

What Drives Stock Exchange Integration?

Abstract

In the last 15 years stock markets experienced an internationalization process that involved most of the main stock exchanges in M&As or other agreements in order to develop more international trading venues. The high number of stakeholders involved in this integration process made the development of the market structure unclear and the drivers of its evolution unknown.

The aim of this paper is to shed light on the determinants of stock markets integration, trying to figure out the key drivers of the process. Using weekly stock index returns of stock exchanges from different countries in a worldwide perspective, from 1995 to 2010, various measures have been applied in order to test the relevance of possible explanatory variables. Correlation and cluster analysis have been used to investigate the similarities between different market performances. A Johansen cointegration test estimated the presence of multilateral long run equilibrium among integrated stock exchanges, while a regression analysis identified a set of explanatory variables of stock exchange integration.

Results suggest that financial regulation, cross-membership agreements, for-profit orientation of the corporate governance of the stock exchange and their integration openness are important drivers of M&As in stock exchange industry. By contrast, the size of stock exchanges negatively affect the likelihood of successful mergers.

Keywords – Stock market integration, Johansen cointegration test, logit

JEL Classification: G15, G17

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Introduction

The integration of stock markets can be considered as one of the most significant changes in the global financial market. The old fashioned pictures of stock exchanges as open outcry markets does not represent stock markets anymore. The demutualization of stock exchanges removed the cultural, economic and regulatory barriers to the development of new companies, called to manage more than one stock markets at once. The new opportunities provided by the ICT supported the development of stock exchanges in doing their business and made international stock exchanges feasible.

This new market framework has been widely analysed by the literature. Many authors confirm that alliances, mergers and other forms and attempts of cooperation between stock and derivatives exchanges represent a new strategy in order to increase the value of stock exchange markets (Cybo-Ottone et al., 2000; Domowitz, 1995; Domowitz and Steil, 1999; Hasan and Schmiedel, 2004; Lee, 1998). Many scholars indicate that deregulation, globalization and technological developments are among the main reasons of development of the stock exchange integration phenomenon that have altered the business strategies of stock exchanges around the world. The traditional role played by stock exchanges as controlled and governed by its members or government is being questioned due to the recent spectacular advances, which in turn has put more pressure on stock markets to change their governance structure to be more cost efficient, transparent and widely accountable. Moreover, the literature confirms the increasing convergence of international stock markets in recent years (Karolyi and Stulz, 2001; Eun and Lee, 2010; Mishkin, 2007). As a result, stock exchange markets started to change their structures to be integrated, consolidated, merged or allied with other stock exchanges either domestically or cross-borders. Thereby, the continued globalisation of financial and securities markets resulted in a rapid expansion of cross-border trading, custody, clearing and settlement activity.

However, there is still a gap in the literature, trying to analyse the stock exchange integration in a comprehensive manner. Moreover, there is some evidence that latent factors may also determine the integration processes between stock exchange markets worldwide. Recent cross-border mergers between NYSE - Euronext (2007) and NASDAQ - OMX (2008) have provided additional case studies to verify the relevant factors of successful integration projects. Furthermore, even the failed attempts of integration represented by TMX Group and London Stock Exchange (2011), Singapore Stock Exchange and Australian Stock Exchange (2011) and NYSE Euronext and Deutsche Börse (2012) have opened new research possibilities to investigate the factors of stock exchange integration.

Moreover, this paper aims to contribute both to the understanding in the academic literature, as well as to the professional practitioners' knowledge of the possible drivers of integration processes between stock exchange markets worldwide. Therefore, the aim of this paper is to shed light on the determinants of M&A projects in stock exchange industry. Thus, the main research questions is formulated as follows: what drives stock exchange integration? The answer of the question is especially important in terms of current financial crisis, where de jure financial linkages between stock exchange markets decrease diversification opportunities for investors and can be also the channels of potential spillover effects and regional shocks.

Overall, this analysis suggests that several characteristics are strong predictors of the likelihood to conclude an integration project during the period of 1995-2010. Moreover, the research confirms the complexity of the integration process, and how it depends on different macroeconomic, structural, cultural-geographical and operative forces. The explanatory power of different variables, that have been supposed to be relevant on a theoretical base by previous studies,

is confirmed by empirical evidence. Specifically, the final results demonstrate that financial harmonization, cross-membership agreements, for-profit corporate structure and integration openness are important drivers of stock exchange fusion. By contrast, a large size of stock exchange market has a negative impact on the likelihood of a successful merger. These results offer a clear support to the growing regulatory attention on stock exchange business and on the need to impose more stringent requirements to decrease the risk of financial contagion, that are generally in line with previous findings reported in the literature.

The rest of paper is organised as follows. A literature review summarises the state of the art of research on stock market integration. The second section describes the data selection and how the variables employed in the empirical analysis. The third section contains the methodology. The fourth section is an empirical part that investigates the determinants of stock market integration, using multistage statistical data analysis. The last section contains concluding remarks and further policy implications.

1. Literature review

The studies related to stock market integration can be summarised in three main areas. Studies related to the definition of financial integration from a theoretical point of view, providing the initial framework to the following researches. A second research field collects studies that analyse the determinants of stock markets integration, while the third area concerns the consequences of having these new global players for the functioning of the financial system. Previous studies confirms a clear market trend toward an internationalisation of stock exchange business since the '90s (Hasan et al. 2010). Furthermore, academic literature demonstrates a huge interest in this topic, trying to analyze it in different ways. However, the complexity of this phenomenon and different points of view adopted by scholars suggest the need for a clear definition of stock exchange integration. The literature provides diverse definitions and approaches of financial integration both from a micro and macro perspectives. According to the law of one price, Pieper and Vogel (1997) define integrated markets as “markets where investors can, in one country, buy and sell without restriction equities that are issued in another country and as a result identical securities are issued and traded at the same price across markets after adjustment for foreign exchange rates”. In terms of risk sharing, Korajczyk (1999) suggests that if equity markets are financially integrated, the price of risk should be the same across markets. Moreover, Bekaert and Harvey (2003), argue that in integrated equity markets, domestic investors are able to invest in foreign assets and foreign investors in domestic assets; hence, assets of identical risk command the same expected return, regardless of trading location. Finally, Bhalla and Shetty (2006) formulate macroeconomic definition stock exchange integration, showing that those events in one country will have its impact felt in the financial markets of other countries.

To analyse the nature of pre-trading integration and the determinants of stock exchange integration, the following broad definition of financial stock exchange integration is used in this research in accordance with Baele et al. (2004) and Schmiedel and Schonenberger (2005). In fact, the market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics (1) face the same set of rules when they decide to deal with those financial instruments and/ or services, (2) have equal access to the above-mentioned set of financial instruments and/or services, and (3) are treated equally when they are active in the market. This definition suggests that financial stock exchange integration includes also legal and operational integration.

In terms of the development of stock exchange integration phenomenon, Hasan and Schmiedel (2004) indicate that deregulation, globalization, and technological developments have altered the business strategies of stock exchanges around the world. Many scholars confirm the increasing convergence in international stock markets in recent years (Karolyi and Stulz, 2001; Eun and Lee, 2006; Mishkin, 2007; Christos and Nektarios, 2009). The traditional role played by stock

exchanges as self-regulatory, controlled and governed by members or governments is being questioned due to the recent spectacular advances in information technology, globalization, growing competition, which in turn has put more pressure on stock markets to change their governance structure in order to be more cost efficient, transparent and widely accountable. As a result, stock exchanges started changing their structures and then integrated, consolidated, merged or allied with other stock exchanges either domestically or cross-borders. Moreover, there are different forms of integration that can be presented as steps towards the full integrated stock exchange: cross border deals, restructuring (domestic mergers), cross remote membership, cross listing, cross membership and cross listing, and other forms of alliances (Shy and Tarkka, 2001; Hasan and Schmiedel, 2004; Armanious, 2005; Nicolini, 2010). Di Noia (1998) showed that the increase in competition among the securities markets in Europe, has produced mergers, technological agreements takeovers, and the creation of new exchanges, even within the same country. Thereby, the continued globalisation of financial and securities markets, resulted in a rapid expansion of cross-border trading, custody, clearing and settlement activity. Finally, Polato and Floreani (2009) show that in recent years stock exchange markets have undergone a process of consolidation aimed at improving their scale and diversifying their activities, where nowadays two stages of the process could be enucleated. In a first stage, consolidation engaged mainly European markets. The main references are the Euronext exchange and the Nordic exchange, but in recent years the phenomenon is expanding, involving even American exchanges.

Thus, if the previous research studies provide the main features of the new regulatory and technological framework that make the integration between stock exchanges feasible mainly from a macroeconomic perspective, this study investigates the stock exchange behaviours in the integration processes, trying to figure out the main drivers that lead them to be part of a new (international) market institution. In this way, the consequences of integration processes among financial markets become especially important. The relevance of consequences related to the integration between stock exchanges for different stakeholders is confirmed by many scholars. For the financial institutions and investors, market integration allows economies of scale and scope and long-term gains from international diversification (Kim and Singal, 2000; Goetzmann et al. 2005; McAndrews and Stefanadis, 2002; Neumann et al. 2002; Carretta and Nicolini, 2006; Syllignakis and Kouretas, 2011). An integrated market supports the intermediaries and the issuers that benefit from higher efficiency and transparency, and they will avoid the duplication of costs related to the market infrastructure (Pagano and Padila, 2005; Varadi and Boppana, 2009). Furthermore, the investors benefit from more diversified portfolios, higher market liquidity and decreased volatility (Polato and Floreani, 2010; Dorodnykh and Youssef, 2012). In other words, the integration of the stock markets seems to be desirable for all its participants.

New evidence on the consequences that integration can have on financial markets have been provided by the recent financial crises, that showed the role stock of exchange integration in terms of financial contagion and difficulties in providing adequate risk diversification opportunities. According to Schmukler and Zoido-Lobaton (2011) the imperfections in financial markets can generate bubbles, irrational behaviour, herding behaviour, speculative attacks, and crashes among other things. Moreover, even though domestic factors tend to be key determinants of crises, there are different channels through which stock exchange integration can be related to crises. In particular, financial linkages can also trigger contagion through potential spillover effects and regional shocks. Finally, as many authors confirm, countries with internationally traded financial assets and liquid markets tend to be subjected to contagion (Alen and Gale, 2000; Lagunoff and Schreft, 2001; Claessens and Forbes, 2004). The analysis of related literature and important consequences of market integration highlight the relevance of present study to further investigate the causes of stock exchange fusion for better early warning modelling.

2. Data

The lack of an available database on stock market integration requested to collect the data in order to construct a cross-country panel data of European and International stock markets' characteristics. Each country is represented by its national stock exchange market. Due to the limited availability of high frequency macroeconomic data, the analysis used annual macroeconomic control variables. This practice is consistent with previous studies (e.g. Kim et al. 2006). Data are referred to the 16-year long period from 1995 to 2010.

All the following geographic areas are represented: North America, Latin America, Africa and Middle East, Asia and Oceania. The list of analysed international stock markets is reported in Table 1.

Table 1: Sample of Analysed International Stock Exchange Markets

GEOGRAPHICAL REGION	NAME OF STOCK EXCHANGE
NORTH AMERICA AND CANADA	Nasdaq (USA), Nyse (USA), Toronto Stock Exchange (CANADA);
LATIN AMERICA	Sao Paulo Stock Exchange (BRAZIL), Buenos Aires Stock Exchange (ARGENTINA), Colombia Stock Exchange (COLOMBIA), Mexican Stock Exchange (MEXICO), Santiago Stock Exchange (CHILE), Lima Stock Exchange (PERU);
OCEANIA AND ASIA	New Zealand Stock Exchange (NEW ZEALAND), Australian Securities Exchange (AUSTRALIA); Shenzhen Stock Exchange (CHINA), Hong Kong Stock Exchange (CHINA), National Stock Exchange of India (INDIA), Jakarta Stock Exchange (INDONESIA), Tokio Stock Exchange (JAPAN), Singapore Stock Exchange (SINGAPORE), Korea Stock Exchange (SOUTH KOREA);
AFRICA AND MIDDLE EAST	Egypt Stock Exchange (EGYPT), Saudi Stock Exchange (SAUDI ARABIA), Johannesburg Stock Exchange (SOUTH AFRICA); Tel Aviv Stock Exchange (ISRAEL)
WESTERN EUROPE	EURONEXT, Brussels Stock Exchange (BELGIUM), Paris Stock Exchange (FRANCE), Amsterdam Stock Exchange (NETHERLANDS), Lisbon Stock Exchange (PORTUGAL), Frankfurt Stock Exchange (GERMANY), Vienna Stock Exchange (AUSTRIA), Swiss Stock Exchange (SWITZERLAND), Italian Stock Exchange (ITALY), London Stock Exchange (UK), Irish Stock Exchange (IRELAND), Luxembourg Stock Exchange (LUXEMBOURG), Athens Stock Exchange (GREECE), Madrid Stock Exchange (SPAIN), Barcelona Stock Exchange (SPAIN), Valencia Stock Exchange (SPAIN), Bilbao Stock Exchange (SPAIN);
NORTHERN EUROPE	OMX Nordic Stock Exchange, Stockholm Stock Exchange (SWEDEN), Helsinki Stock Exchange (FINLAND), Copenhagen Stock Exchange (DENMARK), Oslo Stock Exchange (NORWAY);
EASTERN EUROPE	Prague Stock Exchange (CZECH REPUBLIC), Warsaw Stock Exchange (POLAND), Bucharest Stock Exchange (ROMANIA), Russian Stock Exchange (RUSSIA), Budapest Stock Exchange (HUNGARY).

There are 27 European countries that are represented by their stock exchanges: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland and the United Kingdom. Moreover, 22 international stock exchanges are analysed from the following countries: Argentina, Australia, Canada, China, Colombia, Egypt, India, Indonesia, Israel, Japan, Mexico, New Zealand, Peru, Saudi Arabia, Singapore, South Africa, South Korea and USA.

To identify which of the selected stock markets have been integrated during 1996-2010, the analysis considered the following successful stock exchange integration projects: EURONEXT (2000), BME (2002), OMX (2003-2006), LSE-BORSA ITALIANA (2007), CEE GROUP (2009), NYSE-EURONEXT (2007), NASDAQ OMX GROUP (2008), MERCADO INTEGRADO LATINOAMERICANO (2009). The full sample of analysed integration projects is reported in Table 2.

Table 2: List of the integration projects

INTEGRATION PROJECT	MARKETS	YEAR OF INTEGRATION
<i>European Markets</i>		
EURONEXT	Amsterdam Stock Exchange	September 2000
	Brussels Stock Exchange	September 2000
	Paris Stock Exchange	September 2000
	Lisbon Stock Exchange	September 2002
BME	Madrid Stock Exchange	February 2002
	Barcelona Stock Exchange	February 2002
	Bilbao Stock Exchange	February 2002
	Valencia Stock Exchange	February 2002
OMX	Stockholm Stock Exchange	September 2003
	Helsinki Stock Exchange	September 2003
	Copenhagen Stock Exchange	January 2005
	Oslo Stock Exchange (10% stake)	October 2006
LSE-BORSA ITALIANA	London Stock Exchange	March 2007
	Italian Stock Exchange	March 2007
CEE GROUP	Vienna Stock Exchange	September 2009
	Prague Stock Exchange	September 2009
	Budapest Stock Exchange	September 2009
	Ljubljana Stock Exchange	September 2009
<i>International Markets</i>		
NYSE-EURONEXT	Euronext Stock Exchange	September 2007
	New York Stock Exchange	September 2007
NASDAQ OMX GROUP	Nasdaq	March 2008
	OMX	March 2008
MILVA	Bolsa de Valores de Colombia	December 2009
	Lima Stock Exchange	December 2009
	Santiago Stock Exchange	December 2009

The total sample of European integrated stock markets counts 18 stock exchange markets, meanwhile the total sample of international integrated stock markets consists of 5 stock exchange markets. To test the level of integration within international stock markets from 1995 to 2010 via correlation and cluster analysis, we use a single national stock market indexes for each stock exchange. All indexes are gathered on a weekly base, and they are reported in US dollars. The data source is Datastream (by Thomson Financial). The final sample includes general price indexes of 49 national stock markets between 1995 and 2010. From the time series of price indexes, continuously compounded returns for all 49 stock indexes have been calculated as:

$$R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

In order to investigate the main drivers of an integration process between stock exchanges, data for potential variables have been collected. The list of possible drivers of integration is based on the analysis of previous studies. The awareness that integration can be the result of different decision paths suggested to test the explanatory power of different set of variables: macroeconomic variables, development variables, regulation variables, structural variables, stock exchange regulation variables and trading variables. The full list of control variables is reported in Table 3.

Table 3: List of control variables

Name	Unit	Definition	Source
<i>Macroeconomic variables</i>			
Union	Dummy	Country participation in trade and political unions	Authors' calculation based on the data provided by www.bilaterals.org
Currency	Dummy	Country participation in monetary union (sharing the same currency)	Authors' calculation based on the data provided by www.singleglobalcurrency.org
Trade Openness	Ratio	Degree of trade openness=(Exports+Imports)/GDP as in Rodriguez (2000)	Authors' calculation based on OECD, IMF
GDP	Index	GDP of country (US \$, current prices, current PPPs)	Authors' calculation based on World Bank
<i>Development variables</i>			
Market Development	Ratio	Stock Market Capitalization / GDP	Authors' calculation based on World Bank
Market Value	Ratio	Stock Market Total Value Traded /GDP	Authors' calculation based on World Bank
Market Size	Ratio	Number of listed companies per 10k population	Authors' calculation based on World Bank
Turnover	Ratio	Total value of shares traded during the period divided by the average market capitalization for the period.	Authors' calculation based on World Bank
<i>Regulation variables</i>			
Regulatory Quality	Index	Yearly index (-2.5 - 2.5) reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	Authors' calculation based on the Worldwide Governance Indicators (2012)
Financial Regulation	Dummy	Legislative acts, directives and other harmonization acts, issued by Regulation Authorities that can influence on the decision of stock exchange integration.	Authors' calculation based on official publications of the EC Commission and national Regulators
<i>Stock exchange variables</i>			
Market Capitalization	Discrete	Market capitalization of stock exchange markets.	Authors' calculation based on WFE, FESE, World Bank
Cross-Membership	Dummy	Presence of cross-membership agreement	Authors' calculation based on individual Stock Exchange Annual Reports
Demutualization	Dummy	Change of governance structure of Stock Exchange Market	Authors' calculation based on individual Stock Exchange Annual Reports
Self-Listing	Dummy	Self-listing of Stock Exchange Market	Authors' calculation based on individual

			Stock Exchange Annual Reports
Shareholder	Dummy	Presence of another stock exchange among shareholders	Authors' calculation based on individual Stock Exchange Annual Reports
Acquisition Attempt	Dummy	Presence of hostile takeover attempt by another the stock exchange market.	Authors' calculation based on individual Stock Exchange Annual Reports
<i>Trading Variables</i>			
Average Traded	Discrete	Average amount traded per day (Mln, US \$)	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Equities	Discrete	Total number of traded equities	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Bonds	Discrete	Total number of traded bonds	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Listed Companies	Discrete	Total number of listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Domestic	Discrete	Total number of domestic listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Foreign	Discrete	Total number of foreign listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Foreign Ratio	Ratio	Ratio of foreign listed equities to total number of listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Delisting	Discrete	Number of delisting companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
<i>Operative Variables</i>			
Trading Platform	Dummy	Sharing the same trading software with another stock exchange market	Authors' calculation based on Stock Exchange Annual Reports
Post-Trading Operator	Dummy	Sharing the same post-trading operator with another stock exchange market	Authors' calculation based on Stock Exchange Annual Reports
<i>Control Variables</i>			
Integration Openness	Index	Overall correlation index calculated for each stock market index, measuring the degree of association with other indexes from the sample	Authors' calculation on Datastream data and correlation analysis

Region	Dummy	Presence in the same cluster of three or more stock exchange markets from the same geographical region. Geographical classification is done according to UN macro geographical regions: Eastern Europe, Western, Northern Europe, Southern Europe, Latin America and the Caribbean, Northern America, Africa and Middle East, Asia and Oceania.	Authors' calculation on Datastream data and cluster analysis
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To identify the determinants of stock exchange integration, the analysis is started with a set of macroeconomic variables that are normally associated with country characteristics. **Union** and **Currency** variables are used as dummy variables of country's participation in trade and monetary unions. In particular, the importance of different trade unions, political unions and monetary unions in the financial integration is highlighted by many authors. For example, Heaney et al. (2000) justified that one of the main reasons in regional equity integration is macro-economic integration, which is largely due to trading block formation, where the European financial markets are the result of removals of exchange rate controls and the establishment of common criteria towards the formation of a common currency system together with policy coordination and market liberalization. Moreover, the role of sharing a unique currency in the European financial integration was proved by Kim et al. (2005, 2006), showing the effectiveness of the economic convergence criteria associated with the EMU in driving integration process across the member states. Hooy and Goh (2009) in their study also found that affiliations to trading bloc explain the different level of market integration. The role of **Trade Openness** is tested as one of the factor of integration (Pretourius, 2002). According to Arribas et al. (2006) and Walti (2005), the increased trade openness is also one of major factors influencing globalization, which starts with the openness of economies. Finally, following Edison et al. (2002), Prasad et al. (2003), Vo (2005), Mishkin (2007), **GDP** is controlled as the evidence of financial international integration among developed and rich countries.

A second group of variables includes macroeconomic characteristics of stock market development. **Market Development** is tested as the stock market capitalization to GDP, measuring the importance of the stock market. Stock markets could be sizable because of the large number of listings, but may be illiquid or shallow because of the lack of active trading. Hence, to control for stock market illiquidity, the variables **Market Value** is used as the stock market value traded to GDP and **Turnover** ratio as the total value of shares traded during the period divided by the average market capitalization for the period. Following Beck et al. (2010), Allen et al. (2012), we also use **Market Size** as the number of listed companies per 10k population.

A third group of variables controls for financial reforms and institutional frameworks in the sample countries. According to Vo (2006), regulation of financial markets and official control on cross-border capital movements can explain variation in international financial integration, where a high degree of international financial integration must be associated with the free capital mobility without any impediment. Using the database of Worldwide Governance Indicators, the index of **Regulatory Quality** is constructed, reflecting the perceptions of government ability to formulate and implement sound policies and regulations that permit and promote financial sector development. Moreover, Kokkoris and Olivares-Caminal (2007), Aggarwal et al. (2010) in their studies show that equity market integration is driven by market variables and legislative changes but constrained by regulatory barriers. Thus, **Financial Regulation** is employed as a variable to check the role of financial harmonization acts in terms of stock exchange integration.

The literature on the determinants of stock exchange integration suggests that the nature of stock exchange market can be a relevant factor of the integration phenomenon. Thus, a fourth group of variables control for individual stock exchange characteristics. In particular, Buttner and Hayo (2011) in their empirical study found that the size of relative and absolute market capitalisation is also one of the determinants of equity market integration. This idea was also confirmed by Tan et al. (2010), in explaining the nature of the underlying financial integration dynamics and information

transmission. Accordingly, **Market Capitalization** is calculated as annual capitalization of each stock exchange market. Next, many studies also confirm that stock exchange stakeholders can create important non-official integration links, which can be the first steps towards consolidation. Following El Serafie and Abdel Shahid (2002) and Armanious (2005), thus, the **Cross-Membership** variable is tested. The change of organizational structure of exchanges was found to be a very relevant factor in integration decision (Aggarwal 2002; Aggarwal and Dahiya, 2006). The **Demutualization** variable is employed to check the role of the organizational transformation of the stock exchanges into for-profit corporations. The **Self-listing** variable was added according to the idea that exchanges perform better than their non-listed counterparts as self-listed exchanges are seeking the profit and may create integration projects. Moreover, **Shareholder** controls for the presence of another stock exchanges among main shareholders. In fact, as Nicolini (2010) reports, if two or more exchanges are controlled by different management companies, but governed by the same shareholders, their competitive behaviour and the chances of integration between markets could be different. Finally, to account for differences in a stock exchange's behaviour after the hostile takeover attempt, the **Acquisition Attempt** variable was added.

Theoretical analysis of integrated stock exchange markets both in Europe and abroad suggests that the integration is a complex process, where some new variables can be tested. In particular, to control the individual performance of each stock exchange market **Average Traded** is defined as the average amount traded per day by each stock market. Following the hypothesis that specialization in trading of particular instruments can increase the probability of a new integration project with the aim to create a more important trading venue. The variables of the total number of traded equities (**Equities**) and bonds (**Bonds**) were added to control the specialization of stock exchanges. Furthermore, the control for the total numbers of domestic and foreign listed companies with shares (**Listed Companies, Domestic, Foreign**) can show the level of stock exchange development. Moreover, **Foreign Ratio**, defined as the ratio between foreign and total listed companies, indicates the openness of stock exchange market for integration project. Finally, the **Delisting** variable was added to test the number of delisting companies as important characteristics of the stock exchange market.

Operative variables can be also considered as one of the most important factors of integration decisions. Following Aggarwal (1999), pointing out that technology is making globalization more feasible, **Trading Platform** and **Post-Trading** variables were defined as sharing a common software and the same post-trading operator between stock exchange markets. In fact, the role of non-official electronic integration between international markets was confirmed by many authors (Van Cayseele and Wuyts, 2007; Nicolini, 2010). According to Schmiedel and Schonenberger (2005), the developments in information and communication technology have increased pressure for further consolidation of securities trading, clearing, custody and settlement on a global scale. Meanwhile El Serafie and Abdel Shahid (2002) explain the most successful cases of integration among stock exchanges due to the technology or the development of trading systems that made fast, reliable and cost-effective cross border trading.

There is some evidence in the literature about several other latent factors that may also determine the integration processes between stock exchange markets worldwide. Many scholars, studying the variables of financial integration, indicate the role of geographical and cultural variables among principal drivers of global economic integration (Guerin, 2006; Fridlund, 2005; García-Herrero and Wooldridge, 2007; Sinha and Pradhan, 2008).

Finally, stock exchanges of the same geographic area can improve their external efficiency and pursue a growth strategy through regional financial integration partnerships. To confirm the role of regional integration, the variable **Region** is used as the presence in the same cluster of three or more stock exchange markets from the same geographical region in order to control the cooperation between neighbouring regions. Geographical classification is done according to Table 1. The variable **Integration Openness** is also introduced as an index estimated yearly for each stock exchange market with other stock indexes from the sample, to measure the common degree of financial integration with other stock markets worldwide.

Descriptive statistics for the above mentioned control variables are reported in Table 4. Data are reported separately for integrated and non-integrated stock exchanges.

Table 4: Descriptive statistics of variables

	Integrated Stock Exchange Markets						Non-Integrated Stock Exchange Markets					
	N	Mean	Median	St. Dev	1 Pctile	99 Pctile	N	Mean	Median	St. Dev	1 Pctile	99 Pctile
Union	114	0.921	0.271	1	1	1	568	0.695	0.461	1	0	1
Currency	114	0.456	0.500	0	0	1	568	0.120	0.325	0	0	0
Trade Openess	114	0.746	0.341	0.654	0.543	0.949	568	0.734	0.567	0.585	0.448	0.770
GDP	114	2164851	4190465	388049	244645	1477840	568	1119647	1996884	350645	148010	1061033
Market Development	102	385.8	302.2	246.3	126.2	661.2	547	175.175	183.617	113.490	38.338	221.939
Market Value	102	103.431	93.912	91.935	23.85	143.16	547	45.620	56.842	24.770	7.970	58.468
Market Size	102	0.237	0.198	0.173	0.103	0.353	561	0.292	0.401	0.138	0.043	0.340
Turnover	102	123.7	85.8	117.8	63.4	159.6	547	63.753	55.724	49.776	25.079	86.857
Regulatory Quality	86	1.305	0.421	1.4	1.15	1.61	394	0.791	0.797	0.880	0.055	1.555
Financial Regulation	114	0.877	0.330	1	1	1	568	0.364	0.482	0	0	1
Market Capitalization	104	3089399	14100000	447825	139676	1826025	556	621338.	1438363	116103	34061	550930
Cross Agreement	114	0.219	0.416	0	0	0	568	0.109	0.312	0	0	0
Demutualization	114	0.860	0.349	1	1	1	568	0.435	0.496	0	0	1
Self-Listing	114	0.667	0.473	1	0	1	568	0.255	0.436	0	0	1
Shareholder	114	0.237	0.427	0	0	0	568	0.025	0.155	0	0	0
Acquisition Attempt	114	0.228	0.421	0	0	0	568	0.030	0.171	0	0	0
Average Traded	105	13656.5	28611.6	1828.1	418.8	8279.4	456	3167.709	7584.390	375.72	76.15	2523.395
Stocks	114	1173.561	1508.464	365	236	1861	566	828.000	2044.865	317	158	773
Bonds	91	2533.022	3378.570	1025	300	3657	488	2467.920	5782.323	277.5	59.5	1299.5
Listed Companies	114	1117.956	1484.760	331.5	191	1691	526	847.818	2095.858	317.5	175	759
Domestic Companies	112	344.563	731.930	34.5	8	199	510	542.265	889.452	198	16	579
Foreign Companies	114	899.711	1434.730	326.5	172	924	530	409.434	1952.951	76	15	295
Foreign Ratio	114	0.111	0.118	0.065	0.018	0.174	527	0.131	0.226	0.034	0.003953	0.175
Delisting	90	68.244	109.061	18	9	59	332	44.142	87.004	17	7.5	31
Trading Platfrom	114	0.570	0.497	1	0	1	568	0.174	0.380	0	0	0
Post Trading	114	0.535	0.501	1	0	1	568	0.248	0.432	0	0	0
Integration Openness	114	0.215	0.194	0.1675	0.084	0.291	551	0.198	0.194	0.159	0.067	0.299
Region	114	0.526	0.502	1	0	1	568	0.363	0.481	0	0	1

3. Methodology

The analysis of possible drivers of integration between stock exchanges has been conducted using different methodologies. The application of various methods should ensure the robustness of results.

3.1 Correlation and Cluster Analysis

Following Longin and Solnik (1995), Hassan and Naka (1996), Karolyi and Stulz (2001), Walti (2006), Schindler and Voronkova (2010), correlation analysis has been adopted to investigate the presence of similarities in the performances of different stock markets (Table 1). The correlation coefficient is widely used as a measure of co-movements between different stock returns in a given time period, and is widely exploited by the literature too. According to the Pearson product-moment correlation coefficient, the correlation index has been calculated by dividing the covariance of two index returns by the product of their standard deviations:

$$\rho_{X,Y} = corr(X,Y) = \frac{cov(X,Y)}{\sigma_X * \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X * \sigma_Y} \quad (2)$$

where E is the expected value operator, cov means covariance and $corr$ is a widely used alternative notation for Pearson's correlation. From time series of weekly index returns of stock exchange markets from 1995 to 2010, the annual values of the average correlation will be used as a measure of integration within stock markets worldwide. If correlation can be seen as a pre-condition of integration, a more robust methodology has been applied by a cluster analysis. This type of analysis is also widely exploited by the literature, investigating the interdependence of global equity markets (Hooper et al. 1999, Sørensen and Gutiérrez 2006, Hooy and Goh 2009, Bastos and Caiado 2009). Cluster analysis can show the presence of integration trend between analyzed stock market returns by the reduction of the total number of clusters and by the increase of the total number of cluster groups. In particular, k -medoid was employed as a classical partitioning technique of clustering that clusters the data set of n objects into k clusters known *a priori*. Thus, the number of clusters k is based on certain specific distance measurements (silhouette width), running diagnostic checks for determining the optimal number of clusters in the data set.

Given a set of observations (x_1, x_2, \dots, x_n) , where each observation is a d -dimensional real vector, k -means clustering aims to partition the n observations into k sets ($k \leq n$) $S = \{S_1, S_2, \dots, S_k\}$ so as to minimize the within-cluster sum of squares:

$$\arg \min_S \sum_{i=1}^k \sum_{x_j \in S_i} \|x_j - \mu_i\|^2 \quad (3)$$

where μ_i is the mean of points in S_i . The choice of correlation and cluster methodology is based on the fact that these techniques can indicate the presence of common integration trend between all analysed stock exchange markets. Assuming the hypothesis that high correlation coefficients between the international indexes show the degree of increasing integration within stock exchange markets, the low number of

successful integration projects in recent years can indicate the presence of other relevant determinants in order to conclude the fusion.

3.2 Johansen cointegration test

Following Bessler and Yang (2003) and Kasibhatla et al., (2006), the Johansen cointegration methodology is employed to test the cointegration processes between integrated stock markets from Table 4. The Johansen cointegration test is applied to capture the cointegrating relationships among the selected stock exchange markets and to identify a number of cointegrating vectors via its test statistics. The Johansen test methodology is used to estimate the multilateral long-run equilibrium relationship among the stock exchange market indices of integrated stock exchange markets. In particular, the Johansen cointegration test can indicate whether all integration projects had cointegrated markets before the fusion or it is possible to identify other possible determinants of stock exchange mergers. The main research hypothesis assumes that if there are no cointegrating vectors among integrated stock markets or there is no long-run equilibrium relationship, it suggests the presence of other latent determinants, which will be investigated via multivariable logit regression.

The Johansen process is a maximum likelihood method that determines the number of cointegrating vectors in a non-stationary time series Vector Autoregression (VAR) with restrictions imposed, known as a vector error correction model (VEC). Having a set of g variables ($g \geq 2$) which are integrated of first order $I(1)$ and thought to be cointegrated, a VAR model with k lags containing these variables could be set up:

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \dots + \beta_k y_{t-k} + u_t \quad (4)$$

For Johansen test to be used, the above VAR needs to be transformed into a vector error correction model (VECM) of the following form:

$$\Delta y_t = \Pi y_{t-k} + \Pi \beta_1 \Delta y_{t-1} + \Gamma \beta_2 \Delta y_{t-2} + \dots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t \quad (5)$$

This VAR model contains ‘ g ’ variables and ‘ $k-1$ ’ lags of the dependent variables (differences), with a Γ coefficient matrix. As the Johansen test can be affected by the lag length, the lag length (11) was selected. Moreover, there are two test statistics for cointegration under Johansen methodology: trace statistic (λ_{trace}) and the Max-Eigenvalue statistic (λ_{max}). λ_{trace} is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to ‘ r ’ against the alternative hypothesis that there are more than r . Max-Eigen test statistics is used to check for existence of a co-integrating rank of 0 or 1 is compared against the corresponding critical values at 5 percent. Max-Eigen test statistics is formulated in the following way:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \quad (6)$$

where r is the number of cointegrating vectors under the null hypothesis ($r=0, 1, k-1$), k represents number of variables in the system, T is number of observations, and λ is the

estimated value for the i^{th} ordered eigenvalue (characteristic root) obtained from the estimated Π matrix. λ_{max} conducts separate tests on every eigenvalue and the null hypothesis is that the number of cointegrating vectors is less is 'r' against the alternative hypothesis that there are 'r + 1'. If the test statistic is greater than the critical value from Johansen's tables, the null hypothesis that there are 'r' cointegrating vectors is rejected against the alternative hypothesis that there are more than r (for λ_{trace}) or that there are r + 1 (for λ_{max}).

3.3 Multivariable Logit Model

Regression analysis is the last methodology applied to investigate the drivers of stock market integration. The dichotomous nature of the dependent variable suggested using a multivariable logit regression analysis. The logit model is a widely accepted tool in early warning modelling to evaluate explanatory contribution of each independent variable. Following Panchenko and Vu (2009), Christiansen and Ranaldo (2009), Lin and Cheng (2008), multivariable logit regression is used to test the statistical significance of set of variables presented in Table 3. Following the research aim, interested in the determinants that drive stock market integration, the dependent binary variable Y is lagged (t-3), and it associated with 1, if stock market was integrated and zero otherwise. The lag length for the lagged dependent variables is 3 years before the integration.

The following logistic regression is used to verify the drivers of stock exchange integration:

$$P_{jt}(Y=1|X_1, X_2, \dots, X_k) = 1 / (1 + \exp(-(\beta_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + \dots + \beta_k X_{k,t}))) \quad (7)$$

where $\Pr(Y=1)$ is the probability of integration for stock market j at the end of year t, exp is the exponential function, $\beta_1, \beta_2, \dots, \beta_k$ are the slope coefficients, X_1, X_2, \dots, X_k are the explanatory variables.

In building the multivariate prediction model the following approach is applied:

1. Verification of descriptive statistics for each variable in both samples: integrated stock markets and non-integrated stock markets.
2. Control of sign and statistical significance of correlation between selected variables with dummy variable;
3. Checking for individual performance of each variable in explaining integration event (logit with one model);
4. Checking for collinearity among selected variables;
5. Construction of models in terms of predictive power, statistical significance, and economic meaning of each predicted variable in terms of integration.

4. Empirical results

Results from different methodologies are reported in following sections.

4.1 Correlation and Cluster Analysis

Results from correlation and cluster analysis are reported in Table 7. Time series of weekly index returns have been estimated annually from 1995 to 2010. The values of correlation index report the average of correlation indexes between the performances of all analysed markets. Correlation is used as a first measure of integration under the hypothesis that high level of integration between stock markets can be detected by an increasing correlation trend between stock exchanges indexes. Meanwhile, cluster analysis is assumed under the hypothesis that with higher level of integration, the number of optimal clusters will decrease by the time.

Table 5: Results from correlation and cluster analysis

Market		Correlation															
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
		0.156	0.159	0.288	0.335	0.161	0.302	0.319	0.324	0.301	0.473	0.371	0.509	0.517	0.656	0.599	0.630
North America and Canada	Nasdaq	1	1	1	1	1	1	1	1								
	Nyse	2	1	1	1	1	2	2	1								
	Toronto Stock Exchange	3	2	1	1	1	2	2	2	2	1	1	1	2	2	1	1
Latin America	Sao Paulo Stock Exchange	4	3	2	2	2	3	3	3	3	2	2	3	3	3	1	2
	Buenos Aires Stock Exchange	5	4	3	3	3	3	4	4	4	3	3	3	2	4	1	3
	Colombia Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	5	5	5	1	4	4	4	5	2	4
	Mexican Stock Exchange	6	5	4	3	4	4	6	6	6	1	5	4	1	6	3	1
	Santiago Stock Exchange	n/a	6	5	4	5	5	7	7	7	4	6	4	5	7	4	5
	Lima Stock Exchange	7	7	6	5	6	7	5	7	2	5	7	4	6	4	5	1
Oceania and Asia	New Zealand Stock Exchange	8	8	7	6	6	7	8	2	2	6	8	5	7	8	6	6
	Australian Securities Exchange	9	2	7	6	6	7	8	2	2	7	1	1	8	2	7	1
	Shenzhen Stock Exchange	10	9	8	7	7	8	9	8	8	8	9	6	9	9	8	7
	Hong Kong Stock Exchange	11	10	9	8	8	9	10	2	9	9	10	1	7	10	9	8
	National Stock Exchange of India	12	11	10	9	9	10	11	9	10	10	11	7	10	11	10	9
	Jakarta Stock Exchange	13	12	11	10	10	11	12	10	11	11	12	8	11	12	11	8
	Tokio Stock Exchange	14	13	12	11	11	12	13	11	12	12	1	1	1	1	9	8
	Singapore Stock Exchange	n/a	n/a	n/a	n/a	12	7	8	2	9	13	13	1	7	10	9	8
	Korea Stock Exchange	7	14	13	12	13	13	14	12	13	14	14	9	12	10	12	8
Africa and Middle East	Egypt Stock Exchange	n/a	15	15	10	13	13	13	9								
	Saudi Stock Exchange	n/a	n/a	n/a	n/a	n/a	7	5	7	14	16	16	11	14	2	1	1
	Johannesburg Stock Exchange	n/a	15	14	13	14	14	15	13	15	17	17	12	15	14	14	10
	Tel Aviv Stock Exchange	n/a	16	15	1	12	15	2	14	16	18	18	13	16	1	1	1
Western Europe	Euronext	n/a	n/a	n/a	n/a	n/a	16	16	15	17	13	13	14	2	2	7	11
	Brussels Stock Exchange	15	17	16	14	15	16	16	15	17	13	13	14	2	2	7	11
	Paris Stock Exchange	n/a	18	17	15	15	16	16	15	17	13	13	14	2	2	7	11
	Amsterdam Stock Exchange	15	6	18	15	15	16	16	15	17	13	13	14	2	2	7	11
	Lisbon Stock Exchange	16	6	19	14	16	3	17	16	2	13	10	1	2	4	7	11
	Frankfurt Stock Exchange	15	6	5	1	12	16	8	2	2	13	13	3	2	2	7	12
	Vienna Stock Exchange	17	6	16	14	15	7	8	7	2	7	14	15	2	2	7	11
	Swiss Stock Exchange	18	6	5	14	15	16	17	15	2	13	13	3	2	2	7	12
	Italian Stock Exchange	19	n/a	n/a	14	15	16	16	15	17	13	13	14	2	2	7	11

	London Stock Exchange	20	2	16	16	17	16	16	15	17	13	13	1	2	2	7	1
	Irish Stock Exchange	n/a	n/a	n/a	1	15	7	2	17	1	14	13	14	2	2	7	11
	Luxembourg Stock Exchange	n/a	n/a	n/a	n/a	12	16	8	18	2	13	13	14	2	2	7	11
	Athens Stock Exchange	21	1	20	17	18	17	18	19	18	15	13	14	2	10	7	13
	Madrid Stock Exchange	22	18	21	15	15	3	17	20	19	7	10	3	17	4	15	14
	Barcelona Stock Exchange	n/a	n/a	n/a	1	12	3	17	20	19	7	10	3	17	4	15	14
	Valencia Stock Exchange	22	18	21	15	15	3	17	20	19	7	10	3	17	4	15	14
	Bilbao Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	17	20	19	7	10	3	17	4	15	14
Northern Europe	Omni Nordic Stock Exchange	n/a	21	20	13	15	14	2	2	15	12						
	Stockholm Stock Exchange	23	17	22	14	15	16	16	21	20	13	15	14	2	2	7	12
	Helsinki Stock Exchange	24	17	22	14	19	17	19	21	20	13	15	14	2	2	7	12
	Copenhagen Stock Exchange	15	6	16	1	12	16	2	15	2	13	15	3	2	2	7	12
	Oslo Stock Exchange	15	6	23	18	20	18	8	22	21	7	14	15	2	2	7	12
Eastern Europe	Prague Stock Exchange	25	19	24	19	21	19	20	23	22	19	16	15	2	6	16	11
	Warsaw Stock Exchange	26	20	25	20	22	20	21	24	23	20	17	16	18	6	17	15
	Russian Stock Exchange	27	21	26	21	23	21	22	25	24	21	18	17	17	15	18	12
	Budapest Stock Exchange	n/a	n/a	n/a	22	24	22	23	26	25	22	19	18	7	6	19	16
	Total Clusters	27	21	26	22	24	22	23	26	25	22	19	18	18	15	19	16

First, the results of correlation analysis from Table 5 demonstrate the presence of an increasing integration trend among the returns of stock exchange markets worldwide during the last sixteen years. In particular, the degree of association from (0.156) in 1995 has increased significantly to 0.63 in 2010. These findings confirm the trend of common globalization among international financial markets after 2000.

Second, results of cluster analysis highlight the presence of integration trend between analysed stock market returns and within single geographical regions like Europe and North America even since 1995. Moreover, the globalization within stock exchange markets is growing faster, especially in last five years. It means that stock exchange indexes worldwide tend to cluster together especially in recent years. In fact, the number of total clusters from our sample is reduced from 27 in 1995 to 16 in 2010. Moreover, the findings highlight a strong integration trend within European stock exchange markets even before the creation of Economic and Monetary Union (EMU), which had enormous influence on economic linkages between European financial markets. Furthermore, there is a strong relationship within North American stock markets; meanwhile, stock exchange markets from Asia, Africa and Middle East seem to be less affected by common financial integration.

Finally, the results of correlation and cluster analysis confirm a stable market trend towards integration. If these two methodologies confirm that integration in the stock market exists, results from other research methods will analyse the determinants of this process.

4.2 Johansen Cointegration Test

Johansen multilateral analysis was applied to all the integrated stock exchanges of the sample in order to check the presence of multilateral long-run equilibrium relationship among the stock market indices. Max-Eigen test statistics for the existence of a co-

integrating rank of 0 or 1 were compared against the corresponding critical values at 5 percent. If the calculated test statistics exceed the critical values at 5 percent, the null hypothesis of no co-integrating vectors ($r = 0$) is rejected and the variables are determined to be co-integrated. Table 8 summarizes the results of the Johansen cointegration test.

Table 6: Johansen cointegration test results

Stock Exchange Markets	Integration Project	Hypothesised Number of Cointegrated Equations	Max-Eigen Value	0.05 Critical Value	Prob.**	Number of Cointegrating Equations
Amsterdam Stock Exchange, Brussels Stock Exchange, Paris Stock Exchange, Lisbon Stock Exchange	EURONEXT	None	16.56373	27.58434	0.6175	0
		At most 1	9.879367	21.13162	0.7559	
Madrid Stock Exchange, Barcelona Stock Exchange, Bilbao Stock Exchange Valencia Stock Exchange	BME	None	35.72712	27.58434	0.0036	1
		At most 1	20.34675	21.13162	0.0641	
Stockholm Stock Exchange, Helsinki Stock Exchange, Copenhagen Stock Exchange Oslo Stock Exchange	OMX	None	27.46436	27.58434	0.0518	0
		At most 1	5.301384	21.13162	0.9931	
London Stock Exchange Italian Stock Exchange	LSE-BORSA ITALIANA	None	14.92656	14.26460	0.0392	1
		At most 1	2.372779	3.841466	0.1235	
NYSE Euronext	NYSE EURONEXT	None	175.3156	14.26460	175.3156	1
		At most 1	0.419516	3.841466	0.419516	
Nasdaq OMX	NASDAQ OMX GROUP	None	76.11980	14.26460	0.0000	1
		At most 1	0.003225	3.841466	0.9530	
Vienna Stock Exchange Prague Stock Exchange Budapest Stock Exchange Ljubljana Stock Exchange	CEE GROUP	None	250.1157	21.13162	0.0001	1**
		At most 1	217.9086	14.26460	0.0001	
Bolsa de Valores de Colombia, Lima Stock Exchange, Santiago Stock Exchange	MILVA	None	219.0081	21.13162	0.0001	1**
		At most 1	113.1609	14.26460	0.0001	

Results for the Euronext project show that there was not cointegration relationship between the involved markets. In fact, the Johansen cointegration test statistic (16.56) is lower than 5 percent critical value (27.58), so the null hypothesis of $r = 0$ cannot be rejected. These findings suggest that the merger was driven by harmonization factors of European financial markets without the long-run relationships between the analysed markets.

In case of the Spanish Stock Exchange markets, Johansen cointegration test statistic (35.72) is higher than the 5 percent critical value (27.58). Thus, the null hypothesis of $r = 0$ can be rejected. However, there is no long run relationship between Spanish Stock Exchange markets prior to February 2002 as cannot be rejected $r=1$. Thereby, it is possible to conclude that integration initiative was a response of Spanish markets to the new international financial settings after the creation of Euronext project more than a decision based on the cointegration of the Spanish stock exchanges (Madrid, Barcelona, Valencia and Bilbao).

Results from the OMX project suggest the absence of any long-run relationships between the involve markets as it the null hypothesis of $r = 0$ cannot be rejected. This results show that OMX merger was driven by other factors than stock exchange integration. The strategic role that technology had in the project and the attempts of hostile takeover could have done the main drivers of integrations.

Furthermore, the London Stock Exchange and Borsa Italiana show one cointegration equation between their market indexes at 5 of level of significance. However, we cannot confirm the long run relationship between these markets. The timing of this project, born after the Euronext and OMX project, support the hypothesis that the merger between Borsa Italiana and the London Stock Exchange was part of a defensive strategy in a new scenario featured by an increased competition between stock exchanges and different attempts of hostile takeover.

Analysing NYSE and Euronext stock market indexes, Max-Eigen statistics confirm one cointegration equation between the indices with values (175.31) higher than the 5 percent critical value (15.49). However, there is no existence of long-run relationships between these markets. Consequently, the findings confirm that the merger was the first and the most ambitious attempt to form intercontinental cross-border exchange consolidation without long-lasting cointegration between two markets.

Similar results were obtained for NASDAQ and OMX stock exchange markets. Table 8 shows the existence of one cointegration equation between the markets (the $r=0$ hypothesis must be rejected). However, the findings do not show the long-run relationships before the merger. The fact that the NASDAQ bids for the OMX Group only after the failed attempt to acquire the London Stock Exchange, suggests that the integration process was driven different reasons than the correlation between their market performances.

Testing the null hypothesis of at most one cointegrating vectors for CEE GROUP stock market, the test statistic is higher for both $r=0$ and $r=1$ hypotheses with the 5 percent critical values. It means that a strong multilateral long-run equilibrium between integrated markets exists. A close cooperation between neighbouring countries had resulted in the closer integration of their financial markets.

The same results were obtained for Latin American stock markets, which are part of MILVA project (Chile, Peru and Colombia). The Max-Eigen statistics indicate the presence of more than one cointegrating vector among their indexes.

Summary results for the Johansen multilateral cointegration analysis indicates that not all integration projects held the long-run relationships between their stock exchange markets before the merger. If the presence of a full cointegration in terms of long-run equilibrium for most of the projects was not conclusive in order to explain the behaviour of stock exchanges in their integration process, results from the regression analysis are needed.

4.3 Multivariable Logit Model

This section provides the results from the logit regression model reported in Section 3.3. The dependent variable is a three years lagged dummy variable, equal to one if a stock exchange is engaged in an integration project at time 't', and zero otherwise. The explanatory variables are measured annually from 1995 to 2010.

To avoid the collinearity among selected variables, the logit regression modelling is based on the correlation analysis between all potential variables, presented in Table 7.

Table 7: Correlation between regression variable

	Dummy	Union	Currency	Openess	GDP	Devel	Value	Size	Turnover	Reg qual	Fin Reg	Capital	Cross	Demutliz	Self	Sharehol	Attempt	Av Trad	Equity	Bond	Listed	Domestic	Foreign	Ratio	Delist	Platf	Postg	Integr	Region
Dummy	1																												
Union	0.148	1																											
Currency	0.228	0.279	1																										
Trade Openness	0.024	0.148	0.266	1																									
GDP	0.048	0.149	-0.092	-0.278	1																								
Market Development	0.244	0.120	0.482	0.147	-0.095	1																							
Market Value	0.138	0.132	0.018	-0.062	0.604	0.130	1																						
Market Size	-0.076	0.042	0.018	0.374	-0.130	0.066	0.075	1																					
Turnover	0.123	0.069	0.091	-0.158	0.534	0.170	0.744	-0.087	1																				
Regulation Quality	0.175	0.276	0.293	0.413	0.067	0.288	0.344	0.352	0.139	1																			
Financial Regulation	0.234	0.386	0.511	0.076	0.242	0.404	0.243	0.020	0.315	0.357	1																		
Capitalization	0.156	-0.005	-0.025	-0.071	0.236	-0.040	0.182	0.000	0.159	0.097	0.051	1																	
Cross-membership	0.120	0.022	0.204	0.255	-0.137	0.210	-0.086	0.083	-0.112	0.181	0.202	0.081	1																
Demutualization	0.176	0.186	0.334	0.186	-0.001	0.194	0.226	0.106	0.162	0.352	0.328	0.057	0.079	1															
Self-Listing	0.183	0.205	0.223	0.083	0.079	0.132	0.201	0.134	0.148	0.276	0.249	0.094	0.149	0.684	1														
Shareholder	0.079	0.041	0.061	0.175	-0.068	0.061	0.030	-0.005	0.083	0.059	0.106	-0.007	0.088	0.238	0.299	1													
Acquisition Attempt	0.093	-0.007	0.070	0.044	-0.032	0.146	0.303	0.042	0.174	0.239	0.165	0.022	0.136	0.256	0.246	0.391	1												
Average Tradeded	0.078	0.115	-0.063	-0.198	0.824	-0.057	0.683	-0.046	0.615	0.186	0.256	0.229	-0.082	0.130	0.175	-0.009	0.083	1											
Equity	-0.025	0.084	0.076	-0.006	0.281	0.001	0.332	0.135	0.320	0.164	0.136	0.071	-0.003	0.078	0.106	-0.022	0.084	0.238	1										
Bond	-0.032	0.138	0.393	0.416	-0.005	0.103	0.064	0.172	0.096	0.331	0.292	0.003	0.197	0.145	0.108	-0.031	0.173	0.102	0.286	1									
Listed Companies	-0.037	0.053	0.056	-0.032	0.284	-0.025	0.323	0.126	0.338	0.136	0.115	0.068	-0.034	0.069	0.094	-0.026	0.062	0.243	0.995	0.237	1								
Domestic	-0.094	0.125	-0.241	-0.238	0.627	-0.270	0.430	0.220	0.308	0.176	0.024	0.142	-0.171	0.000	0.086	-0.087	-0.067	0.483	0.394	0.000	0.397	1							
Foreign	0.003	0.013	0.179	0.086	0.016	0.107	0.161	0.061	0.226	0.095	0.148	0.011	0.074	0.068	0.061	0.014	0.127	0.051	0.906	0.338	0.894	-0.020	1						
Foreign Ratio	-0.016	-0.017	0.013	0.269	-0.012	-0.101	0.044	0.084	0.038	0.081	0.167	0.006	0.132	0.053	-0.064	-0.002	0.030	0.018	0.109	0.281	0.084	-0.055	0.180	1					
Delisting	-0.002	0.097	-0.159	-0.172	0.457	-0.124	0.547	0.205	0.358	0.288	0.134	0.103	-0.107	0.119	0.184	0.019	0.292	0.513	0.637	0.205	0.618	0.616	0.315	0.004	1				
Trading Platform	0.232	0.192	0.443	0.137	0.089	0.349	0.210	-0.063	0.239	0.265	0.374	0.081	0.155	0.227	0.278	0.204	0.235	0.108	0.050	0.175	0.044	-0.010	0.051	-0.081	0.076	1			
Post trading	0.155	0.203	0.350	0.071	0.426	0.160	0.309	-0.100	0.419	0.133	0.569	0.086	0.118	0.102	0.052	0.025	0.149	0.348	0.119	0.302	0.125	0.129	0.092	0.189	0.130	0.507	1		
Integration Openness	0.017	0.262	-0.143	-0.131	0.307	-0.212	0.294	0.112	0.163	0.054	-0.094	0.081	-0.172	0.200	0.309	-0.016	-0.067	0.318	0.172	-0.086	0.174	0.446	-0.036	0.029	0.210	0.008	-0.041	1	
Region	0.111	0.034	0.017	0.017	0.108	0.142	0.094	-0.035	0.036	0.095	0.068	0.006	-0.026	0.063	0.057	0.025	0.052	0.084	0.026	0.031	0.011	0.028	-0.002	-0.062	0.029	0.043	0.008	0.038	1

In order to assess the robustness of the findings, and with the purpose to maximize the sample size, six different specifications have been estimated starting from Column 1 with a macroeconomic model which includes only basic country characteristic available for the full set of selected stock exchange markets. Next, in Column 2, the model is re-estimated with a measure of regulatory variables and self-listing variable. Progressively, the following variables are added, referring to structural stock exchange characteristics in Column 3 and in Column 4. Meanwhile, the variable Self-Listing is dropped due to the collinearity with the variable Demutualization. Column 5 controls for trading variables associated with stock exchanges' performance. The final specification reported in Column 6 controls for all variables. Table 10 reports the regression results of six different specifications presented above.

Table 8: Determinants of international stock exchange integration - Logit Model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Regression Analysis						
Union	1.507*** (0.526)	0.566 (0.579)	0.845 (0.651)	0.753 (0.781)	0.234 (0.733)	1.123 (1.019)
Currency	0.398 (0.371)	-0.578 (0.468)	-1.002* (0.570)	-0.188 (0.674)	-0.565 (0.650)	-0.355 (0.771)
Trade Openess	0.378 (0.335)	-0.110 (0.511)	-0.446 (0.611)	-0.502 (0.960)	-0.913 (0.864)	0.741 (1.230)
GDP	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001*** (0.001)	0.001 (0.001)	-0.001** (0.001)
Market Development	0.002*** (0.001)	0.001 (0.001)	0.001 (0.001)	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)
Market Value	0.011*** (0.003)	0.003 (0.005)	0.001 (0.005)	-0.007 (0.007)	-0.001 (0.008)	-0.009 (0.009)
Market Size	-2.913*** (0.879)	-4.868*** (1.373)	-5.607*** (1.773)	-9.378*** (3.553)	-6.241** (2.951)	-10.051*** (3.432)
Turnover	-0.003 (0.004)	-0.002 (0.005)	-0.004 (0.005)	0.003 (0.007)	-0.001 (0.007)	0.013 (0.011)
Regulation Quality		1.399*** (0.429)	1.495*** (0.480)	1.610** (0.700)	1.937*** (0.677)	2.351*** (0.809)
Financial Regulation		0.017 (0.512)	0.180 (0.544)	-0.320 (0.650)	-0.739 (0.675)	-0.751 (0.857)
Market Capitalization			0.001 (0.001)	0.001*** (0.001)	0.001 (0.001)	0.001** (0.001)
Cross-Membership			1.079* (0.563)	1.633** (0.690)	0.574 (0.637)	1.923** (0.775)
Demutualization			1.896*** (0.564)	2.132*** (0.745)	1.397** (0.626)	1.406* (0.838)
Self-Listing		1.400*** (0.369)				
Shareholder			0.054 (0.564)	-0.620 (0.745)	0.561 (0.626)	-1.166 (0.838)
Acquisition attempt			0.063 (0.690)	0.879 (0.942)	0.026 (0.833)	0.104 (1.044)
Average Traded				0.001** (0.001)		0.001 (0.001)
Equity				-0.001 (0.003)		-0.002 (0.036)
Bond				-0.001 (0.001)		-0.001* (0.001)
Listed Companies				0.001 (0.003)	0.003 (0.003)	0.002 (0.018)
Foreign					-0.003 (0.002)	0.001 (0.018)
Domestic					-0.005* (0.003)	-0.007 (0.019)
Foreign Ratio					-2.424 (2.351)	-3.185 (2.944)
Delisting					0.007 (0.006)	
Trading Platform						0.525 (0.732)
Post Trading						-1.431 (0.908)
Integration Openness						7.525*** (2.715)
Region						-0.019 (0.545)

Constant	-4.210*** (0.576)	-3.924*** (0.652)	-4.616*** (0.831)	-3.957*** (1.048)	-2.928*** (0.869)	-6.010*** (1.696)
Observations	649	468	459	348	305	331
Pseudo R2	0.164	0.197	0.241	0.303	0.253	0.416
Panel B: Model Performance and Integration Probability						
Correctly classified	89.98%	89.32%	90.41%	90.52%	87.21%	90.63%
Pr average (integration)	20.8 %	21.7%	24.6%	30.1%	29.5%	41.4%
Pr average (non-integration)	8.5%	8.7%	7.9%	7.8%	10%	6.9%

*** p<0.01, ** p<0.05, * p<0.1

Overall, this analysis suggests that several characteristics are strong predictors of the likelihood to conclude an integration projects during the period of 1995-2010. Specifically, in all models this probability increases with Regulation Quality, Cross-membership agreement, Demutualization and the degree of Integration Openness while it decreases for big stock exchange markets in terms of Market Size and systematic risk.

In terms of macroeconomic characteristics, Column 1 shows that Union, Market Development and Market Size variables appear strong predictors of the likelihood to participate in stock exchange projects. In particular, the probability increases with participation in trade or political union and high stock market capitalization in terms of GDP. However, these variables are significant only in the first model. In fact, Model 7 suggests that significant GDP level and systemic size of stock market decrease the probability of integration. Furthermore, this finding confirms the failed merger between NYSE Euronext and Deutsche Börse due to their market sizes, where the European Commission has blocked the deal to prevent a near-monopoly in European financial markets.

Second, in terms of regulation variables Regulation Quality in form of legislative changes and government ability to formulate and implement sound policies to promote financial development, increase the probability of stock exchange integration (Wellons 1998; Di Giorgio and Di Noia, 2003). Moreover, implementation of common financial regulation implies the presence of trade or political union and high economic characteristics of analysed countries. In fact, regulation variables are highly correlated with macroeconomic variables that lose their significance starting from Model 2.

Next, among structural stock exchange characteristics, the results confirm the presence of a Cross-Membership agreement as an initial step towards the consolidation and the role of Demutualization process of the stock exchanges into for-profit corporations. Meanwhile Market Capitalization demonstrated very low contribution to stock exchange integration. Finally, Self-Listing provides an important contribution to the likelihood; however, this variable is highly associated with Demutualization. In fact, stock exchange markets after the organizational transformation perform better than their non-listed counterparts, and self-listed exchanges are seeking the profit and may be interested in integration projects (Otchere, 2006 and 2007; Otchere and Abou-Zied, 2008).

Furthermore, among the variables of stock exchange business performance, the Average Amount Traded per day seems to be a significant determinant of integration; however, it shows very low contribution. Meanwhile, the high number of domestic listed companies is negatively related to the integration likelihood. In fact, high concentration of domestic shares confirms the lack of stock market openness towards the international cross-listing.

In terms of operative forces, the results of regression analysis do not confirm the role of Trading Platform and Post-Trading Operator as significant variables in terms of probability. Finally, integration openness measured based on correlation analysis is an important driver of stock exchange projects. In fact, according to Tam and Tam (2012) and Dorodnykh (2012) market integration manifests in the convergence of stock ratios in the long run, driven by common global factors across markets. However, it is not an equal process for all stock markets, where various clusters of markets are engaged in different manners.

To conclude Table 9 reports the values of the probability of stock exchange integration, estimated for main explanatory variables (Market Size, Regulation Quality, Cross-Membership, Demutualization and Integration Openness), when the remaining variables are fixed at their

average. The calculation is based on the final model presented in Column 6. The results show that in terms of contribution to the probability of stock exchange merger, quality of financial regulation appears the key variable: when the sample size increases from the 10th to the 90th of the sample distribution this probability becomes 124 times larger. Furthermore, integration openness provides an important impact on the likelihood due to the fact that the consolidation process has stepped over national frontiers and continents. Next, Cross-Membership agreements and for-profit corporate structure in terms of Demutualization contribute significantly to the likelihood of successful merger. Finally, there is a higher probability of integration for medium and small stock markets than for big ones, where Regulator cannot block the fusion because of their systemic importance.

To investigate the probability of stock exchange integration for each key variable, Table 9 reports the values estimated for explanatory variables (Market Size, Regulation Quality, Cross-Membership, Demutualization and Integration Openness), when the remaining variables are fixed at their average. The calculation is based on the final logit model presented in Column 6. The results show that in terms of contribution to the probability of stock exchange merger, quality of financial regulation appears the key variable: when the sample size increases from the 10th to the 90th. Furthermore, integration openness provides an important impact on the likelihood due to the fact that the consolidation process has stepped over national frontiers and continents. Next, Cross-Membership agreements and for-profit corporate structure in terms of Demutualization contribute significantly to the likelihood of successful merger. Finally, there is a higher probability of integration for medium and small stock markets than for big ones, where Regulator cannot block the fusion in terms of competition.

Table 11: Probability of stock exchange integration

	(1)	(2)
	Probability of Integration: 10 th percentile (%)	Probability of Integration: 90 th percentile (%)
Market Size	3.96	0.001
Regulation Quality	0.013	1.627
Cross-Membership	0.2	1.378
Demutualization	0.117	0.476
Integration Openness	0.044	2.073

To conclude interaction between Market Size and Regulation Quality on the probability was estimated for different levels of Market Size and Regulation Quality, which were identified by values equal to the 10th percentile, the mean and the 90th percentile of the sample distribution, and plotted on probability. Notably this effect was estimated only for demutualized stock markets. The main results are in Figures 1.

Figure 1: The impact of Regulation Quality on probability of stock market integration for different levels of Market Size.

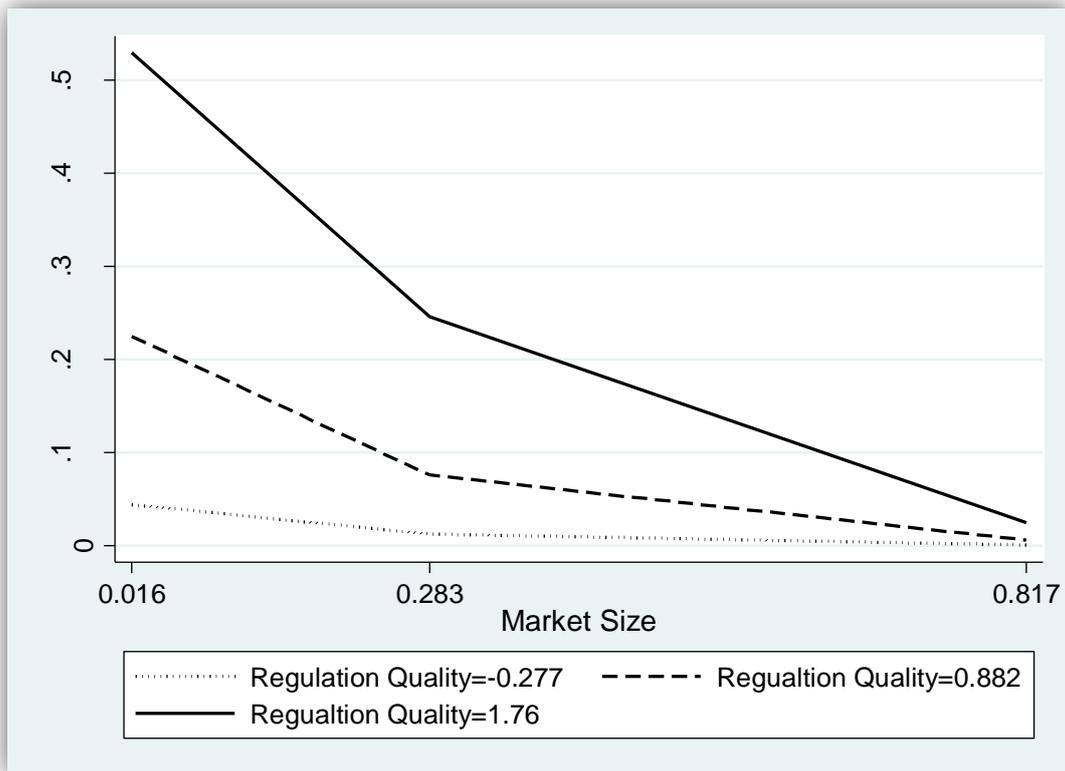
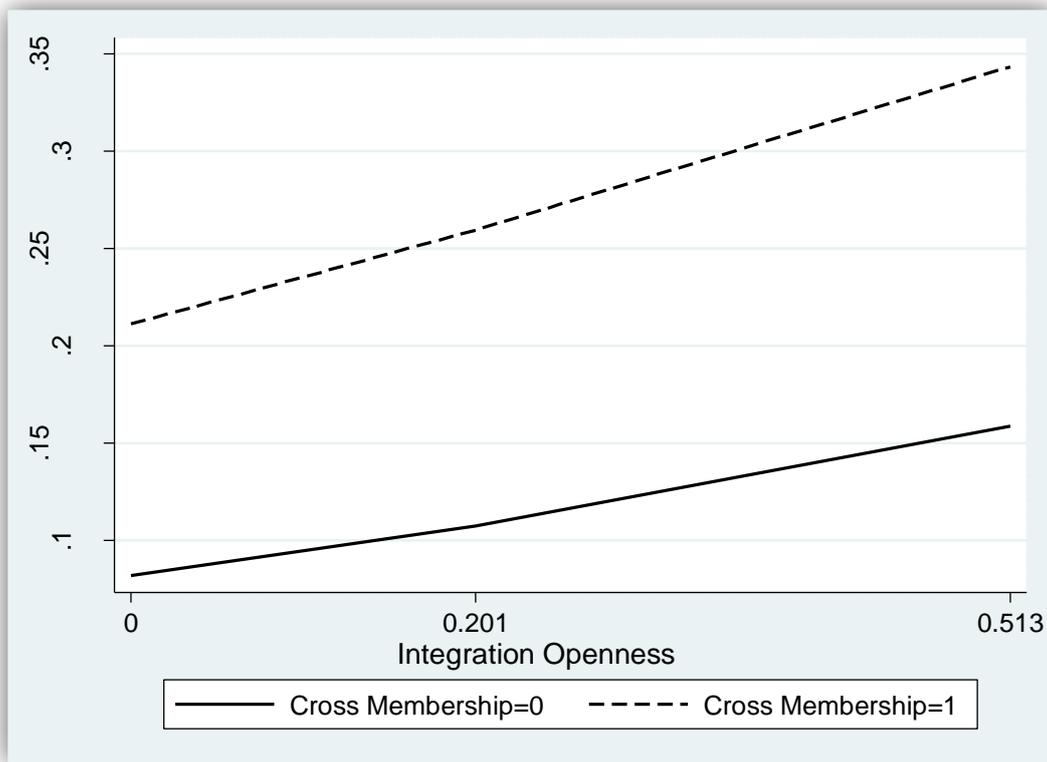


Figure 1 confirms that being a large stock exchange market substantially decreases the chances of stock exchange integration. The extremely large markets maintain a much higher systemic risk and attract the attention of Regulators in terms of competition. Thus, the probability of integration is higher for smaller markets. Furthermore, high Regulation Quality to implement sound policies and to promote financial development increases significantly the likelihood of successful merger.

In spite of the size and regulation, the probability of integration was checked with the presence of Cross-Membership Agreement and Integration Openness. Values of Integration Openness and Cross-Membership Agreement equal to the 10th percentile, the mean and the 90th percentile of the sample distribution were plotted on probability for demutualized stock markets. Figure 2 demonstrates that the probability to be integrated is increasing for stock markets that have cross-trading agreements and are highly integrated in global trading activity.

Figure 2: The impact of Cross-Membership on probability of stock market integration for different levels of Integration Openness.



The results discussed in this section offer a clear support to the growing regulatory attention on stock exchange business and on the need to impose more stringent requirements to decrease the risk of financial contagion, that are generally in line with previous findings reported in the literature.

Conclusions

Historically, the stock exchange industry has been highly fragmented along national markets, but over the past twenty years, the importance of the domestic stock market in many industrialized economies has grown sharply, while at the same time the degree of co-movement among international equity markets has increased. Indeed, last 10 years demonstrate a tendency between stock exchanges worldwide to integrate via M&A solutions, providing the possibility to analyse the data of successful case studies in order to reveal the common factors of consolidation processes.

The main aim of this paper was to shed light on the determinants of M&A projects in stock exchange industry, identifying the main drivers of stock exchange integration. To achieve the research objective the integration phenomenon within the stock exchange markets worldwide has been analysed from different perspective. Besides, this paper provides an analysis of the determinants of stock exchange integration in an international perspective, adopting a multistage statistical data analysis, based on annual panel data of 43 stock exchanges from 1995 to 2010.

Results confirm the complexity of the integration processes, and how it depends by different macroeconomic, structural, cultural-geographical and operative forces. In particular, the results of correlation and cluster analysis confirm a trend of common globalization within international financial markets, measured by a growing values of correlation indexes and by a reducing numbers of clusters. Many stock markets show a long-run relationship between their returns; however, the low numbers of successful integration projects with the long-run relationships suggest the presence of relevant drivers in order to conclude the merger between stock exchanges. Results from a multivariable logit regression analysis are consistent with previous studies. The explanatory power of different variables that have been supposed to be relevant on a theoretical basis by previous studies is confirmed by empirical evidence. Meantime, the findings demonstrate that financial harmonization, cross-membership agreements, for-profit corporate structure and integration openness are important drivers of stock exchange fusion. By contrast, a large size of stock exchange market has a negative impact on the likelihood of successful merger.

To the knowledge of the author, this study is one of the first to attempt to analyze the stock market integration in an international perspective, trying to figure out the similarities between different integration projects and to identify the key drivers of successful fusions. Results from this study can be useful for policy makers, regulatory authorities and stock exchanges in their responsibilities on market supervision and the evaluation M&As of strategies. In particular, the existence of de jure stock market integration projects suggests designing a special regulatory framework in order to benefit from important consequences of an integration and to decrease the risk of financial contagion.

Finally, in the current regulatory environment, the growing strategy through mergers and acquisitions becomes very difficult for big stock exchanges markets, meanwhile possible co-operation and partnership agreements are still available solutions for large and small operators, where the large exchange operators can bring their reputation and trading technology, meanwhile the smaller markets can provide access to fast-growing and emerging markets.

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