0.08)	-0.05 (0.10)
GDP per capita	0.07*** (0.02)	0.06** (0.02)	0.06*** (0.02)	0.06** (0.02)	0.06*** (0.02)
Constant	-0.20 (0.12)	-0.14 (0.12)	-0.12 (0.11)	-0.12 (0.11)	-0.13 (0.11)
Fixed effect	Yes	Yes	Yes	Yes	Yes
Monthly dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	113111	113111	113111	113111	113111
Number of firms	1180	1180	1180	1180	1180
R-squared	0.01	0.01	0.01	0.01	0.02

**Table 4. Individual Effect of Merger Events on Turnover**

The four merger dummies show the individual effect of each key merger event on turnover. Firm size and foreign sales/assets are dummies indicating whether the firm was big/small (in terms of market value) or had foreign sales/assets at the outset of the merger period. All regressions include firm fixed effects and monthly dummies. Robust standard errors are reported in parenthesis, clustered by security to allow for heterogeneity and autocorrelation within securities. Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

Turnover	(1)		(2)	
	Coefficient	Standard dev.	Coefficient	Standard dev.
Access	-0.02	(0.02)	-0.04*	(0.02)
Trading	0.03***	(0.01)	0.05**	(0.03)
Clearing	0.05***	(0.01)	0.01	(0.03)
Eurolist	-0.02	(0.02)	-0.03	(0.02)
For.sales * Access			0.01	(0.01)
For.sales * Trading			-0.04	(0.03)
For.sales * Clearing			0.04	(0.03)
For.sales * Eurolist			0.04***	(0.01)
Small * Access			0.02	(0.02)
Small * Trading			-0.02	(0.03)
Small * Clearing			0.03	(0.03)
Small * Eurolist			-0.02	(0.02)
Big * Access			0.14***	(0.04)
Big * Trading			-0.06	(0.04)
Big * Clearing			0.10**	(0.05)
Big * Eurolist			-0.05	(0.04)
For.sales * Small * Access			-0.04	(0.04)
For.sales * Small * Trading			0.02	(0.03)
For.sales * Small * Clearing			-0.04	(0.03)
For.sales * Small * Eurolist			-0.01	(0.02)
For.sales * Big * Access			-0.01	(0.05)
For.sales * Big * Trading			0.08*	(0.04)
For.sales * Big * Clearing			-0.04	(0.06)
For.sales * Big * Eurolist			0.02	(0.05)
GDP per capita	0.07***	(0.02)	0.06***	(0.02)
Constant	-0.20	(0.11)	-0.13	(0.11)
Fixed effect	Yes		Yes	
Monthly dummies	Yes		Yes	
Number of observations	113111		113111	
Number of firms	1180		1180	
R-squared	0.01		0.02	

**Table 5. Merger Effect on Turnover Across Industries**

The merger dummy shows the combined effect of all four merger events on turnover. Firm size and foreign sales/assets are dummies indicating whether the firm was big/small (in terms of market value) or had foreign sales/assets at the outset of the merger period (there are no financial firms that are both small and have foreign sales). Robust standard errors are reported in parenthesis, clustered by security to allow for heterogeneity and autocorrelation within securities. Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

Turnover	Industrial	Techn. manufac.	Cons. goods	Services	Electronics/ Electrical	Financial	Miscellaneous
Merger	-0.02 (0.06)	-0.09 (0.23)	0.01 (0.05)	-0.02 (0.06)	0.17 (0.24)	0.03 (0.03)	-0.08 (0.06)
For.sales * Merger	0.04* (0.02)	0.21* (0.12)	0.06* (0.03)	0.02 (0.04)	0.04 (0.08)	0.10** (0.04)	0.08* (0.04)
Small * Merger	0.02 (0.05)	0.16 (0.12)	0.01 (0.03)	-0.27 (0.18)	-0.07 (0.12)	-0.02 (0.03)	0.04 (0.05)
Big * Merger	-0.01 (0.07)	0.34*** (0.12)	0.06 (0.05)	0.14 (0.12)	0.44*** (0.07)	0.03 (0.03)	0.34*** (0.08)
For.sales * Small * Merger	-0.05 (0.05)	0.04 (0.04)	-0.01 (0.04)	0.07 (0.04)	0.28* (0.17)	(N/A)	-0.07 (0.06)
For.sales * Big * Merger	0.09 (0.08)	-0.01 (0.15)	-0.06** (0.03)	-0.11 (0.12)	0.40* (0.22)	-0.12*** (0.05)	0.09 (0.13)
GDP per capita	0.04 (0.03)	0.26*** (0.08)	0.03 (0.05)	0.11* (0.06)	-0.01 (0.10)	0.07** (0.03)	0.05 (0.05)
Constant	0.01 (0.15)	-1.18*** (0.42)	-0.03 (0.24)	-0.36 (0.29)	0.40 (0.54)	-0.31* (0.18)	-0.13 (0.28)
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Monthly dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean turnover of industry	0.13	0.18	0.13	0.15	0.25	0.09	0.14
Number of observations	21372	6359	14438	8237	13042	19321	30462
Number of firms	213	66	141	94	151	186	330
R-squared	0.03	0.07	0.02	0.05	0.05	0.01	0.03

**Table 6. Merger Effect on Turnover Across Exchanges**

The merger dummy shows the combined effect of all four merger events on turnover. Firm size and foreign sales/assets are dummies indicating whether the firm was big/small (in terms of market value) or had foreign sales/assets at the outset of the merger period (there are no firms small firms with foreign sales listed in Brussels or Lisbon). All regressions include firm fixed effects, but monthly dummies are replaced by a 5<sup>th</sup> order polynomial (flexible time trend). Robust standard errors are reported in parenthesis, clustered by security to allow for heterogeneity and autocorrelation within securities. Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

Turnover	Amsterdam	Brussels	Lisbon	Paris
Merger	-0.07 (0.07)	0.04*** (0.02)	0.07 (0.09)	-0.01 (0.02)
For.sales * Merger	0.02 (0.07)	0.01 (0.02)	-0.01 (0.05)	0.06*** (0.02)
Small * Merger	-0.03 (0.06)	0.03 (0.03)	0.05 (0.04)	-0.00 (0.03)
Big * Merger	-0.05 (0.07)	0.19*** (0.05)	-0.17*** (0.04)	0.22*** (0.05)
For.sales * Small * Merger	-0.10 (0.07)	(N/A)	(N/A)	0.01 (0.03)
For.sales * Big * Merger	-0.15* (0.09)	-0.03 (0.06)	-0.00 (0.09)	0.09 (0.07)
London turnover	1.20*** (0.15)	0.33*** (0.04)	1.19*** (0.45)	0.55*** (0.05)
GDP per capita	-0.02 (0.05)	-0.02 (0.05)	-0.00 (0.26)	0.07*** (0.09)
Constant	0.09 (0.24)	0.11 (0.27)	-0.03 (0.61)	-0.31 (0.49)
Fixed effect	Yes	Yes	Yes	Yes
Monthly dummies	No	No	No	No
Flexible time trend	Yes	Yes	Yes	Yes
Number of observations	16085	13307	6514	77205
Number of small firms	6	12	15	110
Number of big firms	25	12	10	63
Number of firms w/ for.sales	123	69	30	468
Number of firms in total	148	138	67	827
R-squared	0.04	0.03	0.03	0.01

**Table 7. Robustness of Merger Effect on Turnover**

The merger dummy shows the combined effect of all four merger events on turnover. Regression (1) drops monthly dummies and instead includes a 5<sup>th</sup> order polynomial (flexible time trend). Also included is the average monthly turnover of London listed firms, which controls for non-related merger events that influence world markets (avg. monthly turnover in London and Euronext is about the same). Regression (2) uses a 20% cutoff (instead of 10%) when defining big/small firms. Regression (3) defines firm size in terms of domestic asset value (instead of market value of outstanding shares). Regression (4) uses logs of foreign sales figures (in billions of Euros) in January 2000 instead of the previous dummy specification. Regression (5) repeats (4) where the dummy definitions for size are also replaced by logs of actual market values. In regression (5) the exact coefficient values on the interactions of foreign sales and size is -0.0003 (0.0002) and 0.0002 (0.0001), respectively. Finally, regression (6) compares the change in liquidity before and after the merger events (1<sup>st</sup> difference) between firms listed on Euronext and firms listed in Frankfurt/BME (2<sup>nd</sup> difference). The merger dates for Frankfurt and BME listed firms are assumed to be September 2000, May 2001, March 2002 and April 2005. The data sample includes 1188 Frankfurt listed firms and 137 BME listed firms. Robust standard errors are reported in parenthesis, clustered by security to allow for heterogeneity and autocorrelation within securities. Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

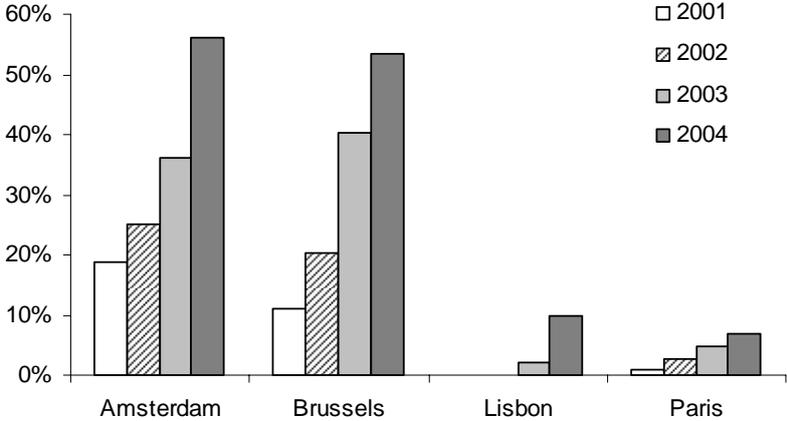
Turnover	(1) Flex. trend	(2) Cutoff 20%	(3) Assets as size	(4) Log f.sales	(5) Log f.sal. & size	(6) Control gr.
Merger	0.01 (0.02)	-0.01 (0.03)	-0.01 (0.03)	0.00 (0.03)	0.00 (0.03)	-0.01 (0.02)
For.sales * Merger	0.05*** (0.02)	0.04* (0.02)	0.06*** (0.02)	0.003*** (0.001)	0.003*** (0.001)	
Small * Merger	-0.00 (0.02)	0.00 (0.02)	-0.00 (0.04)	-0.02 (0.02)	-0.001 (0.001)	
Big * Merger	0.13*** (0.04)	0.11*** (0.03)	0.05*** (0.02)	0.10*** (0.03)	0.004*** (0.001)	
For.sales * Small * Merger	-0.07 (0.05)	0.01 (0.04)	-0.06 (0.05)	-0.004 (0.003)	-0.000 (0.000)	
For.sales * Big * Merger	0.05 (0.06)	0.05 (0.04)	0.06* (0.03)	0.004 (0.003)	0.000 (0.000)	
London turnover	0.64*** (0.05)					
Frankfurt listed * Merger						-0.06*** (0.02)
BME listed * Merger						-0.12* (0.07)
GDP per capita	0.06*** (0.02)	0.05** (0.02)	0.06** (0.02)	0.05** (0.02)	0.05** (0.02)	0.04* (0.02)
Constant	-0.27** (0.11)	-0.08 (0.11)	-0.13 (0.12)	-0.10 (0.11)	-0.09 (0.11)	-0.05 (0.12)
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Monthly dummies	No	Yes	Yes	Yes	Yes	Yes
Flexible trend	Yes	No	No	No	No	No
Number of observations	113111	113111	113111	113111	113111	184818
Number of firms	1180	1180	1180	1180	1180	2060
R-squared	0.01	0.02	0.01	0.02	0.02	0.01

**Table 8. Merger Effect on Market Shares of Exchanges**

The merger dummy shows the combined effect of all four merger events on market shares of stock exchanges, where market share is reported in percentage units. Market share is defined in terms of the Euro value of trading volume. The data, which is provided by the Federation of European Securities Exchanges, is from January 2000 to August 2006, i.e. 480 observations in total (80 for each exchange). The event dates for all exchanges are set to September 2000, May 2001, March 2002 and April 2005. In panel A a system of equations is estimated simultaneously (SURE regression), with the dependent variable in each equation being market share of the particular stock exchange. Panel B estimates each equation separately (OLS). Panel C makes small sample adjustments (to panel A) in calculating standard errors. Specifically, this implies using an alternative divisor in computing the covariance matrix for the equation residuals, i.e.  $\hat{\sigma}_{ij} = e_i e_j / n$  is replaced by  $\hat{\sigma}_{ij} = e_i e_j / \sqrt{(n - k_i)(n - k_j)}$ , where  $k_i$  and  $k_j$  are the number of parameters in equations  $i$  and  $j$ . Significance is reported at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level.

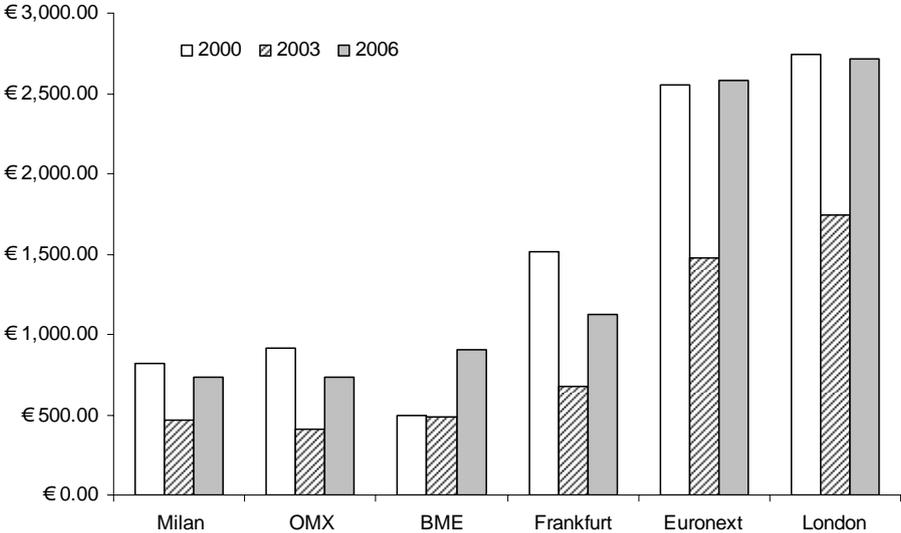
Market Share	Euronext	Frankfurt	London	BME	Milan	OMX
<i>Panel A</i>						
Merger	2.18** (0.91)	0.74 (0.81)	-5.78*** (1.72)	1.44 (1.08)	1.90* (1.02)	-0.13 (0.52)
GDP per capita	-1.52 (2.65)	-4.85*** (1.80)	4.98 (4.22)	7.13** (3.38)	-6.33** (2.74)	1.63** (0.58)
Constant	28.39* (16.48)	39.52*** (6.88)	9.08 (23.84)	-22.22* (13.38)	41.06*** (13.75)	-4.15 (4.19)
Flexible trend	Yes	Yes	Yes	Yes	Yes	Yes
Mkt.sh. in Jan.2000	20.5%	18.7%	38.2%	7.6%	8.0%	7.0%
Number of obs.	80	80	80	80	80	80
R-squared	0.31	0.69	0.52	0.72	0.32	0.44
<i>Panel B</i>						
Merger	2.13* (0.98)	0.77 (0.87)	-5.13*** (1.90)	1.72 (1.18)	2.04* (1.10)	-0.20 (0.56)
GDP per capita	-8.68 (6.45)	-6.41* (3.39)	22.53* (11.77)	16.76** (7.59)	-18.49*** (5.35)	2.34** (0.91)
Constant	72.77 (40.04)	45.39*** (12.86)	-89.73 (66.28)	-60.20** (29.98)	101.91*** (26.82)	-9.14 (6.53)
Flexible trend	Yes	Yes	Yes	Yes	Yes	Yes
Mkt.sh. in Jan.2000	20.5%	18.7%	38.2%	7.6%	8.0%	7.0%
Number of obs.	80	80	80	80	80	80
R-squared	0.32	0.69	0.54	0.73	0.37	0.45
<i>Panel C</i>						
Merger	2.18** (0.98)	0.74 (0.87)	-5.78*** (1.86)	1.44 (1.16)	1.90* (1.10)	-0.13 (0.56)
GDP per capita	-1.52 (2.86)	-4.85** (1.94)	4.98 (4.55)	7.13** (3.64)	-6.33** (2.95)	1.63** (0.63)
Constant	28.39* (17.75)	39.52*** (7.41)	9.08 (25.67)	-22.22 (14.41)	41.06*** (14.80)	-4.15 (4.51)
Flexible trend	Yes	Yes	Yes	Yes	Yes	Yes
Mkt.sh. in Jan.2000	20.5%	18.7%	38.2%	7.6%	8.0%	7.0%
Number of obs.	80	80	80	80	80	80
R-squared	0.31	0.69	0.52	0.72	0.32	0.44

**Figure 1. Share of Trade by Non-local Euronext Members**



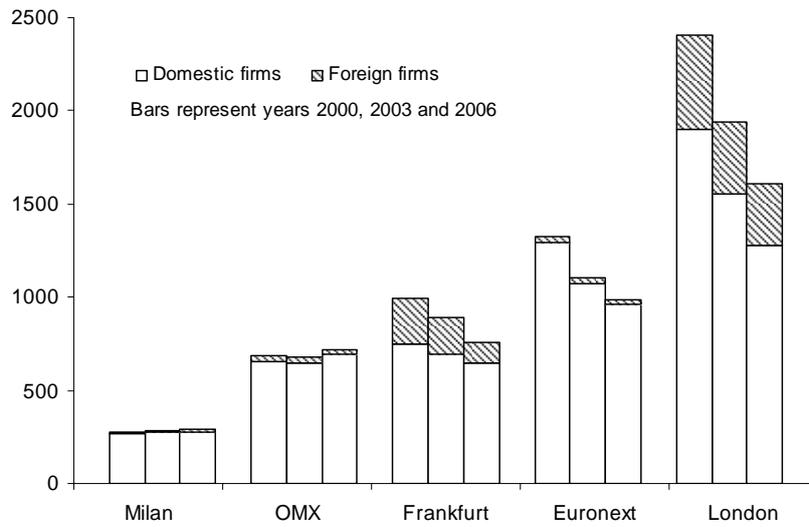
Source: Euronext Annual Reports

**Figure 2. Market Capitalization (EUR bill.)**



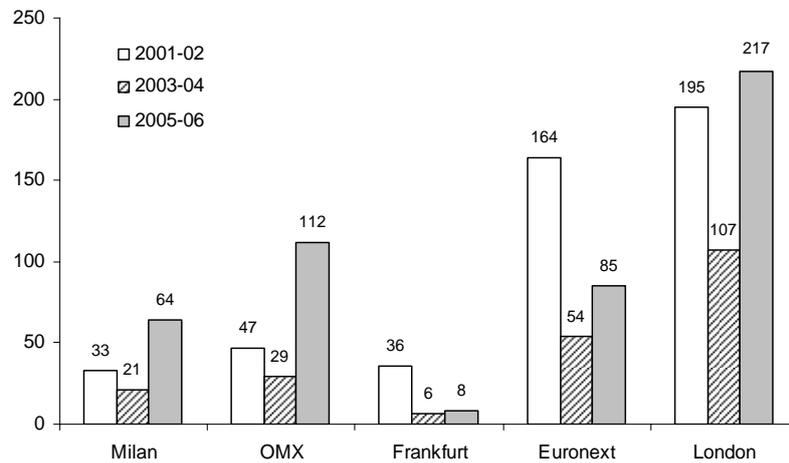
Source: Federation of European Securities Exchanges

**Figure 3. Number of Firms Listed**



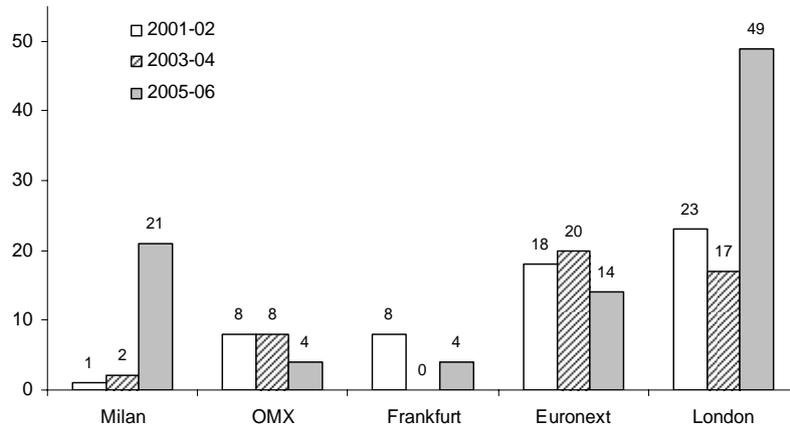
Source: Federation of European Securities Exchanges and London Stock Exchange

**Figure 4. Number of New Firms Listed**



Source: Federation of European Securities Exchanges and London Stock Exchange

**Figure 5. Number of New Foreign Firms Listed**



Source: Federation of European Securities Exchanges and London Stock Exchange