What Drives Stock Exchange Integration?

Ekaterina Dorodnykh[1]

Abstract

This paper contains an empirical analysis of determinants of international integration projects over the time period 1995-2010. After a broad discussion of the existent literature, the investigation combines a large number of potentially relevant determinants for the explanation of whether stock exchanges are participating in formal integration projects. Using the weekly data of stock market returns, correlation and cluster analysis investigate a measure of integration among stock markets. Johansen cointegration test estimates the presence of multilateral long run equilibrium relationship among integrated stock exchanges. Finally, multivariable logit regression with three-year lagged dependent variable is applied and interpreted. A number of significant variables are identified as determining the existence of de jure stock market integration projects.

Keywords: stock market integration, Johansen cointegration test, logit

JEL Classification: G15, G17

1. Introduction

The integration of stock markets can be considered as one of the most significant changes in the global financial market and an evidence of the globalization that the world economy is leaving. The old fashioned pictures of stock exchanges as open outcry markets is not representing 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;

[1] Ph.D, University of Rome Tor Vergata, Department of Economics and Finance (DEF), via Columbia, 2, 00133, Rome Italy, ekaterina.dorodnykh@uniroma2.it

Hasan and Schmiedel, 2004; Lee, 1998). Moreover, there are some evidences that latent factors may also determine the integration processes between stock exchange markets worldwide. Recent attempts of merge between stock exchanges provided also new case studies in order to verify what factors make successful integration projects, have opened the new research possibilities to investigate the determinants of stock exchange integration. Such mergers like NYSE - Euronext (2007), NASDAQ - OMX (2008), and 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 Borse (2012), opened the new research possibilities to investigate the determinants of stock exchange integration. However, 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. Thus, the aim of this paper is to shed light on the determinants of M&A projects in stock exchange industry and 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.

This paper extends the literature on the determinants of stock exchange cooperation, providing new evidence on the key elements of a successful integration project. Data from 1995 to 2010 have been collected in order to test empirically the relevance of different possible explanatory variables. Data from failed and succeed integration projects were both included in the analysis to highlight the differences between the two groups. Furthermore, different methodologies have been applied, including correlation and cluster analysis, Johansen cointegration test and multivariable logitmodelling.

Overall, this 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. Moreover, 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 successful merger.

The paper is organised as follows. A literature review will summarise the state of the art of research on stock market integration. Data will be presented by the analysis of the sampling criteria and some descriptive statistics. The next section describes the methodology applied to measure stock exchange integration and to analyse the determinants of integration, while the results will be presented prior to some conclusions and remarks.

2. 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 clearmarket trend toward an internationalisation of stock exchange business since the ’90s (Hasan et al., 2010). Furthermore, academic literature demonstratesa huge interest in this topic, trying to analyzeit 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.

The following broad definition of financial stock exchange integration will be adopted in this paper, in accordance with Baele et al. (2004) and Schmiedel and Schonenberger (2005). 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-mentionedset of financial instruments and/or services, and (3) are treated equally when they are active in the market. 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 pressureon stock markets to change their governance structure in order 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 researches 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 (McAndrews and Stefanadis, 2002; Neumann et al., 2002; Carretta and Nicolini, 2006). An integrated market will support the intermediaries and the issuers that will benefit from higher efficiency and transparency, and they will avoid the duplication of costsrelated to the market infrastructure (Pagano and Padila, 2005; Varadi and Boppana, 2009). Furthermore, the investors will benefit from more diversified portfolios and higher market liquidity (Polato and Floreani, 2010; Grose, 2011). However, if the integration of the stock markets seems to be desirable for all its participants, the interests represented by the various stakeholders are mutually different and sometimes conflicting.

New evidences 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-Lobatón (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. Stock markets, as a proxy variable for economic activity, positively affects the real economy (Sariannidis et al., 2009; Sariannidis, 2010). 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).

Overall, 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. Recent studies provide some theoretical and empirical underpinning of possible drivers; however, there is still a gap in the literature, trying to analyse the stock exchange integration in a comprehensive manner. Thus, this paper represents a multilateral work on the field of stock exchange integration to shed light on the determinants of M&A projects in stock exchange industry and to identify the main drivers of stock exchange integration. 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.

3. Data

The lack of 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 16 years 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 analyzed 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 (SHENZHEN), Hong Kong Stock Exchange (HONG KONG), National Stock Exchange of India (INDIA), Jakarta Stock Exchange (INDONESIA), Tel Aviv Stock Exchange (TEL-AVIV), Tokio Stock Exchange (TOKIO), SingaporeStock 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);
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 (MILAN), London Stock Exchange (UK), Irish Stock Exchange (IRELAND), Luxembourg Stock Exchange (LUXEMBOURG), Athens Stock Exchange(GREECE), Madrid Stock Exchange (SPAIN), BarcelonaStock Exchange (SPAIN), Valencia Stock Exchange (SPAIN), BilbaoStock 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	PragueStock Exchange (CZECH REPUBLIC), Warsaw Stock Exchange (POLAND), Bucharest Stock Exchange (ROMANIA), RussianStock 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: Sample of Analysed Integration Projects

INTEGRATION PROJECT	MARKET INDEX	YEAR OF INTEGRATION
European Markets		
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
International Markets		
NYSE-EURONEXT	Euronext Stock Exchange	September 2007
	New York Stock Exchange	September 2007
NASDAQ OMX GROUP	Nasdaq	March 2008
	OMX	March 2008
MILA	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:

$$R_t = \ln P_t - \ln P_{t-1} \tag{1}$$

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.

3.1 Predictor variables

The analysis of literature suggests that various classes of variables can be relevant indicators of stock exchange integration. In this study we use different types of predictor variables: macroeconomic variables, development variables, regulation variables, structural variables, stock exchange regulation variables, operative variables and control variables. The full list of regression variables in presented in Table 3.

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 as 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 reason in regional equity integration is macro-economic integration, which is largely due to trading block formation, where the European financial markets are the results 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. We test the role of *Trade Openness* 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), we control for *GDP* as the evidence of financial international integration among developed and rich countries.

Table 3: List of control variables

Name	Unit	Definition	Source
Macroeconomic variables			
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
Development variables			
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
Regulation variables			
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
Stock exchange variables			
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

Trading Variables			
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
Operative Variables			
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 (clearing and settlement of transactions) with another stock exchange market	Authors' calculation based on Stock Exchange Annual Reports
Control Variables			
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

A second group of variables includes macroeconomic characteristics of stock market development. We test *Market Development* 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, we control for stock market illiquidity, using the variables *Market Value* 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. (2011), 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 we constructed the index of *Regulatory Quality*, 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, we employ the *Financial Regulation* 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, we use *Market Capitalization*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), we test *Cross-Membership* variable. The change of organizational structure of exchanges was found to be a very relevant factor in integration decision (Aggarwal 2002; Aggarwal and Dahiya, 2006). We use a *Demutualization* variable to check the role of the organizational transformation of the stock exchanges into for-profit corporations. We add *Self-listing* variable 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 stock exchange's behaviour after the hostile takeover attempt, we use *Acquisition Attempt* variable.

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, we control the individual performance of each stock exchange market. *Average Traded* is defined as the average amount traded per day by each stock market. Furthermore, we test the role of the total number of traded equities (*Equities*) and bonds (*Bonds*) in order to control the specialization of stock exchanges. We test the hypothesis that trading particular instruments can increase the probability of a new integration project with the aim to create a more important trading venue. 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, indicate the openness of stock exchange market for integration project. Finally, we add *Delisting* to test the number of delisting companies as important characteristics of stock exchange market.

Operative variables can be also considered as one of the most important factors of integration decisions. Following Aggarwal (1999), who pointed out that technology is making globalization more feasible, we test *Trading Platform* and *Post-Trading* variables 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.

Finally, there are evidences 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).

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, we use *Region* variable 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. We also introduce *Integration Openness* variable as 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.

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

In particular, integrated stock exchange markets demonstrate, especially, high difference in macroeconomic variables, financial regulation, development of stock exchange

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
TradeOpeness	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
RegulatoryQuality	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
AcquisitionAttempt	114	0.228	0.421	0	0	0	568	0.030	0.171	0	0	0
AverageTraded	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
Correlation	114	0.215	0.194	0.1675	0.084	0.291	551	0.198	0.194	0.159	0.067	0.299
Cluster	114	0.526	0.502	1	0	1	568	0.363	0.481	0	0	1

and trading activities. These observations highlight the findings of Hasan and Schmiedel (2004), indicating that deregulation, globalization, and technological developments have altered the business strategies of stock exchanges around the world.

4. Methodology

4.1 Correlation and Cluster Analysis

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. 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 3). 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:

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

where E is the expected value operator, *cov* means covariance and *corr* is a widely used alternative notation for Pearson's correlation. From the 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, Sorensen and Gutiérrez, 2006, Hooy and Goh, 2009; Bastos and Caiado, 2009). Cluster analysis can show the presence of integration trend between analysed 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 ($x_1, x_2, \ldots, x_n$), where each observation is a *d*-dimensional real vector, *k*-means clustering aims to partition the *n* observations into *k* sets ($k \leq n$) $S = \{S_1, S_2, \ldots, S_k\}$ so as to minimize the within-cluster sum of squares:

$$\mathrm{argmin}_s \sum_{i=1}^{k} \sum_{xj \in Si} \| x_j - \mu_i \|^2 \tag{3}$$

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 analyzed stock exchange markets. We assume that high correlation coefficients between the international indexes show the degree of increasing integration within stock exchange markets; however, the low number of successful integration projects in recent years can indicate the presence of other relevant determinants in order to conclude the fusion.

4.2 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:

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_k y_{t-k} + u_t \tag{4}$$

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

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

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 (λtrace) and the Max-Eigenvalue statistic (λmax). λtrace 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 ith ordered eigenvalue (characteristic root) obtained from the estimated Π matrix. λmax 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 λtrace) or that there are r + 1 (for λmax).

4.3 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:

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

where Pr(Y=1) is the probability of integration for stock market j at the end of year t, exp is the exponential function, β_1, $\beta_2 \ldots \beta_k$ are the slope coefficients, X_1, $X_2 \ldots X_k$ are the explanatory variables.

5. Empirical results

5.1 Correlation and Cluster Analysis

Results from correlation and cluster analysis are reported in Table 5. 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 of correlation and cluster analysis

	Correlation / Market 0.156	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
		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	1	1	1	1	1	1	1	1
	Nyse	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	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	n/a	n/a	n/a	n/a	n/a	n/a	n/a	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	OmxNordic Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	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 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 analyzed 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 toward an integration. If these two methodologies confirm that integration in the stock market exists, results from other research methods will analyze the determinants of this process.

5.2 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 6 summarizes the results of the Johansen cointegration test.

Results for the Euronext project show that there was not cointegration relationship between the involved markets. In fact, Johansen cointegration test statistic (16.56)is lower than 5 percent criticalvalue (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-runrelationships between the analyzed 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 we cannot reject r=1. Thereby, we can conclude that integration initiative was a response of Spanish markets to the new international

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	

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-runrelationships between the involve markets as we cannot rejectthe null hypothesis of r = 0. 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, London Stock Exchange and BorsaItalianashow 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 BorsaItaliana 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.

Analyzing 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 criticalvalue (15.49). However, there is no existence of long run relationship between these markets. Consequently, the findings confirm that themerger 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 6 showsthe existence of one cointegration equation between the markets (the r=0 hypothesis must be rejected). However, the findings do not show the long run relationship 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 neighboring 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-runrelationships 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 behavior of stock exchanges in their integration process, results from the regression analysis are needed.

5.3 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 check the collinearity among selected variablesthe correlation analysis between all potential variables was applied before logit regression modeling. Moreover, 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 characteristics available for the full set of selected stock exchange markets. Next, in Column 2, we re-estimate the model with a measure of regulatory variables. We then, progressively, add variables referring to structural stock exchange characteristics in Column 3 and in Column 4. In Column 5 we control for trading variables associated with stock exchanges' performance. The final specification reported in Column 6 control for most important variables. The final results are presented in Table 7.

Table 7: Determinants of International Stock Exchange Integration - Logit Model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Regression Analysis						
Union	1.507***	0.566	0.845	0.753	0.234	1.123
	(0.526)	(0.579)	(0.651)	(0.781)	(0.733)	(1.019)
Currency	0.398	-0.578	-1.002*	-0.188	-0.565	-0.355
	(0.371)	(0.468)	(0.570)	(0.674)	(0.650)	(0.771)
TradeOpeness	0.378	-0.110	-0.446	-0.502	-0.913	0.741
	(0.335)	(0.511)	(0.611)	(0.960)	(0.864)	(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	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market Value	0.011***	0.003	0.001	-0.007	-0.001	-0.009
	(0.003)	(0.005)	(0.005)	(0.007)	(0.008)	(0.009)
Market Size	-2.913***	-4.868***	-5.607***	-9.378***	-6.241**	-10.051***
	(0.879)	(1.373)	(1.773)	(3.553)	(2.951)	(3.432)
Turnover	-0.003	-0.002	-0.004	0.003	-0.001	0.013
	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.011)
RegulationQuality		1.399***	1.495***	1.610**	1.937***	2.351***
		(0.429)	(0.480)	(0.700)	(0.677)	(0.809)
Financial Regulation		0.017	0.180	-0.320	-0.739	-0.751
		(0.512)	(0.544)	(0.650)	(0.675)	(0.857)
Market Capitalization			0.001	0.001***	0.001	0.001**
			(0.001)	(0.001)	(0.001)	(0.001)
Cross-Membership			1.079*	1.633**	0.574	1.923**
			(0.563)	(0.690)	(0.637)	(0.775)

Demutualization			1.896***	2.132***	1.397**	1.406*
			(0.564)	(0.745)	(0.626)	(0.838)
Self-Listing		1.400***				
		(0.369)				
Shareholder			(0.564)	(0.745)	(0.626)	(0.838)
			0.054	-0.620	0.561	-1.166
Acquisitionattempt			(0.690)	(0.942)	(0.833)	(1.044)
			0.063	0.879	0.026	0.104
AverageTraded				0.001**		0.001
				(0.001)		(0.001)
Equity				-0.001		-0.002
				(0.003)		(0.036)
Bond				-0.001		-0.001*
				(0.001)		(0.001)
Listed Companies				0.001	0.003	0.002
				(0.003)	(0.003)	(0.018)
Foreign					-0.003	0.001
					(0.002)	(0.018)
Domestic					-0.005*	-0.007
					(0.003)	(0.019)
Foreign Ratio					-2.424	-3.185
					(2.351)	(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***	-3.924***	-4.616***	-3.957***	-2.928***	-6.010***
	(0.576)	(0.652)	(0.831)	(1.048)	(0.869)	(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

Correctlyclassified	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 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.[1]

Second, in terms of regulation variables we observe that Regulation Quality in terms 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 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; 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, 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.

[1] http://europa.eu/rapid/press-release_SPEECH-12-52_en.htm

Finally, integration openness measured in terms of correlation analysis is an important driver of stock exchange projects. In fact, according to Tam and Tam (2012) market integration manifests in the convergence of stock ratios in the long run, driven by common global factors across markets.

To investigate the probability of stock exchange integration for each key variable, Table 8 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 model presented in Column 6.

Table 8: Probability of Stock Exchange Integration

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

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 providesan 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.

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

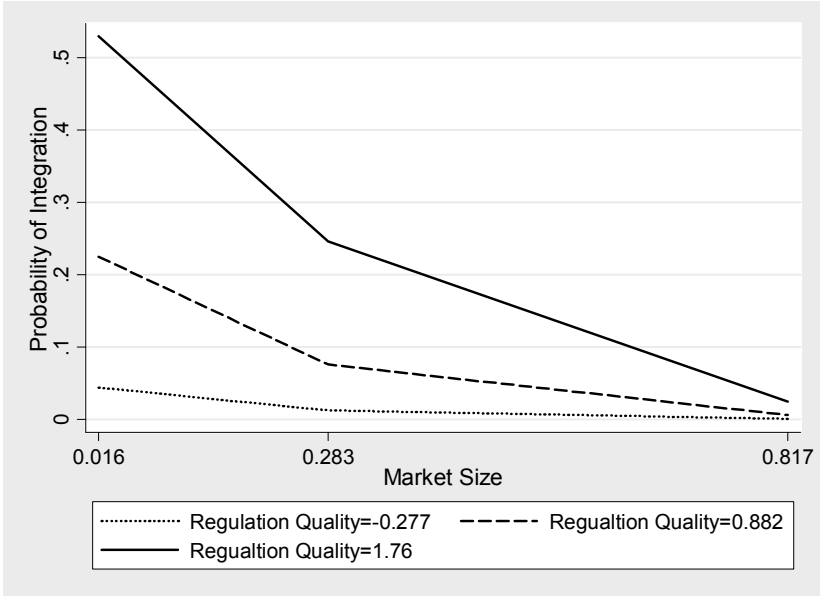

Figure 1 confirms that being a large stock exchange market substantially decreases the chances of stock exchange integration. The extremely large markets maintain a much higher systemic risk and attract the attention of Regulators in terms of competition. Thus, the probability of integration is higher 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 in Figure 2 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: The impact of Cross-Membership on probability of stock market integration for different levels of Integration Openness

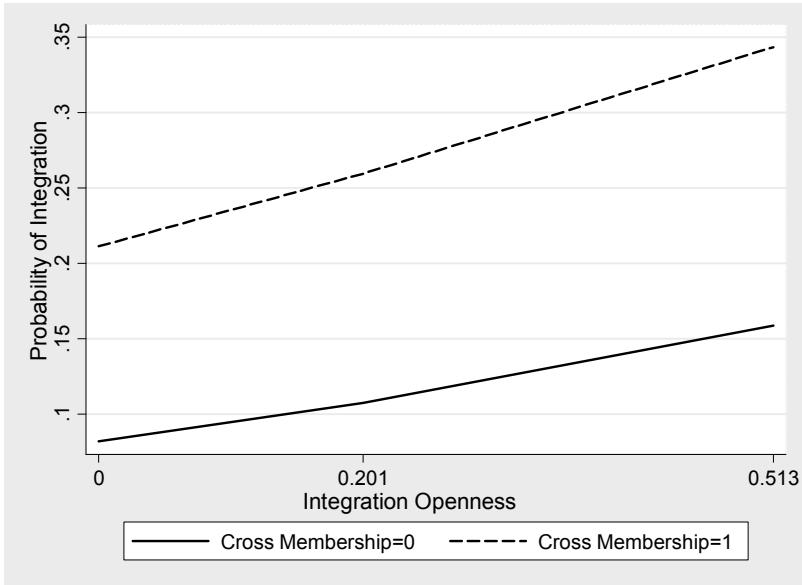

Figure 2 demonstrates that the probability to be integrated is increasing for stock markets that have cross-trading agreements and are highly integrated in global trading activity.

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

This paper analysed 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.

Furthermore, the integration phenomenon within the stock exchange markets worldwide has been analysed from different perspective. 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 along-runrelationships 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 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.

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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