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Working Paper

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BUSINESS ADMINISTRATION VIENNA

Working Papers

EI Working Paper No. 74

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November 2006

Download: http://fgr.wu-wien.ac.at/institut/ef/publicat.html

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Medieninhaber, Eigentümer Herausgeber und Verleger: Europainstitut der Wirtschaftsuniversität Wien, Althanstraße 39—45, A—1090 Wien;

Für den Inhalt verantwortlich: Univ.-Prof. Dr. Stefan Griller, Althanstraße 39—45, A—1090 Wien.

Integration of European Stock Markets: A Review and Extension of Quantity-Based Measures

DAGMAR INZINGER / PETER HAISS[1]

ABSTRACT

We examine to what extent Europe´s stock markets are integrated, and how this can be measured. We review 54 empirical studies and find an overemphasis on price-based measures and a need for more quantity-based studies. We update the Baele et al (2004) study on investment funds´ equity holdings to March 2006 for ten euro area and four non-euro area countries, provide additional quantity based evidence, and discuss integration theories. Our results indicate a decline in home bias particularly after the advent of the euro. We conclude that although European stock markets have undergone significant developments, the level of European integration is below expectations and there is a high joint integration with the U.S.

Keywords: Financial Markets Research; Integration of Stock Markets; Integration Measurement; Quantity-based Indicators

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1. INTRODUCTION

The European financial landscape has changed rapidly in the last decade. The most decisive development is the integration of European financial markets due to the creation of Economic and Monetary Union (EMU), the single European market, the ongoing deregulation of financial policies, e.g. via the Financial Service Action Plan (FSAP), as well as additional structural or technological modifications. In this context, the integration of European stock markets is still one of the most current issues. According to McAndrews and Stefanadis (2002), integration of equity markets results in a more open and dynamic business and investment environment with increased market liquidity, more profitable and productive trading systems, and a more efficient allocation of capital. However, extended financial integration may also involve additional risks.

This paper is provides an overview of the existing empirical literature on European stock market integration and discusses underlying institutional theories. In addition, we examine the level to which European stock markets are already integrated by using quantity-based integration measurement indicators. In particular, we investigate stock market home bias by assessing investment funds' equity holdings from December 1997 to March 2006 for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, and the U.K. We highlight information on foreign portfolio equity holdings in order to analyse the development of European countries' bilateral holdings. We also investigate collective trends in the foreign listings of companies, as well as compare domestic and foreign equity volumes to examine the degree to which European stock exchanges are outward oriented. As the literature has mainly focused on return-based indicators in order to measure interdependencies among markets and rather neglecting quantity-based measures, we address this gap by contributing an updated analysis of the latter kind.

Stock market integration as research issue is of particular relevance for the future development of European financial systems since the integration of European financial markets may spur economic growth and may result in higher efficiencies. Understanding the process of integration of the stock market segment as well as being aware of the current state of financial integration is necessary in order to further promote Europe's integration process. Measuring the degree of stock market integration may thus be important for policymakers,

regulators, and central banks. Our results should provide valuable information to scientists and practitioners working on financial, regulatory, and/or institutional aspects of European integration.

This paper is structured as follows: Section 2 provides a theoretical framework by discussing theories supportive of integration and theories in favour of segmentation. Section 3 examines various measures of integration. The following two sections represent the core parts of the paper. Section 4 discusses the empirical literature on stock market integration. Moreover, in section 5 the results of the conducted data are portrayed. Finally, section 6 concludes.

2. THEORETICAL FRAMEWORK

Due to political and structural changes, linkages and cooperations among European stock markets have intensified. There is a vast amount of literature aiming to explain why and how interrelationships among organisations are established, e.g. Thorwartl (2005). Even though not all of these theories are suitable for explaining stock market integration, there are still numerous aspects which serve as good explanations. We have chosen to combine three theoretical paradigms, namely transaction cost economics, agglomeration theory, and institutional economics, in order to explain linkages among European stock markets. As the current degree of integration is not as far as predicted by theory, we will illuminate two possible approaches to explain resisting forces to integration.

2.1. Theories supportive of stock market integration

As mentioned above, this section will present three theoretical frameworks which try to explain interorganisational relationships. The reason for deciding on transaction cost economics, agglomeration theory, and institutional theory was to gain insight on different perspectives on the formation of interorganisational linkages. Whereas transaction cost and agglomeration theory represent economic explanations, institutional theory corresponds to the notion of behavioural disciplines (Barringer and Harrison 2000: 381-382). In the following, the key concepts of these theories will be described by interlinking them to the phenomenon of stock market integration.

Transaction cost theory defines transactions as “an exchange of goods or services from one party to another” (Jones and Hill 1988: 160). Furthermore, transaction costs are the “negotiating, monitoring, and enforcement costs that have to be borne” to make this exchange

possible (Jones and Hill 1988: 160). The core question is whether these transaction costs can be minimised via the market or within a hierarchy (firm). If transaction costs via the market are high, it is recommended to "internalise" the transactions in order to gain economic benefits. There have been six factors identified which may result in transaction problems. These are: bounded rationality, opportunism, uncertainty and complexity, small numbers, information impactedness, and asset specificity (Jones and Hill 1988: 160). The internalisation of production, through networks or partners, helps to reduce these difficulties (Barringer and Harrison 2000: 371).

This theory may be applied to the integration of stock markets as most of the above outlined transaction problems, and thus the consequential costs, can be minimised when stock exchanges enter into cooperation networks either with competitors or with other organisations, such as clearing and settlement institutions. Thus, transaction cost economics can serve as an explanation for stock exchange alliances.[2] The main shortcoming of this theory is that it does not include any other reasons for the establishment of networks besides efficiency or cost-minimising rationales (Barringer and Harrison 2000: 372). Therefore, other approaches aiming to explain integration will be highlighted in the following.

The second theoretical paradigm applied here is "agglomeration economies", or agglomeration theory, which is part of the "New Economic Geography". The latter focuses on the explanation of the spatial concentration of firms, workers, and consumers. According to Simonis (2002: 7), the reason for concentration of economic activity is "the existence of externalities, the so-called "agglomeration economies", which means that spatial concentration itself creates a favourable environment for the location of economic activity". Hence, geographic concentration may lead to numerous positive outcomes such as innovation, ease of the adoption to new technologies or other organisational changes, time savings, and so forth (Cohen 2006: 96-97). Furthermore, Johansson and Quigley (2004: 7-8) point out that agglomeration results in two sources of efficiency gains. Firstly, various products are exclusively exchanged inside the agglomeration, especially those products "whose transaction costs increase strongly with distance" (Johansson and Quigley 2004: 7). These transaction costs encourage diversity in agglomerations. And secondly, transaction and transportation costs reduce with proximity (Johansson and Quigley 2004: 7-8).

[2] This is also confirmed by Thorwartl (2005: 133).

In the light of stock market integration, agglomeration theory may be appropriate to explain the increasing linkages. Due to the exploitation of the above mentioned advantages, stock exchanges may prefer proximity and cooperations. Especially in such fast moving industries, where technologies and products frequently change, facilitated exchange of information through networks may result in economic benefits. However, as this theory is closely linked to transaction cost economics it will be supplemented with a more behavioural approach, i.e. institutional theory.

The focal point of institutional theory is that the institutional environment exerts pressure on organisations, thereby encouraging them to "pursue activities that will increase their legitimacy and cause them to appear to be in agreement with the prevailing rules, requirements, and norms of their business environment" (Barringer and Harrison 2000: 380). This may be achieved by participating in interorganisational relationships (Barringer and Harrison 2000: 380). In general, there are three ways how organisations assent to the environment's pressure: habit, imitation, and compliance. Habit refers to the blind adherence to rules, imitation includes the "either conscious or unconscious mimicry of institutional models", and compliance implies conformity with "values, norms, or institutional requirements" (Oliver 1991: 152). Institutional theory can be also linked to stakeholder theory, as an organisation's environment is very much influenced by its stakeholders, i.e. any group of individual who can affect or is affected by the firm (Thorwartl 2005: 191).

Although heavily behavioural oriented, institutional theory may explain stock market integration. The general environment and the stakeholders of an equity market are strongly influencing its performance. Stock exchanges' stakeholders are investors (private, institutional), intermediaries (brokers, dealers), listed companies, national and EU regulatory and supervisory bodies, governments, clearing and settlement institutions, derivatives exchanges, employees, other exchanges, competitors, banks, and the public in general.

Considering these three theoretical paradigms, the increasing integration of stock markets is on the one hand advanced by cost-minimising rationales, either due to internalisation or to proximity and cooperation with competitors, and on the other hand by environmental pressure. In view of this, stock markets would definitely prefer to establish networks instead of staying alone. However, as the European stock exchange landscape is still rather

fragmented with only a few alliances in full operation, the next section will try to explain this phenomenon.

2.2. Theories in favour of segmentation

The objective of this section is to explain which forces may slow down economic integration. On the one hand, the impact of globalisation on economies will be critically discussed, thereby arguing that the pressure generated by globalisation will not inevitably lead to a convergent outcome. On the other hand, the phenomenon of "economic patriotism" and its influence on integration will be discussed.

The neo-classical view of globalisation is that globalisation exerts common pressures, or inputs, which result in common (i.e. convergent) outcomes. In addition, it is assumed that institutional mediation through states or other political-economic regimes is nonexistent (Hay 2004: 233-235). Thus, convergence on best practice presumes "complete information, rational action and Darwinian competition" (Hay 2004: 234). However, as the neo-classical assumptions can be considered as inappropriate, another perspective on globalisation was advanced, namely the dual convergence thesis (Hay 2004: 233-235). It states that globalisation generates numerous common pressures "to which competing models of capitalism are differentially exposed" (Hay 2004: 236). Dual convergence theorists include "institutional mediations which may serve to channel common inputs and pressures in different directions" (Hay 2004: 237). These different directions can be observed in the four following ways. Firstly, different structures result in different reactions to pressure. Secondly, comparative institutional advantages and disadvantages can be enforced or reduced by the globalisation pressure. Thirdly, opposing interpretations may be reached from the experiences made in this process. And finally, even if the same conclusions are reached, strategic and institutional capacities, economic intervention, and corporate governance systems may be different (Hay 2004: 235-237). Hay (2006: 6-7) argues that it is "difficult to see globalization as the principal agent determining the path on which European social models are embarked, since the empirical evidence points if anything to *de-globalization* rather than globalization".

Nevertheless, even if globalisation is not the "principal agent" of change, it is at least an "influencing process … that embodies a transformation in the spatial organisation of social relations and transactions, generating transcontinental or inter-regional flows and networks of activity, interaction and power" (Hay 2006: 3). If this perception holds true for stock markets,

one should be aware of the fact that globalisation may not implicitly enforce integration; but it may lead to quite divergent outcomes. This may in turn partly explain, why the degree of integration among European stock markets is still not as far as predicted by theory.

Contrary to the outlined discussion on globalisation, a quite opposing development to this process has been observed recently in Europe, namely the growing "economic patriotism". This term can be defined as a "general euphemism for a wide array of protectionist and industrial policy measures" (Wruuck 2006: 3). It deals with the phenomenon that states try to protect the domestic market in order to retain "the right to shape corporate decisions at home" (Wruuck 2006: 3). This run for national champions "has increased lately, and, ironically in many cases their goal is to block the formation of European champions" (Riess and Välilä 2006: 21). The protection of domestic companies has been mainly observed in the energy and banking sector (Riess and Välilä 2006: 21). For stock markets, this tendency implies that with increasing financial market liberalisation, the existence of local stock exchanges as "national champions" diminishes as the "country of incorporation can be easily changed, without affecting the company's operations" (Bris 2006). Thus, the fear to "loose" these companies could be a serious obstacle to further stock market integration. One must not forget that stock exchanges are considered as "public goods", and thus merger and acquisition talks are sensitive issues involving political and public interest. However, in the long run, economic patriotism does not seem to pay off, as this would lead to competitive distortion and induce high economic and political costs (Wruuck 2006: 15).

3. MEASUREMENT INDICATORS FOR STOCK MARKET INTEGRATION

While the preceding sections discussed institutional aspects, this section will survey indicators which are suitable for the measurement of stock market integration. On the one side, we will describe return-based indicators, which are based on the "law of one price", and on the other side, we will portray quantity-based indicators. With this classification we follow Adam et al. (2002), Baele et al. (2004), Ferrando and Vesala (2005) and Pagano et al (2001, 2002). We suggest organising the measures of integration as illustrated in Table 1. In the following, these measures will be described and discussed in more detail.

TABLE 1
Overview of stock market integration indicators

Stock market integration indicators	
Return-based indicators	*Quantity-based indicators*[3]
Risk-based indicators	Portfolio composition
News-based indicators	Equity holdings of investment funds
Country versus industry effects	Cross-listings
	Trading volumes
	Contestable markets

3.1. Return-based indicators

The first group of indicators measure differences in prices or returns on assets resulting from the "geographic origin of the assets" (Baele et al. 2004: 11). First of all it has be outlined that return-based (price-based) indicators are generally founded on the idea that financial markets are integrated if the law of one price[4] holds in equilibrium. In short, the law of one price indicates that "the prices for a fully homogeneous product in question are the same irrespective of the geographical domicile of the seller or the buyer" (Ferrando and Vesala 2005: 54). However, it is important to be aware of the fact that returns can vary across countries as a result of the exchange rate risk. Consequently, one has to take the exchange rate risk into account when measuring integration. When analysing the euro area markets, this is no longer a problem since 1999 (Baele et al. 2004: 12). Furthermore, there are two other basic preconditions for the application of the law of one price. Firstly, goods or services have to be homogeneous, i.e. they should be priced equally in integrated markets, and secondly comprehensive and high quality price data has to be available. As for equity markets each of these two requirements can be fulfilled easily (Ferrando and Vesala 2005: 55). In general, we distinguish between three different types of return-based measures, namely risk-based and news-based indicators, as well as measures focusing on country versus industry effects.

[3] As for quantity-based indicators, one may also distinguish between indicators analysing the primary or secondary market.

[4] The law of one price can be defined as the "proposition that where the same good or asset is traded in different markets, the prices will not diverge … The law of one price can be taken to imply that where there are costs of transferring goods or assets, prices will not diverge by more that the transfer costs; they may of course diverge less than this" (Black 2002: 265).

Risk-based indicators

The first group of studies is based on the assumption, that expected returns are influenced by global-specific rather than by country-specific risk factors. As Bekaert and Harvey (1995: 403) point out "markets are completely integrated if assets with the same risk have identical expected returns irrespective of the market". If markets are fully integrated, investors have to cope with "common and country-specific risk, but price (identically in all markets) only common risk factors, because country-specific risk is fully diversifiable" (Emiris 2002: 200). In partially integrated markets, investors have to deal with both "common and country-specific risks and price them both" (Emiris 2002: 200). And finally, in segmented markets, investors have to manage and to price only country-specific risks (Emiris 2002: 200).

The most important papers which focused on the investigation of completely integrated markets have been written by Adler and Dumas (1983), Stulz (1981, 1998), Harvey (1989, 1991), Dumas (1994), Dumas and Solnik (1995), De Santis and Gerard (1997), and De Santis et al (1998) (Emiris 2002: 200). As for articles which are based on the theoretical assumption of partial integration, the key authors are Black (1974), Stulz (1981), Errunza and Losq (1985), Eun and Janakiramanan (1986) and Cooper and Kaplanis (2000) (Hardouvelis et al. 2004: 3).

Earlier studies which employed risk-based measures have mainly used international capital asset pricing models (CAPM). The most central shortcoming of these world CAPM studies is that they do not allow for a time-varying degree of integration. Bekaert and Harvey (1995) were first to consider this within a new methodology (Adam et al. 2002: 8). A new way of testing for integration has been suggested by Chen and Knez (1995). Furthermore, recent studies, like Söhnke et al. (2005) and Cappiello (2005a) have employed alternative methodologies as well.

News-based indicators

As investigating the law of one price does not include "information about the dynamics of the integration process, nor […] the drivers of integration" (Baele et al. 2004: 70) the literature has shifted to the analysis of shock spillover intensities, or in short, how markets react to innovations in another market, in order to measure the degree of integration (Baele et al. 2004: 70 and 74). Therefore, the objective of news-based measures is to untangle "the effects of new information on different shocks from other market frictions" (Ferrando and Vesala

2005: 60). This means that apart from common factors, returns are, due to their "betas"[5], reacting differently to innovations. With the help of these betas, it is possible to examine the intensity of country-wide and global shocks to equity markets. Thus, if betas are increasing, the degree of integration among stock market rises (Baele 2004: 74).

The empirical frameworks which can be found in the literature are considerably different. Next to vector autoregressions (VARs), which were applied by Eun and Shim (1989), and King and Wadhwani (1990), Hamao et al. (1990) as well as Susmel and Engle (1994) used ARCH variants. Bekaert and Harvey (1997) extended the framework to a semi-parametric ARCH model (SPARCH). Moreover, from the 1990s onwards, scientists have more or less changed to univariate and multivariate GARCH models in order to examine interdependencies among equity markets, e.g. Bekaert and Harvey (1997), Hardouvelis et al. (1999); Morana and Beltratti (2002), Fratzscher (2002), and Baele (2004). Longin and Solnik (1995) and Bodart and Reding (1999) employed "regressions on different sub-periods to gain insight into long-term changes in stock market integration dynamics" (Kim et al. 2005: 2478-2479).

Country versus industry effects

Besides the examination of stock markets' integration at the country level, a lot of empirical studies have investigated the integration process including the industry level. In practice, portfolio managers use a "two-stage approach to portfolio selection" (Heston and Rouwenhorst 1995: 53). This means that they first diversify the securities over different industries, and afterwards they choose the best equities in accordance with their allocation. This strategy is used by investors considering industry factors as more dominant. However, if investors perceive domestic market factors as more important, they firstly select equities in view of their location, and afterwards they choose the most attractive securities from each country (Heston and Rouwenhorst 1995: 53). The different allocation of equities is highly relevant for the "discussion on the relative importance of country vs. industry or sector factors in explaining the cross-section of international returns" (Adjaouté and Danthine 2003: 212).

Prior to EMU, scientists and practitioners were in favour of diversifying the risk of stocks across countries rather than sectors. However, in ex-post analysis, Rouwenhorst (1999) and Adjaouté and Danthine (2003) found evidence that to start allocating at the industry level

[5] Baele et al. (2004: 20) define the term beta as follows: "While returns for all countries share the same two factors, they are allowed to have different sensitivities, or "betas", to these common factors".

became the best way of spreading the risk. Most of the papers which analysed to which extent "equity returns are determined by sector rather than country effects" followed the methodology suggested by Heston and Rouwenhorst (1994) (Baele 2004: 17). Considering their approach as inaccurate, Adjaouté and Danthine (2003: 217-218) introduced an alternative way of analysing the problem.

3.2. Quantity-based indicators

Next to price-based measures of integration which are determined by the law of one price, alternative ways of investigating stock market integration were established. These indicators are based on the examination of quantities, either by measuring "the size of capital flows or the composition of portfolios (stock measures)" (Adam et al. 2002: 9). Additionally, as mentioned above, quantity-based indicators may also be divided referring to the markets they analyse, i.e. either primary or secondary markets. For instance, if integration is measured by analysing the geographic breakdown of initial public offerings (IPOs), it is solely focused on the primary market. However, the investigation of domestic or foreign trading volumes, or the composition of investment funds' equity holdings, relates mainly to the secondary market. Studying the geographic dispersion of portfolios is a combination of both, as they may include newly issued securities as well.

In view of the demand-side, quantity-based indicators can be motivated by portfolio theory. Analysing a portfolio's allocation structure including both domestic and foreign securities can give insight in the degree of integration. In case of integrated financial markets, investors are more likely to diversify and invest into foreign assets. In practice, investors often prefer investing in domestic shares owing to the so-called "home bias". This is largely in contrast to the assumption of the standard portfolio theory, suggesting that investors would "optimally diversify away domestic risk factors" (Ferrando and Vesala 2005: 57). In short, home bias are likely to disappear, if markets are fully integrated. Indicators comparing the "share of foreign over total assets invested by the domestic sector" (Ferrando and Vesala 2005: 57) with the optimal diversification strategy can be regarded as one possible quantity-based measure. There is different kind of data which can serve as basic information, e.g. cross-border flows on the acquisition of investment products and services (Ferrando and Vesala 2005: 57).

Equity market home bias can also be assessed by the investigation of investment funds' strategies. As pointed out by Baele et al. (2004: 22) a "decrease in the bias toward domestic

stocks is a sign of further integration". A good example of implementing quantity-based indicators is the study by Adam et al. (2002: 3), in which the authors used international investment strategies of equity funds as quantity-based indicators, thereby differentiating into the analysis of the investment fund industry, pension funds, and foreign assets held by insurance companies.

As pointed out by Pagano et al (2001: 771) "one may expect that as capital market integration proceeds, geography becomes increasingly irrelevant to finance". In the context of cross-listings of companies this would imply that the more integrated a market, the more companies would seek to list abroad. This means that the examination of dual listings on European stock markets can be a valuable measure of integration. In view of cross-listings, one can analyse the issuance of new securities on domestic and foreign stock exchanges as well. In short, if the number of cross-border initial public offerings (IPO) increases, the degree of integration rises too. Cross-border equity flows can be an indicator of integration as well. An increasing percentage of foreign equity trading implies an increasing openness of stock exchanges.

Quantity-based indicators can also be influenced by other effects. According to the theory of contestable markets, the degree of integration can be measured by analysing cross-border establishment and acquisition of financial institutions, domestic markets' structural changes, as well foreign investors' stake in the local market (Ferrando and Vesala 2005: 57).

3.3. Return-based versus quantity-based indicators

This section briefly reviews the various merits and disadvantages of the indicators discussed above. In contrast to quantity-based indicators, price-based measures can be interpreted clearly, as they are founded on the law-of-one price (Adam et al. 2002: 1). A possible drawback is that the "law may fail to hold true because of factors such as transport and transaction costs, consumer switching costs or barriers to entry, maintaining market segmentation" (Cabral et al. 2002: 7). Furthermore, these indicators are based on price data which is better accessible and more precise (Adam et al. 2002: 1). On the contrary, in order to use return-based measures, complicated methodologies are necessary (Adam et al. 2002: 13). According to Kiehlborn and Mietzner (2005: 7), price-based indicators are particularly effective when analysing long-term integration processes. In addition, they are more responsive to new integration measures. With the help of quantitative indicators, the presence

of foreign investors in domestic markets (through portfolio composition, share in total issuing activity), can be assessed easily. Certainly, the existence of cross-border activity does not definitely provide evidence for market integration, but it signals that "markets are contestable to some degree" (European Commission 2004: 2). Indicators based on quantities have the main advantage that their implementation is less difficult (Adam et al. 2002: 13). The major disadvantage of all quantity-based indicators is that they can not certainly proof the existence of integration (Ferrando and Vesala 2005: 58).

It is not clear, which indicator serves the best results. On the one hand, it is argued that price-based indicators are considered as being most accurate for capital market integration measurement (Ferrando and Vesala 2005: 54). On the other hand, as Adam et al. (2002: 13) point out "given that quantity data based on stocks of assets […] can be given clear economic interpretation, they should be preferred to flow data".

4. LITERATURE REVIEW

A thorough literature review will shed light on the current empirical evidence and will provide a basis for further research. Overall, we review 54 empirical studies on stock market integration from various journals and working paper series. In general, we focused on papers analysing the impact of the European Economic and Monetary Union (EMU) on the integration of stock markets, on general studies on European stock market integration, as well as on papers investigating the degree of integration among or with Central and Eastern European stock markets. In the following we will briefly discuss and summarise the studies under review. A comprehensive overview is given in the appendix.

4.1. Discussion and summary of empirical evidence

In general, considering the variety of stock market integration indicators (defined in section 3), it is surprising that most of the authors solely focus on return-based indicators. As can be clearly seen in the appendix, only five out of fifty-four have applied quantity-based indicators. In addition, few of the papers differentiate between primary or secondary market. To sum up, the results of the empirical studies under review can be grouped as suggested by Table 2.

TABLE 2
Overview of grouped results (Frequencies in brackets).

Overview of grouped results		
(1) Risk- and news based indicators	**(2) Country versus industry effects**	**(3) Quantity-based indicators**
a) No integration among European (CEE) stock markets (5) b) Increasing integration among European (CEE) stock markets (24) c) Increasing integration among European stock markets due to the EMU/ euro (13) d) Increasing integration of European (CEE) stock markets with internatio-nal stock markets (9) e) Decreasing integration of European (CEE) stock markets with internatio-nal stock markets (1)	a) Country effects dominate industry effects (2) b) Industry effects dominate country effects (4) c) Country effects equal to industry effects (2)	a) Home bias in portfolios reduced (2) b) Proportion of foreign listed companies fell (3)

Only five of the analysed studies found evidence that stock market integration did not increase at all (1a in table 2). Most of the papers which focused on the integration of European (EU/EMU) stock markets proved increased integration, either due to the EMU or not. Of the 54 reviewed studies, 24 found an increase in integration, and 13 confirmed that the degree of integration increased with the euro introduction. Additionally, authors who concentrated on capital markets in the New EU Member States from Central and Eastern Europe (CEE) mostly confirmed an increasing degree of integration either among CEE equity markets, or with international capital markets (i.e. the U.S.). Of the ten articles concentrating on CEE stock market integration, only three did not support these outcomes. As for the examination of country versus industry effects, half of the studies suggested that industry effects exceeded country effects, the other half stated that country effects still are more important than industry factors. However, two of them point out that they are at least in an equal position. And finally, regarding the papers which applied quantity-based indicators, two studies found a decline in home bias and therefore an increase in the internationalisation of portfolios. In addition, all studies which analysed cross-listings found that the proportion of foreign listed companies fell. As already mentioned, an overview of the studies can be found in the appendix.

There is of course the question why these empirical studies came to rather diverse conclusions. One could argue that most of the papers used different sampling data, i.e. the authors analysed different countries within a different time span. Furthermore, the articles generally did not apply the same empirical methodology. And even if the authors decided on the same standard model, they mostly changed some features. In addition, it has to be clearly outlined that though these papers are concentrated on the analysis of the integration of European stock markets, they focused on different research problems.

As we could not observe particular patterns in the results, we analysed whether the studies came to similar outcomes at particular times. More precisely, we focused on the stock market crash in 1987, the ERM crisis in 1992/1993, the emerging market crisis in 1997/1998, and the euro introduction in 1999. Unfortunately, we could not include all studies, because some of them did not split up their results. In addition, we did not consider CEE-studies, because equity markets in Central and Eastern European countries have undergone different developments.

The analysis shows, however, that results still vary. As for the time period around the stock market crash, an increase after 1987 was observed by all of them. Six papers clearly outline that before 1987, European stock markets were less integrated. As for the 1992/1993 ERM crisis, two authors suggest that the degree of integration decreased during this period. Through the years 1997/1998, three papers find a sharp increase in integration. It is worth noticing that all papers discovered that European stock markets were more integrated due to the euro introduction. On the other hand, three studies find a decrease in integration after 1999. This investigation is illustrated by Table 3.

Various authors also analysed the impact of the U.S. market on European stock markets. Most of them confirmed that European stock markets became increasingly integrated with their U.S. counterparts. This confirms that interdependencies did not only rise among European countries, but that international stock markets moved together in general.

TABLE 3

Analysis of the results focusing on particular occurrences. Source: Inzinger (2006)

		Stock market crash			ERM Crisis		Emerging markets crisis		Euro introduction	
Author	**Time period**	**Pre 1987**	**1987**	**1988**	**1992**	**1993**	**1997**	**1998**	**1999**	**Post 1999**
Meric and Meric (1997)	1975-1994	Less integrated	Increase	Increase	Increase	Increase	N/A	N/A	N/A	N/A
Kanas (1998)	1984-1993	Less integrated	Increase	Increase	Increase	N/A	N/A	N/A	N/A	N/A
Freimann (1998)	1975-1996	Less integrated	Increase	Increase	Increase	Increase	N/A	N/A	N/A	N/A
Cheung and Lai (1999)	1979-1992	Less integrated	Increase	Increase	N/A	N/A	N/A	N/A	N/A	N/A
Worthington; Masaki and Higgs (2003)	1988-2000	N/A	N/A	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Emiris (2002)	1979-1997	Increase	Increase	Increase	Increase	Increase	N/A	N/A	N/A	N/A
Morana and Beltratti (2002)	1988-2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Sharp Increase	N/A
Fratzscher (2002)	1986-2000	Increase	Increase	Decrease	Decrease	Decrease	Sharp Increase	Sharp Increase	Sharp Increase	Decrease
Adam et al. (2002)	1994-2001	N/A	N/A	N/A	N/A	N/A	Sharp Increase	Sharp Increase	Increase	Decrease
Schich, Sebastian T. (2002)	1973-2001	Less integrated	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Billio and Pelizzon (2003)	1988-2001	N/A	N/A	Stable	Increase	Increase	Increase	Decrease	Increase	Increase
Yang, Jiang et al. (2003)	1996-2001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Sharp Increase	Increase
Hardouvelis; Malliaropulos, and Priestley (2004)	1992-1998	N/A	N/A	N/A	Increase	Increase	Increase	N/A	N/A	N/A
Melle Hernandez (2004)	1997-2002	N/A	N/A	N/A	N/A	N/A	Increase	Increase	Sharp Increase	Increase
Baele et al. (2004)	1973-2003	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Berben and Jansen (2005)	1980-2003	Increase	Sharp Increase	Sharp Increase	Sharp Increase	Sharp Increase	Increase	Increase	Increase	Increase
Söhnke; Taylor, and Wang (2005)	1994-2003	N/A	N/A	N/A	N/A	N/A	Sharp Increase	Sharp Increase	Increase	Increase
Friedman and Shackmurove (2005)	1990-2003	N/A	N/A	N/A	Increase	Increase	Increase	Increase	Sharp Increase	Increase
Kim; Moshirian, and Wu (2005)	1989- 2003	N/A	N/A	N/A	Decrease	Decrease	Increase	Increase	Sharp Increase	Increase
Baele (2005)	1980-2001	Less integrated	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Decrease
Chou and Wu (2006)	1995-2004	N/A	N/A	N/A	N/A	N/A	Increase	Increase	Increase	Increase

Overall, we conclude that while risk and return-based measures seem to indicate growing integration of EU stock exchanges among themselves and with U.S. stock exchanges, EU-integration can hardly be distinguished from global (i.e. U.S.-based) integration. Thus there is a clear need to update quantity-based measures focusing on the EU. The following analysis fills this gap.

5. DATA ANALYSIS

The aim of this chapter is to add to the examination of the current level of integration in European stock markets empirically. As outlined in the previous section, literature has mainly focused on return-based indicators in order to measure interdependencies among markets rather neglecting quantity-based measures. To address this gap in the existing literature and to contribute an updated analysis on the extent to which stock markets are already integrated, in the following we will use a series of quantity-based indicators (defined in 3.2).Following Adam et al. (2002) and Baele et al. (2004), we examine stock market home bias by assessing investment funds' equity holdings from December 1997 to March 2006. Moreover, we highlight information on foreign portfolio equity holdings in order to analyse the development of European countries' bilateral holdings. We also investigate collective trends in the foreign listings of companies, as well as compare domestic and foreign equity volumes to examine the degree to which European stock exchanges are outward oriented.

5.1. Investment strategies

The following section will focus on European investment strategies. On the one hand, it will be analysed how investment funds allocate their assets geographically. On the other hand, the aim is to find trends in the geographic breakdown of foreign portfolio equity holdings.

Investment funds

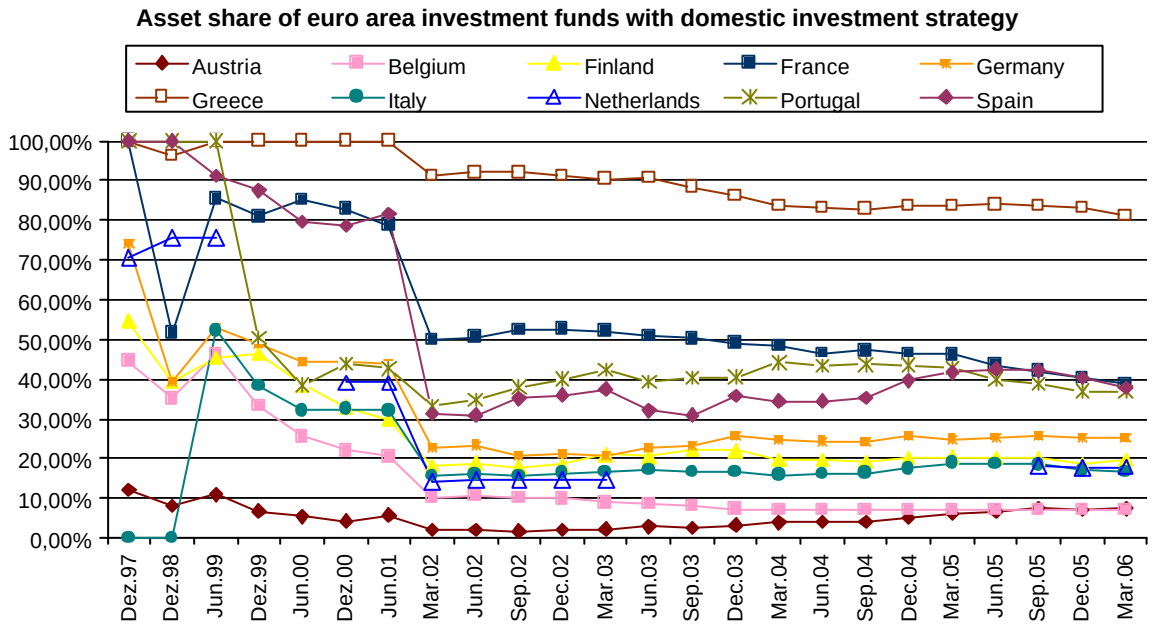
The European Fund and Asset Management Association (EFAMA) provides data on equity funds classified by region of investment. More precisely, they split the information in three broad categories: domestic, European, and international. The EFAMA data we use here covers the time period from December 1997 through March 2006. From the year 2002 on, the data is on a quarterly basis. Until 2002, it is rather unsystematic containing observations for at least one quarter per year. In what follows, we update and extend the results of Adam et al.

(2002) and Baele et al. (2004)[6] by providing a detailed analysis of developments in investment funds' strategies.

Figure 1 shows the asset share of euro area investment funds with a domestic investment strategy. In all countries, the share decreased over the period 1997-2006. Except for Greece, the share has fallen to 40% since March 2006 in all countries. Looking at the developments in detail, the chart suggests that after the unification of the currencies in 1999 in non-cash format there is a shift in the allocation strategy. The more visible change over from legacy currency notes to euro coins and euro notes after the two year non-cash euro period seems to have been an even stronger trigger, as can bee seen from the March 2002 rise in integration. It is notable that especially in the Netherlands the share of non-domestic investment funds has increased from around 20% in 1999 to 80% in 2006. Greece still has a big amount invested in domestic shares indicating that it is not as much integrated as the other countries. This may be explained by its location at the periphery of the eurozone or by a traditional preference for the home country.[7] Home bias in Belgium have decreased most, with a decline of approximately 30% from 1997 until March 2006.

FIGURE 1

Asset share of euro area investment funds with domestic investment strategy.



Data source: EFAMA. Own calculation.

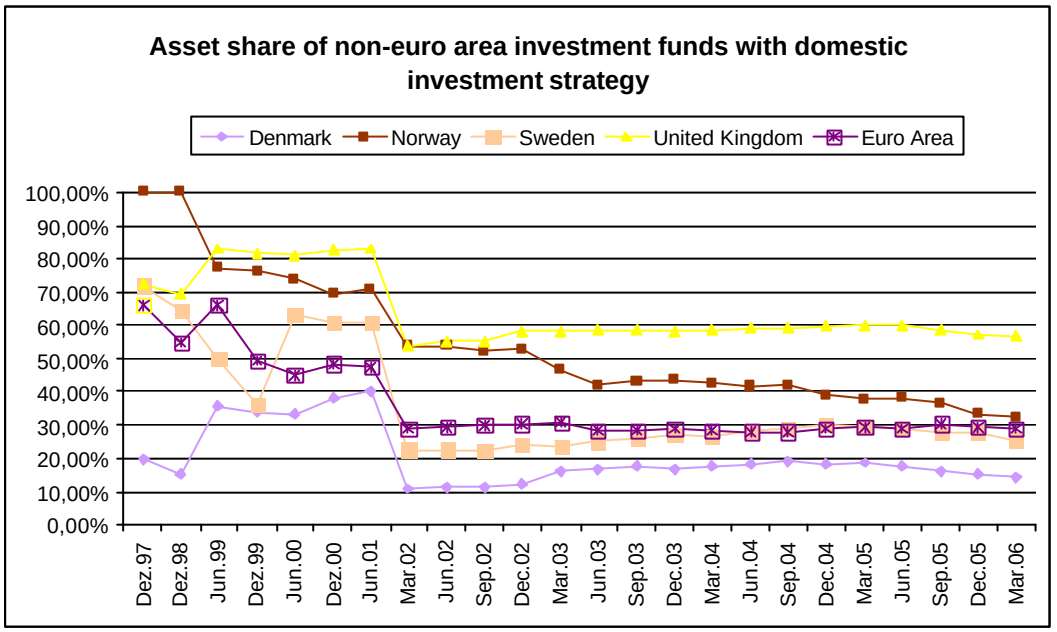
[6] The investigation of Baele et al. (2004) ranges until the end of 2003. The studies by Adam et al. (2002) and Baele et al. (2004) are briefly summarised in the appendix.

[7] Rational investors, however, would be expected to diversify.

As for the non-euro countries (Denmark, Norway, Sweden, UK), Figure 2 illustrates that they experienced almost the same as euro-area country. This can be attributed to spillover effects. After the introduction of the euro in 2002, there was a sharp decline in all of the four countries. Nevertheless, the share did not fall under 50% in the UK. Denmark is the country which has the least amount of domestic assets, thereby strongly diversifying into the eurozone.

FIGURE 2

Asset share of non-euro area investment funds with domestic investment strategy.

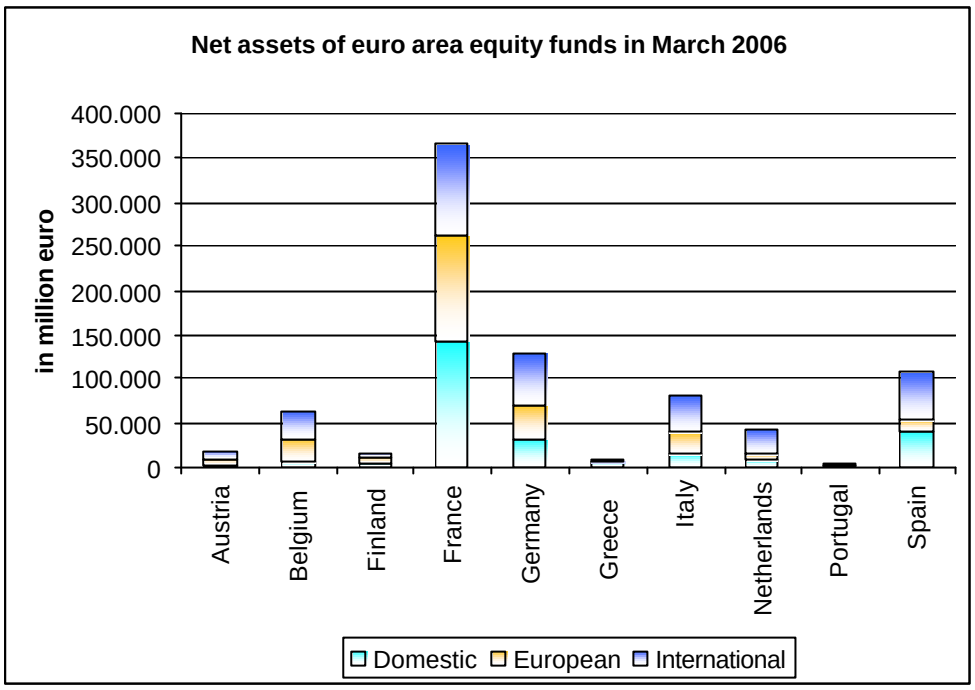


Data source: EFAMA. Own calculation.

In order to provide a more detailed picture of investment fund's allocation strategy, Figure 3 and Figure 4 show net assets of investment funds in March 2006. It is worth noticing that in euro-area countries, France invests the largest amount (over 350.000 million euro) of assets. Overall the U.K. is in the leading position with 400.000 million euro invested. As can be seen in Figure 3 , domestic equity funds in euro-area countries amount for 50% or less of the overall investment strategy, in non-euro countries (Figure 4), the strategies are quite different. Whereas in the U.K. a vast amount is invested in domestic shares, Denmark and Sweden definitely prefer international investments. For further research it might be interesting to inquire whether country size makes a difference, e.g. do larger countries invest more domestically, do smaller countries invest more abroad.

FIGURE 3

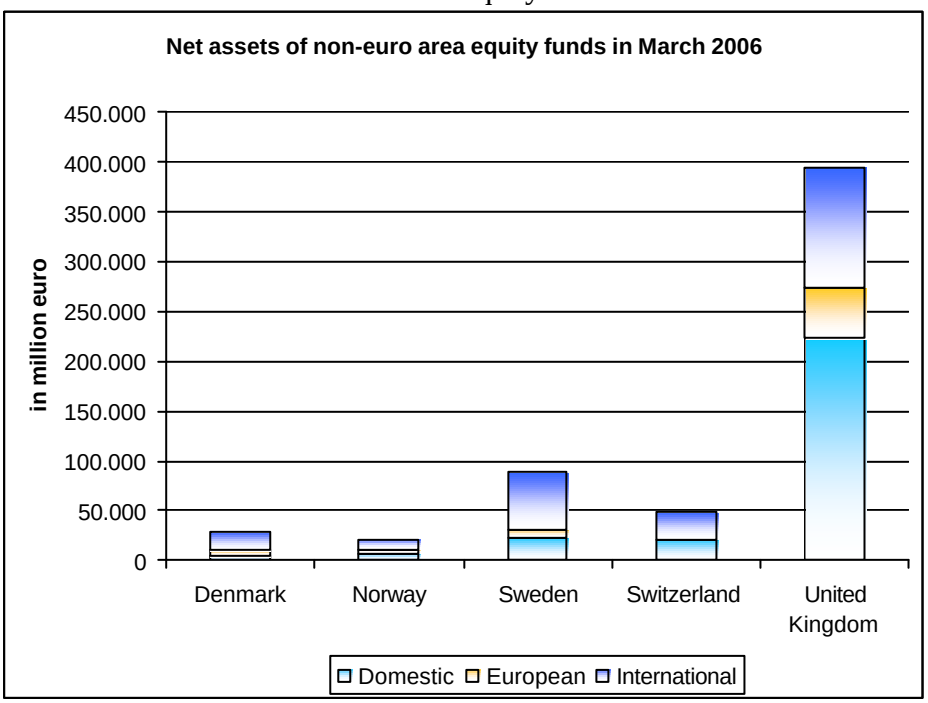
Net assets of euro area equity funds in March 2006.



Data source: EFAMA. Own calculation.

FIGURE 4

Net assets of non-euro area equity funds in March 2006.

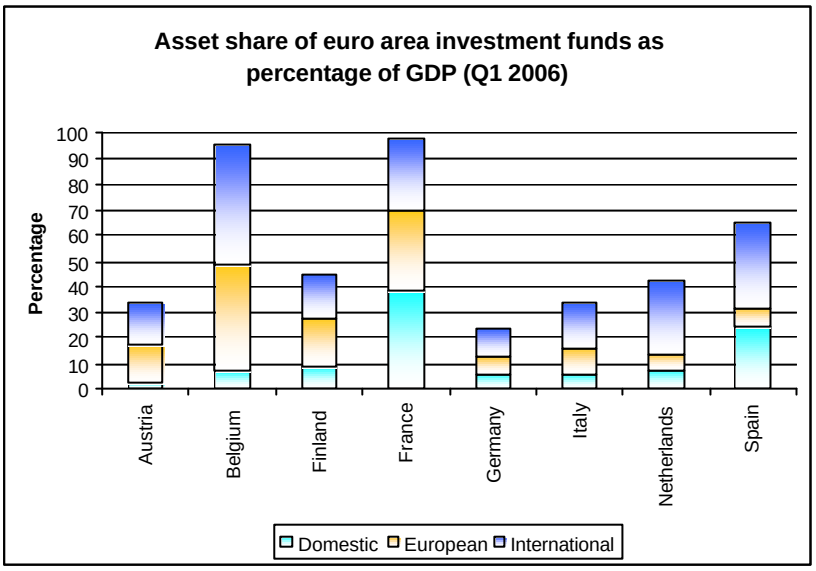


Data source: EFAMA. Own calculation.

The following figures illustrate the asset share of euro area and non-euro area investment funds as a percentage of GDP. Quarterly GDP data (1st quarter 2006) was obtained from Eurostat. Due to data limitations, Greece and Portugal were left out. It is shown that euro area investment funds invest comparatively more in European and international assets as in domestic funds. Non-euro countries also largely prefer international investments. In relation to euro area investment funds, they still have a large proportion invested in domestic equity funds.

FIGURE 5

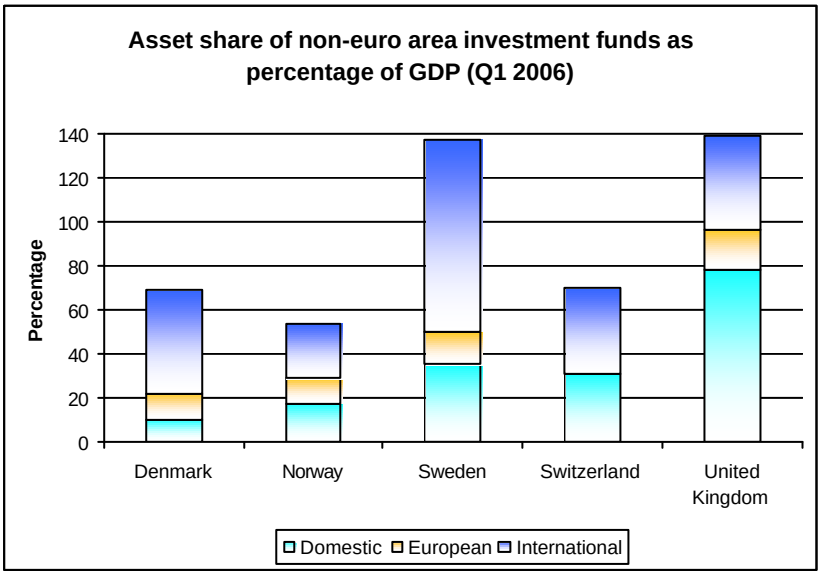
Asset share of euro area investment funds as percentage of GDP.



Data source: EFAMA and Eurostat. Own calculation.

FIGURE 6

Asset share of non-euro area investment funds as percentage of GDP.

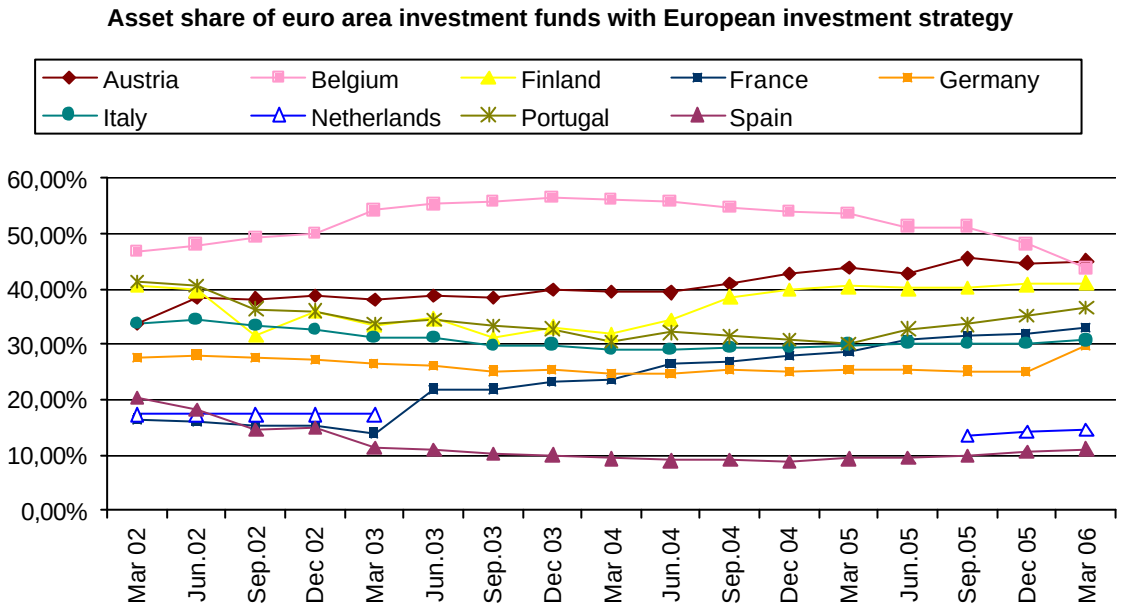


Data source: EFAMA and Eurostat. Own calculation.

On the contrary, Figure 7 shows the asset share of investment funds with European investment strategy from the first quarter of 2002 until the first quarter of 2006. Unfortunately, data before March 2002 could not be included as previous to this point, EFAMA's statistics do not separate between European and international investment strategy. Nevertheless, it is worth noticing that most countries either increased their share in European investments, or they remained at least stable. In contrast, institutional investors in the Netherlands and Spain largely preferred international assets other than European.

FIGURE 7

Asset share of euro area investment funds with European investment strategy.



Data source: EFAMA. Own calculation.

In short, the conclusion is that home bias decreased to a large extent, particularly after the advent of the euro in cash (notes and coins) format. Since then, domestic shares remain stable.

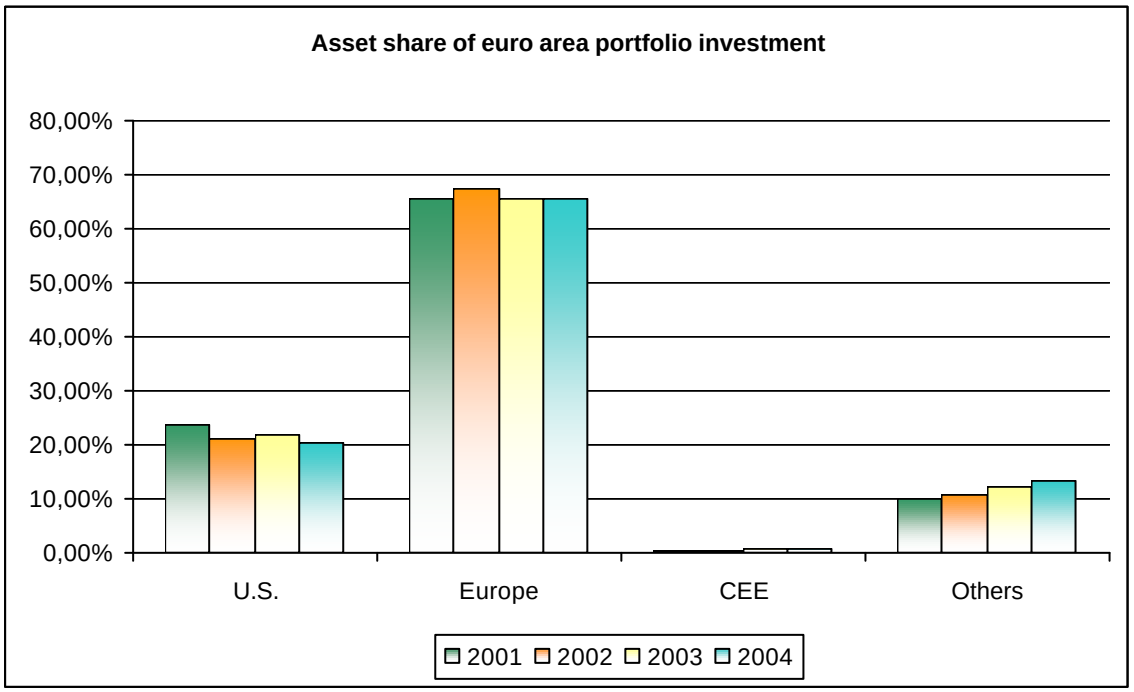
Foreign portfolio equity holding

This section reports information on the geographic breakdown of foreign portfolio equity holding. The data was obtained from the Coordinated Portfolio Investment Survey (CPIS), a database offered by the International Monetary Fund (IMF). The time period is rather short, ranging from 2001 until 2004. Unfortunately, as CPIS does not contain information on domestic investments, it was not possible to examine whether home bias have decreased or

not. However, in the following useful information on foreign equity holdings is provided to enhance interpretation.

As illustrated by Figure 8, investors in euro area countries prefer to hold European equities. The difference in percentages between Figure 7 and Figure 8 can be explained as follows. Whereas in Figure 8 the overall euro area portfolio investment in equity funds is included, Figure 7 only compromises equity assets invested by investment funds. This is also confirmed by Table 4. In addition, Euro-area countries tend to invest less in the US. Still accounting for an insignificant proportion of the overall portfolio, investments in transition countries[8] have increased over the time period investigated. More detailed information on investments in CEE countries is given by Figure 9. For example, while approximately 3% of the assets of Austrian investors are invested in CEE countries, the proportion invested in other European is constantly low at around 1%. Austria's relatively large stake may be due to its geographical nearness, historical linkages, and the large number of Austrian foreign direct investments (FDI) in CEE countries.

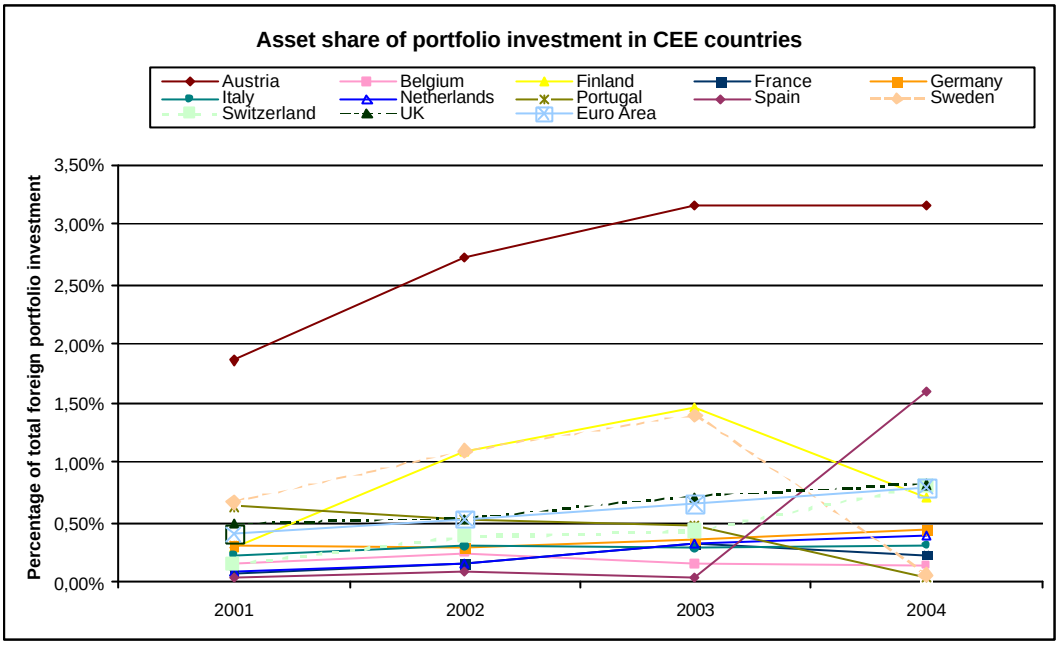
FIGURE 8
Asset share of euro area portfolio investment.



Data source: CPIS. Own calculation.

[8] Including Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latria, Lithuania, Macedonia, Moldova, Poland, Romania, Russian Federation, Serbia and Montenegro, Slovak Republic, Slovenia, and Ukraine.

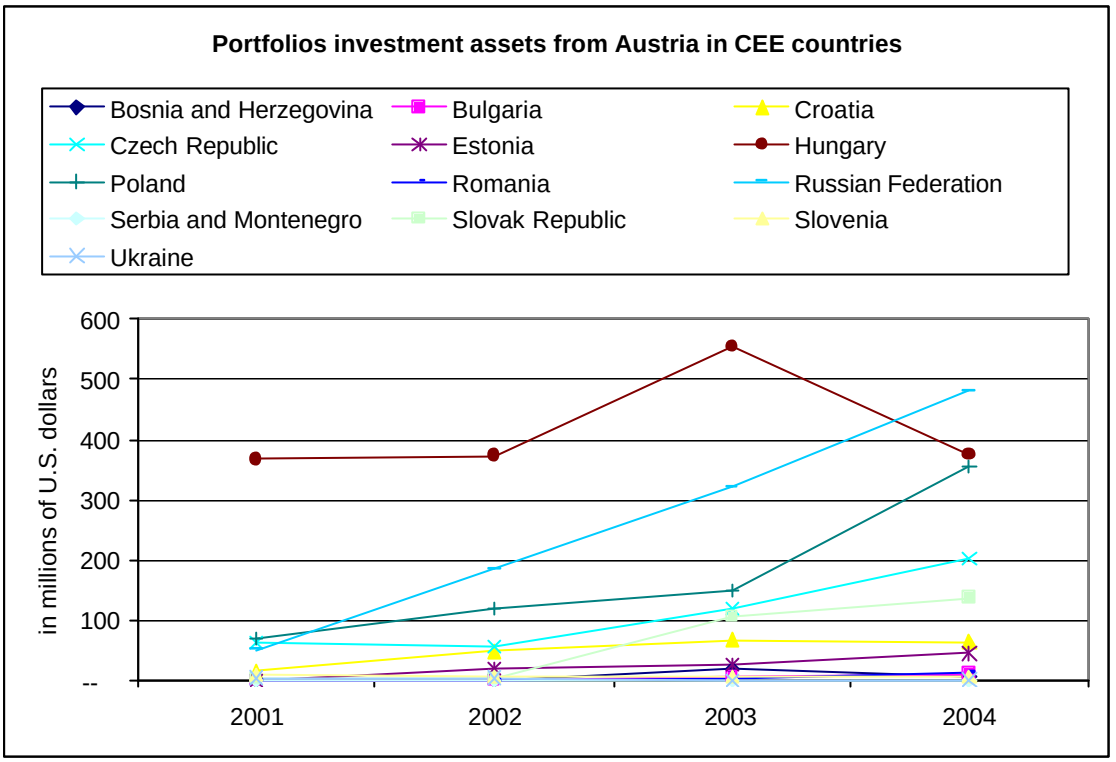
FIGURE 9
Asset share of portfolio investment in CEE countries.



Data source: CPIS. Own calculation.

A closer look at Austria's investment strategy in CEE countries is provided by Figure 10. Hungary accounted for 375 million US dollar in 2004 and investments in Russia increased from 50 million in 2001 to 481 million US dollars in 2004.

FIGURE 10
Portfolios investment assets from Austria in CEE countries.



Data source: CPIS. Own calculation.

The following table shows the asset share of portfolio investment in European countries other than CEE. It is conspicuous that especially non-euro countries, i.e. UK, Switzerland, and Sweden, as well as the Netherlands mainly invest in securities from abroad. This underlines that stock markets from countries which did not join the EMU are less integrated than those from euro-area countries. As for the Netherlands, it shows a similar result as in the previous figures. This, however, confirms the assumption that the Netherlands are more outward oriented and liberal as the more "traditional" European countries. The financial system of the Netherlands (and of the U.K.) differs from the rest of continental Europe as being rather capital-market oriented and less bank oriented. Via offering tax incentives, the Netherlands (similar to Luxembourg) became an attractive hub for international funds and institutional investors.

TABLE 4
Asset share of portfolio investment in European countries other than CEE.

	2001	2002	2003	2004
Austria	68,88%	68,04%	68,74%	70,03%
Belgium	87,28%	87,75%	86,68%	89,05%
Finland	70,07%	72,93%	77,42%	76,48%
France	71,13%	72,69%	71,11%	71,85%
Germany	78,09%	81,10%	80,07%	81,88%
Italy	74,35%	78,97%	79,17%	79,38%
Netherlands	45,58%	49,17%	43,41%	41,98%
Portugal	74,07%	79,93%	78,44%	83,58%
Spain	75,79%	82,69%	80,15%	82,40%
Sweden	54,16%	58,25%	57,00%	57,95%
Switzerland	58,96%	60,92%	60,58%	56,81%
UK	50,70%	40,62%	38,05%	41,63%
EURO	65,66%	67,45%	65,41%	65,53%

Source: CPIS.

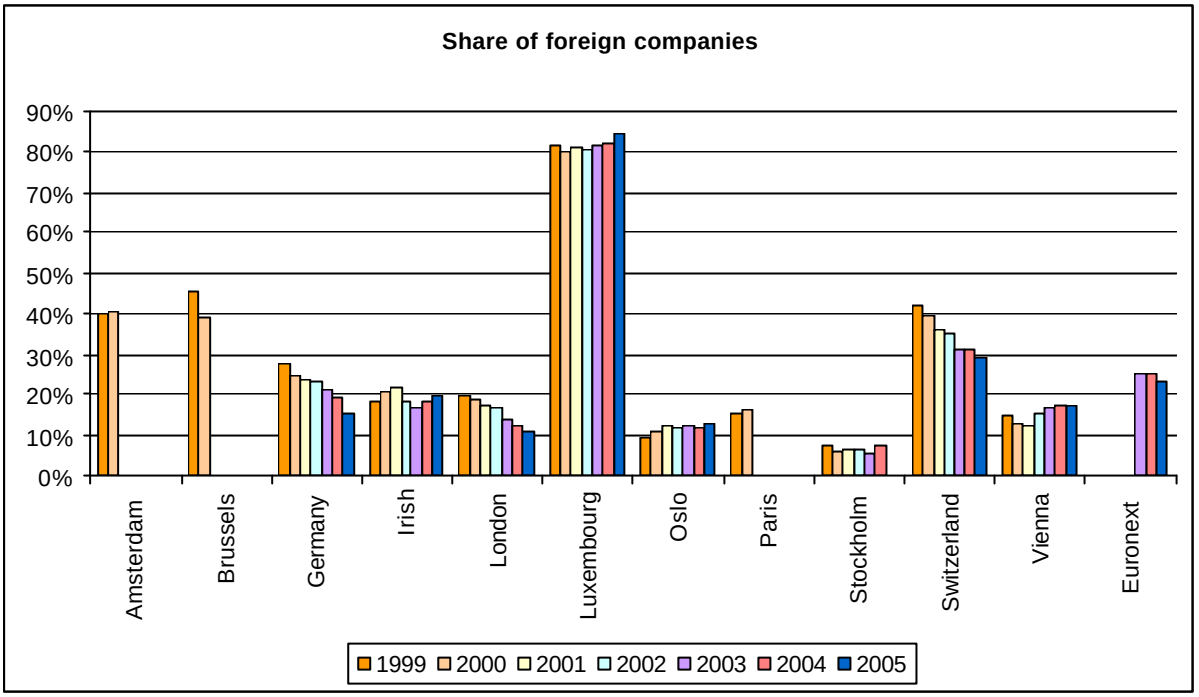
5.2. Development of stock exchanges

The following two sections contain information on the openness of European stock exchanges. Firstly, the proportion of foreign listed companies will be highlighted, and secondly developments in domestic and foreign equity trading will be investigated.

Cross-listings

The World Federation of Exchanges (WFE Statistics) regularly publishes information on global stock exchanges. In the context of integration, it is of particular interest to study the percentage of foreign listed companies. As can be seen in Figure 11, the share of foreign listed companies on European stock exchanges is still small. Previous to the merger of Brussels, Amsterdam, and Paris stock exchanges to Euronext, the Belgium stock exchange "possessed" the largest amount of foreign companies listed. However, in 2005 the alliance had approximately 25% foreign listed companies. In almost all European countries the ratio fell from 1999 until 2005.

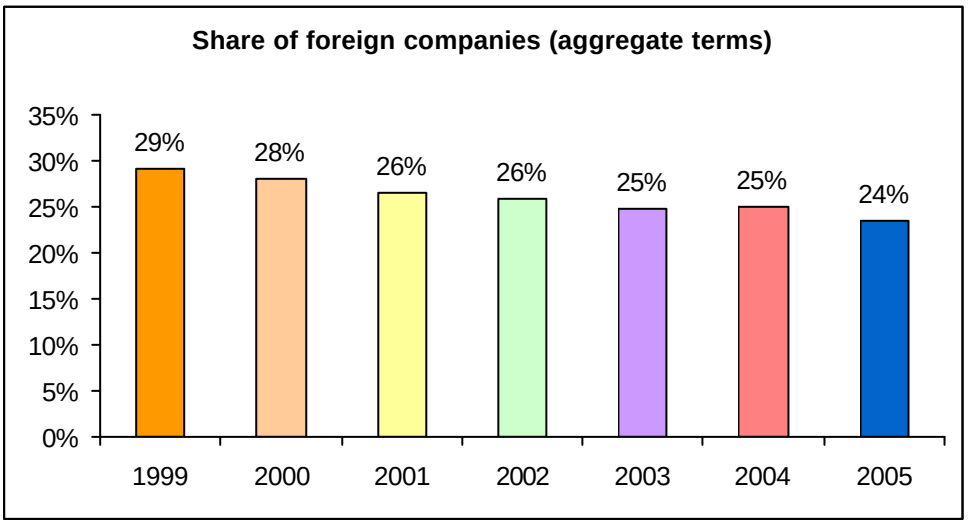
FIGURE 11
Share of foreign listed companies.



Data source: WFE Statistics. Own calculation.

In aggregate terms, i.e. foreign companies of all European stock exchanges, the share of foreign companies fell over time (seeFigure 12).[9] We take this as a further confirmation of the previous result indicating that European stock exchanges remain domestic oriented.

FIGURE 12
Share of foreign companies in European stock exchange listings in aggregate terms.



Data source: WFE Statistics. Own calculation.

[9] Please note that our analysis is based on the total number of foreign companies listed only. Due to data limitations we cannot report new listings, delistings and mergers separately.

In total numbers, London has by far the largest amount of foreign companies listed, with 334 in 2005. This is, though, a slim majority as Euronext has 293 foreign companies, followed by Germany, Luxembourg, and Switzerland (see Table 5).

TABLE 5
Number of foreign companies with shares listed.

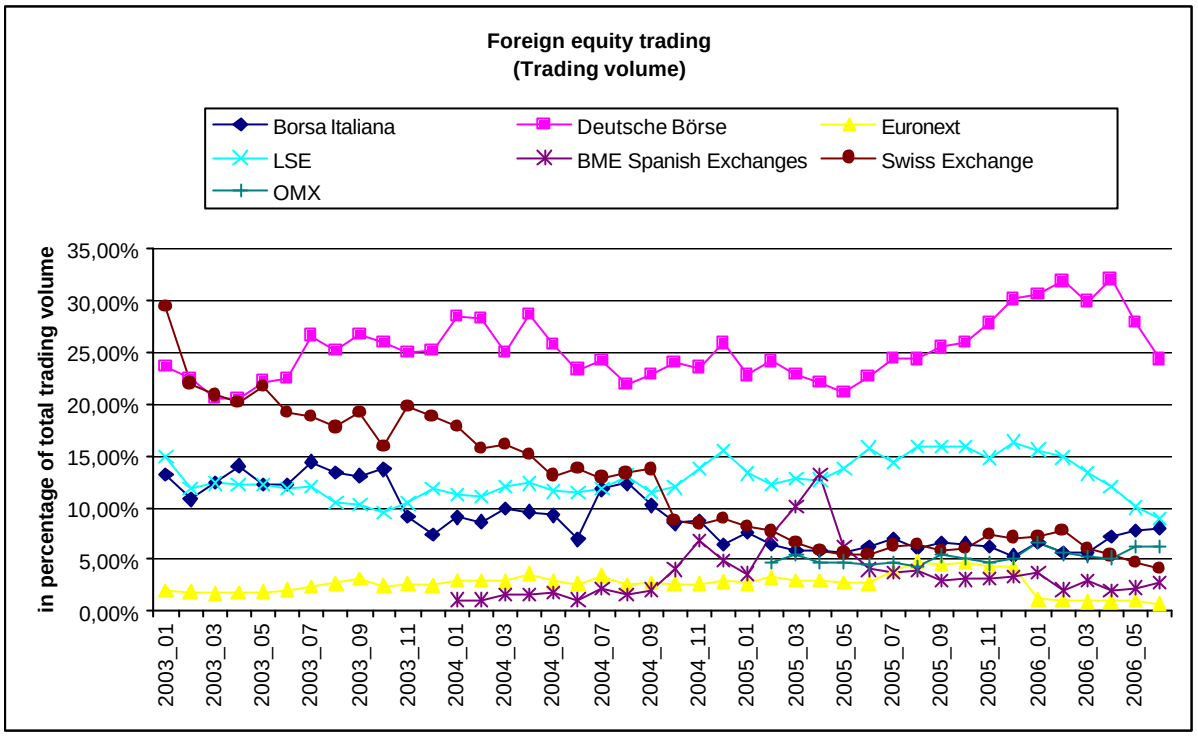
	1998	1999	2000	2001	2002	2003	2004	2005
London	466	448	448	409	382	381	351	334
Amsterdam	144	154	158					
Brussels	122	122	104					
Paris	183	176	158					
Euronext						346	334	293
Luxembourg	223	226	216	209	197	198	192	206
Germany	210	234	245	235	219	182	159	116
Switzerland	193	173	164	149	140	130	127	116
Oslo	22	20	24	26	24	22	22	28
Stockholm	18	23	19	20	19	16	20	
Vienna	32	17	14	14	20	21	21	19
Irish	21	19	20	19	14	11	12	13
Mean (all countries)	120	113	131	124	113	120	113	131

Source: WFE Statistics.

Equity trading

This section will provide a brief overview of European stock exchange's equity trading. The following data is obtained from FESE, the Federation of European Securities Exchanges. Due to data limitations, it is not possible to distinguish between e.g. EU and U.S. shares in theses non-domestic figures. In general, the share of foreign equity trading decreased on almost every European stock market, except Deutsche Börse and LSE on which the proportion remained virtually stable. Especially Borsa Italiana and Swiss Exchange lost a huge amount of foreign equity trading volumes. It is important to note that Figure 13 shows the percentage of foreign trading volume. However, as for foreign trading turnover, the picture is quite the same. The only difference is that it is not the German equity market which is in the leading position but the London Stock Exchange (see Table 6).

FIGURE 13
Foreign equity trading volume in percentage of total volume.



Source: FESE Statistics (2006). Own calculation.

TABLE 6
Foreign equity trading turnover in percentage of total turnover.

	Borsa Italiana	Deutsche Börse	Euronext	LSE	BME Spanish Exchanges	Swiss Exchange
2003_05	12,51%	7,25%	0,23%	40,39%	0,39%	17,21%
2003_11	12,90%	9,82%	0,58%	50,90%	0,35%	22,81%
2004_05	9,01%	9,85%	1,95%	43,50%	0,45%	13,43%
2004_11	9,62%	7,84%	2,25%	48,15%	1,83%	8,45%
2005_05	5,06%	7,34%	1,32%	45,25%	1,25%	5,04%
2005_11	4,98%	9,51%	6,04%	44,39%	0,72%	7,34%
2006_05	4,35%	9,67%	0,90%	39,42%	0,68%	4,61%

Data source: FESE Statistics (2006). Own calculation.

5.3. Summary and discussion

This chapter intended to assess the current level of integration among European stock markets according to quantity-based measures. Overall, it can be summarised that home bias in investment fund's strategies decreased, and that investors from euro-area countries prefer

European assets. Following Baele et al. (2004: 22) we interpret this decrease in the bias toward domestic stocks as a sign of further integration. In addition, non-EMU members experienced similar developments, but they tend to be less integrated with other European countries. As for the investigation of stock exchanges in particular, a shift towards foreign listings, or foreign trades, cannot be observed. European stock exchanges remain domestic oriented, though it has to be acknowledged that Euronext and the Nordic alliance provide cross access.

It is obvious that the sole use of quantity-based indicators does not definitely prove integration. Nevertheless, this analysis can provide a tendency to which European equity markets are linked. According to equity fund portfolio mix, foreign portfolio equity holding, portfolio investment trends and foreign equity trading, European stock exchanges do not seem to be fully integrated and did not converge fully over time. It is worth noticing that although investment strategies incline to be less domestic driven, stock markets do still not have as much as foreign companies, or equities, as they could have. A suitable explanation may be that investors are comparatively more convinced of the benefits of financial integration, than stock exchanges are willing and able to achieve by now, held back e.g. by national patriotism. Kindleberger´s (1974) analysis that the politics drive the economics rather than the other way around may still prevail within the eurozone. In accordance with Pagano et al. (2001), we conclude that geography is still not irrelevant to finance within the EU; stock market integration within the EU is still linked below potential.

5.4. Limitations

This chapter provides a short discussion on the data used above. As stock market integration is a widespread topic including many aspects it was fairly complex to give a comprehensive picture on this research issue. Firstly, the review and analysis of the scientific papers was quite difficult because the authors used different methods and focused on various details; see the tables in the appendix for details. As for the data analysis, it was also not easy to obtain useful information. Some data sources which would have been of particular interest for investigating this research issue often were not for free and thus not obtainable.

6. SUMMARY AND CONCLUSION

This paper examined the integration of European stock markets. Motives for investigating into this research issue were on the one side its relevance to the EU economy and its dynamics, and on the other side its importance in view of the overall integration of European (financial)

markets. European stock market integration is a significant topic as it has a variety of implications. Equity market's efficiency benefits from this development through shared trading platforms, heightened market liquidity, risk sharing, and other advantages. In addition, it can be argued that economic growth may be spurred by an increasing integration and growth of stock markets (Levine and Zervos, 1998). Furthermore, as well as the regulatory and supervisory environment, different stock markets' players are going to take advantage of the changing stock exchange landscape. For example investors and intermediaries will face fewer barriers, consumers will benefit from lower transaction costs, listed companies will profit from reduced trading costs etc. However, due to economic patriotism, regulators, supervisors, and governments may also be worried about possible implications of stock market integration.

A thorough literature review of 54 of empirical studies provided insight on this fast moving topic. The empirical studies under review were grouped into three categories: papers focusing on the EMU, general studies on European stock markets, and studies with a focus on CEE stock markets. Overall, most of the return-based studies document evidence for increased stock market integration among EU members. However, the results varied strongly among authors and some studies also point to strong price integration with the U.S. market. Alternative measures should be used to complement these findings and check for robustness.

In order to fill this research gap, we examined the current level of integration of European stock markets with the help of quantity-based indicators. In extending the work of Baele et al (2004) we investigated into stock market home bias by assessing investment funds' equity holdings from December 1997 to March 2006 for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, and the U.K. Furthermore, we highlighted information on foreign portfolio equity holdings and we investigated into collective trends in the foreign listing of companies, and compared domestic and foreign equity volumes. We find a decline in home bias, particularly after the advent of the euro. As for the investigation into stock exchanges in particular, a shift towards foreign listings, or foreign trades, cannot be observed. A suitable explanation may be that investors are comparatively more convinced of the benefits of financial integration, than stock exchanges themselves are willing and are able to achieve by now. For further research, we suggest that stakeholder analysis should be used into investigating the merits of stock market integration.

We conclude that although European stock markets have undergone significant developments in the last few years, and although integration among EU stock exchanges rose, the level of integration reached is not as high as initially predicted by theory. We attribute that to the fact that (domestic) stock exchange owners and other national stakeholders are still more geared towards domestic interests and less to joint EU goals; politics still drive stock exchange econmics. We also find that quantity-based integration measures indicate a strong impact of the inception of the euro on stock market integration. Return-based evidence on European stock exchange integration implies that joint integration into the U.S. stock market also rose. Combining these observations with institutional economics theory, we interpret the current efforts for transatlantic (U.S.-EU) -organizational stock exchange linkups as a consequence of rising integration amidst diverging European interests.

For further research, we recommend a meta-analysis of the existing empirical studies that takes the market microstructure into account, e.g. size of the respective countries, eurozone-members and outsiders, level of GDP, and central or peripheral location within the eurozone. Such inquiries into e.g. whether the larger EMU-countries are price makers and the smaller ones price-takers, or whether large countries invest more into domestic (national) markets compared to smaller countries investing more abroad may help to isolate critical factors and add to the understanding of stock market integration.

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APPENDIX

2.1. Empirical studies on EMU and stock market integration

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Adjaouté and Danthine (2002)	EU 15	1987-2002	Monthly returns	Heston-Rouwenhorst methodology/ mean-variance optimisation	Country versus industry effects	Shift in asset allocation paradigm, partly due to Maastricht Treaty and the euro.	(1c) Increasing integration among European stock markets due to the EMU/ euro	(2b) Industry effects dominate country effects
Arnold (2001)	Belgium, Germany, Finland, France, Ireland, Italy, Netherlands, Austria, Portugal, Spain	1999	Weekly returns	Approach of Rouwenhorst (1999); Cross sectional regression	Country versus industry effects	Industry effects exceeded country effects; Monetary union stimulated European financial market integration	(1c) Increasing integration among European stock markets due to the EMU/ euro	(2b) Industry effects dominate country effects
Baele et al. (2004)	Euro 12	1973-2003	Monthly returns	Cross-country dispersion	Country versus industry effects	Since 2000, sector factors more important than country factors.		(2b) Industry effects dominate country effects
Baele et al. (2004)	Euro 12	1973-2003	Monthly returns	Analysis of return variance proportions	News-based indicator	Euro-area equity returns more influenced by common news factors.	(1b) Increasing integration among European (CEE) stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Baele et al. (2004)	Euro 15	1995-2003	Institutional investors' equity holdings	International portfolio diversification	Quantity-based indicator	Home bias in equity holdings of both insurance companies and investment and pension funds has decreased.		(3a) Home bias in portfolios reduced
Berben and Jansen (2005)	Belgium, Denmark, Germany, France, Italy, Netherlands, Sweden, Switzerland, Spain, UK	1980-2003	Weekly returns	Smooth-Transition Correlation GARCH process.	Risk-based indicator	Clear shift towards integration. Nor EMU, neither exc hange rate stability due to the euro had impact on degree of integration, but it was caused by the overall globalisation process.	(1b) Increasing integration among European (CEE) stock markets	
Billio and Pelizzon (2003)	Germany, France, Italy, Spain, UK	1988-2001	Weekly returns	Multivariate switching regime model	News-based indicator	Link between European countries has increased. Importance of world market index shocks and German shock spillover has increased for EMU countries.	(1b) Increasing integration among European (CEE) stock markets	
Chou and Wu (2006)	France, Germany, Spain, Italy	1995-2004	Daily returns	GARCH model and Smooth transition regression	News-based indicator	Convergence of European stock markets after the euro's introduction in the dynamic structure of the volatility process.	(1c) Increasing integration among European stock markets due to the EMU/ euro	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Ehling and Ramos (2002)	Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Greece, Netherlands, Portugal, Czech Republic, Denmark, Hungary, Norway, Poland, Sweden Switzerland, UK	1988-2001	DataStream country and sector indices	Mean-variance spanning test	Country versus industry effects	Industry portfolios are equivalent to country portfolios. No evidence for crucial role of EMU for changes in portfolio diversification strategies.		(2c) Country effects equal to industry effects
Emiris (2002)	Belgium, France, Germany, Italy, the Netherlands, Spain, Finland, I.K.	1979-1997	Monthly returns	Dynamic factor model for returns and an asset pricing model	Risk-based indicator	Foreign exchange markets are obviously more integrated than stock markets; nevertheless they experienced a positive development towards integration. Small markets like Belgium, Spain, and Finland more integrated than Germany and France.	(1b) Increasing integration among European (CEE) stock markets	
Fratzscher (2002)	Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Denmark, Sweden, the U.K., Australia, Canada, Japan, Norway, Switzerland	1986-2000	Daily returns	Trivariate GARCH model	News-based indicator	European equity market highly integrated since 1996. Euro area market has gained significance in the world financial markets. European equity market integration is basically explained by EMU. Reduced exchange rate uncertainty, monetary policy convergence of interest rates and inflation rates => force behind integration	(1c) Increasing integration among European stock markets due to the EMU/ euro	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Friedman and Shackmurove (2005)	France, Germany, Netherlands, Italy, and Spain, UK	1990-2003	Daily returns	Vector Autoregressive model	News-based indicator	Co-movements of the European stock markets have increased after the introduction of the Euro. Substantial increased international financial integration.	(1c) Increasing integration among European stock markets due to the EMU/ euro	
Hardouvelis; Malliaropulos, and Priestley (2004)	Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, U.K.	1992-1998	Weekly returns	Conditional asset pricing model with a time-varying degree of integration.	Risk-based indicator	Process of increased integration of European stock markets in the 1990s is linked with the formation of EMU and the adoption of the euro as the single currency. The experience in the UK is different than the rest of the European stock markets. European stock market integration cannot be interpreted as a consequence of world-wide market integration.	(1c) Increasing integration among European stock markets due to the EMU/ euro	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Kim; Moshirian, and Wu (2005)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Denmark , Sweden, UK, Japan, US	January 1989-May 2003	Daily returns	Bivariate ARMA-EGARCH model and OLS and SURE	News-based indicator	There has been a clear regime shift in European stock market integration with the introduction of the EMU. The EMU has been necessary for stock market integration as unidirectional causality.	(1c) Increasing integration among European stock markets due to the EMU/ euro	
Melle Hernandez (2004)	Austria, Belgium, Finland, German, Greece, Ireland, Italy, Luxembourg, Denmark, Portugal, Spain, Denmark, Sweden, U.K., U.S., Japan	1997-2002	Daily returns	Correlation analyses and VAR	News-based indicator	Euro contributed to an increased interdependence among European equity markets. German stock market became leading market. Decreasing weight of the U.S. stock market.	(1c) Increasing integration among European stock markets due to the EMU/ euro	
Moerman (2004)	All-EMU countries except Luxembourg	1995-2002	MSCI country and sector indexes	Markowitz mean-variance methodology, spanning and intersection tests, multivariate GARCH-methodology	Country versus industry effects	Industries are more important than countries with respect to diversification opportunities. Best portfolio is constructed with the combination of countries and sectors.		(2b) Industry effects dominate country effects

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Morana and Beltratti (2002)	France, Germany, Spain, Italy, UK and USA	1988-2000	N/A	Standard GARCH + Markov switching three-regime model.	News-based indicator	Slight influence of the euro on the volatility of European stock markets. As far as the convergence process is concerned, there are signs of a stabilization of the Italian and Spanish stock markets. US has been largely unaffected by the introduction of the euro.	(1c) Increasing integration among European stock markets due to the EMU/ euro	
Rouwenhorst (1999)	Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, U.K.	1978-1998	N/A	Cross-sectional regression analysis	Country versus industry effects	Although fiscal and monetary policies converged, country effects are still important in European stock returns.		(2a) Country effects dominate industry effects
Söhnke; Taylor, and Wang (2005)	France, Germany, Italy, the Netherlands, Spain, Finland, Belgium, Greece, Ireland, Portugal, Austria, Luxembourg, U.K., Switzerland, Sweden, Denmark, Norway	1994-2003	Daily returns	Time-varying copula model (GJR-GARCH t-model + Gaussian copula)	Risk-based indicator	Within the euro-area, integration increased, especially in France, Germany, Italy, the Netherlands, and Spain. Integration in UK and Sweden also rose.	(1b) Increasing integration among European (CEE) stock markets. (1c) Increasing integration among European stock markets due to the EMU/ euro	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Sontchik (2003)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain	1995-2002	Weekly returns	Top down integration measure and pair wise integration measure.	Country versus industry effects	Degree of integration reduced after the unification of currencies.	(1a) No integration among European (CEE) stock markets	
Westermann (2004)	France, Germany, Italy and U.S.	1998-1999	Daily returns	GARCH model	News-based indicator	Lead–lag relationship between stock market returns, disappeared after the introduction of the euro.	(1c) Increasing integration among European stock markets due to the EMU/ euro	
Worthington; Masaki and Higgs (2003)	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden, Switzerland, U.K.	1988-2000	Weekly returns	Multivariate co-integration techniques, granger causality tests, error correction model	News-based indicator	Co-integration among EMU markets existed before and after the euro, degree of integration increased after introduction.	(1b) Increasing integration among European (CEE) stock markets. (1c) Increasing integration among European stock markets due to the EMU/ euro	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Yang et al. (2003)	Germany, France, Italy, Netherlands, Austria, Belgium, Finland, Ireland, Portugal, Spain, UK, US	1996-2001	Daily prices	Error correction model	News-based indicator	EMU strengthened European stock market relationships, but decreased with UK. Large EMU countries more integrated after EMU, small markets more integrated with large markets, 3 smallest markets became more isolated.	(1c) Increasing integration among European stock markets due to the EMU/ euro	

2.2. General studies on stock market integration

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Adam et al. (2002)	EU-15	1994-2001	Monthly returns	International portfolio diversification	Quantity-based indicator	The degree of stocks managed by investment funds increased from 1997 on and the share of foreign assets in pension funds rose in 1999 --> increased integration.		(3a) Home bias in portfolios reduced
Adam et al. (2002)	EU-15	1994-2001	Monthly returns	Return correlation analysis	News-based indicator	In 1999 correlation among the stock markets increased considerably, but decreased until 2001.	(1a) No integration among European (CEE) stock markets. (1b) Increasing integration among European (CEE) stock markets	
Baele (2005)	Austria, Belgium, France, Germany, Ireland, Italy, The Netherlands, Spain, Denmark, Sweden, Norway, Switzerland, the U.K., US, EU	1980-2001	Weekly returns	A Regime-Switching Volatility Spillover Model	News-based indicator	EU and U.S. shock spillover intensity increased over 80s and 90s. Trade integration, equity market development and low inflation contribute to the increase in EU shock spillover intensity. Contagion from the U.S. market to a number of local European equity markets.	(1b) Increasing integration among European (CEE) stock markets. (1d) Increasing integration of European (CEE) stock markets with international stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Beckers; Connor, and Curds (1996)	Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Spain, Sweden, Switzerland, U.K., U.S.	1982-1995	Monthly returns	Factor model approach (Heston and Rouwenhorst)	Country versus industry effects	Within the EU the degree of integration increased comparatively more than the level of world market integration.	(1b) Increasing integration among European (CEE) stock markets	
Bodart and Reding (1999)	Germany, France, Belgium, Italy, the UK, Sweden	1989-1994	Daily returns	Correlation analysis and threshold analysis	News-based indicator	Exchange rate variability influenced the cross-country relationship of stock markets. Degree of international correlation among stock markets is supposed to decrease.	(1b) Increasing integration among European (CEE) stock markets	
Chelley-Steeley and Steeley (1999)	United Kingdom, Germany, Italy, Switzerland, and France	1975-1991	Daily returns	Vector autoregression model and principal components based regressions	News-based indicator	Removal of exchange controls impacted on the integration of European equity markets and therefore domestic factors had a less significant impact on national equity market returns. Markets reacted more intensely to worldwide innovations after the relaxation of exchange controls.	(1b) Increasing integration among European (CEE) stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Cheung and Lai (1999)	France, Germany, Italy	1979-1992	Monthly returns	Gonzalo and Granger's analysis of common permanent components within the framework of a co-integration analysis	News-based indicator	Long-term co-movements between the three European markets exist. Co-integration did not exist between the major European stock markets and smaller markets, like Belgium and the Netherlands.	(1b) Increasing integration among European (CEE) stock markets	
European Commission (2006 a + b)	EU	N/A	N/A	Descriptive analysis	Quantity-based indicator	Proportion of foreign listed companies decreased. Proportion of non-domestic equity holdings by euro area institutional investor increased.		(3b) Proportion of foreign listed companies fell
Fraser; Helliar, and Power (1994)	France, Germany, Italy, the UK, USA	1974-1990	Market-value-weighted price indices	Time-varying methodology	Risk-based indicator	British equity market has stronger correlations with the New York stock exchange. Results did not vary with the examination of different branches.	(1d) Increasing integration of European (CEE) stock markets with international stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Freimann (1998)	France, Germany, Italy, the Netherlands, Spain, Sweden, U.K.	1975-1996	Monthly returns	Randomization methodology and country-by-country analysis.	Country versus industry effects	Integration of European stock markets is consistent with European economic integration. Between mid-70s until 1996, European stock market correlation has tripled. Diversification bargains of peripheral European countries have disappeared.	(1b) Increasing integration among European (CEE) stock markets	
Galati and Tsatsaronis (2001)	Belgium, France, Finland, Germany, Italy, Ireland, the Netherlands, Portugal, Spain	1990-2000	Monthly returns	Monthly cross-sectional regression	Country versus industry effects	The influence of sectoral effects on equity prices increased and country factors persisted stable.		(2c) Country effects equal to industry effects
Gerrits and Yüce (1999)	U.K., Germany, the Netherlands, U.S.	1990-1994	Daily returns	Vector error correction model	News-based indicator	U.S. influenced on the European equity markets in the short- and also in the long run. Stock markets in Europe showed strong relationships.	(1b) Increasing integration among European (CEE) stock markets. (1d) Increasing integration of European (CEE) stock markets with international stock markets	
Heston and Rouwenhorst (1995)	Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, U.K.	1978-1992	MSCI country indexes	Heston-Rouwenhorst methodology	Country versus industry effects	Country effects dominate industry effects.		(2a) Country effects dominate industry effects

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Kanas (1998)	UK, Germany, France	1984-1993	Daily prices	EGARCH model	News-based indicator	Asymmetric volatility among the examined stock markets. After the 1987 crash more spillovers and spillovers of greater intensity existed	(1b) Increasing integration among European (CEE) stock markets	
Koutmos (1996)	UK, France, Germany, Italy	1986-1991	Daily prices	Multivariate VAR-EGARCH model	News-based indicator	Lead/lag relationships and asymmetric volatility among the examined stock markets exist.	(1b) Increasing integration among European (CEE) stock markets	
Meric and Meric (1997)	Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, U.K., US	1975-1994	Monthly returns	Box's M methodology and a factor analysis	News-based indicator	Level of co-movement between the U.S. and European equity markets augmented considerably in the post-cash period.	(1d) Increasing integration of European (CEE) stock markets with international stock markets	
Pagano et al. (2001)	Amsterdam, Brussels, Frankfurt, London, Madrid, Milan, Paris, Stockholm, Vienna, Switzerland, Nyse, Nasdaq, Amex	1986-1997	Number of domestic companies	Analysis of cross-listings	Quantity-based indicator	Some European stock exchanges are more outward oriented than others. Over time, however, the proportion of foreign companies decreases.		(3b) Proportion of foreign listed companies fell

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Pagano; Röell, Zechner (2002)	AMEX, Amsterdam, Brussels, Easdaq, Frankfurt, Milan, London, Madrid, Nasdaq, NYSE, Paris, Stockholm, Vienna	1986-1997	Number of domestic companies	Analysis of cross-listings	Quantity-based indicator	European companies who list their shares abroad increased significantly, but most of them decided to list on US exchanges. Cross-listing European companies are large and privatised.		(3b) Proportion of foreign listed companies fell
Schich, Sebastian T. (2002)	UK, Germany, France, Netherlands, and Italy	1973-2001	Daily returns	Multivariate extreme value theory (MEVT) and Spectral measure	News-based indicator	Dependencies between European equity markets strengthened. Negative returns were transmitted more often than positive ones. And, dependencies were symmetric.	(1b) Increasing integration among European (CEE) stock markets	
Serletis and King (1997)	Belgium, Denmark, Greece, Germany, France, Ireland, Italy, Netherlands, Spain, UK	1971-1992	Quarterly returns	Johansen's (1988) maximum likelihood extension of the Engle and Granger (1987) cointegration framework, Time varying parameter technique	News-based indicator	Some stock markets shared stochastic trends. Relationship of EU equity markets was intensified.	(1b) Increasing integration among European (CEE) stock markets	

2.3. Empirical studies on stock market integration in CEE

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Birg and Lucey (2006)	Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia	1993-2004	Monthly returns	International risk decomposition model and moving average estimates	News-based indicator	Two broad groups: 1) both regionally and internationally integrated: Estonia, Hungary, Czech Republic, Lithuania, and Poland. 2) Only integrated with the regional market: Latvia, Slovakia, and Slovenia.	(1b) Increasing integration among European (CEE) stock markets. (1d) Increasing integration of European (CEE) stock markets with international stock markets	
Cappiello, Lorenzo et al. (2005)	Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Poland, Slovenia	1993-2004	Daily returns	"Comovement box" methodology and variance decomposition approach	Risk-based indicator	Increase in comovement among the new EU member states. Markets with larger volume more integrated than small markets.	(1b) Increasing integration among European (CEE) stock markets	
Chelley-Steeley (2005)	Poland, Hungary, Czech Republic, Russia	1994-1999	Daily returns	Vector autoregressive process (VAR) and smooth transition analysis	Risk-based indicator	Eastern European stock markets showed a high degree of segmentation. Though, Hungary's and Poland's level of integration slightly increased.	(1a) No integration among European (CEE) stock markets. (1b) Increasing integration among European (CEE) stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Dvorak and Podpiera (2005)	Poland, Hungary, Czech Republic, Slovenia, Slovakia, Lithuania, Latvia, Estonia, Romania, Russia, Croatia	2001-2003	Monthly returns	Baseline regressions	Risk-based indicator	Stock prices can to some extent be explained by the difference between stocks' local and world betas". Capital market integration is not changing covariances or betas.	(1a) No integration among European (CEE) stock markets	
Egert and Kocenda (2005)	Hungary, Czech Republic, Poland, Germany, UK, France	2003-2005	Daily returns	Granger causality test and VAR estimation	News-based indicator	No cointegration relationship between the analysed CEE markets. Short-term spillover effects in terms of stock returns and stock price volatility. Spillover effects not only from Western markets to CEE stock markets, but also the other way around	(1a) No integration among European (CEE) stock markets. (1d) Increasing integration of European (CEE) stock markets with international stock markets	
Gelos and Ratna (2000)	Czech Republic, Hungary, Poland, Asian Emerging Markets, Germany, U.S., Russia	n/a	Daily returns	Composite exchange market pressure index and VAR	News-based indicator	From 1994 to 1999 equity market correlations increased. Whereas the Asian and Russian crisis had a strong impact on CEE stock market prices, strong spillovers during Czech crisis could not be observed.	(1b) Increasing integration among European (CEE) stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Gilmore and McManus (2002)	N/A	1996-2001	Weekly prices	Cointegration analysis (Engle-Granger methodology and Johansen framework)	News-based indicator	Interdependencies between the Hungarian and the Polish market, no relationship with the US. Czech equity market was neither impacted by the European nor by the U.S. stock markets.	(1b) Increasing integration among European (CEE) stock markets. (1e) Decreasing integration of European (CEE) stock markets with international stock markets	
Jochum et al. (1999)	Russia, Poland, Czech Republic, Hungary, US	1995-1998	N/A	Cointegration analysis and Variance decomposition	News-based indicator	Before the emerging market crisis, CEE stock markets showed long-run equilibrium. After 1997, there was a shift towards short-term.	(1b) Increasing integration among European (CEE) stock markets	
Schotman and Zalewska (2005)	Czech Republic, Hungary, Poland, Germany, U.K., U.S.	1994-2004	Daily returns	Time-varying parameter regression model	News-based indicator	CEE equity markets showed dynamic linkages with the Western markets.	(1d) Increasing integration of European (CEE) stock markets with international stock markets	

Authors, Year of publication	Sample coverage data (Region)	Sample coverage data (Time)	Data characteristics	Empirical methodology	Integration measurement indicator	Major findings	Integration effects	Other effects
Voronkova (2004)	Czech Republic, Hungary, Poland, U.K., France, Germany, U.S.	1993-2002	Daily prices	Gregory-Hansen methodology	News-based indicator	Emerging CEE markets have become increasingly integrated with the world markets.	(1d) Increasing integration of European (CEE) stock markets with international stock markets	
Yang et al. (2005)	Czech Republic, Hungary, Poland, Russia, Germany, US	1995-2002	Daily prices	Persistent profile technique, Generalized forecast error variance decomposition and impulse response	News-based indicator	After crisis, not only long-term but also short-term linkages among CEE stock markets and the U.S. strengthened. Eastern European stock market integration is time-varying.	(1d) Increasing integration of European (CEE) stock markets with international stock markets	

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