



EUROPEAN CENTRAL BANK

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NO. 14 / APRIL 2004

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FINANCIAL  
INTEGRATION IN  
THE EURO AREA**

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## I INTRODUCTION

During the last decade, the European financial landscape has changed dramatically, and the establishment of Economic and Monetary Union (EMU) seems to have accelerated the pace of these changes. One important change has been the continued process of integration in European financial markets, which has brought about a surge in cross-border trading. However, some segments of the market seem to have made greater progress than others in terms of integration. European financial integration is an important issue, since both economic theory and empirical findings suggest that the integration and development of financial markets are likely to contribute to economic growth by removing frictions and barriers to exchange, and by allocating capital more efficiently. To this end, a number of initiatives promoting greater integration in European financial markets, such as the Financial Services Action Plan (FSAP)<sup>1</sup>, have been pursued and both policy makers and market participants are discussing new ones. While it is generally agreed that deepening financial integration is beneficial on the whole, it is also conceivable that it may have less positive effects. For example, too much consolidation in a market segment might hinder competition.<sup>2</sup> As a consequence, it is extremely important to monitor and understand the process of financial market integration. In addition, insofar as policymakers and private agents see good reasons to promote further integration, it is important to measure accurately the state of integration in various segments of the market so that we may identify areas where further initiatives are particularly needed.

Financial integration is also important for other reasons. For example, since monetary policy is implemented through the financial system, this system must be as efficient as possible in order to guarantee a smooth and effective transmission of monetary policy. The degree of financial integration is therefore important in determining how effectively this transmission will work in practice. In addition, financial integration affects the structure of the financial system, which in turn may have implications for

financial stability. Monitoring integration is therefore important for regulators and central banks. The ECB explicitly expressed its interest in financial integration in a recent ECB Monthly Bulletin article on “The integration of Europe’s financial markets” (ECB, 2003a).<sup>3</sup> Tellingly the main topic of the 2<sup>nd</sup> ECB Central Banking Conference was the transformation of the European financial system (see Gaspar et al., 2003).

Given these reasons for monitoring financial integration, this paper proposes a number of measures to quantify the state and evolution of financial integration in the euro area. We focus explicitly on the euro area and its member countries, rather than on euro-currency markets which are located both within and outside the area. The measures proposed here are applied to a number of key markets, namely the money, corporate bond, government bond, credit and equity markets. Hence, the paper’s main objective is to present a set of specific measures to assess (1) the current level of integration in different euro area financial markets and (2) whether integration is progressing, stable or regressing. In order to facilitate the comparison across markets, we devise a common methodological framework built upon a precise definition of financial integration. Our

1 See EU Commission 1999 and the website [http://europa.eu.int/comm/internal\\_market/en/finances/actionplan/index.htm](http://europa.eu.int/comm/internal_market/en/finances/actionplan/index.htm).

2 Financial integration obviously does not necessarily have implications for consolidation in some market segments. While integration may lead to further consolidation in an industry, due to increased competition for instance, there is no direct causal link between integration and consolidation.

3 The ECB interest in financial integration has already resulted in several activities and undertakings. First, the Report on Financial Structures (ECB, 2002a) provides a description of the financial structures of the euro area countries and their recent evolution. Moreover, Cabral et al. (2002) examined the integration of the euro area banking market. While their study is similar to our analysis of the credit market, the present paper focuses mainly on measures of financial integration in retail banking activities and should be seen as a complement to the banking integration study. The structure of the banking sector has also been thoroughly analysed in the Banking Supervision Committee report (ECB, 2003b). Hartmann et al. (2003) deal with a broader set of issues than measures of integration, addressing also financial structure and policy initiatives. Finally, the ECB is engaged in several activities in order to promote research in financial integration, such as the ECB-CFS research network on “Capital Markets and Financial on Integration in Europe” (see [www.eu-financial-system.org](http://www.eu-financial-system.org)).

definition is based on the notion that financial integration in euro area financial markets is achieved when all economic agents in euro area financial markets face identical rules and have equal access to financial instruments or services in these markets. In order to make this definition operational for the purpose of measuring the degree of financial integration in various market segments, we consider two broad categories of measures based on the law of one price: price-based and news-based measures. In addition, we briefly consider information about euro area financial integration coming from quantity-based measures. Our choice of measures is such that they can be regularly updated so as to serve as tools for monitoring and assessing the changes and trends in euro area financial market integration.

In devising the measures, we were inspired by the existing literature on measuring financial integration, notably Adam et al. (2002) and Adjaouté and Danthine (2003), and our study can be seen as a complement to these two. The study by Adam et al. (2002) formed the background for a recent Commission services working paper, “Tracking EU Financial Integration”<sup>4</sup>. The study presents several price-based and quantity-based indicators. While some similarities exist between the work done at the Commission’s request and this paper, there are important differences. First, we complete the list of price-based measures presented by the Commission study by considering, in addition to interest rate convergence, the extent to which interest rates are affected by common news as compared with local news. Furthermore, we study the impact of country versus sector effects on equity markets and measure the importance of country-specific effects in the pricing of corporate bonds in the euro area. To our knowledge, this paper is the first to analyse the state of integration in the euro area’s rapidly expanding corporate bond market. Finally, with the help of more detailed data from the money market, we are able to provide a much more detailed analysis of integration in this market, which is of great

importance for monetary policy implementation. The Commission’s work is complementary to ours, as it also provides indicators related to the efficiency of financial integration, a topic which is beyond the scope of the present study.

The paper is structured as follows. In the second chapter, we present the definition of financial integration used throughout this study. We then discuss benefits of financial integration, as well as possible caveats. Chapter 3 describes the common framework we use to assess the degree of financial integration in the euro area and the methods used to construct the measures. The remaining sections are devoted to applying the measures to each of the euro area market segments we are interested in. Chapter 4 considers the money market, Chapter 5 and 6 the government and corporate bond markets, respectively, Chapter 7 the bank credit market, and, finally, Chapter 8 analyses the euro area equity market. Chapter 9 summarises the results and provides some conclusions.

<sup>4</sup> See European Commission (2003) and the website [http://europa.eu.int/comm/internal\\_market/en/finances/cross-sector/index.htm#tracking](http://europa.eu.int/comm/internal_market/en/finances/cross-sector/index.htm#tracking).

## 2 FINANCIAL INTEGRATION: DEFINITION AND BENEFITS

In this chapter, we first define financial integration. Then we briefly review the generally accepted benefits of financial integration.

### 2.1 DEFINITION OF FINANCIAL INTEGRATION

We adopt the following definition of an integrated financial market:

The market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics

- (1) face a single set of rules when they decide to deal with those financial instruments and/or services;
- (2) have equal access to the above-mentioned set of financial instruments and/or services; and
- (3) are treated equally when they are active in the market.

The adopted definition of financial integration contains three important features.

First, it is independent of the financial structures within regions. Financial structures encompass all financial intermediaries – institutions or markets – and how they relate to each other with respect to the flow of funds to and from households, governments and corporations. It is not unusual for regions to develop different financial structures before integration takes place. As habits persist, it is not surprising if these different structures remain once regions are integrated. Indeed, there is no support for the claim that financial integration will lead to a convergence in financial structures. On the contrary, Hartmann et al. (2003) find that the importance of currency deposits and of loans in different euro area countries has become more heterogeneous over time, including the period following the introduction of the euro.

Second, frictions in the process of intermediation – i.e. the access to or investment

of capital either through institutions or markets – can persist after financial integration is completed. Our definition stresses that financial integration is not about removing frictions that hamper the optimal allocation of capital. Rather, financial integration is concerned with the symmetric or asymmetric effects of existing frictions on different areas. In other words, even in the presence of frictions, several areas can be financially integrated as long as frictions affect these areas symmetrically. Just to illustrate this point, let us consider France and Germany as an area. Suppose that all financial contracts in a given country must by law be written in the language of that country. German citizens contracting in France would be treated asymmetrically relative to French citizens contracting in France, as the Germans would bear the cost of translating the contracts, while French citizens would not. Now, suppose instead that all financial contracts in the area must be written in a third language. In this case there is still a friction, as both French and German citizens would have to bear the translation cost from this third language into their respective languages. However, both French and German citizens are treated symmetrically by this friction, which therefore does not constitute a barrier to financial integration between the two countries. In the next chapter, we will describe a common framework for measuring financial integration in which price-based measures rely strongly on this aspect of the definition.

Third, our definition of financial integration separates the two constituents of a financial market, namely the supply of and the demand for investment opportunities. Full integration requires the same access to banks or trading, clearing and settlement platforms for both investors (demand for investment opportunities) and firms (supply of investment opportunities, e.g. listings), regardless of their region of origin. In addition, once access has been granted, full integration requires that there is no discrimination among comparable market participants based solely on their location of origin. When a structure systematically

discriminates against foreign investment opportunities due to, say, national legal restrictions, then the area is not financially integrated. An area can also be partially financially integrated. This is the case if, for example, a region does not favour the access of domestic investors over foreign ones, but does impose constraints on the listings of foreign firms on the domestic exchange. Our quantity-based measures will be related to this aspect of the definition.

The adopted definition of financial integration is closely linked to the law of one price, which many other studies have chosen as their definition of financial integration. The law of one price states that if assets have identical risks and returns, then they should be priced identically regardless of where they are transacted.<sup>5</sup> The definition of financial integration stated above encompasses the law of one price. If the law of one price does not hold, then there is room for arbitrage opportunities. However, if the investment of capital is non-discriminatory, then any investors will be free to exploit any arbitrage opportunities, which will then cease to exist, thereby restoring the validity of the law of one price.

Although the law of one price is very attractive since it allows for quantitative measures of financial integration, it still misses an important aspect of financial integration, namely whether the supply of investment opportunities is subject to discriminatory practices or not. Indeed, in practice the law of one price can only be tested on instruments that are listed or quoted. Hence, the analysis based on the law of one price cannot serve as a basis for measuring integration among unlisted instruments. For instance, take an asset that may not be listed on one region's exchange because of that exchange's discriminatory practices. In this case, while it is possible for the law of one price to hold, we would not consider the whole area to be financially integrated. As a consequence, we have adopted the more general aforementioned definition. That said, checking the validity of the law of one price remains the

natural basis for developing quantitative measures of financial integration. Consequently, most of our integration measures will depend explicitly on the law of one price.

## 2.2 BENEFITS OF FINANCIAL INTEGRATION

In this section, we consider three widely accepted interrelated benefits of financial integration: more opportunities for risk sharing and risk diversification, better allocation of capital among investment opportunities, and potential for higher growth. Below, we first discuss these benefits in more detail and then consider some caveats.

### 2.2.1 RISK SHARING

Financial integration should offer additional opportunities to share risk and to smooth consumption inter-temporally. This is an important element of financial integration. Kalemli-Ozcan et al. (2001) provide empirical evidence that sharing risk across regions enhances specialisation in production, thereby resulting in well-known benefits. The increase in the set of financial instruments and in the cross-ownership of assets resulting from financial integration should offer additional possibilities to diversify portfolios and share idiosyncratic risk across regions. From theoretical models of risk-sharing<sup>6</sup>, we know that when agents in an area fully share risk, the consumption of agents in one region co-moves with that of agents located in other regions of that area, while consumption does not co-move with region-specific shocks. There is a lot of evidence that this level of risk sharing is not yet achieved in the euro area. Adjaouté and Danthine (2003) find that consumption growth rates in the euro area are less correlated than are GDP growth rates, suggesting that risk sharing

<sup>5</sup> In addition to financial instruments, the law of one price should also apply to the goods market. However, given transportation costs and other frictions (non fungibility, non storability, etc.) that are impossible or difficult to remove, the law of one price is unlikely to hold as well in the goods market as in financial markets.

<sup>6</sup> See for instance Cochrane (1991) or Townsend (1994).



opportunities are far from fully exploited. This complements the study of Adam et al. (2002), which rejects the hypothesis that consumption growth rates are unaffected by idiosyncratic changes in GDP growth rates. Hence, further financial integration should bring additional gains that have yet to be fully exploited.

### 2.2.2 IMPROVED CAPITAL ALLOCATION

It is a generally accepted view that greater financial integration should allow a better allocation of capital. The complete elimination of barriers to trading, clearing and settlement platforms will allow firms to choose the most efficient trading, clearing and/or settlement platforms. In addition, investors will be permitted to invest their funds wherever they believe these funds will be allocated to the most productive uses. More productive investment opportunities will therefore become available to some or all investors, and a reallocation of funds to the most productive investment opportunities will take place.

### 2.2.3 ECONOMIC GROWTH

Another implication of greater financial integration, which is partially linked to the issue of capital allocation described above, is additional economic growth. One channel through which financial integration acts upon economic growth is greater financial development.

Financial integration should increase flows of funds for investment opportunities in some regions. This should be the case whenever financial integration facilitates the access to investment opportunities in these regions, provided they are more productive relative to foreign ones. With additional funds flowing in, further financial development of these regions appears plausible, as discussed in Gianetti et al. (2002). In that report, the authors argue that the integration process will increase competition within less developed regions and thereby improve the efficiency of their financial systems by, for instance, reducing

intermediation costs. Moreover, the authors argue that this should render these regions' financial systems more attractive, thus enhancing participation from local and foreign agents and contributing to further development of these financial systems.

In an alternative scenario, the financial system in the more financially developed regions overtakes all or parts of the intermediation process in the least financially developed regions. This is notably the case in the new EU member states. A recent ECB study (Financial sectors in the EU accession countries, 2002b) observed a high degree of foreign involvement in almost all financial market segments in these countries. With respect to the degree of financial integration, what counts is increased availability of intermediated investment opportunities, not the location of the intermediation. As a matter of fact, if the financial system of a financially well-developed region takes all or parts of the financial activities of another region, then one may regard this process as a development in the financial system of the latter region. However, there is concern that financial integration could result in a wave of consolidation that might hamper the efficient process of intermediation. For instance, bank sector take-overs could create a monopoly. Since it is crucial for the overall financial system to remain efficient after financial integration has taken place, it may be desirable to monitor the process of integration closely as it unfolds.

The link between financial development and financial integration is of the utmost importance, as there is strong evidence that financial development is linked with economic growth.<sup>7</sup> As described in Levine (1997), financial systems serve some basic purposes. Among others, they 1) lower uncertainty by facilitating the trading, hedging, diversifying and pooling of risk; 2) allocate resources; and 3) mobilise savings. These functions may

<sup>7</sup> For a short but rather complete summary on this issue, see also London Economics (2002).

affect economic growth through capital and technological accumulation in an intuitive way. Risk-sharing opportunities make it possible to finance projects with potentially very high return but great risk, as risk-averse investors can hedge their position to some extent. As intermediaries specialise in the collection and dissemination of information, the allocation of resources can be performed more efficiently and at a lower cost. Also, project owners with low initial capital can turn to an intermediary that can mobilise savings so as to cover the initial costs. These channels are quantitatively important, as Levine (1997) stresses, “While many gaps remain, broad cross-country comparisons, individual country studies, industry-level analyses, and firm-level investigations point in the same direction: the functioning of financial systems is vitally linked to economic growth” (p.689-690).<sup>8</sup> However, while Levine (1997) recognises the positive relationship between economic growth and financial development, he is careful not to infer any causality. Indeed, economic growth and financial development are so intertwined that it is difficult to draw any firm conclusion with respect to causality.

Nevertheless, recent research has found evidence that financial development affects growth positively. Rousseau (2002) finds empirical evidence that financial development promotes investment and business by reallocating capital. Also, industry-level studies like that of Jayaratne and Strahan (1996) show that financial development causes economic growth. Moreover, Bekaert et al. (2002) find that equity market liberalisation – defined as the right given to foreign investors to trade in domestic securities and to domestic investors to trade in foreign securities – increases subsequent average annual real economic growth. This highlights the importance of financial integration as an additional step towards financial development, which in turn seems to be conducive to greater economic growth.

#### 2.2.4 THEORETICAL CAVEATS

From a theoretical perspective, financial integration might not be sufficient to produce the most efficient outcome, unless it results in financial markets in which one can perfectly hedge risks, i.e. complete markets. When financial markets are complete, risk-averse agents can achieve full risk sharing and perfect consumption smoothing. As shown by the analysis in Hart (1975), expanding the set of financial instruments when markets are incomplete is guaranteed to be beneficial only if the new instruments bring enough hedging opportunities to complete the markets. Otherwise, he shows that it is possible that all agents might actually be worse off because returns on assets in different states depend on state prices. Introducing a new security can distort the equilibrium prices of the existing securities in such a way that the new returns offer fewer rather than more risk sharing opportunities. From the perspective of a risk-averse agent who seeks to share risk, introducing new financial instruments when markets are incomplete can therefore be harmful. In other words, unless it results in complete markets, financial integration may not lead to higher welfare for all agents. For instance, if one interprets financial integration as merely allowing access to a system of intermediation – be it financial markets or banks – then Allen and Gale (1997) argue that financial integration might hurt some. Indeed, in an overlapping generation model, they show that banks alone do a better job of sharing risk intertemporally than do financial markets alone. In addition, they show that when a financial system combines both banks and financial markets, the latter constrain the former since agents can always opt out of the banking arrangements to enter financial markets. In this case, a mixed financial system does not perform better than a financial market alone. For this reason, when several regions with structurally different financial systems open up to financial

<sup>8</sup> See also Beck and Levine (2002) or Giannetti et al. (2002) for an overview of the evidence.

trades, it is not clear that all regions will benefit.

Of course, financial integration is more complex than described here, as the process will transform the financial systems of all regions. But the aforementioned theoretical results are ambiguous as to how further financial integration affects welfare. The process of financial integration should therefore be monitored closely, to observe whether markets evolve toward an efficient structure.

Financial integration will clearly entail winners and losers. Improved capital allocation is likely to benefit many and harm some. If financial integration results in greater risk-sharing opportunities, this should benefit all. By modifying the prevalent financial structure, financial integration has the potential to harm some incumbent financial institutions through, for instance, consolidation or the loss of market share. However, it is a generally accepted view that, overall, the benefits of a well-monitored financial integration process outweigh the implied costs.

### 3 A COMMON FRAMEWORK FOR MEASURING FINANCIAL INTEGRATION

Building upon our proposed definition of financial integration, this chapter aims to present a common framework for (1) measuring the current level of financial integration in the different euro area financial markets, i.e. the money, bond, credit, and equity markets and (2) measuring the trend of integration in these areas. As already explained in the previous section, our definition of financial integration deals mainly with the asymmetric effects of existing frictions or barriers to the intermediation process in different areas. The more symmetric these effects are, the higher the degree of integration. Hence, our common framework for measuring financial integration focuses on determining whether existing frictions affect different regions asymmetrically. The best way to measure the current state of financial integration would be to list *all* frictions and barriers to financial integration and check whether or not they still hold. However, it is impossible to compile such a list. Consequently, instead we measure the state of integration using equilibrium prices, since these prices should reflect all information at the disposal of economic agents, including possible frictions and barriers that these agents face. In order to derive and make operational measures of integration in this context, we rely on the strongest implication of our definition of integration, namely the law of one price. We consider two broad categories of measures based on the law of one price: price-based and news-based measures. While the bulk of our measures fall into these two categories, we also consider a third broad category, namely quantity-based measures of integration. Below, we give brief descriptions of these three broad categories of measures before proceeding to discuss the individual measures in detail.

Our first broad category of measures includes *price-based measures*, which measure discrepancies in prices or returns on assets caused by the geographic origin of the assets. This constitutes a direct check of the law of one price, which in turn must hold if financial integration is complete. If assets have sufficiently similar characteristics, we can base

these measures on direct price or yield comparisons. Otherwise we need to take into account differences in systematic (or non-diversifiable) risk factors and other important characteristics. Given these considerations, we can construct a number of specific integration measures. The cross-sectional dispersion of interest rate spreads or asset return differentials can be used as an indicator of how far away the various market segments are from being fully integrated. Similarly, beta convergence, a measure borrowed from the growth literature, is an indicator for the speed at which markets are integrating. In addition, measuring the degree of cross-border price or yield variation relative to the variability within individual countries may be informative with respect to the degree of integration in different markets.

Our second broad category of measures refers to *news-based measures*. These are designed to distinguish the information effects from other frictions or barriers. More precisely, in a financially integrated area, portfolios should be well diversified. Hence, one would expect news (i.e. arrival of new economic information) of a regional character to have little impact on prices, whereas common or global news should be relatively more important. This presupposes that the degree of systematic risk is identical across assets in different countries; to the extent that it is not, local news may continue to influence asset prices.

Our third category of integration measures is *quantity-based measures*, which we consider in order to quantify the effects of frictions faced by the demand for and supply of investment opportunities. When they are available, we will use statistics giving information on the ease of market access, such as cross-border activities or listings. In addition, we present statistics on the cross-border holdings of a number of institutional investors as a measure of the portfolio home bias. Of course, no measure can be used for all markets, as the specifics of some market or the data available for implementing a measure can differ across markets. However, the spirit is the same across all markets, as

we strive to capture the extent of possible asymmetries.

In some cases, we cannot apply some measures of integration to all markets; or alternatively, we may need to apply different versions of a given measure to different markets. The reason is that markets differ in terms of structure, availability of data, and other important characteristics. One particularly important consideration to keep in mind in this context is that in order to base our measures on the law of one price, the risk characteristics of the assets we use must be comparable. The risk of an asset's return is composed of a systematic part and an idiosyncratic part. While the latter can be diversified away, the former cannot, and as a result we must control for the systematic risks in order to compare asset returns in a meaningful way. While this type of risk may be considered negligible in some cases, for example in the money market, it is crucial to control for it in the corporate bond and equity markets. This necessitates an extension of the basic framework for these markets. In principle, if the systematic risk factors affecting asset returns were known, one could estimate and filter out their systematic impact before comparing returns of different assets. However, there is considerable uncertainty about the identity of these systematic risk factors, in particular for equity returns.<sup>9</sup> The results will therefore be highly dependent upon the specific asset pricing model used to correct for systematic risk. Hence, we instead choose to rely on measures that are not dependent on specific assumptions about the identity of the systematic risk factors. For instance, in keeping with a large stream of literature initiated by Heston and Rouwenhorst (1994), we estimate sector versus country effects in equity returns. Under full integration, one would expect much of a stock's return to be determined by the performance of the sector to which it belongs, and to a much lesser extent by the country in which it is listed.

The remainder of this chapter is structured as follows. In the first section, we discuss price-

based measures, then news-based measures, and lastly those related to quantities or flows. At the end of the chapter, for clarity, we include a table that summarises our chosen measures for each market and how they relate to each other (see Table 1).

### 3.1 PRICE-BASED MEASURES OF FINANCIAL INTEGRATION

The strongest implication of our definition for financial integration is that the law of one price should hold in equilibrium. The law of one price implies that assets with the same risk should have the same expected return, irrespective of the residence of the issuer and of the asset holder. According to this "law", euro area assets with the same risk that generate identical cash flows should trade at the same price. More generally, this means that markets are integrated as long as the stochastic discount factor, the rate at which cash flows are discounted, is equal across markets. Taking the case of the euro area as a specific example, one can note that prior to 1999, returns on a specific kind of asset in one country differed from returns on the same kind of asset in other countries due to an important source of risk, namely the exchange rate. Hence, without taking into account exchange rate risk, one cannot accurately measure the degree of integration across euro area countries in the period prior to the introduction of the euro. As of 1999, this is of course no longer the case. In the empirical analysis that follows, we are mainly concerned with measuring the state and evolution of integration in euro area financial markets after the introduction of the euro. However, we will also apply measures of integration to data prior to 1999 in order to provide some comparison, knowing well that these results are influenced by exchange rate considerations.

<sup>9</sup> For instance, while some authors use the single factor Capital Asset Pricing Model (CAPM) to determine whether expected returns are driven by common rather than local factors (see e.g. Bekaert and Harvey, 1995, Hardouvelis et al., 2000a), others have used multifactor models (see e.g. Sentana, 2002) or model-free approaches (see e.g. Chen and Knez, 1995, Ayuso and Blanco, 1999).

Aside from the exchange rates issue, various barriers to international investment may prevent discount factors from equalising. While most restrictions on the free movement of capital flows had already been lifted by the end of the 1980s, there still exist a number of direct and indirect barriers that prevent the emergence of a fully integrated European capital market. Direct barriers include differences in tax rates and considerable fragmentation in trading, settlement, and payment systems across countries. On the other hand, differences in accounting and reporting standards, corporate governance practices, languages, and cultures may constitute a considerable informational barrier.

To test whether discount factors are equal across countries, and hence whether the law of one price holds, one should compare the prices of assets that have identical cash flows and risk characteristics but that are traded in different countries. In the money and government bond markets, many assets are comparable enough that price differences can serve directly as good integration indicators. Corporate bond yields, retail interest rates, and equity returns, however, are normally not directly comparable, as one first needs to correct for differences in systematic risk. For instance, the yield on a corporate bond with a given maturity depends on the credit quality of the issuer, among other things. Similarly, banks will charge a higher loan rate to customers they perceive to be less credit-worthy. The systematic risk on a stock can be defined relative to a market portfolio. Depending on whether or not markets are financially integrated, the benchmark market portfolio may be given by the local equity market portfolio (full segmentation), the euro area market portfolio (regional integration), or the world market portfolio (full world market integration).

The structure of this section is as follows. First, we introduce the various measures pertaining to yields for each market where these measures are available. Then we present measures related to the relative weight of country effects on returns. Lastly, we present the measures that are specific to some individual markets.

### 3.1.1 YIELD-BASED MEASURES

For fixed-income securities, it is only natural to examine yield-based measures to check if the law of one price holds. However, first we must consider whether such measures should be based on nominal or real yields. There are several reasons why nominal yields are preferable. First, for real interest rates to be equal across countries, not only do markets have to be integrated, but purchasing power parity (PPP) must also hold. The latter is generally not the case, certainly not in the short run, given that there are still considerable frictions left in the market for international goods (e.g. trade barriers and transaction costs). Testing whether real yields are equal across countries is hence a joint test of financial integration and purchasing power parity. Second, certain countries may have higher inflation rates than others, e.g. because their per capita GDP is converging towards the euro area average. However, one of the advantages of more integrated markets is that local debt no longer has to be financed entirely by local investors. Consequently, the required yield on assets should no longer depend upon local factors such as the relative supply and demand of local capital, risk appetite, and the inflation faced by local investors. For instance, suppose that real yields are equal across countries. In this case, nominal yields will differ across countries to reflect inflation differentials. However, in integrated markets without exchange rate risk, these differences cannot be sustained, as investors from low-inflation countries have the incentive to benefit from higher nominal yields offered in countries with higher inflation. Consequently, asset prices will adjust until all arbitrage opportunities have disappeared, i.e. until nominal yields have equalised. Notice that this reasoning is only valid when higher inflation in one country is unrelated to the credit risk of the assets considered in that country. This assumption seems very reasonable in the euro area, but clearly excludes countries with hyperinflation.

### 3.1.1.1 MONEY, GOVERNMENT BOND, AND CREDIT MARKET INTEGRATION MEASURES

As argued before, the construction of integration measures for the money and government bond markets is facilitated by the fact that relatively homogeneous assets are available across countries. This is not necessarily the case for credit market rates, as there may be very significant differences with respect to credit risk, and it may be difficult to find data for rates with sufficiently similar maturities to allow direct comparisons. Fortunately, the data on national retail interest rates provided by the ECB are carefully grouped together so as to make the underlying assets as comparable as possible. Therefore, in the subsequent analysis, we will treat the various retail rates as if they are perfectly comparable. In the interpretation however, we will try to assess whether remaining differences are due to a lack of integration or to unharmonised data series.

Given comparable maturities and other relevant characteristics, interest rate differences between borrowers of the same risk class in different countries are a direct measure of the degree of integration, as it constitutes a test of the equality of discount rates. Hence, given the assumptions listed above, yields in perfectly integrated markets should be equal across countries. We note that not all government debt in the euro area has identical credit risk, as reflected by some differences in the credit ratings of such debt. However, in our analysis we usually assume that credit risk does not play a major role in the pricing of euro area government debt. We return to this issue later on in the paper.

Ideally, one should compare local yields with the yield that would prevail in a perfectly integrated market. As this yield is unobservable in practice, most studies have used the yield on a benchmark asset as a second-best alternative (see e.g. Adam et al., 2002, Adjaouté and Danthine, 2003). Suppose for instance that one would like to measure the degree of integration in the market for 10-year government bonds in the euro area. In this maturity segment, market

participants consider German bonds to be the reference bond. Consequently, it seems reasonable to measure integration in this segment of the bond market by calculating the difference between local yields and the Germany yield. In perfectly integrated markets the spread should be equal to zero, the time variation in the size of the spread serves as a good indicator of how integration is proceeding in a particular country and market. This, of course, assumes that the different bonds share a similar degree of systematic risk. More generally, our first measure of integration is the *spread between the yield on a local asset and a well-chosen benchmark asset*.

Another measure, proposed by Adam et al. (2002), is the *beta-convergence* measure, which they borrowed from the growth literature to measure the speed of convergence. This measure involves running the following panel regression:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t} + \sum_{l=1}^L \gamma_l \Delta R_{i,t-l} + \varepsilon_{i,t}, \quad (3.1)$$

where  $R_{i,t}$  represents the yield spread on a 10-year government bond in country  $i$  at time  $t$ , relative to some relevant benchmark rate,  $\Delta$  is the difference operator, and  $\alpha_i$  a country dummy. A negative  $\beta$  coefficient indicates that yields in countries with relatively high yields have a tendency to decrease more rapidly than in countries with relatively low yields. Moreover, the size of  $\beta$  is a direct measure of the speed of convergence in the overall market. To analyse whether the speed of convergence is larger in one period relative to another, one can decompose  $\beta$  in  $\beta = \beta_1 I + (1 - I)\beta_2$ , where  $I$  is a dummy variable that takes on the value of 1 in a particular sub period.

While beta convergence measures the speed of convergence, it does not indicate to what extent markets are already integrated. Consequently, Adam et al. (2002) proposed *the cross-sectional dispersion in bond yields* as a measure of the degree of integration.<sup>10</sup> Cross-

<sup>10</sup> Adam et al. (2002) also refer to this integration measure as the "sigma-convergence".

sectional dispersion is the cross-sectional counterpart to correlations. The main advantage of using cross-sectional dispersions is that, contrary to correlations, they can be calculated at each point in time by taking the standard deviation of yields (returns) across countries. Correlations and cross-sectional dispersions are inversely related. When series are highly correlated, as they should be in integrated markets, yields (returns) will generally move in the same direction, and the instantaneous cross-sectional dispersion will be low. Alternatively, dispersion will be high when yields (returns) in different countries drift apart. As with beta convergence, one can calculate the speed at which the cross-sectional dispersion decreases over time. This measure is obtained from a regression of the cross-sectional dispersion on a time trend.

Finally, for some segments of the money market, we can measure the degree of integration by examining whether discrepancies between interest rates in different countries are larger than within countries. In an integrated market, we would not expect the cross-country dispersion to be greater than the within-country dispersion. The unsecured overnight market is an example of when this type of investigation may be particularly useful. Here, data from the daily EONIA panel give us an opportunity to investigate this issue by comparing the dispersion of lending rates of individual banks across countries with the dispersion of rates of banks within countries at each point in time. In particular, the ratio between these two measures of dispersion should be close to one if the market is fully integrated, since integration would imply that rates are not more dispersed across countries than within countries. If, on the other hand, markets are not integrated, then overnight lending rates may tend to be more dispersed across countries than within countries, raising the ratio above one. The specific measure we use is based on (i) all possible combinations of absolute lending rate differences between panel banks reported on a given day in any two different EMU countries, and (ii) all possible combinations of such

absolute differences between panel banks within any given country. Calculating the ratio between the average of (i) and the average of (ii) for each day gives us our measure of integration. We can apply a similar approach using data on EURIBOR and EUREPO quotes reported daily by panel banks, although these rates are only indicative quotations, rather than actual transaction rates, as in the case of the EONIA data.

### 3.1.1.2 CORPORATE BOND MARKET INTEGRATION MEASURES

In analysing corporate bond market integration, one cannot directly analyse yield differentials relative to a benchmark, as corporate bonds are generally not homogeneous enough to allow easy comparison. Specifically, corporate bonds typically differ in their cash flow structure, liquidity, sector and, most importantly, their credit rating.<sup>11</sup> In what follows, we introduce a model (similar to the one that Heston and Rouwenhorst (1994) proposed for equity returns) that investigates whether yields, once corrected for differences in systematic risk and other characteristics, still depend on the country where the bond was issued.<sup>12</sup> Annaert and De Ceuster (2000) used a similar model to investigate the relative importance of rating versus maturity effects in 19 rating-maturity Merrill Lynch indices for euro-denominated corporate bonds. Unlike their analysis, our uses individual bond rates rather than indices. This allows us to investigate explicitly whether there is a country component in euro area corporate bond yields.

Suppose the yield on a corporate bond  $i$  at time  $t$  issued in country  $c$  with  $\tau$  years to maturity and with credit rating  $r$  is represented by  $R_{c,r}^i(\tau, t)$ . Moreover, assume that any other

<sup>11</sup> While there are also differences in credit ratings of government debt among individual euro area countries, these differences are typically much smaller than in the corporate bond market.

<sup>12</sup> Another possibility would be to use corporate bond indices for individual eurozone members. However, contrary to the rich set of indices covering euro-denominated issues for different rating categories and maturity buckets, there is no agency providing corporate bond indices for individual euro-area countries.



factors that might influence investors' required rate of return on corporate bonds at time  $t$ , like the structure of cash flows or the bond's liquidity, are grouped into a vector  $z_t$ , so that the yield on the bond can be denoted  $R_{c,r}^i(\tau, t, z_t)$ . When investigating the corporate bond market, we are not interested in the portion of corporate bond yields attributable to the general level of the default-free term structure. We therefore subtract the yield of a benchmark government bond with identical time to maturity,  $R_{gb}(\tau, t)$ , from the corporate bond yield. Here, the benchmark we choose is the zero-coupon yield on German government bonds, which we obtain at each point in time by reconstructing the German government zero-coupon term structure using the method proposed by Svensson (1994).<sup>13</sup> The yield spread for corporate bond  $i$  is then given by  $S_{c,r}^i(\tau, t, z_t) = R_{c,r}^i(\tau, t, z_t) - R_{gb}(\tau, t)$ .<sup>14</sup>

Next, in order to measure the degree of integration in the euro area corporate bond market with these spreads, we first need to filter out any systematic effects attributable to risk factors which may be priced in this market, as well as other relevant characteristics. The size of the spread depends, among other things, on the perceived risk of a corporate bond, which in turn largely depends on its credit rating. In general, the yield spread will tend to be larger for a corporate bond with a low credit rating than for a bond with a higher credit rating. While the credit rating is not the only relevant factor in explaining corporate bond spreads (see e.g. Elton et al., 2002), it seems reasonable that it should play an important role in capturing systematic features in such spreads. In addition to credit ratings, several studies have shown that spreads depend on the time to maturity of corporate bonds. Since we use yields to maturity and not zero-coupon rates, the size of the coupons may also be relevant in explaining spreads. Moreover, liquidity may also be important for corporate bond pricing, with less liquid bonds tending to exhibit higher yield premia. Finally, on average, bonds issued by financial corporations tend to have lower spreads than bonds issued by non-financials.

Given the arguments above, we estimate the following equation to fit the corporate bond spreads in our sample:

$$S_{c,r}^i(\tau, t) = \alpha + \sum_{r=1}^K \gamma_{r,t} CR_{i,t}^r + \sum_{s=1}^2 \delta_{s,t} S_{i,t}^s + \varphi_t z_t + \varepsilon_{i,t} \quad (3.2)$$

where  $\alpha$  is an intercept common to all corporate bonds,  $CR_{i,t}^r$  is a rating dummy which takes a value of one when corporate bond  $i$  belongs to rating category  $r$  at time  $t$ , and  $S_{i,t}^s$  is a sector dummy which takes a value of one for financial corporations and zero for non-financials. The parameter vector  $\varphi$  groups the sensitivities of the various corporate bonds to the instruments contained in  $z_t$ , namely time to maturity, liquidity, and coupon of the  $i$ -th bond. As a proxy of liquidity, we use the ratio of days that the bond has been traded relative to the total number of trading days within every time interval. Having corrected for the systematic risk and other relevant characteristics inherent in the various corporate bonds, one can test for integration by investigating whether there are systematic country effects remaining in the various error terms. Consider the following decomposition of the error terms:

$$\varepsilon_{i,t} = \sum_{c=1}^C \beta_{c,t} C_{i,c,t} + e_{i,t} \quad (3.3)$$

where  $C_{i,c,t}$  is a country dummy that equals one when corporate bond  $i$  belongs to country  $c$  at time  $t$ , and zero otherwise. In a financially integrated corporate bond market, yield spreads, once corrected for systematic risk, should not depend on the country of issue. Consequently, as a test for integration, we test whether the country parameters  $\beta_{c,t}$  are zero, or at least converge towards zero. By inserting the error decomposition into the spread regression equation, we obtain the following equation, which we estimate using OLS<sup>15</sup>:

<sup>13</sup> Svensson's model interpolates the term-structure using two exponential decay terms with a total of six parameters. The parameters, which are estimated on a monthly basis, are obtained from the Bundesbank.

<sup>14</sup> In principle, it would be desirable to convert yields to maturity of corporate bonds into zero-coupon bond yields. However, due to the large number of bonds in our data set and the resulting computational burden, we instead correct the spread of every bond according to its coupon.

$$S_{i,t}(\tau, t, z_i) = \alpha_i + \sum_{r=1}^K \gamma_{r,t} CR_{i,t}^r + \sum_{c=1}^N \delta_{c,t} S_{i,t}^c + \varphi_i z_i + \sum_{s=1}^M \beta_{s,t} C_{i,t,s} + e_{i,t} \quad (3.4)$$

While the estimation results of equation (3.4)<sup>16</sup> may provide interesting insights into the determinants of euro area corporate bonds, our analysis focuses on the estimates for the country dummies, which are of relevance in assessing the degree of integration in the euro area corporate bond market. More specifically, we calculate three measures. First, we report the *size of the coefficients of the various country dummies*. Confidence bands will be calculated in order to assess whether country premia are statistically significant or not. Second, we calculate the *cross-sectional dispersion of the country effects*. An overall decrease in the level of cross-sectional dispersion would be consistent with an increase in the degree of corporate bond market integration. Finally, we compare the *proportion of the variance of corporate bond spreads that is explained by country effects* to the part explained by the systematic characteristics considered. Under full integration, the country effect should be negligible.

### 3.1.2 RELATIVE WEIGHT OF COUNTRY EFFECTS IN RETURNS

#### 3.1.2.1 COUNTRY VS. SECTOR EFFECTS AS AN EQUITY MARKET INTEGRATION MEASURE

As equity markets become more and more integrated, the country-specific component in equity returns should decrease. In keeping with a large stream of literature initiated by Heston and Rouwenhorst (1994), we estimate the *extent to which equity returns are determined by sector rather than country effects*. Under full integration, one would expect that the return on a particular stock is largely determined by the performance of the sector to which it belongs, and not by the country in which it is listed. This measure is similar to the one described above for the corporate bond market.

Until recently, it was a “stylised fact” of international stock returns that the total risk of a portfolio could be reduced more by diversifying

across countries than across sectors. Recent evidence by e.g. Rouwenhorst (1999) and Adjaouté and Danthine (2003), however, suggests that sector diversification has become more promising, and that it may even have overtaken country diversification as the best way to reduce portfolio risk. These results are confirmed in an international context by Brooks and Del Negro (2002).

While most studies have used (improved versions of) the methodology due to Heston and Rouwenhorst (1994), Adjaouté and Danthine (2003) presented a similar measure based on the cross-sectional dispersion of country and sector returns. The higher the cross-sectional dispersion, the lower the correlation, and the higher the diversification potential. A shift from country to sector diversification would mean that the cross-sectional dispersion in country returns would decrease below the dispersion in sector returns.

15 We also estimated equation (1) by weighted least squares (WLS) methods using market weights related to the outstanding values of bond issues. The WLS parameter estimates we obtained were similar to those obtained using OLS, albeit noisier, and we therefore report only results of the OLS estimations later on.

16 As discussed in Heston and Rouwenhorst (1994), it is not possible to estimate the parameters in (3.4) directly by a cross-sectional regression because of perfect multicollinearity between the regressors. More specifically, the 8 rating dummies, 2 sector dummies and the 14 country dummies all sum up to the intercept, which is common to all corporate bonds. To overcome this problem, we impose the following constraints:

$$\begin{aligned} \sum_{r=1}^K \omega_{r,t} \gamma_{r,t} &= 0 \\ \sum_{c=1}^N v_{c,t} \beta_{c,t} &= 0 \\ \sum_{s=1}^M \eta_{s,t} \delta_{s,t} &= 0 \end{aligned}$$

where  $\omega_{rt}$ ,  $v_{ct}$  and  $\eta_{st}$  are the weights of respectively rating category  $r$ , country  $c$  and sector  $s$  relative to the total outstanding value of corporate bonds. Moreover, by imposing these constraints, the parameter estimates become easier to interpret. Weighted average rating, country and sector components are equal to zero at every point in time and the estimate of  $\alpha$  reflects the general component affecting all spreads identically.

### 3.1.2.2 COUNTRY EFFECTS AS A CORPORATE BOND MARKET INTEGRATION MEASURE

Unlike for the equity market, we do not consider the relative weight of sector versus country effects for the corporate bond market. The reason is that more than 60% of the corporate bonds we consider are issued by financial corporations. A meaningful comparison across countries would require a homogenous representation of sectors in each country, which is difficult to obtain. For these reasons, we instead analyse the importance of country effects in explaining the cross-section of corporate bond yield spreads by measuring *the proportion of variance explained by country-specific factors*. Under full integration, agents would be expected to care more about common risk factors like bond ratings than about their country of issuance. Hence, we would interpret a relatively small country effect impact as a sign of high integration in this market.

### 3.2 NEWS-BASED MEASURES

An important implication of integration is that asset prices should only react to common news. If there are no barriers to international investment, purely local shocks can generally be diversified away by investing in assets from different regions. Local shocks should therefore not constitute a systematic risk. For example, in a financially integrated market, the interest rate for borrowers of the same risk category should be equal across countries and influenced only by factors common to all. In addition, expected returns on assets from different countries but with the same risk characteristics should depend on common rather than local news. An alternative measure of integration is therefore *the proportion of asset price changes that is explained by common factors*, i.e. relevant news common to assets across all countries.

To make this measure operational, one needs to provide a proxy for common news. One possibility is to specify explicitly the relevant

local and common information variables and then test whether the former have any statistically significant power to explain asset returns (see e.g. Barr and Priestley, 2002). However, there is considerable uncertainty about which information variables to include and how they relate to asset returns. Therefore, in this paper we assume that the price movements of a benchmark asset are a good reflection of all relevant common news. Typically, we choose the price of an asset in a market considered to be highly integrated with the markets we study. For instance, in the euro area 10-year government bond market, German bonds are generally considered to be the benchmark bond. If we assume that this segment of the market is highly integrated, then we would expect German 10-year government bond yields to react mainly to common euro area news rather than purely German factors. Hence, if one assumes that in a perfectly integrated government bond market the degree of systematic risk is identical across countries, bond prices across countries should all react to common news factors the same way the German benchmark bonds do. However, there are differences in the perceived credit risk and liquidity of individual countries. Hence, one would expect local news to play some limited role in explaining local bond yield movements even after 1998. Nevertheless, we use the proportion of yield changes explained by common news, as reflected by yield changes in the 10-year German government bond market, to measure the degree of integration in this market segment.

#### 3.2.1 GOVERNMENT BOND AND CREDIT MARKET INTEGRATION MEASURES

To make this more formal for the government bond and credit markets, define  $\Delta R_{i,t}$  as the change in the yield on an asset in country  $i$  at time  $t$ , and  $\Delta R_{b,t}$  as the yield change on a comparable asset in benchmark country  $b$ . In integrated markets, yield changes in the benchmark asset should be a good proxy for the correct reaction of bond prices (and hence yields) across countries, if we also assume that

the degree of systematic risk is identical. To separate common from local influences, we run the following regression:

$$\Delta R_{i,t} = \alpha_{i,t} + \beta_{i,t} \Delta R_{b,t} + \varepsilon_{i,t} \quad (3.5)$$

where  $\alpha_{i,t}$  is a time-varying intercept,  $\beta_{i,t}$  the time-dependent beta with respect to the benchmark asset, and  $\varepsilon_{i,t}$  a country specific shock. As we explain below, increasing integration requires (i) the intercept  $\alpha_{i,t}$  to converge to zero, (ii) the beta with respect to the benchmark asset,  $\beta_{i,t}$  to converge to one, and (iii) the proportion of the variance in explained  $\Delta R_{i,t}$  by the common factor,  $\Delta R_{b,t}$ , to increase towards 1.

More specifically, (i) follows from the fact that in fully integrated markets, yield changes in one country should not be systematically larger or smaller than those in the benchmark market. Consequently,  $\alpha_{i,t}$  should be close to zero in highly integrated markets. Next, to see why (ii) should hold, recall that the estimate for  $\beta_{i,t}$  is given by

$$\beta_{i,t} = \frac{Cov_{t-1}(\Delta R_{i,t}, \Delta R_{b,t})}{Var_{t-1}(\Delta R_{b,t})} = \rho_{i,b,t} \frac{\sigma_{i,t}}{\sigma_{b,t}} \quad (3.6)$$

where  $Cov_{t-1}$  and  $Var_{t-1}$  are respectively the conditional covariance and variance operators,  $\rho_{i,b,t}$  is the conditional correlation between yield (price) changes of the local and the benchmark assets, and  $\sigma_{i,t}$  and  $\sigma_{b,t}$  are the conditional standard deviations of these yield (price) changes respectively. Hence,  $\beta_{i,t}$  depends on both the correlation between local and benchmark yield changes, and the ratio between local and benchmark yield volatilities. When integration increases, yield changes should increasingly be driven by common factors, and the correlation should increase towards one. For the same reason, the level of local volatility should converge towards that of the benchmark asset. As a result, increasing integration implies that  $\beta_{i,t}$  should converge to one. While the size of  $\beta_{i,t}$  relative to one is an indicator of the degree of integration within a specific country, *the average distance of the different country betas to unity* (the beta under

integration) may serve as an integration measure for the overall market. Moreover, the evolution of this measure should provide information about the integration process over time.

Finally, (iii) follows from the fact that, to the extent that assets are sufficiently comparable across countries, the country specific error  $\varepsilon_{i,t}$  should shrink as integration increases. We therefore use *the proportion of local variance explained by the common factor* as another measure of integration. Under full integration, only common news should drive local yields (assuming that the degree of systematic risk is identical across bonds), and the variance proportion should be close to 1. Alternatively, when yields are driven purely by local factors, this ratio will be zero. To calculate the variance ratio, first note that  $\Delta R_{b,t}$  and  $\varepsilon_{i,t}$  are orthogonal by construction. The total variance of local yields is then given by

$$Var(\Delta R_{i,t}) = \beta_{i,t}^2 Var(\Delta R_{b,t}) + Var(\varepsilon_{i,t}) \quad (3.7)$$

and the variance ratio by

$$VR_{i,t} = \frac{\beta_{i,t}^2 Var(\Delta R_{b,t})}{Var(\Delta R_{i,t})} \quad (3.8)$$

The variance ratio  $VR_{i,t}$  is positively related to the beta of local yield changes with respect to the benchmark asset, and with the relative size of volatility in the benchmark and local bond market. A variance ratio close to one is obtained when the beta goes to unity and when the volatility in local and benchmark bond yield changes are of similar magnitude.

### 3.2.2 EQUITY MARKET INTEGRATION MEASURES

In this section, we propose a method to measure whether the common news component in stock returns has increased. This measure is similar to the variance proportions calculated for the government bond and credit markets. First, we develop a simple shock spillover model similar to those of Bekaert and Harvey (1997), Ng (2000), Fratzscher (2001), and Baele (2003).

This model is an extended version of the model used for measuring the degree of integration in the fixed income markets. In the bond and credit markets, we use yield changes in well-chosen euro area benchmarks as proxies for common news. The natural equivalent for the equity market is to use returns on a euro area-wide equity market portfolio. However, available empirical evidence shows that equity returns are significantly affected by global factors, not just regional ones. Hence, for the purpose of examining integration in euro area equity markets, we need to distinguish between global and euro area-wide effects on equity returns in the euro area. To this end, the return on US stock markets is used as a proxy for world news, while the return on a euro area-wide stock market index, corrected for US news, is used as the euro factor. While returns for all countries share the same two factors, they are allowed to have different sensitivities, or “betas”, to these common factors. In addition, we allow the betas to vary across three different sub-periods in order to examine how the sensitivities to common factors evolve. We assume that the portion of local returns not explained by common factors is due to local news.

As markets become more and more integrated, we expect the importance of euro area-wide risk factors in explaining equity returns in individual countries to increase relative to purely local news. Consequently, *ceteris paribus*, betas are expected to be higher in integrated than in segmented markets. Alternatively, betas may increase over time if the respective domestic economies are becoming more and more similar. The implication is that local shocks in area countries would become more and more similar. This explanation may also be relevant for the euro area, which has undergone a period of considerable economic integration.

To provide a more detailed look at the model, consider the stock return for a particular country  $i$ ,  $R_{i,t}$ , which has an expected component  $\mu_{i,t}$  and an unexpected part  $\varepsilon_{i,t}$ :

$$R_{i,t} = \mu_{i,t} + \varepsilon_{i,t} \quad (3.9)$$

As described before, the unexpected return  $\varepsilon_{i,t}$  is decomposed into a purely local shock ( $e_{i,t}$ ), and a reaction to euro area ( $\varepsilon_{eu,t}$ ) news as well as world news, where the latter is represented by innovations in the US stock market ( $\varepsilon_{us,t}$ ):

$$\varepsilon_{i,t} = e_{i,t} + \beta_{i,t}^{eu} \varepsilon_{eu,t} + \beta_{i,t}^{us} \varepsilon_{us,t} \quad (3.10)$$

where  $\beta_{i,t}^{eu}$  and  $\beta_{i,t}^{us}$  represent the country-dependent sensitivities to euro and US equity market innovations,<sup>17</sup> which are allowed to vary across three sub-periods (hence the subscript  $t$  of the betas). To distinguish global shocks from purely euro area shocks, we orthogonalise them by assuming that euro area equity market innovations are partly driven by events in the US market. To allow the betas to vary across sub-periods, we introduce time dummies that cover (a) the period directly following the Single European Act (1986-1992), (b) the period between the Treaty of Maastricht and the introduction of the single currency (1992-1998), and (c) the post-euro period (1999-2003). Hence, while the betas are allowed to differ across these sub-periods, they are assumed to be constant within each sub-period.

To compare the relevance of euro area and US shocks across country returns, we calculate variance ratios, i.e. the proportion of total domestic equity volatility explained by euro area and US shocks. Assuming that local shocks are uncorrelated across countries, and uncorrelated with the euro area and US benchmark indices, then the total variance of country  $i$  is given by

$$\sigma_{i,t}^2 = h_{i,t} + (\beta_{i,t}^{eu})^2 \sigma_{eu,t}^2 + (\beta_{i,t}^{us})^2 \sigma_{us,t}^2 \quad (3.11)$$

<sup>17</sup> With euro area and US market innovations, we mean the unexpected component of equity returns. Given the low predictability in weekly stock returns, the expected return  $\mu_{i,t}$  is simply obtained relating euro area and US returns to a constant and one lag of the returns. The conditional variance of the error terms is governed by a bivariate asymmetric GARCH(1,1) model. To reduce the computational burden, we estimate the euro area and US innovations in a first step.

where  $h_{i,t}$  is the variance of the local shock component. The euro area variance ratio is then given by

$$VR_{i,t}^{eu} = \frac{(\beta_t^{eu})^2 \sigma_{eu,t}^2}{\sigma_{i,t}^2} = \rho_{i,eu,t}^2 \quad (3.12)$$

and correspondingly for the US variance ratio. The conditional variances in the euro area, US, and local equity market are obtained from a standard asymmetric GARCH(1,1) model.

### 3.3 QUANTITY-BASED MEASURES OF FINANCIAL INTEGRATION

In this section we describe integration measures based on asset quantities and flows. Since most of these measures are self-explanatory, this section is relatively brief. All measures depend on the specific markets being considered. However, we can broadly classify the measures into two groups. The first group includes measures dealing with cross-border activities in a specific market, and the second group refers to measures dealing with home bias.

#### 3.3.1 CROSS-BORDER ACTIVITIES

There are two markets for which cross-border activity measures can be applied, namely the credit market and the money market.

##### 3.3.1.1 CREDIT MARKET INTEGRATION MEASURES

From our brief discussion of the proposed definition of financial integration, we concluded that the smaller the asymmetric effects of frictions on different areas, the greater the degree of financial integration. Hence, one way to assess the progress made toward integration is to consider whether the existing barriers to entry imposed on foreign economic agents willing to invest in a specific region have been reduced over time. Our analysis of the credit market looks at the volumes of cross-border loans to non-banks and interbank loans. An increase in these volumes would suggest that it is easier for foreigners to access a regional credit market.

##### 3.3.1.2 MONEY MARKET INTEGRATION MEASURES

For the unsecured segment of the money market, we use increased cross-border lending activity as a sign of possible progress in integration. Indeed, one implication of increased financial integration is that cross-border lending activity rises as banks are treated equally regardless of where they are based. Moreover, when banks seldom simultaneously resort to the Eurosystem's credit and deposit facilities, we view this as an indirect sign of integration. In an integrated market, the allocation of liquidity across all euro area banks should function well enough that banks would rarely require this type of recourse to the Eurosystem's standing facilities. Finally, regarding the repo market, we consider an increase in the fractions of trades involving a non-domestic euro area counterpart as a sign of further integration. The same will be true for increased use of non-domestic collateral originating in other euro area countries.

##### 3.3.1.3 MEASURES OF CORPORATE AND GOVERNMENT BOND MARKET INTEGRATION

For corporate and government bonds, we regard an increase in the share of non-domestic bond holdings as a sign of further integration. This follows from our definition of financial integration, which implies that economic agents are able to access non-domestic financial products more easily when markets become financially integrated.

#### 3.3.2. HOME BIAS

The extent of the home bias, defined as the fact that agents tend to invest more in domestic assets even though risk is shared more effectively if foreign assets are held, is a sign that financial integration is still not complete. In some markets, we will use portfolio holdings of market participants and similar measures when examining the issue of home bias.

##### 3.3.2.1 CREDIT MARKET INTEGRATION MEASURE

Regarding the credit market, we consider cross-border holdings of securities issued by banks as well as non-banks.

### 3.3.2.2 CORPORATE AND GOVERNMENT BOND MARKET INTEGRATION MEASURE

To measure the extent of a home bias in bond markets, we follow Adam et al. (2002) and examine the share of assets invested in bond funds with a Europe-wide investment strategy.

### 3.3.2.3 EQUITY MARKET INTEGRATION MEASURE

We assess equity market home bias by examining institutional investors' equity holdings to find evidence of more (or less) international diversification. A decrease in the bias toward domestic stocks is a sign of further financial integration.

Table I Summary of integration measures for different market segments

	Price-based measures	Country effects
	Yield-based measures	
Money market	<ul style="list-style-type: none"> <li>– Spread between interest rates</li> <li>– Cross-sectional dispersion</li> </ul>	<ul style="list-style-type: none"> <li>– Dispersion of rates across countries vs. within countries</li> </ul>
Credit market	<ul style="list-style-type: none"> <li>– Spread between interest rates using a reference country interest rate</li> <li>– Margins using comparable market rates</li> <li>– <math>\beta</math>-convergence</li> <li>– Cross-sectional dispersion</li> </ul>	–
Corporate bond market	<ul style="list-style-type: none"> <li>– Size and significance of country effect for corporate bond spreads</li> <li>– Cross-sectional dispersion in country effect</li> <li>– Proportion of cross-sectional variance explained by country effect</li> </ul>	<ul style="list-style-type: none"> <li>– Country versus rating effects within the country (rating) portfolios</li> </ul>
Government bond market	<ul style="list-style-type: none"> <li>– Spread between yields using a reference asset</li> <li>– <math>\beta</math>-convergence</li> <li>– Cross-sectional dispersion</li> </ul>	–
Equity market		<ul style="list-style-type: none"> <li>– Sector versus country effects</li> </ul>
	News-based measures	Quantity-based measures
Money market	–	<ul style="list-style-type: none"> <li>– Cross-border lending activities</li> <li>– Resort to standing facilities</li> <li>– Repo-market: number of trades involving non-euro area banks</li> </ul>
Credit market	<ul style="list-style-type: none"> <li>– Percentage of interest rate change explained by common factors</li> </ul>	<ul style="list-style-type: none"> <li>– Cross-border loans to non-banks and interbank loans</li> <li>– Cross-border securities holdings issued by banks and non-banks</li> </ul>
Corporate bond market		<ul style="list-style-type: none"> <li>– Share of assets invested in bond funds with a European-wide investment strategy</li> </ul>
Government bond market	<ul style="list-style-type: none"> <li>– Percentage of asset price change explained by common factors</li> </ul>	<ul style="list-style-type: none"> <li>– As in corporate bond market</li> </ul>
Equity market	<ul style="list-style-type: none"> <li>– Increase in common news components in equity returns</li> </ul>	<ul style="list-style-type: none"> <li>– Asset share of euro area Investment funds with non-domestic and European horizon</li> <li>– Share of foreign euro area equity in total equity portfolio of pension fund and life insurance sectors</li> </ul>

## 4 EURO AREA MONEY MARKETS

The money market is commonly defined as the market for short-term debt, where “short-term” means a maturity of up to one year. There are various segments within the money market, and each segment falls into one of three broad categories: unsecured debt, secured debt, and derivatives of short-term debt. This section looks at all three of these categories, but for the latter two categories the focus is on the two largest and most important sub-segments, which are the repo and the interest rate swap markets respectively.<sup>18</sup> Other segments of the secured and the derivatives markets are not explored either due to data limitations, as in the case of the commercial paper segment, or because the market is concentrated almost completely outside the euro area, as in the case of short-term interest rate (EURIBOR) futures and options.<sup>19</sup> Furthermore, since this study focuses on euro-dominated financial instruments, some additional segments, such as the foreign exchange swap market or the cross-currency swap market, are not considered.

Monitoring the integration of euro area money markets is important for a number of reasons. First, this market is central to the implementation of the single monetary policy of the euro area, since it constitutes the first step in the transmission mechanism of monetary policy.<sup>20</sup> Indeed, the money market is regularly used by the Eurosystem to distribute liquidity to the market. For example, repo transactions are one of the main instruments used for the Eurosystem’s regular refinancing operations. The integration of these markets is therefore essential to allow a smooth flow of liquidity between markets and across country borders so that liquidity is distributed evenly within the money market. Beyond these considerations, money market integration is important for the efficient allocation of resources in the euro area and for promoting a more efficient pricing of short-term debt in the euro area.

Before proceeding with the specific measures of euro area money market integration, the next sub-section provides a brief description of the various segments of the money market on which

we focus, and an outline of recent developments in those segments.

### 4.1 MARKET DEVELOPMENTS<sup>21</sup>

#### 4.1.1 THE UNSECURED MARKET SEGMENT

The unsecured deposit market is where credit institutions exchange short-term liquidity without any collateral as guarantee. Within the unsecured deposit market, trading volumes are distributed unevenly between various maturity segments, with the bulk concentrated at the short end of the maturity spectrum. According to the survey results in the Money Market Study 2002 (ECB, 2003c), overnight transactions accounted for slightly less than 70% of the unsecured market’s total turnover, while transactions with maturities up to one month accounted for the largest part of the remainder. Immediately following the introduction of the euro, the euro area unsecured deposit market grew significantly as a result of a 40% jump in volume in the overnight segment between mid-1998 and mid-1999. Other maturities, on the other hand, experienced declining volumes on average.

Following the introduction of the euro in 1999, market participants adopted new daily benchmark indices for unsecured lending rates in the euro area, namely the EONIA and the EURIBOR indices. EONIA (euro overnight

18 Although the money market normally refers to the market for short-term debt, all swaps, including long-maturity contracts, are commonly categorised as belonging to the money market. Following this convention, we also consider swaps with maturities longer than one year in this section.

19 After an initial period during which EURIBOR futures and options were actively traded on both LIFFE in London and EUREX in Frankfurt, trading activity subsequently became almost completely concentrated on LIFFE.

20 An in-depth treatment of the monetary transmission mechanism in the euro area is given by Angeloni et al. (2003).

21 This sub-section is largely based on data and information in a number of previous studies and surveys, including the ECB publications “The euro money market” (2001a), “Euro money market study 2001 (MOC)” (2002c), “Money Market Study 2002” (2003c), the October 2002 ECB Monthly Bulletin article “Main features of the repo market in the euro area”, Santillan et al. (2000), and the European repo market survey (number 4, December 2002), published by the International Securities Market Association (ISMA)



index average) is the reference rate for the euro area overnight rate, and it is calculated by the ECB as a weighted average of all overnight unsecured lending transactions undertaken in the interbank market by a number of contributing panel banks. EURIBOR (euro interbank offered rate) is the benchmark rate of the euro money market for a number of standardised maturities up to one year. For any given maturity, the EURIBOR reference rate is the rate at which euro interbank term deposits are offered by contributing panel banks.<sup>22</sup> The immediate and full acceptance of these indices by market participants after the introduction of the euro contributed further to the growth in the unsecured euro market, in part because the indices were increasingly used as underlying or reference indices in derivatives markets.

#### 4.1.2 THE REPO MARKET SEGMENT

In the repo market, financial agents exchange securities for liquidity, with a simultaneous agreement to reverse the transaction at some pre-specified future date and at a pre-set price.<sup>23</sup> In general, a repo transaction can be seen either as a secured loan of cash, or alternatively as a way of obtaining some specific security for a limited period. While some repo operations are made against equities or corporate bonds, the vast majority of transactions are based on sovereign bonds. In recent years, the euro area repo market has grown rapidly, largely due to the introduction of the common currency, which made available an increased number of euro area securities for repo transactions, and which also appears to have encouraged new players to enter the market. According to the survey results in the Money Market Study 2002 (ECB, 2003c), the total size of the euro area repo market recently surpassed that of the unsecured deposit market. As in the case of the unsecured market, activity in the repo market is mainly concentrated at the short end of the maturity spectrum. However, by contrast with the unsecured market, the overnight segment is not as dominant in the repo market.

#### 4.1.3 THE INTEREST RATE SWAP MARKET SEGMENT<sup>24</sup>

In the interest rate swap market, financial agents agree to exchange periodic payments of interest rates according to some pre-specified formula, based on an underlying principal, which itself is not exchanged. An interest rate swap often involves exchanging a fixed amount per payment period for a payment that is not fixed. This floating side of the swap is then typically linked to another interest rate, such as a EURIBOR reference rate or the EONIA. Trading in the interest rate swap market takes place mostly between banks and activity is highly concentrated among a few large market players. Because the average transaction size in this market has increased in the last few years – individual transactions on the order of several billion euros are standard – smaller banks have found it difficult to enter the market.

Growth in the euro area interest rate swap market has been very strong following the introduction of the euro. A number of factors seem to have contributed to the growing interest in this market. Following the introduction of the common currency, the interest rate swap curve relatively quickly established itself as the benchmark curve for the euro area. Rather than choose among individual member countries' government yield curves, many market participants found it advantageous to use a single euro area swap curve as a reference, and activity in the swap market was boosted as a result. This growth in turn led to enhanced swap market liquidity, which acted as an added attraction for market participants as arbitrage and hedging activity picked up. Finally, the fact that swaps consume relatively less credit limits has added to their success.<sup>25</sup> Activity in the euro

<sup>22</sup> See [www.euribor.org](http://www.euribor.org) for further details on the EONIA and the EURIBOR indices.

<sup>23</sup> In the following, we do not differentiate between repos (cash borrowing against securities) and reverse repos (cash lending against securities).

<sup>24</sup> This includes both the Overnight Index Swap (OIS) market and the market for other interest rate swaps.

<sup>25</sup> See the ESCB money market surveys for further information on the factors that have contributed to the growing interest in the interest rate swap market.

area interest rate swap market is mainly concentrated at shorter maturities, although the market is liquid up to the two-year segment (ECB, 2002c).

## 4.2 MEASURES OF INTEGRATION

Before turning to our measures of integration, we will take a brief look at the available literature on money market integration. Relatively few studies seem to have focused on integration in this market segment. However, there are a few exceptions worth mentioning. Santillan et al. (2000) investigate the effects of the introduction of the euro in 1999 on euro area bond and money markets. Based on measured interest rate differences across countries and market survey data, the authors of this early study concluded that while the unsecured money market segment very quickly became highly integrated, the repo market lagged in this respect. A number of reasons were put forward for the relatively lower degree of integration in the repo market, including a lack of harmonisation of repo agreements throughout the euro area, uneven distribution of collateral in different countries, and difficulties in the cross-border management of collateral. Hartmann et al. (2001) examine intra-day data for unsecured euro area lending rates during a 5-month period and find cross-border rate differentials to be very small. They therefore conclude that the unsecured segment of the money market became very highly integrated almost immediately after the introduction of the euro. Gaspar, Perez-Quiros and Sicilia (2001) investigate the functioning of the overnight segment of the money market after the introduction of the euro in detail, and document what they call a “learning period” in the money market. In the first few days after the introduction of the euro, a number of inefficiencies were identified in this market segment. However, as learning took place and banks adapted to the new environment, such inefficiencies were swiftly eliminated. Overall, Gaspar et al. (2001) find that this period of learning took less than one month.

Galati and Tsatsaronis (2001) and Gaspar et al. (2003) report that the percentage of cross-border interbank lending increased considerably around the time of the euro’s introduction, indicating a strengthening of the degree of integration in this segment. It is interesting to note here that a two-tier system seems to have emerged, in which the larger banks trade across borders directly with each other, while smaller institutions operate at a domestic level. As pointed out by Galati and Tsatsaronis (2001), this is not necessarily bad, as large banks tend to have more experience with measuring and managing foreign counterparty risk. Galati and Tsatsaronis (2001) also present some evidence on the integration of the market for unsecured deposits based on bid-ask spreads. They find that while significant cross-country dispersions in spreads were present prior to 1999, spreads were subsequently identical across the different countries within the euro area. Adam et al. (2002) use  $\beta$ - and  $\sigma$ -convergence measures applied to 3-month deposit rates to assess the degree of integration in euro area money markets. Unsurprisingly, they find that the integration of this market increased markedly after the introduction of the euro, when the market became essentially fully integrated. Finally, Hartmann et al. (2003) summarise the results of the literature on financial market integration, as described above.

### 4.2.1 PRICE-BASED MEASURES OF INTEGRATION

#### 4.2.1.1 THE UNSECURED MARKET SEGMENT

Since January 1999, the ESCB monetary policy operations have been implemented based on euro area-wide demand for liquidity, rather than on the needs of each member country. Hence, early on there was a need to redistribute liquidity efficiently among the euro area countries. This enhanced the development of cross-border transactions in the money market and resulted almost immediately in 1999 in a very high degree of integration in the unsecured money market, which is the segment where short-term liquidity redistribution is concentrated.

When examining price-based measures of integration in the euro area unsecured money market, we focus on interest rate differentials between countries. As argued in the previous section, the characteristics of money market instruments or transactions in individual euro area countries are similar enough for direct interest rate comparisons to be informative regarding the degree of integration. Specifically, in perfectly integrated markets, interest rates on contracts of the same type and of the same maturity should be identical across all countries. In our examination of the unsecured market segment, we first investigate the overnight market, which is of particular interest for the ECB due to its proximity to monetary policy implementation. We then turn to longer-maturity unsecured lending.

#### 4.2.1.2 INTEGRATION IN THE UNSECURED OVERNIGHT MARKET

Chart 1 plots the dispersion of overnight lending rates in the euro area, measured as the cross-sectional standard deviation among the 12 average country rates (11 before 2001) at each point in time. Specifically, for the period after 1998, this measure is based on weighted average overnight lending rates for each of the euro area countries, as reported by the banks participating in the EONIA panel.<sup>26</sup> The chart also includes five years of pre-EMU data (for those countries where data is available, but excluding Greece) to provide some perspective on this measure.<sup>27</sup>

The chart shows that the cross-sectional standard deviation was of the order of several hundred basis points in the mid-1990s. The convergence process appears to have started around late 1996 or early 1997, bringing the standard deviation down to around 100 basis points in late 1998. However, following the introduction of the euro on 4 January 1999, the cross-sectional standard deviation collapsed to a very low level, where it has remained since. Of course, the elimination of exchange rate risk and the gradual harmonisation of national economic policies, rather than increased market integration, is likely to have accounted for the

bulk of the drop in the cross-sectional standard deviation during the run-up to EMU. However, after 1998, when exchange rate risks were eliminated, this measure should tell a lot more about the state of integration. As shown by the insert in Chart 1, the post-EMU standard deviation has remained within 1-4 basis points since the beginning of 1999, indicating a high degree of integration in the euro area overnight market segment. This result is in line with the results in Hartmann et al. (2001), who examined the microstructure of the euro area money market using a short intra-day sample based on quotes by brokers in several countries. Our results indicate that monetary integration strongly drives financial integration in the overnight money market, which is the segment most closely related to monetary policy. In a recent study of the Eurosystem's monetary policy auctions, Scalia and Ordine (2003) also conclude that the setup of monetary policy implementation in the euro area represents a vehicle for integration in the euro area money market.

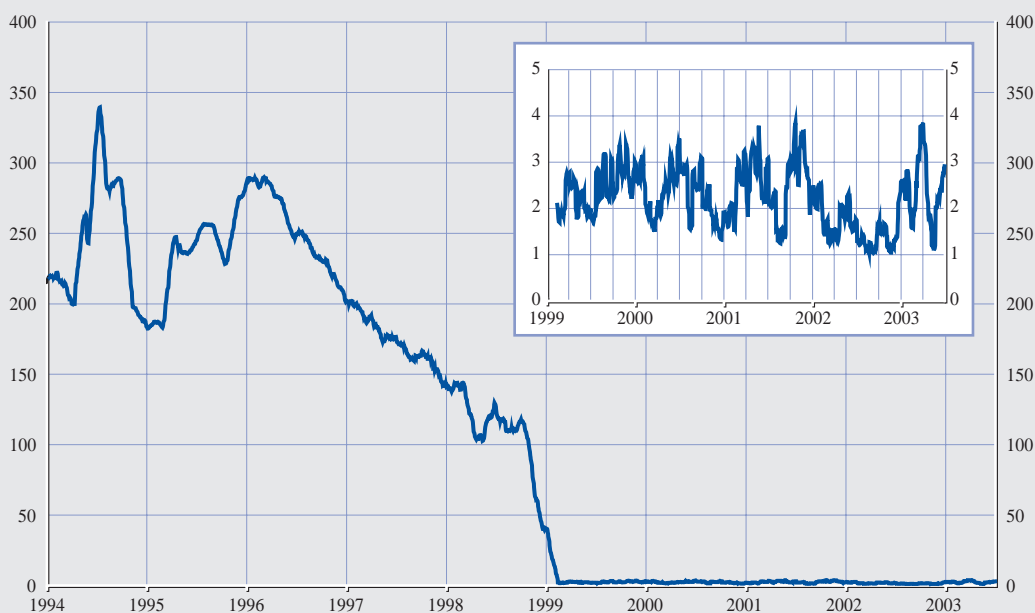
As shown by Chart 1, there remains some dispersion, albeit small, in the daily overnight interest rates across euro area countries. It may be interesting to examine whether discrepancies between country rates are larger than the "normal" dispersion among banks within each member state. We would not expect the cross-country dispersion in an integrated market to be greater than the within-country dispersion. As outlined in Chapter 3, we use the daily EONIA panel data to try to investigate this issue by examining the ratio of the average dispersion of lending rates across countries to the average dispersion of rates within countries at each point in time. As argued before, we

<sup>26</sup> Specifically, the overnight rate for each country is the average of the overnight lending rates reported by the EONIA panel banks in the respective country, weighted by the total overnight lending amount. The data is gathered by the European Banking Federation (EBF). We thank the EBF for making this data, as well as data from the EURIBOR and EUREPO panels, available to us.

<sup>27</sup> The pre-EMU period is added for comparison reasons; it should be recognised that there is no reason why the overnight rates among individual countries should be identical prior to EMU, although increased co-ordination of policies would tend to result in convergence of rates.

**Chart 1 Cross-sectional standard deviation of the average overnight lending rates among euro area countries**

(30-day moving average, basis points).



Source: European Banking Federation, Global Financial Data Inc., author's calculations.

would expect the ratio between these two measures of dispersion to be close to one if the market is fully integrated. However, at the same time, it should be recognised that this is not a perfect measure of integration. For example, the EONIA panel dataset comprises only information on the daily average lending rates of the contributing banks. It contains no information about rates on domestic or cross-border transactions. This means that both our measure of the average dispersion of lending rates across countries and that of the average dispersion of rates within countries are calculated using within-country as well as cross-border transaction rates, thereby diminishing the informational value of this measure as an indicator of integration. Moreover, the EONIA panel consists of large banks, which are likely to be more involved in cross-border transactions than smaller banks, hence possibly reducing the average rate difference between banks in our panel. In this case, our measure may tend to overstate somewhat the degree of integration in the

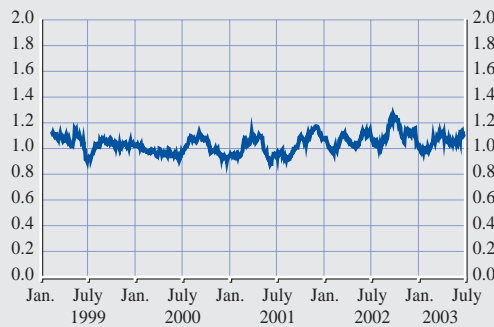
market. As a result, it could be argued that this measure of integration is more informative when there are clear and systematic differences between within-country and cross-country dispersions, than when they are similar.<sup>28</sup> However, if it turns out that there are systematic differences between various segments of the market (EONIA, EURIBOR, EUREPO), this would suggest that the caveats discussed above should not be the drivers of these differences, since the types of banks that contribute to these panels have similar or in many cases identical characteristics.<sup>29</sup>

<sup>28</sup> Here, we do not test explicitly whether the results for various market segments differ in a statistical sense. A rigorous test of this type would require modelling the joint dynamics of within- and cross-country interest rate differences for all market segments considered in this paper. This is left for future research.

<sup>29</sup> For example, in March 2004, of the 38 banks contributing to the EUREPO panel, 32 were also contributing to the EURIBOR/EUREPO panel. Moreover, the banks contributing to EURIBOR are the same as the panel banks contributing to EONIA.

**Chart 2 Ratio between average cross-country EONIA rate deviations and average within-country deviations**

(30-day moving average).



Source: European Banking Federation, author's calculations.

With the caveats discussed above in mind, we turn to the results for the overnight market segment. Chart 2 plots the ratio of average cross-country to within-country dispersion for the EONIA panel banks. As shown in the chart, this ratio has been quite close to one since the

introduction of the euro, consistent with a high degree of integration in the overnight money market.<sup>30</sup> Moreover, this ratio has oscillated around one within a fairly tight range, suggesting that the high degree of integration has been an enduring feature of this market since 1999.

#### 4.2.1.3 INTEGRATION IN THE LONGER SEGMENT OF THE UNSECURED MONEY MARKET

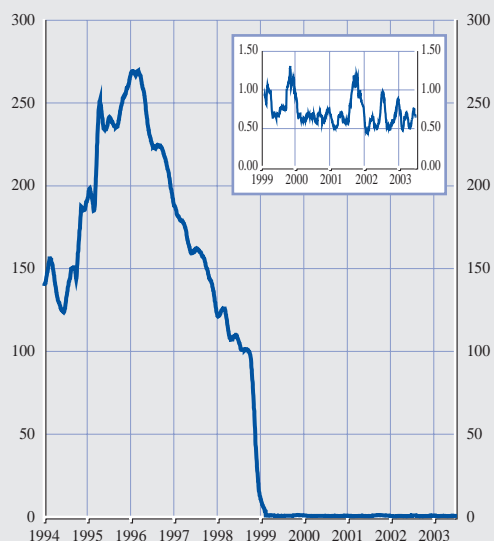
Like the unsecured overnight lending market, the longer unsecured segment also experienced a swift move to a high degree of integration following the introduction of the euro. Repeating the exercise from the previous subsection, Chart 3 shows time series of the cross-sectional standard deviation of one- and 12-month lending rates for each of the 12 euro area countries (11 before 2001) from January 1994 through June 2003. As in the overnight market,

<sup>30</sup> The average ratio of cross-country to within-country dispersion during the sample period was 1.04. The average cross-country interest rate dispersion was 2.40 basis points, while the average within-country dispersion was 2.37 basis points.

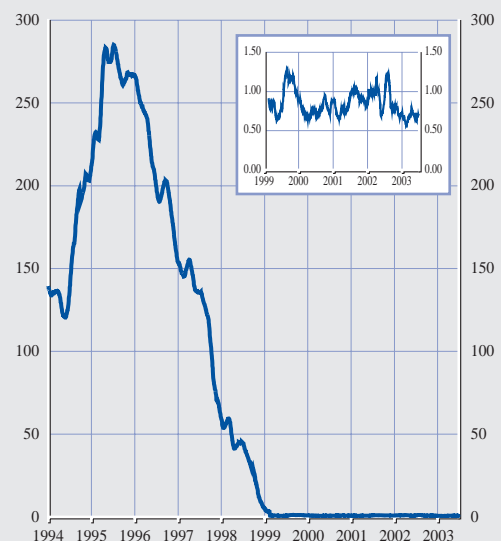
**Chart 3 Cross-sectional standard deviation of unsecured lending rates among euro area countries**

(30-day moving average, basis points)

#### (a) One-month maturity



#### (b) 12-month maturity



Source: Datastream, European Banking Federation, author's calculations.

dispersion was typically on the order of hundreds of basis points in the mid-1990s before starting to decline around 1996. Again, the elimination of exchange rate volatility is likely to have accounted for most of the decline in the cross-sectional standard deviation prior to 1999. Following the introduction of the euro in January 1999, the cross-sectional standard deviation fell very close to zero. Since the start of EMU, the 30-day moving average of this measure of dispersion has remained within less than 2 basis points for both the one-month and the 12-month segments. Results for other maturity segments (not shown) are also in line with these findings, providing evidence that the entire euro area unsecured money market enjoys a very high degree of integration. Adam et al. (2002) report similar results.

Finally, we investigate the degree of cross-country dispersion vis-à-vis the degree of within-country dispersion. For this purpose, we use daily data from the EURIBOR panel, i.e. the banks that provide daily quotes of the various interest rates in order to determine the EURIBOR reference rate.<sup>31</sup> Again, we study the ratio between the average distance across all possible combinations of lending rates of individual EURIBOR panel banks between

countries, and the average distance across all combinations of lending rates among such banks within all countries for each day. Chart 4 plots this ratio for the one- and 12-month maturities and shows that the ratio of dispersions has been close to one since the start of step 3 of EMU. Subject to the caveats discussed before, this result is in line with a high degree of integration in the unsecured money market. In this context, however, one should also bear in mind that EURIBOR panel data is less reliable than the EONIA data, since the EURIBOR data merely consist of indicative quotes rather than actual transaction rates.

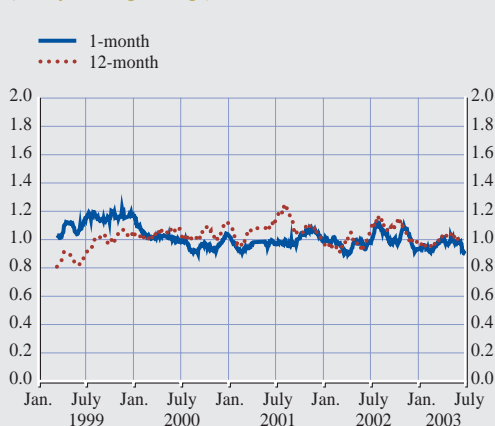
#### 4.2.1.4 THE REPO MARKET SEGMENT

By contrast with developments in the unsecured money market, the euro area repo market segment has been making slower progress towards integration, despite some considerable improvement. Initially, various factors impeded the euro area repo market integration. For example the market lacked standardised and harmonised legal documentation. Such problems have gradually been addressed, and progress has been made in resolving these kinds of difficulties.<sup>32</sup>

The creation of the EUREPO index by the European Repo Council and the European Banking Federation in March 2002 was an important recent initiative for promoting the repo market's integration. EUREPO, which was introduced as the benchmark for secured money market transactions in the euro area, is the rate at which one prime bank offers funds in euro to another prime bank in exchange for EUREPO general collateral (GC). The fact that EUREPO GC is clearly and uniquely defined for all market participants facilitates cross-border trades and therefore promotes repo market

**Chart 4 Ratio between average cross-country EURIBOR rate deviations and average within-country deviations**

(30-day moving average).



Source: European Banking Federation, author's calculations.

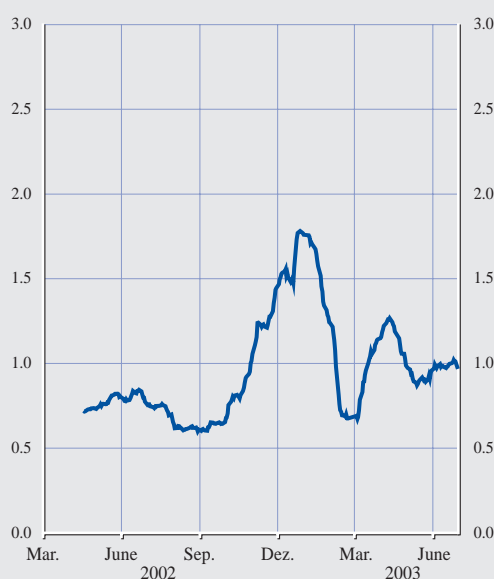
<sup>31</sup> We would like to thank Jean-Louis Schirmann for helping us to obtain the data from the European Banking Federation, and Peter Galos for assisting with the data handling.

<sup>32</sup> See the article "Main features of the repo market in the euro area", in the October 2002 issue of the ECB Monthly Bulletin, for a detailed description of the various initiatives launched for the purpose of improving the integration of the repo market.

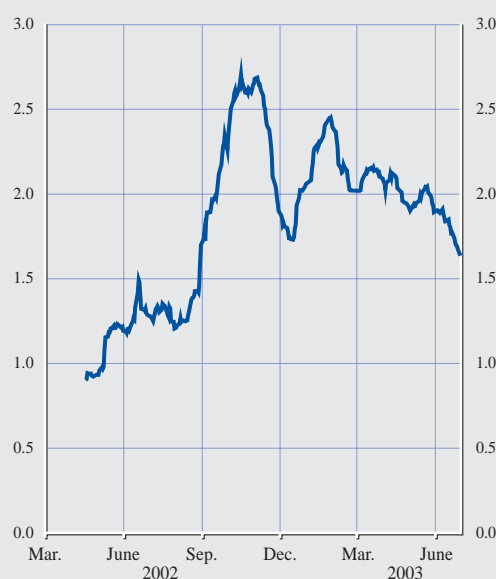
Chart 5 Cross-sectional standard deviation of repo rates among euro area countries

(30-day moving average, basis points)

(a) One-month maturity



(b) 12-month maturity



Source: European Banking Federation, author's calculations.

integration. The daily EUREPO index is itself calculated as an average of quotes obtained from a representative panel of prime banks for each of the maturities considered.<sup>33</sup>

With respect to price-based measures of integration in the euro area repo market, it should be noted that poor data availability significantly restricts the range of possible indicators that can be implemented in practice. The introduction of the EUREPO index in early 2002 improved matters somewhat, in that it made it possible to compare repo quotes across individual euro area countries, although the available sample period is quite short. Given that the pool of collateral eligible for EUREPO transactions is standardised, and that the risk characteristics of the banks in the EUREPO panel are similar, direct comparisons of repo rates across countries should be informative with respect to the degree of integration. We focus on two maturities: one month and 12 months.

Chart 5 plots the cross-sectional standard deviation of one- and 12-month repo rates across country averages of the quotes reported by the banks participating in the EUREPO panel. The chart shows that the cross-sectional standard deviation has remained relatively low throughout this relatively short sample period, although it seems to have increased slightly for the longer maturity. This evidence would suggest that the degree of integration in the euro area repo market has been reasonably high during this period, albeit somewhat lower than in the unsecured market segment. However, when interpreting these results, it should again be recognised that the quality of the available data is inferior to that of the EONIA data, not only because of the shorter sample availability, but also because the EUREPO data consists of indicative quotes rather than actual transaction rates. Moreover, as pointed out before, lack of data prior to 2002 prevents us from

<sup>33</sup> See [www.eurepo.org](http://www.eurepo.org) for further details.

quantitatively investigating the progress towards integration before this year.

Turning to the degree of cross-country dispersion relative to the degree of within-country dispersion, we use the individual daily EUREPO quotes of the banks participating in the panel. These data allow us to study the ratio between the average distance across all possible combinations of repo rates between countries and the average distance across all combinations of repo rates within countries for each day. As shown in Chart 6, this measure of integration has tended to deviate more from one than did the EONIA or the EURIBOR market segments, suggesting that the repo market is less integrated than these other segments. It is interesting to note that the repo market results clearly differ from those of the EONIA and the EURIBOR markets. As discussed before, this would tend to support our view that this measure can be informative with respect to the degree of integration, despite the fact that only large banks are included in the panel.

Looking at the two different maturities results, it seems that, the cross-country to within-

country ratio has exhibited more pronounced deviations from one for the 12-month maturity than for the 1-month maturity. This may reflect the aforementioned fact that much of the trading in the repo market is concentrated at short maturities, and that a lack of liquidity for longer maturities may tend to hamper integration in these market segments. However, at the same time, the degree of cross-country dispersion in repo rates should not be exaggerated: the average cross-country 12-month repo rate difference is 1.6 basis points, compared to 1.1 basis points for the average within-country difference.<sup>34</sup>

#### 4.2.1.5 THE INTEREST RATE SWAP MARKET SEGMENT

Like the unsecured lending market, the euro area interest rate swap market rapidly became highly integrated following the introduction of the euro in 1999. Price-based measures of integration in the euro area interest rate swap market confirm that this segment indeed already enjoyed a very high degree of integration shortly after the euro's introduction. Chart 7 plots the development of cross-sectional standard deviations of one-year and 10-year interbank swap rates across different euro area countries. The chart shows that very soon after the single currency was introduced, the convergence of swap rates in the euro area was for all intents and purposes complete (as of 2001 in the case of Greece), implying that the market became almost perfectly integrated very quickly. Since mid-1999, the cross-sectional standard deviation has not exceeded one basis point on any single day for either one-year or 10-year swaps.

On the whole, all evidence suggests that the euro area interest rate swap market is not only extremely large and liquid, but also one of the most integrated in the euro area financial landscape.

**Chart 6 Ratio between average cross-country EUREPO rate deviations and average within-country deviations**

(30-day moving average).



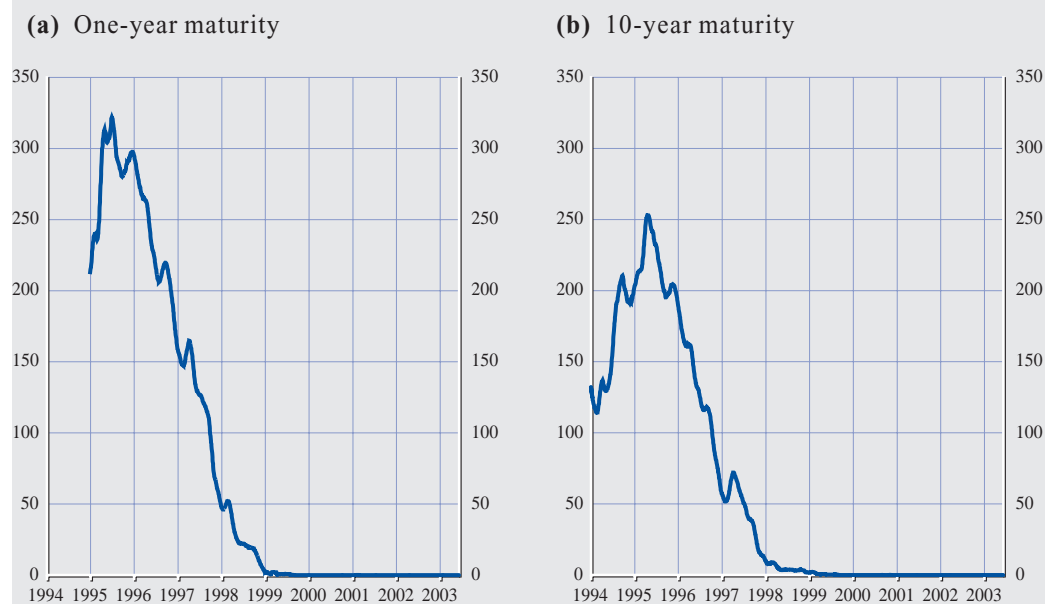
Source: European Banking Federation, author's calculations.

<sup>34</sup> For the 1-month maturity, the average cross-country difference is 1.1 basis points, and the average within-country difference is 0.9 basis points.



**Chart 7 Cross-sectional standard deviation of interest rate swap rates among euro area countries**

(30-day moving average, basis points)



Source: Datastream, author's calculations.

#### 4.2.2 QUANTITY-BASED MEASURES OF INTEGRATION

##### 4.2.2.1 THE UNSECURED MARKET SEGMENT

As discussed earlier in this chapter, the unsecured money market attained a very high degree of integration almost immediately in 1999. An indirect quantitative sign of integration is the fact that market participants have only rarely had to resort simultaneously to the Eurosystem's credit and deposit facilities to any significant extent (see e.g. Gaspar et al. (2001)). Moreover, statistics from the ESCB money market surveys confirm that cross-border lending activity within the euro area increased in the unsecured money market following the introduction of the euro. While such transactions made up around 20% in 1998, their share had increased to close to 40% in 1999. In addition, Gaspar et al. (2003) provide supporting evidence on increasing integration in this segment. In keeping with the analysis in

Galati and Tsatsaronis (2001), they report that following a significant increase in 1998 and 1999, the cross-border lending in the euro area interbank market now accounts for almost half of the global total of cross-border interbank lending.

##### 4.2.2.2 THE REPO MARKET SEGMENT

Quantitative evidence of cross-border activity in the repo market and of the use of non-domestic collateral can provide insights into the development of integration in this market segment. Recent initiatives in the euro area repo market, such as the aforementioned introduction of the EUREPO index in 2002, seem to have helped improve integration in the repo market through a heightened level of cross-border activity within the euro area. However, this increase in cross-border transactions materialised slowly, reflecting the gradual progress towards integration. Between 1998 and 1999, the fraction of trades involving a

non-domestic euro area counterpart remained unchanged at 33%, but by 2000 this fraction had increased to 40%.<sup>35</sup>

#### 4.2.2.3 THE INTEREST RATE SWAP MARKET SEGMENT

As in the case of the unsecured lending market, the euro area interest rate swap market rapidly became highly integrated following the introduction of the euro in 1999. Quantitative evidence of the market's swift progress towards integration can be found in statistics for cross-border activity within the euro area. Whereas 34% of the average daily transactions in the euro area in the fourth quarter of 1998 took place across national boundaries, the fraction of cross-border trades had jumped to 52% by the second quarter of 1999.<sup>36</sup>

introduction of the euro. Our integration measures indicate that improvements in the degree of integration have taken place since then. As for the unsecured lending market and the swap market, our results confirm not only that these segments became very highly integrated after the introduction of the euro, but also that this very high level of integration has remained an enduring feature of these markets in the period thereafter.

### 4.3 SUMMARY

Given the important role the money market plays in the implementation of the single monetary policy of the euro area, measuring this market's degree of integration is of particular interest for the ECB. Overall, we find that, on the basis of various price-based measures, the state of market integration in euro area money markets is very advanced. As also shown by previous studies, uniform conditions across money markets in the euro area and a high degree of integration generally prevailed very shortly after the start of implementation of the single monetary policy. However, it also clear that not all segments of the market have yet reached the same level of what might be called "near-perfect" integration. In particular, the euro area repo market segment seems to be less integrated than the swap and unsecured segments. The most relevant factors underlying the less advanced state of integration in this market segment are likely to be differences in practices, laws and regulations as well as remaining fragmentation of the market infrastructure. Still, it should be recognised that the repo market was generally considered substantially less integrated than the other segments immediately following the

<sup>35</sup> Santillan et al. (2000), ECB (2001a).

<sup>36</sup> Santillan et al. (2000).

## 5 EURO AREA GOVERNMENT BOND MARKETS

The government bond markets of the euro area are the main source of financing for central and local governments within the area. They also play an important role in helping the financial system function. Not only do government bonds often serve as benchmark assets when pricing other securities, they are also frequently used as collateral in various financial transactions.

In recent years, we have witnessed a considerable change in euro area government bond markets. With the introduction of the euro and a common monetary policy, investors have started to focus more on credit and liquidity risk. At the same time, bond portfolios have become increasingly internationally diversified, especially in the smaller euro area countries. In this more competitive environment, governments have put great effort into making their outstanding debt and new issues more attractive to international bond investors. To this end, they have adopted a number of supply-side innovations, some of which are described in more detail in section 5.1. Overall, the evidence seems to suggest that euro government bond markets now exhibit a high degree of integration, albeit not as high as in the euro area money market.

The potential benefits of further integration in the government bond market are considerable. First, by promoting integration, governments can considerably reduce the cost of servicing their debt. In an integrated government bond market, it is easier for investors to diversify geographically and thereby largely eliminate their exposure to purely local economic shocks. This, in turn, should reduce the yield required by investors and result in lower interest payments for governments. Similarly, to the extent that governments succeed in improving the liquidity of their outstanding bonds, investors will require a lower liquidity premium, which further reduces debt servicing costs. Recently, Adjaouté and Danthine (2003) estimated that further integration could potentially reduce debt servicing costs for the euro area by €5 billion per year. Second, further integration in the government bond market leads

to increased transparency and a more homogeneous pricing of bonds. As a consequence, government bonds of similar maturity become closer substitutes. This greatly facilitates the functioning of euro area collateral-backed asset markets, which to a large extent rely upon government bonds as collateral, by granting market participants access to a larger pool of eligible collateral.

Further integration of euro area government bond markets may also affect the transmission of monetary policy<sup>37</sup>. The increase in liquidity and efficiency of euro area government bond markets, as well as the general convergence of the characteristics of government bond markets in the various euro area countries could be expected to lead to a more symmetric impact of monetary policy in these markets.

This chapter is structured as follows. We first briefly discuss the main developments in euro area government bond markets. We then discuss the measures of government bond market integration that were introduced in Chapter 3. The final section presents our conclusions.

### 5.1 MARKET DEVELOPMENTS

The introduction of the euro, combined with the acceleration of supply-side innovations in government bond markets discussed above, has significantly changed investor behaviour in this market. For example, eager to benefit from the improved diversification benefits and liquidity, investors have considerably increased their holdings of non-domestic bonds, leading to a reduction in the home bias of bond markets. In what follows, we briefly summarise the major changes that have taken place in the market, distinguishing between those changes that have been mainly supply-driven and those that have been demand-driven<sup>38</sup>. The section also

<sup>37</sup> For more details on the effect of innovations in the bond market on the transmission of monetary policy, see e.g. Favero et al. (2000).

<sup>38</sup> See Santillan et al. (2000) and ECB (2001b) for a more detailed discussion of government bond market developments following the introduction of the euro.

includes a brief description of recent developments in the financial infrastructure of bond markets.

### 5.1.1 SUPPLY-DRIVEN CHANGES

The new competitive environment brought about by the euro's introduction has caused numerous changes in the issuance of sovereign bonds. Government debt managers now have to compete to access a common investor base (ECB, 2000b). First, competition has led to increasing liquidity of government securities and larger volumes of outstanding issues. In this respect, issue sizes have become bigger and sovereign issuers, particularly small countries, have started to focus increasingly on creating benchmark issues. In addition, some governments have undertaken buy-back programmes and carried out bond exchanges. Following a trend that started prior to the introduction of the euro, those programmes have targeted illiquid and/or short-dated instruments<sup>39</sup>. As a result, net issuance in euro declined more sharply than gross issuance in the late nineties. Second, debt managers have also made issuance activity more regular and predictable by introducing pre-announced auction calendars, which has improved market transparency. They have also made greater use of primary dealers in order to secure a smooth and diversified placement of debts. At the same time, some of the small issuers (Finland and Portugal, for instance) have resorted to syndication to make the investor base broader. Third, governments have tried to focus their efforts on "niches" targeting particular investor needs. For instance, Spain and France have introduced constant-maturity bonds, while France (followed by Greece and Italy) has taken the lead in the issuance of index-linked bonds.<sup>40</sup> Fourth, governments have also started to use trading systems for the secondary market in order to enhance efficiency and increase the liquidity of their bonds. In addition, the introduction of the euro has led to an expansion in the interest rate swap market, which has given debt managers more flexibility to actively manage their liabilities without influencing issuance volumes in the bond market.

Notwithstanding the efforts to harmonise market practices, the decentralised management of the public debt market, in combination with remaining differences in credit risk among individual countries, is a source of continued fragmentation of the market and the absence of a unique government bond yield curve. Indeed, the launch of the euro also triggered a search for a euro-denominated benchmark to replace benchmarks in the legacy currencies. As discussed in chapter 4, market participants seem to have adopted the euro interest rate swap curve as such a reference, due to the homogeneity of swaps across countries and the high degree of liquidity in this market.

### 5.1.2 DEMAND-DRIVEN CHANGES

The elimination of intra-euro area exchange rate risk as well as the efforts of debtors to make their issues more liquid induced investors to start taking a euro area-wide perspective rather than a national one when deciding their portfolio allocations. Moreover, regulatory changes have relaxed constraints (such as currency matching rules) on foreign holdings for certain categories of institutional investors, who were not allowed to diversify their portfolios internationally<sup>41</sup>. Evidence suggests that institutional investors in smaller euro area countries diversified their portfolios more quickly than investors in larger countries, partly as a result of their relatively smaller choice of domestic assets.

### 5.1.3 DEVELOPMENTS IN FINANCIAL INFRASTRUCTURE

Trading in bond markets has historically taken place over the counter (OTC), where it was

<sup>39</sup> The most prominent examples are Ireland, which in May 1999 completely restructured its outstanding debt into a few liquid benchmark issues, and Spain and the Netherlands, which also introduced programmes to exchange old illiquid bonds for new benchmark bonds.

<sup>40</sup> Insurance corporations and pension funds are among the biggest customers of this new instrument. They acquired around 18% of the total supply of French index-linked bonds on the occasion of the first issuance in October 2001.

<sup>41</sup> See section 7.3 for some data on the composition of portfolios of institutional investors.

typically concentrated among a relatively small group of counterparts. Technological advances and the introduction of a broader euro-denominated market have reduced the advantages of this type of trading. At the same time, intensified competition among debt managers, intermediaries and investors has led to increased demand for efficiency, which has been made feasible through technological innovation. As a result, several structured trading platforms have emerged in the euro area, which in turn seem to have had a positive impact on market integration<sup>42</sup>. The fact that traders have gained access to a common marketplace in which counterparts can be found rapidly has had a beneficial impact on liquidity, particularly in some of the smaller countries. Indeed, many investors, who previously might not have found smaller government debt markets attractive enough to incur the costs of entering them, now invest in these markets through common, cross-border platforms.

## 5.2 MEASURES OF INTEGRATION

### 5.2.1 RELATED LITERATURE

There are only few studies that have focused on measuring the degree of integration in government bond markets. Barr and Priestley (2002) investigate to what extent expected bond returns are determined by world risk factors rather than by domestic risk factors. They argue that under full integration, exposure to purely local news can be diversified away, and local factors should not have any systematic impact on expected returns. They estimate their model on monthly excess returns on bond indices from the UK, US, Japan, Germany, and Canada over the period 1986-1996. Their results indicate that world government bond markets are not completely integrated, as the average contribution of world factors to domestic returns across the five countries is only 70%. However, their estimates of the degree of integration vary considerably across countries. While Germany and Japan appear to be very well integrated with world bond markets, the

UK is not. The authors offer the relatively low level of liquidity (caused by fairly low outstanding values of debt) and the relatively underdeveloped repo market as potential reasons for the low level of integration of the UK government bond market.

Codogno et al. (2003) provide new evidence that the movements in yield differentials on euro area government bonds are mostly explained by changes in international risk factors, as measured by US swap and corporate bond spreads relative to US Treasury yields. The international factors affect spreads because they change the perceived default risk of government bonds in the euro area. On the other hand, liquidity factors play a smaller role.

In more policy-oriented contributions, Adam et al. (2002) and Adjaouté and Danthine (2003) use the spread between 10-year local benchmark government bond yields and the corresponding German rate to measure integration. Given the relatively similar risk characteristics of government bonds across most euro area countries and the elimination of exchange rate risk after 1999, yield differences should be small as long as markets are integrated. For bonds issued by countries with identical credit ratings, yield differences would be expected to be particularly small, although differences in liquidity or perceived credit risk not captured by ratings may result in non-zero yield spreads, even if markets were fully integrated. Adjaouté and Danthine (2003) find that considerable convergence has taken place, even though yield differentials have not disappeared completely. They attribute the strong convergence of government bond yields mainly to the convergence of fundamentals and the elimination of exchange rate risk, but interpret the remaining yield differences as evidence that

<sup>42</sup> The most successful example of these platforms is MTS (for the national markets in Italy, the Netherlands, France, Belgium and Portugal) and EuroMTS, based in London, for trading in benchmark government bonds of several euro area countries (Italy, Germany, Spain, Austria, the Netherlands, France, Belgium, Portugal and Finland). Other developments include Senaf in Spain and Eurex Bonds in Germany.

government bond markets are not fully integrated.

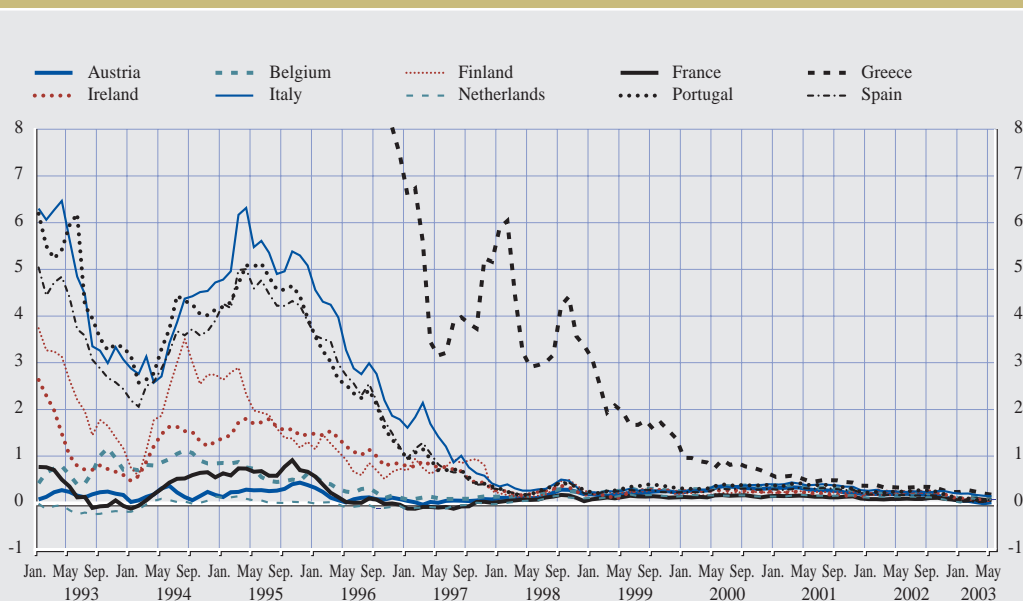
In addition to yield spreads, Adam et al. (2002) propose the cross-sectional standard deviation (dispersion) of yields as a measure of bond market integration. While this measure is unable to distinguish between countries, it can serve as a composite measure for the degree of integration in the aggregate euro area government bond market. They find that, in line with the strong convergence in yields, dispersions have fallen substantially. Using this measure, Adjaouté and Danthine (2003) found an average cross-sectional dispersion of 2.28% in the pre-euro period, compared with 0.16% since the introduction of the euro; a decrease of more than 90%. These authors also show that in all countries the volatility of government bond yields has decreased substantially since the introduction of the euro, indicating that euro area bond markets now respond to a lesser extent to idiosyncratic local shocks.

### 5.2.2 PRICE-BASED MEASURES OF GOVERNMENT BOND MARKET INTEGRATION

Most studies that have analysed the integration process of euro area government bond markets have focused on the highly liquid 10-year maturity segment. While most of the analysis in this chapter will also focus on this maturity, at the end of each section we will briefly discuss integration in shorter maturity segments as well.

As argued before, the strongest measures of financial integration are those based on the law of one price. Insofar as government bonds are sufficiently homogeneous across the various euro area markets, one can directly test the law of one price by comparing the yields on local government bonds across countries. If we assume that the degree of systematic risk is identical across countries, then risk premia should also be identical in perfectly integrated markets, and hence yields on government bonds with the same maturity should be identical as well. Of course, systematic risk may differ

Chart 8 Yield spread for 10-year government bonds relative to Germany



Source: ECB.

across countries, for example due to differences in credit risk or liquidity. In fact, the “no bail-out” clause of the Treaty, which stipulates that neither the Community nor any Member State is liable for or can assume the debts incurred by any other Member State, shows that governments who accumulate excessive debt cannot eventually be bailed out. Hence, if the market perceives that a country’s fiscal policies are unsound, this will tend to lead to a higher risk premium for that country’s government debt. In the following, however, we largely disregard such differences in risk, and proceed to investigate the degree of integration by comparing yields directly. As a robustness check, however, we also compare – where possible – yields from countries with the same credit rating.

Ideally, to measure the degree of integration of a particular government bond market, one would calculate the difference between the local yield and the yield that would prevail in perfectly integrated markets. As the latter is not directly available, most studies analysing the 10-year maturity segment have used German government bond yields (for bonds with identical maturity) as a second-best alternative. Several studies have shown that the 10-year German government bond market is very well integrated with world capital markets (see e.g. Barr and Priestley (2002)). International investors are especially attracted by the high

liquidity, as well as by the very well developed derivatives market linked to this market segment. As a result, the yield on German government bonds should be reasonably close, albeit not exactly identical, to the one that would prevail in fully integrated markets.

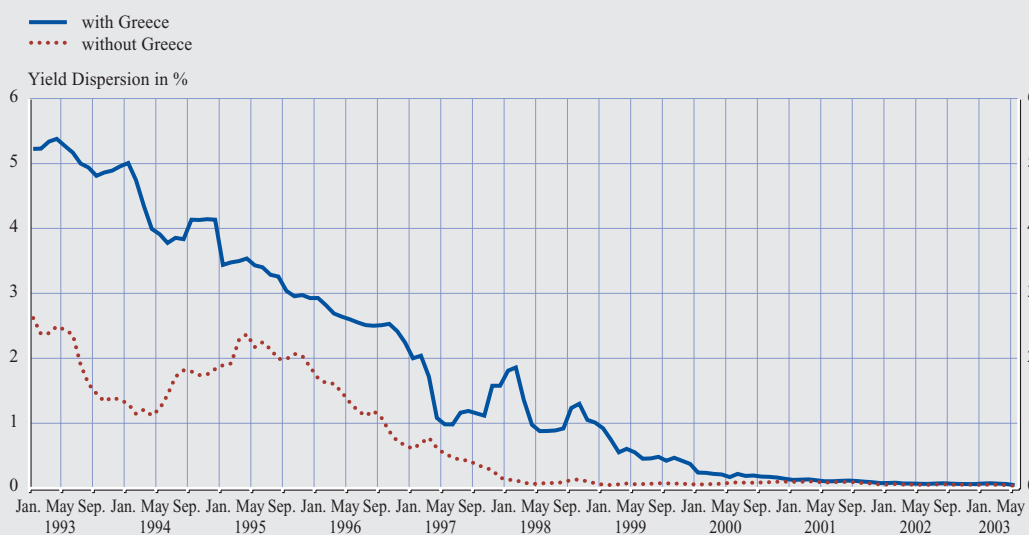
Chart 8 plots the spread between yields in the various euro area government bond markets and in Germany from January 1993 to April 2003 (10-year maturity segment). With the exception of Greece, government bond yield spreads have become very small as of early 1998. The considerable convergence in government bond yields is to a large extent explained by a similarly strong convergence in underlying fundamentals. First, exchange rate stability in the run-up to the single currency followed by the eventual introduction of the euro initially decreased and then eliminated any possibility for competitive devaluations among individual countries. This removed one major discrepancy between yields on bonds issued by different countries in the euro area by eliminating exchange rate risk premia. Second, further convergence in economic policies and of monetary policies led to a substantial convergence of inflation expectations across countries in the run-up to the euro’s launch. Lastly, restrictions on fiscal policies as outlined in the Stability and Growth Pact have helped keep perceived levels of credit risk relatively small.

**Table 2 Average yield spread for 10-year government bonds relative to Germany**

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
1993	18.4	70.6	230.1	25.5	1685.7	119.9	467.2	-16.2	468.1	369.9
1994	16.6	88.8	217.5	35.3	1402.7	122.9	365.8	0.2	361.2	313.3
1995	28.4	63.1	194.0	68.6	1042.6	160.2	535.7	4.9	462.1	442.7
1996	11.3	27.8	88.3	11.6	842.0	115.0	313.1	-5.9	235.5	252.2
1997	3.3	10.1	76.5	-7.1	454.4	65.1	118.0	-7.3	71.8	73.9
1998	16.3	19.1	24.6	8.5	393.3	24.5	33.7	7.0	28.6	27.8
1999	20.3	26.2	22.6	11.8	190.8	21.6	25.1	14.1	31.2	24.2
2000	29.9	33.3	20.3	13.9	82.2	25.2	33.3	15.2	35.1	27.0
2001	27.4	32.0	22.8	13.3	48.9	19.3	37.5	14.9	35.8	28.8
2002	16.8	19.8	18.2	8.4	32.3	21.6	24.2	11.1	22.6	15.2

Source: ECB.

Chart 9 Dispersion in yield spreads for 10-year government bonds relative to Germany



Source: ECB.

In Table 2, we report the average yield spread relative to Germany for the different euro area countries over time. Whereas countries like Austria, Belgium, France, and the Netherlands had relatively low yields spread relative to Germany over most of the last decade, the yields in Finland, Ireland, Italy, Portugal, Spain, and more recently Greece, have exhibited a dramatic convergence toward German levels. While the level of convergence is impressive, integration in euro area government bond markets is not complete, in the sense that yields of government bonds with similar, or in some cases identical, credit risk and maturity have not entirely converged. For instance, even though Austria, France, and the Netherlands all share the AAA credit rating with Germany, in 2002 their governments had to pay on average 16.8, 8.4, and 11.1 basis points more than Germany. Note, however, that relative to 2000 levels, spreads in most countries appear to have decreased further in 2001 and 2002.<sup>43</sup> It should also be noted that differences in liquidity between markets might account for a sizeable portion of the observed differences in bond yields.

A similar picture emerges from Chart 9, which plots the cross-sectional dispersion in yield spreads across countries<sup>44</sup>. Dispersions in monthly yields have fallen from an average of 1.98 in 1993 to 0.06 in 2002, or by more than 97 percent. The chart also shows that the yield on Greek government debt only converged once Greece joined the monetary union in January 2001. As was the case for spreads, dispersions decreased substantially as of 1998, but have stayed at roughly the same levels since then.

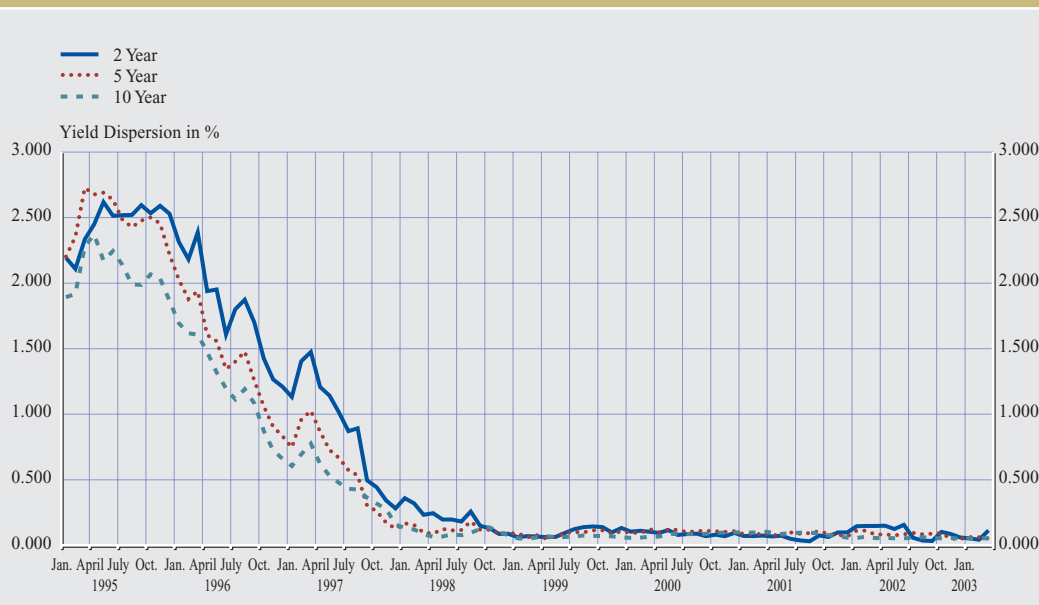
Until now, we have focused entirely on the 10-year maturity segment. In order to gauge the degree of integration in other maturity segments of the government bond market, we plot the cross-sectional dispersion in yield spreads for the 2-year, 5-year, and 10-year maturities in

<sup>43</sup> As pointed shown in ECB (2003e), changes in the perceived credit risk of individual countries – as captured by changes in relative debt-to-GDP ratios – may have been important in explaining yield spread movements during this period.

<sup>44</sup> Previous studies reported the cross-sectional dispersion in yields rather than in the spread relative to Germany. By using the yield spread, we hope to partly eliminate potential level effects, i.e. the empirical regularity that interest rate volatility tends to be positively related with the level of interest rates.



Chart 10 Dispersion in government bond yield spreads for 2-, 5-, and 10-year maturities



Source: ECB

Chart 10<sup>45</sup>. Overall, the cross-sectional dispersion for the 2- and 5-year maturities closely follows the pattern observed for the 10-year maturity bonds. Notice, however, that before 1998, the dispersion in 10-year government bond yield spreads was systematically lower compared to the other segments. While the degree of dispersion is comparably low for all maturities after the introduction of the single currency, no further decrease is observed after 1999.

### 5.2.3 NEWS-BASED MEASURES OF GOVERNMENT BOND MARKET INTEGRATION

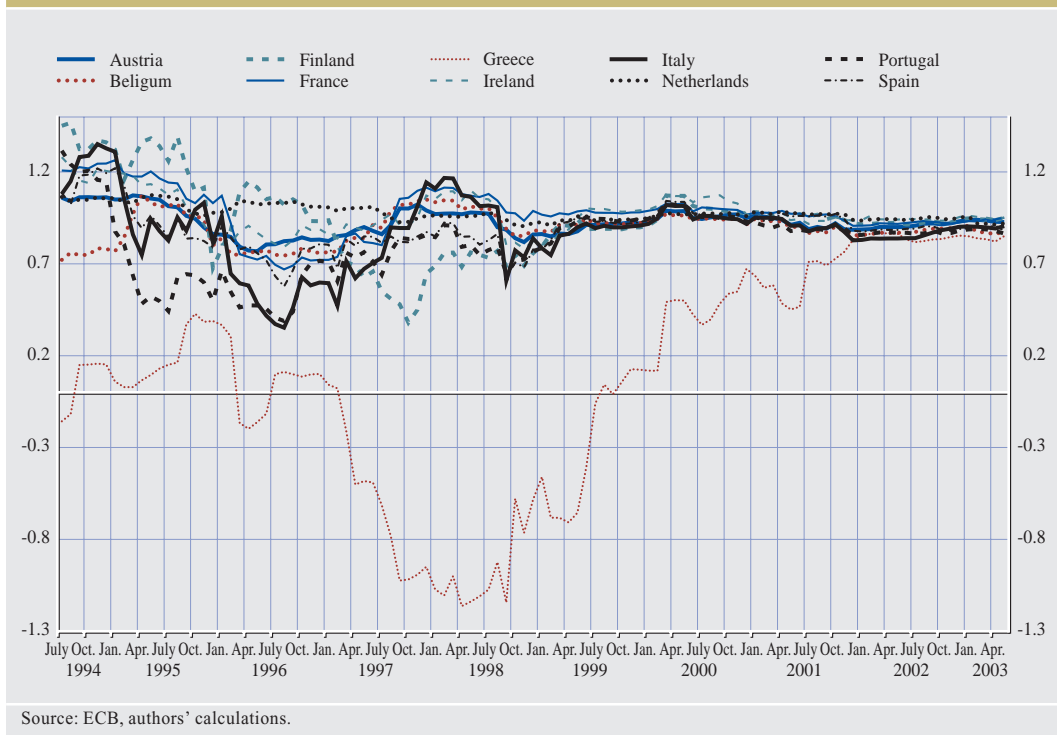
While most studies of government bond market integration have focused on yields, the following set of indicators investigates to what extent changes in local yields are driven by common rather than by local news. When markets are fully integrated, bond yields should react only to news common to all markets, since purely local risk factors can be diversified away by investing in bonds in different regions. Local news may affect bond yields, but only to the extent that it changes the perception market

participants have about the euro area economy as a whole. This, however, presupposes that the degree of systematic risk is identical across countries. Since credit risk is in fact not identical for all countries, and since differences in liquidity prevail in individual markets, we would not expect common factors to fully explain changes in local bond yields. In fact, local news, which investors perceive to be informative about credit or liquidity risk in individual countries, will have a systematic affect on local yields, even if markets are integrated. Moreover – and arguably more importantly – prior to 1999, differences in the currency of denomination in some cases implied substantial differences in systematic risk across countries.

As in the previous section, we first focus on government bonds with 10 years to maturity. Moreover, as the benchmark we use German 10-year government bonds, since we have argued that the information contained in this

<sup>45</sup> As a benchmark, we take the German yield for the 10-year maturity, and the yield on French Government bonds for the 2 and 5 year maturities. The results do not seem to be very sensitive to the choice of benchmark, though.

Chart 11 Evolution of conditional betas



segment of the market can be considered a good composite measure of all relevant common news in euro area bond markets.

As outlined in Chapter 3, we separate the effects of local and common news by estimating the following regression:

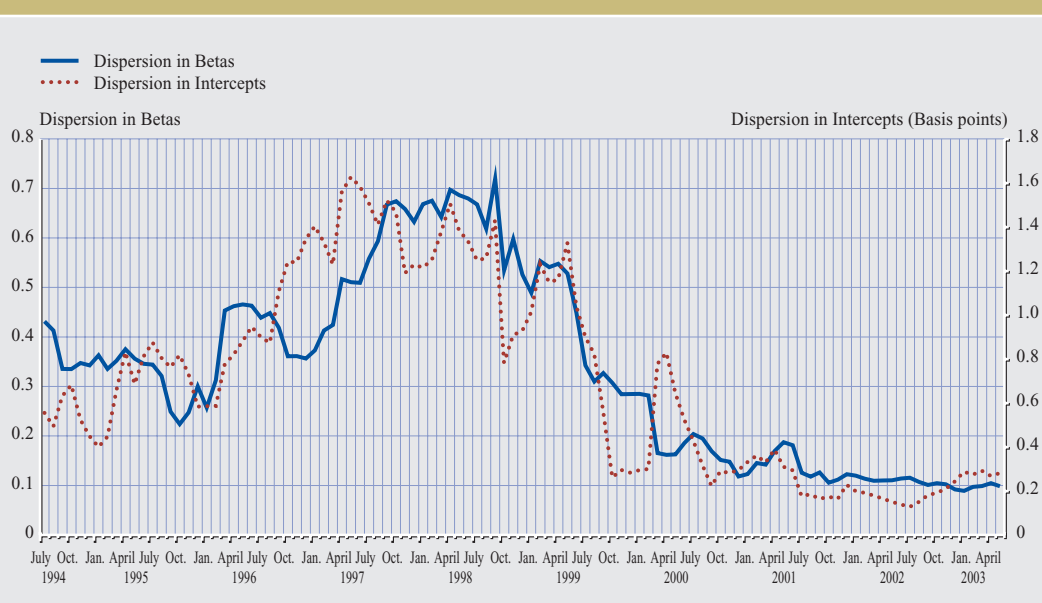
$$\Delta R_{i,t} = \alpha_{i,t} + \beta_{i,t} \Delta R_{ger,t} + \varepsilon_{i,t},$$

where  $\alpha_{i,t}$  is a time-varying intercept,  $\beta_{i,t}$  is the time dependent beta with respect to yield changes in the German benchmark bond, and  $\varepsilon_{i,t}$  is a country-specific shock. Because we are not only interested in the magnitude of the parameters, but also in their dynamics over time, we use a simple moving regression technique. Specifically, we start by estimating the parameters using the first 18 months of data. We then repeatedly move the data window one month ahead and re-estimate, until the last observation has been reached. By using this simple procedure, we obtain a time series for both  $\alpha_{i,t}$  and  $\beta_{i,t}$ .

In the methodological section, we argued that  $\beta_{i,t}$  should converge to one as the markets become more integrated. Chart 11 reports the evolution of the estimated beta coefficients through time. The betas varied substantially across countries up until around 1998, when they converged considerably. Again, Greece was an exception due to its later membership of the monetary union. To better understand the dynamics of the betas over time, it is instructive to look at the evolution of two components of the betas<sup>46</sup>. First, in all countries, the correlation of local yield changes with those in Germany gradually increased and reached levels close to one as of the beginning of 1999. This increase largely explains why the betas of countries that initially had relatively low betas (especially Italy, Greece, Portugal, Spain) gradually increased to levels close to one by 1999 (January 2002 for Greece). Second, we observe that while the level of yield volatility in many countries was

46 Charts of the two components are not reported to economise on space, but are available on request.

Chart 12 Average distance of intercept / beta from values implied by complete integration



Source: ECB, authors' calculations.

considerably higher than in Germany, yield volatilities have converged strongly since 1999. This suggests that local bond markets are considerably less affected by idiosyncratic local news than before (this effect of course also includes the elimination of exchange rate risk). This further contributes to the convergence of betas to values close to one<sup>47</sup>.

As an aggregate measure of government bond market integration, Chart 12 reports the average distance of the betas relative to one<sup>48</sup>, as well as

the average distance of the intercepts from zero. The average distance in cross-country betas has come down significantly, from more than 0.7 in 1997 to levels close to 0.1 as of the end of 2000. The cross-sectional dispersion in the intercept

47 Notice that after 1999, betas have stabilised at a level systematically *below* one. This is explained by the slightly higher volatility of yield changes in German 10-year government bond yields compared to other markets.

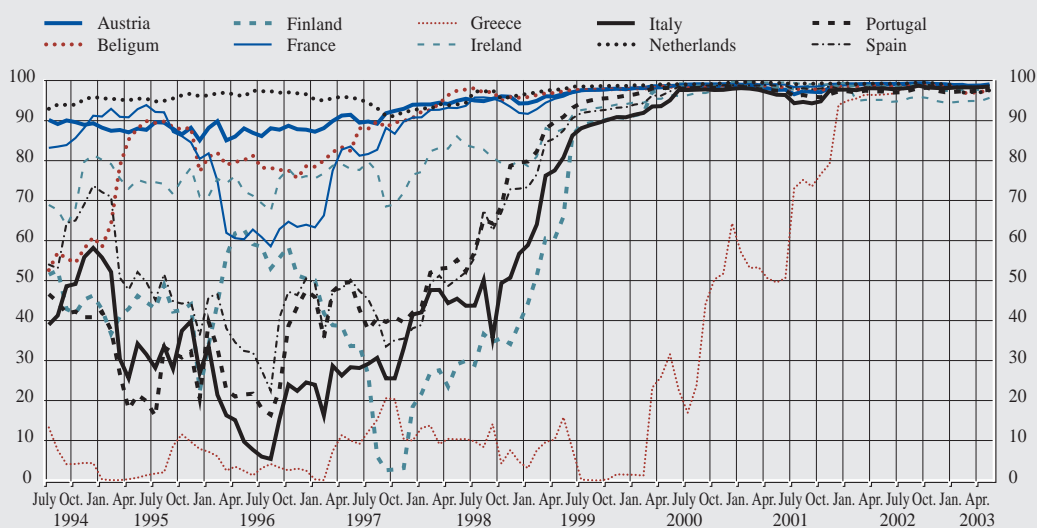
48 This measure is similar to the cross-sectional dispersion measure used elsewhere. The only difference is that here we impose the mean to be equal to one, the theoretical value under full integration (given identical risk characteristics across markets).

Table 3 Average proportion of local variance explained by German yield changes

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherland	Portugal	Spain
1995	87.7	82.1	41.4	89.6	3.7	75.2	35.3	95.5	27.5	50.8
1996	87.5	79.0	53.8	64.7	3.4	73.5	16.8	96.8	28.9	38.7
1997	90.6	85.9	24.7	81.2	10.6	75.7	28.1	93.9	42.6	42.2
1998	94.9	95.8	30.7	93.6	9.7	81.7	46.4	95.2	60.2	57.4
1999	96.8	97.3	75.7	96.1	4.8	89.5	81.8	98.1	91.3	87.8
2000	98.5	98.3	97.5	98.8	29.8	96.5	95.8	99.1	98.0	97.4
2001	97.8	98.4	98.5	98.9	65.5	99.4	96.4	99.3	97.1	98.4
2002	99.1	98.7	98.6	99.4	97.1	95.5	98.1	99.2	97.4	98.2
2003	98.8	97.4	97.9	98.9	98.4	95.0	98.3	97.5	97.4	98.3

Source: ECB, authors' calculations.

Chart 13 Variance ratio for 10-year euro area government bond yields



Source: ECB, authors' calculations.

has followed a similar pattern, and stayed consistently below a level of about 1.5 basis points.

As a final measure, we report the proportion of variance in local yield changes that is explained by changes in German 10-year government bond yields. Chart 13 plots the variance ratio through time, while Table 3 reports average variance ratios per country and year.

Until the end of 1997, common news, as reflected in changes in German bond yields, explained less than 50 percent of the total yield variance in Finland, Greece, Italy, Portugal, and Spain. While the variance ratios are considerably higher for the other countries, it is only in 1999 that levels close to 100 percent are reached (January 2002 for Greece). From 2000 onwards, typically less than 5 percent of yield changes remains unexplained by shocks in the benchmark bond market, suggesting a very high degree of integration in this segment of euro area bond markets.

In the previous section, we showed that the evolution of cross-sectional dispersion in government bond yield spreads is remarkably similar across various maturities. In Table 4, we report the proportion of variance of local yield changes explained by changes in the relevant benchmark bond, for the 2-, 5-, and 10-year maturity segments. As argued before, German bonds are the natural benchmark in the 10-year segment, whereas we choose French bonds for the 2-year and 5-year maturity segments.

As in the 10-year maturity segment, the proportion of local variance explained by the benchmark has increased considerably in the post-euro period for government bonds with 2 and 5 years to maturity. Notice, however, that variance proportions are typically lower in the 2- and 5-year segments than in the 10-year government bond market. This may in part reflect a lower level of liquidity, as well as the absence of well-developed derivatives markets in these maturity segments.

**Table 4 Average proportion of local variance explained by benchmark for 2-, 5-, 10-year maturities**

(in percentage)

	2-Year Maturity		5-Year Maturity		10-Year Maturity	
	95-98	99-03	95-98	99-03	95-98	99-03
Austria	60	83	61	92	90	98
Belgium	61	84	70	94	86	98
Finland	38	87	53	85	38	93
France	Benchmark		Benchmark		82	98
Germany	55	88	72	96	Benchmark	
Greece	NA	NA	NA	70	7	54
Ireland	NA	NA	58	83	77	95
Italy	23	81	46	91	32	94
Netherlands	59	93	72	91	95	99
Portugal	44	63	62	85	40	96
Spain	37	87	59	90	47	96

Source: ECB, authors' calculations.

### 5.3 SUMMARY

The measures of integration presented in this chapter indicate that, since the introduction of the euro, the degree of integration in the euro area government bond market has been very high. With the introduction of the single currency and a common monetary policy, government bond yields converged swiftly in all countries. Moreover, yields became increasingly driven by common news, and less by purely local risk factors.

However, the results also seem to indicate that additional integration of the government bond market may be possible. First, yields of government bonds with similar, or in many cases identical, credit risk and maturity have not entirely converged. Differences in liquidity as well as in the availability of developed derivatives markets tied to the various individual bond markets may partly account for these spreads. Second, while government bond yields are now mainly driven by common news, local factors continue to play a role. This is more the case in the 2- and 5-year maturity segments than in the market for 10-year government bonds. Insofar as bond yields in different countries also reflect differences in perceived credit risks, this could partly explain

why local news continues to play a role in the pricing of government bonds. Whether or not differences in credit risk and liquidity among individual countries account for the majority of these remaining yield differences, determines the extent to which there is still scope for increased integration in euro area government bond markets.

## 6 EURO AREA CORPORATE BOND MARKETS

The European corporate bond market is relatively young, certainly compared with the government bond market. However, in recent years the size of the market has grown rapidly and the market's structure has undergone some important changes. Before 1998, the market was dominated by debt issued by highly-rated financial corporations, whereas thereafter industrial corporations have increasingly found their way to the corporate bond market. Moreover, there has been a dramatic growth in the lower-rated A and BBB market segments since then.

Further development and integration of the euro area corporate bond market benefits both investors and issuers for several reasons. First, it broadens the base of assets investors can choose from, thereby facilitating the construction of portfolios with risk structures that fits investors' needs and expectations. Second, as integration in the corporate bond market progresses, companies will not only have access to a larger pool of investors, but they will also benefit from improved issuance conditions in general. In the absence of barriers to international investment, investors can better spread their risks. This reduces their risk premium and hence also the debt servicing costs corporations have to bear. In addition, further development and integration of the corporate bond market would make it easier for corporations to diversify their corporate financing and would reduce their dependence on domestic credit decision-makers (see e.g. Davis (2001)). This may be especially important in periods of corporate restructuring and strong demand for new funds. Third, as was suggested by e.g. Davis (2001), the existence of debt securities markets as an alternative to intermediated debt may also reduce the sensitivity of corporate financing both to business cycle downturns and to banking and securities market crises. Fourth, companies with large outstanding corporate debt are exposed to "market discipline". This gives corporations the incentive to increase shareholder value and improve information

disclosure and corporate governance, as this will allow them to reduce their cost of capital.

Further development and integration of euro area corporate bond markets may also affect the transmission of monetary policy. More specifically, a shift from intermediated to market financing would imply a reduced role for a bank-lending channel of monetary policy. The importance of this factor will depend on both the size (now still relatively small) of the market relative to the economy and monetary policy's effect on the term structure of corporate bond yields.

This chapter is structured as follows. First, we discuss the main developments in euro area corporate bond markets. Second, we discuss the measures of corporate bond market integration that were introduced in Chapter 3. The final section presents our conclusions.

### 6.1 MARKET DEVELOPMENTS

In this section, we discuss the main developments in the euro area corporate bond market. We do so by looking respectively at the supply and demand side of this market.

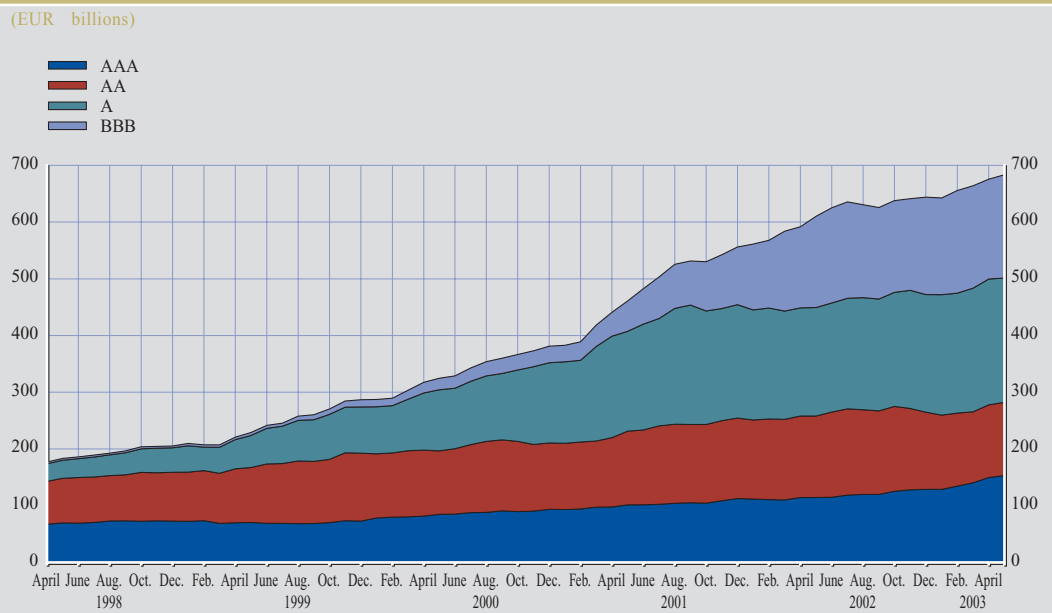
#### 6.1.1 SUPPLY SIDE

To illustrate the structural changes that have shaped the euro area corporate bond market over the last few years, we use information on all available bonds in the Merrill Lynch EMU corporate bond index over the period April 1998 – May 2003 (2,215 individual bonds). While this index does not cover the entire euro area corporate bond market, it constitutes a very good approximation of it<sup>49</sup>. More details about the dataset can be found in Appendix 1.

Chart 14 shows at each point in time the total outstanding value of all corporate bonds in our

<sup>49</sup> A similar dataset is used in a recent paper by Van Landschoot (2003).

Chart 14 Euro area corporate bond market: outstanding value per rating category



Source: Bloomberg and ECB calculations.  
 Note: The sample includes only bonds, constituting the Merrill Lynch corporate bond index.

sample, per rating category<sup>50</sup>. The total outstanding value has increased from about €180 billion at the beginning of 1998 to about €680 billion in April 2003, i.e. an increase of about 280%<sup>51</sup>. Looking at the separate rating categories, the substantial increase in the outstanding value of lower-rated bonds is noteworthy. The value of the A-rated segment increased from €30 billion in 1998 to €220 billion in 2003, or by more than 600%. Whereas the BBB-rated segment was almost non-existent in 1998 (about €3 billion), its total outstanding value in 2003 amounted to more than €182 billion. As a percentage of total outstanding value, the BBB segment increased from less than 2 percent in 1998 to about 27 percent in 2003.

The increase in the volume of lower-rated bonds is to a large extent explained by the increased participation of non-financial corporations. In 1998 financials constituted more than 85% of the total value of outstanding corporate bonds, compared to 7% and 6% respectively for industrials and utilities. By 2003, however, the

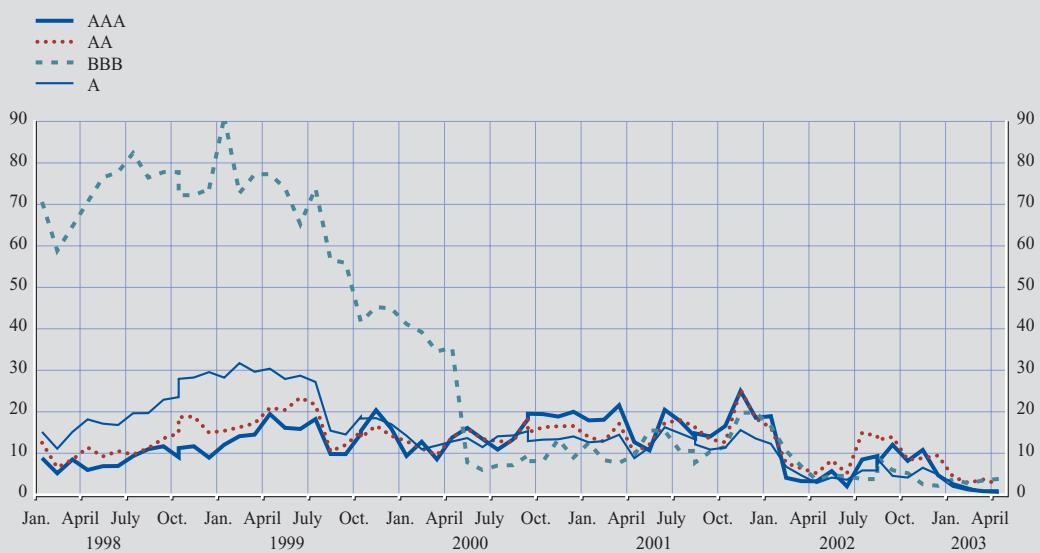
picture had changed markedly. While the share of utilities has remained more or less constant, the share of outstanding debt issued by industrials has increased to about 38%. This increase has come at the expense of the share of financials, which has decreased to 54%.

The increasing importance of lower-rated bonds, typically issued by industrials, is not only reflected in the rapid increase in their outstanding value, but also in the strong improvement in their overall liquidity. Chart 15 reports for each rating category a time series of the share of bonds that were not traded at least once within each 4-week time interval. Much like Van Landschoot (2003), we find that until the end of 1999 less than 30% of BBB rated bonds were traded at least once a week,

<sup>50</sup> More specifically, we distinguish between AAA, AA+, AA, AA-, A+, A, A-, and BBB rated bonds. Following Merrill Lynch, we use a composite measure of Moody's and Standard & Poor's ratings. We take into account changes in rating over time.

<sup>51</sup> The sample covers only investment-grade corporate bonds with a minimum size of issue of €100 million. The total amount outstanding of euro denominated corporate bonds reached €1,008 billion in April 2003.

Chart 15 Proportion of Corporate bonds not traded at least once a month



Source: Bloomberg and ECB calculations.

compared with about 90% for higher rated bonds. The liquidity situation for BBB-rated bonds improved dramatically in 2000 and since then has been comparable to the other rating categories. Finally, the indicator suggests that liquidity has improved further for all rating categories during 2002 and 2003.

There are a number of reasons for the increased issuance of corporate debt, especially by industrial organisations. First, the introduction of the euro removed the currency risk component in corporate bonds. This significantly increased the pool of funds corporations have access to in order to finance their projects without currency risk. Second, when the single currency was being introduced, Europe was going through a period of considerable corporate restructuring. Carnegie-Brown and King (2003), for instance, argue that the strong increase in corporate debt issuance in the euro area went hand in hand with increased M&A activity. Telecommunication companies' need to finance UMTS licences and some large Initial Public Offerings (IPO's) strengthened this effect. Third, more competition in the

European business sector led corporate managers to focus more on their financial structure and optimal financing leverage. This may partly explain why large corporations – often with a better credit rating than their bank – began exploring alternative ways of financing, such as through the corporate bond market.

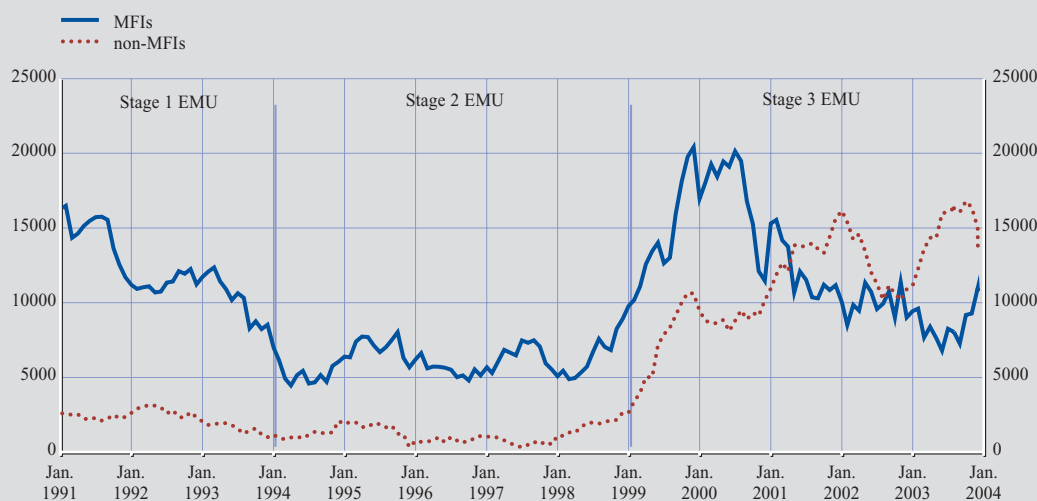
Some of the reasons for the strong growth in corporate debt issuance outlined above, such as the need to finance M&As, UMTS licences or IPOs, are of a temporary nature. Chart 16 shows, however, that while the net issuance of corporate debt by monetary and financial institutions (MFIs) soared after 2000, it has remained at sustained levels for non-MFIs. This suggests that the strong growth in the euro corporate bond market is not only a temporary phenomenon.

Finally, it is worth noting that the euro area corporate bond market is, despite its substantial growth, still considerably smaller those of the United States and Japan. According to 2001 figures reported in Hartmann et al. (2003), total bond financing by non-financial corporations



Chart 16 Net euro area issuance of corporate bonds, broken down by issuer

(EUR billions, 12-month moving average)



Source: ECB.

did not exceed 8% of GDP in the euro area, compared with 29% and 25% respectively for the United States and Japan.

### 6.1.2 DEMAND SIDE

The increased supply, diversity, and liquidity of corporate bonds have stimulated the demand for corporate bonds. However, other factors besides a more developed market have contributed to stronger interest in corporate bonds. First, with government bond yields reaching historically low levels, investors have increasingly been looking towards investment-grade corporate bonds as an alternative. This trend was amplified by the bear equity market, especially in 2001 and 2002. Nervous investors shifted their portfolio holdings to safer assets, such as corporate bonds. Second, because of reduced government bond debt in the late 1990s – related to the constraints imposed by Treaty and the Stability and Growth Pact – investors that were looking for long-term fixed income investments turned increasingly to corporate bonds. While this general trend of fiscal consolidation seems to have been interrupted, it contributed to the demand of corporate bonds in

the years immediately following the introduction of the euro. Third, the combination of an ageing population and large unfunded pension liabilities has greatly expanded the demand for long-term savings, including in the corporate bond market.

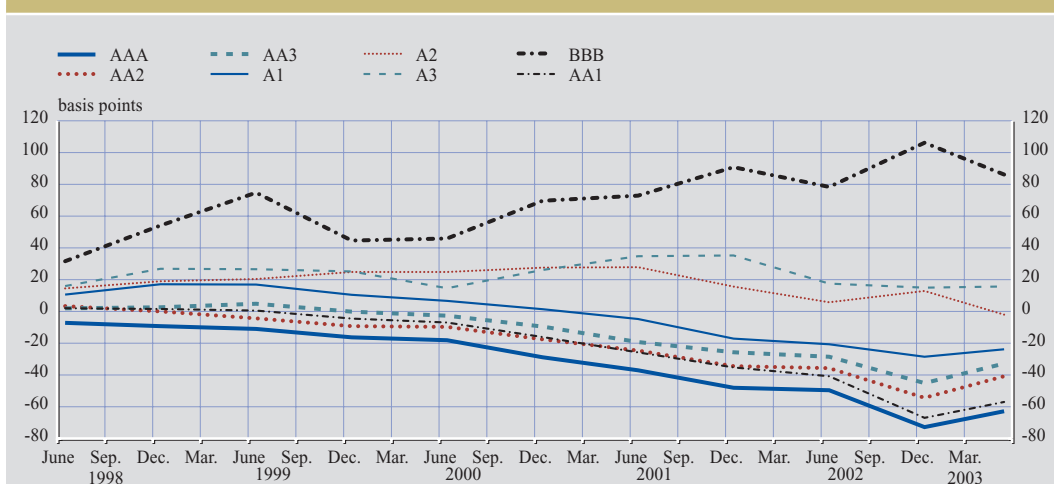
## 6.2 MEASURES OF INTEGRATION

### 6.2.1 PRICE-BASED MEASURES OF INTEGRATION

We study the degree of government bond market integration by analysing the differences between local and benchmark bond yields within a certain maturity class. Unfortunately, a direct comparison of corporate bond yields across countries does not serve as a good indicator of integration, as yield differences are likely to reflect factors such as differences in pervasive risk, rather than only a lack of integration.

The yield on a corporate bond typically depends on a number of factors, such as the bond's credit rating, time-to-maturity, liquidity and cash-flow structure. To correct for these factors, we

Chart 17 Estimated coefficients of rating dummies over time



Source: Bloomberg and ECB calculations.

estimate the cross-sectional regression outlined in Section 3.1.1. Specifically, we decompose the yield spread on a corporate bond relative to a benchmark government bond yield<sup>52</sup> into a component common to all and a part due to the corporate bond's coupon size, time-to-maturity, liquidity, sector, and credit quality (see Equation 3.2 in Section 3.1.1). Under full integration, the impact of these factors should be identical across all countries. We therefore impose that the parameters related to these factors are equal for all bonds, irrespective of the country of origin.

Given this correction, we can obtain measures of corporate bond market integration by investigating whether or not risk-adjusted yield spreads have a systematic country component. In a first step, we relate the risk-adjusted spreads to a number of country dummies. Under the hypothesis of full integration, the parameters related to the country dummies should not be statistically different from zero. As a measure of overall corporate bond market integration, we calculate at each point in time the average distance from zero of all country dummies. Second, much like we did with the variance ratios reported in other chapters, at each point in time, we report the proportion of total yield spread variance explained by country

effects. In a highly integrated market, this proportion should be close to zero.

Below, we first briefly discuss the adjustment of yield spreads for the systematic factors described above. We then go on to report the results obtained from the integration measures.

#### 6.2.1.1 COMMON RISK COMPONENTS

From our original sample of 2,215 bonds in the Merrill Lynch EMU corporate bond index, we eliminate certain bonds according to specific criteria before performing the empirical analysis. Given our focus on the euro area, we select only corporate bonds issued in one of the 12 euro area countries. Moreover, to obtain sensible estimates of country effects, we eliminate data from countries that do not have at least 10 bonds in the index over the full period. This leaves us with six countries (Austria, France, Germany, Ireland, The Netherlands, and Spain), and a total of 1,256 individual corporate bonds.

For each month, we estimate a cross-sectional regression relating corporate bond yield

<sup>52</sup> As explained in Chapter 3, we subtract from each corporate bond yield the zero-coupon yield on a German government bond with identical time to maturity.

spreads to a constant, the bond's coupon, liquidity and time-to-maturity, and a set of dummies proxying for respectively rating, sector and country. Chart 17 reports the dynamics of the estimated coefficients for the rating dummies over time, while Table 5 reports the average size and significance level of the various parameters. The values for the rating effects are nearly all statistically significant and in line with expectations. Relative to the intercept, which represents the yield on an equally weighted portfolio of all corporate bonds, highly rated bonds have a lower credit spread, as reflected by the negative coefficients for AAA, AA, and A+ rated bonds. Conversely, coefficients for bonds with lower ratings are positive, reflecting higher spreads for A, A- and BBB-rated bonds. As can be seen in Chart 17, the rating coefficients for the higher rated bonds gradually decrease over time. This reflects the surge in A and BBB rated bonds after 1999, which increases the risk profile of the average bond in the sample.

The intercept represents the yield on an equally weighted euro area corporate bond portfolio. The results (not reported here) indicate that the intercept gradually increases over time, reflecting, on the one hand, the increasing proportion of lower-rated bonds and, on the other hand, the gradual deterioration of economic conditions after 2000. The parameters related to the coupon and the time-to-maturity are statistically significant, but small in

economic terms. The positive sign of the time-to-maturity effect is in line with the observed upward-sloping term-structure of corporate bond spreads. The liquidity effect is statistically significant and has the expected negative sign, reflecting a lower spread for more liquid bonds. The estimates for the sector effect are small and not statistically significant, but the average size of the coefficient confirms the stylised fact that bonds of financial companies have on average lower spreads than non-financials.

To get an understanding of the relative importance of the various factors, in Chart 18 we show the proportion of cross-sectional variance explained by the various components over time. On average, the factors explain about 33 percent of the cross-sectional variance, which is of similar magnitude as in other studies (see e.g. Varotto, 2003). The bulk of the total variance explained can be attributed to the rating effect, which on average explains 25 percent of the total variance. The common, coupon, maturity, liquidity and sector effects explain the remaining 8 percent.

#### 6.2.1.2 COUNTRY-SPECIFIC RISK COMPONENTS

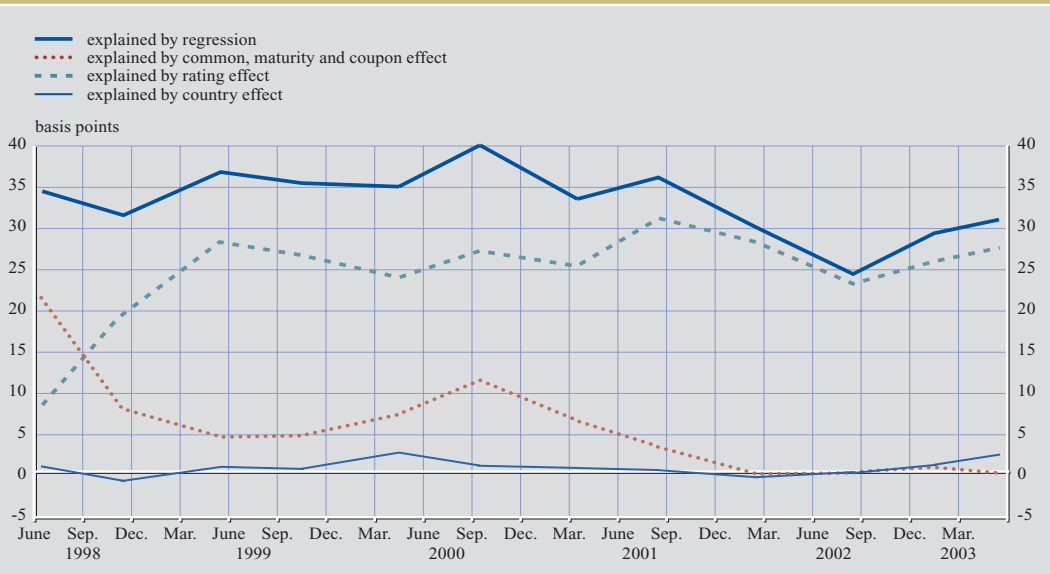
The results in the previous section suggest that our model performs reasonably well in explaining the cross-section of corporate bond yields. In what follows, we examine the integration of this market by investigating whether corporate bond yields, once corrected for risk, contain a country-specific component.

**Table 5 Average parameter estimates for cross-sectional regression**

(with <i>p</i> -values)						
Rating effect			Country effect			
AAA	-33.79	0.00	Austria	2.21	0.00	
AA1	-23.09	0.00	Germany	-1.54	0.06	
AA2	-21.74	0.00	Spain	3.86	0.00	
AA3	-14.66	0.00	France	-7.64	0.00	
A1	-2.55	0.21	Ireland	5.78	0.00	
A2	17.94	0.00	Netherlands	-0.57	0.01	
A3	24.10	0.00				
BBB	69.46	0.00				
			<b>Common effect</b>	86.52	0.00	
<b>Sector effect</b>			<b>Maturity effect</b>	1.88	0.00	
Financial	-0.27	0.19	<b>Coupon effect</b>	4.17	0.00	
Non-financial	0.31	0.38	<b>Liquidity effect</b>	-66.19	0.00	

Source: Bloomberg and ECB calculations.

**Chart 18 Proportion of cross-sectional variance explained by various factors**

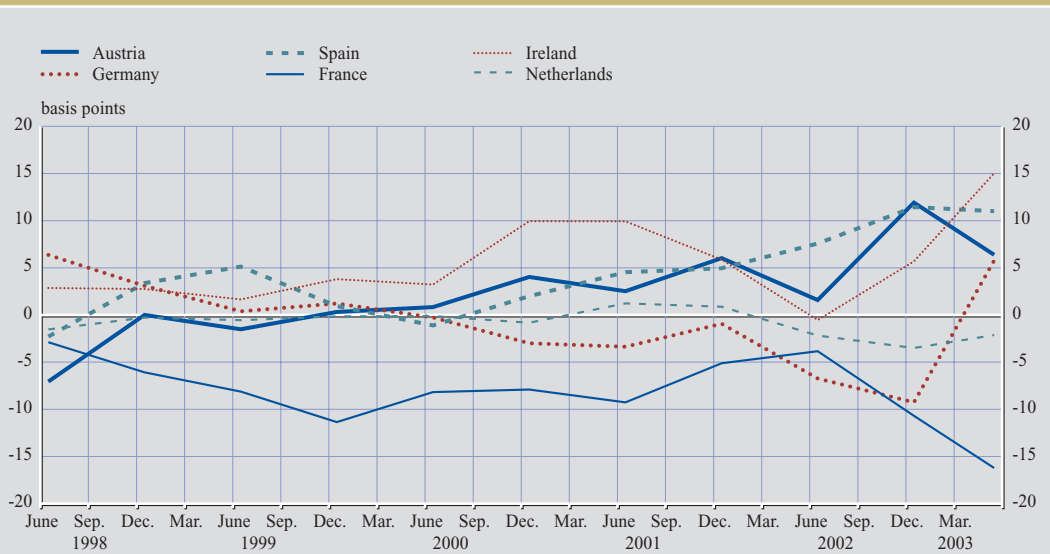


Source: Bloomberg and ECB calculations.

Chart 19 plots the size of the various country dummies over time, while Table 5 reports the average size and significance level of the country dummies. In every case except

Germany, the parameter related to the country dummy is statistically significant at the 5% level, but the country-specific spread is relatively small in economic terms. Spanish,

**Chart 6.6 Coefficients of country dummies**



Source: Bloomberg and ECB calculations.

Chart 20 Cross-sectional dispersion in country parameters



Source: Bloomberg and ECB calculations.

Irish and Austrian corporations pay respective country premia of about 4, 6 and 2 basis points, while French corporations get a premium of about 8 basis points less. The premium is close to zero for Germany and the Netherlands. These country premia are only slightly higher than for the government bond market and moreover not statistically significant for Germany<sup>53</sup>. Therefore, these results indicate that the corporate bond market is reasonably well integrated.

However, though relatively small, the country effects on spreads are not zero. To analyse whether they gradually converge to zero, in Chart 20 we calculate their average distance from zero over time. Dispersions are very small, typically lower than 15 basis points. However, instead of decreasing over time, the opposite seems to have occurred. Whereas until the middle of 2001 the cross-sectional dispersion amounted to less than 10 basis points, it gradually increases to about 15 basis points thereafter. This is mainly explained by a decrease of France's country premium (and an increase for Ireland, Spain and Austria) relative to the other markets.

Another way of investigating the importance of country effects in explaining the cross-section of corporate bond yield spreads is to examine the proportion of variance explained by the country dummies. Chart 18 not only reports the proportion of variance explained by the common, coupon, maturity, liquidity, sector and rating effects, but also shows the relative contribution of the country dummies. Country effects explain a very small proportion of the cross-sectional variance of corporate bond yield spreads, typically no more than 2 percent. This confirms the previous result that country effects are small.

### 6.2.2 QUANTITY-BASED MEASURES OF INTEGRATION

Further information on the dynamics of bond market integration can be gained from data on international portfolio compositions of institutional investors. As the data do not permit us to investigate government and corporate bond holdings separately, we treat them jointly.

<sup>53</sup> We should take in account that we constructed our spreads with respect to German government bond yield. Another approach would be to use government bond yields of each corresponding country.

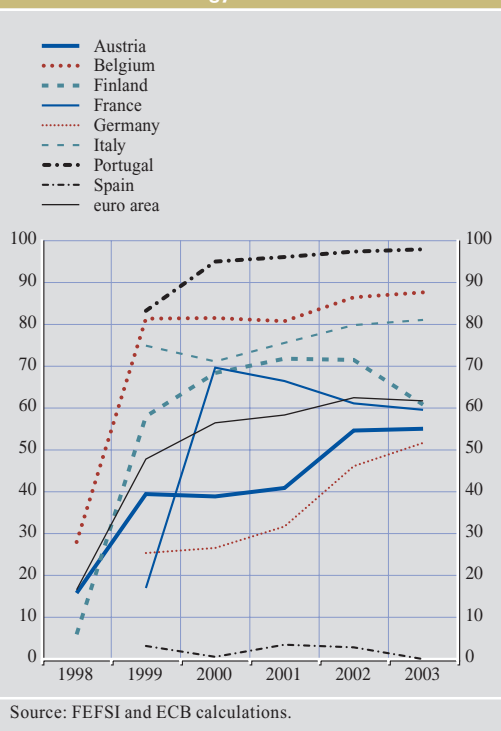
A priori, it would seem reasonable to expect an increase in the share of non-domestic bond holdings in recent years. A number of reasons for this presumption have been mentioned earlier in this chapter and in the previous one, including the elimination of exchange rate risk and of intra-area currency matching rules, as well as the emergence of electronic quote-driven markets, which have facilitated cross-border activity and improved liquidity. In addition to these factors, the demand side of the international corporate bond market has been boosted as a result of the market's rapid development and the low yields on government bonds in recent years.

While the convergence in bond yields since the late 1990s has reduced the diversification potential of euro area bond portfolios, there are other factors that may induce investors to increase the international component of their portfolios. First, in their quest for liquidity, investors no longer have to restrict themselves to the local market. They can now select the most liquid bonds in the entire euro area without facing exchange rate risk. Second, trying to offer as much liquidity as possible, issuers have increasingly specialised in particular (maturity) segments of the market. As a consequence, investors purchase bonds in different countries, depending on what segment of the market they want to invest in.

In order to investigate the home bias in euro area bond markets, we follow Adam et al. (2002) and examine the share of assets invested in bond funds with a Europe-wide investment strategy (updated to include 2001, 2002 and 2003). The data, which is provided for by the Fédération Européenne des Fonds et Société d'Investissement, distinguishes between funds that invest domestically, Europe-wide, and globally. This breakdown is, however, only available from 1998 onwards, so our sample is rather short.

Chart 21 shows the proportion of assets invested in bond market funds with a European-wide investment strategy for 8 euro area

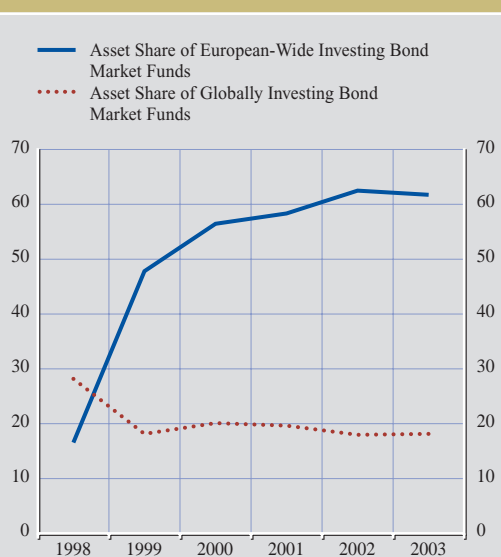
**Chart 21** Proportion of assets invested in bond market funds with a Europe-wide investment strategy



countries, together with an unweighted average across these countries. The chart clearly displays a general upward trend in the relative size of Europe-wide bond investment funds, including a particularly pronounced increase coinciding with the introduction of the euro. Overall, while the average market share amounted to only 17 percent in 1998, it had increased to about 60 percent by 2002. Over this period, the share of European-wide managed bond funds increased in all countries but Spain. As argued by Adam et al. (2002), the suspiciously low market share of Spanish Europe-wide funds is likely to be due to a misclassification rather than to a lack of integration.

One may wonder whether the increasing share of funds with a Europe-wide investment strategy is not part of a general trend towards more global diversification, rather than the result of increasing European bond market integration. To analyse this, in Chart 22, we

**Chart 22 Average share of bond funds with European or global investment strategies**



Source: FEFSI and ECB calculations.

compare the average share of bond funds with respectively European or global investment strategies. Throughout the last six years, the share of bond funds with a global bond allocation strategy has remained more or less constant at around 20 percent, while the share of Europe-wide bond funds has increased dramatically. This indicates that the reduction in the home bias in bond portfolios was restricted to the euro area only, suggesting that bond market integration has increased to a much greater extent between the various euro area markets than between world bond markets. Hence, our results suggest that while the country home bias largely has been eliminated, it may instead have been replaced with a “euro area home bias”.

### 6.3 SUMMARY

Overall, the analysis of price-based integration measures suggests that the level and evolution of corporate bond yield spreads in the euro area is to a large extent determined by credit rating, and to a lesser extent by the common, coupon, maturity, liquidity and sector factors.

Furthermore, the results show that – once corrected for pervasive risk – the country where a bond is issued has only marginal explanatory power for the cross-section of corporate bond yield spreads. This suggests that the corporate bond markets of the countries we analysed, i.e. Austria, France, Germany, Ireland, the Netherlands, and Spain, are reasonably integrated with each other. Quantitative indicators tend to support this conclusion. Specifically, throughout the last five years, the share of European-wide bond funds has increased dramatically, indicating a reduction in the home bias of bond portfolios in the euro area.

## 7 EURO AREA BANK CREDIT MARKETS

Banks are crucial to the transmission of monetary policy impulses to the economy since they are the counterparties for central bank monetary policy operations and since they grant credit to households and firms, *inter alia*, on the basis of credit received from the central bank. Additionally, despite recent developments in the intermediation process, banks are still the most important type of intermediary in the euro area. Indeed, the existence of structural asymmetries in euro area banking systems has often been seen as a primary source of monetary policy transmission asymmetries.

In this chapter we focus mainly on the retail banking market, where integration has clearly been slower than in other banking activities. Evidence presented by e.g. Cabral et al. (2002) shows that the degree of integration in the retail banking system was quite limited at the beginning of the nineties, but that it increased slightly just before the introduction of the single currency in 1999. However, in contrast to some of the other markets considered in this paper, the introduction of the single currency does not seem to have represented a clear watershed.

This notwithstanding, strong efforts towards liberalisation and integration were made on the regulatory side. These efforts started well before the nineties with the introduction of the First (1977) and Second (1988) Banking Directives and continued with the publication of the Financial Services Action Plan (FSAP) in 1999. As regards retail financial services, one of the FSAP's stated strategic objectives was the creation of open and secure retail markets. In this respect, the FSAP proposed nine specific measures aimed at eliminating price differentials across the EU and enhancing consumer protection. Since then, most of those measures have been adopted.

In this respect, integration in the euro area banking markets may be considered quite advanced from a legal perspective. That means that there are other types of barriers to

integration that have remained in place. Non-regulatory barriers to integration continue to exist and are, for instance, due to cultural differences in consumer behaviours or preferences for different types of credit. In this context, we need to be able to measure market integration accurately in order to better understand the integration process and help identify any remaining obstacles.

The remainder of this chapter is structured as follows. First, we briefly discuss the main developments in euro area banking markets. Second, we discuss the measures of credit market integration that were introduced in Chapter 3. The final section presents our conclusions.

### 7.1 MARKET DEVELOPMENTS

Retail business activities, which are normally considered as part of traditional banking activities, still take up a large part of the aggregated bank balance sheet<sup>54</sup>. At the end of 2001, loans amounted to 54% of total MFI assets, and deposits amounted to 44% of total MFI liabilities. These shares were basically unchanged by the end of 2003. Moreover, the amounts outstanding of loans to euro area non-financial corporations were six times as large as debt securities issued by companies. Furthermore, traditional deposits are still substantially larger than money market mutual funds (at the end of 2003, they were 16 times bigger).

From a structural point of view, there is no doubt that the European banking sector has undergone a consolidation process in recent times. At the end of 2001 there were 8,849 MFIs (excluding central banks) in the euro area. By end-2003 this number had declined to 8,247. This figure reflects the presence of a large number of savings and co-operative banks – often operating only at a local level – and

<sup>54</sup> A more extensive description of market developments in the euro area retail banking market can be found in Cabral et al. (2002).



**Table 6 Number of euro area Monetary Financial Institutions**

(end of year)

	1999	2000	2001	2002	2003
Credit institutions	7,897	7,521	7,218	6,906	6,593
Money market funds	1,525	1,651	1,631	1,620	1,654
Central banks and other institutions	20	21	19	18	22
All MFIs	9,442	9,193	8,868	8,544	8,269

Source: ECB.

specialised credit institutions in several countries. The number of MFIs has been declining steadily in the last five years: compared with 1999, there are nearly 1,200 fewer MFIs, representing a 12%-decline in the past five years (Table 6).

The trend towards consolidation in the credit institution sector is a response to changing market conditions, driven by a number of factors, such as technological developments, deregulation, liberalisation and globalisation. The introduction of the euro has probably been fuelling these developments by creating more transparency across national borders. Although the consolidation process has mainly taken place in the form of mergers between (primarily) smaller credit institutions within national boundaries, it has been noted that most of the M&A activity in the euro area has taken place in countries where bank concentration is lowest. This would suggest that the initial asymmetries in banking concentration, while still high, are diminishing (Angeloni and Ehrmann, 2003).

## 7.2 MEASURES OF INTEGRATION

This section is structured as follows. First, we give a brief discussion of the available literature on banking market integration in the euro area. In the second part, we discuss measures of integration based on interest rate differentials. Third, we investigate whether the proportion of the variance of interest rates explained by common factors has increased in the nineties. Finally, we provide some evidence on recent

developments in cross-border flows in the euro area.

### 7.2.1 RELATED LITERATURE

For two main reasons, there are few studies that directly investigate the degree of integration in the euro area banking market before and after 1999. One reason is clearly the limited availability of data. The second reason has to do with the intrinsic characteristics of retail banking. Differences across products and the financial institutions that offer those products may make it difficult to verify the law of one price, and thereby complicate an assessment of the degree of integration using price-based measures. Generally speaking, under the law of one price, we expect that as the degree of financial integration increases, the price differentials among different countries will decrease. Since retail banking is still a rather localised phenomenon, retail interest rates in different countries may not be strictly comparable if the underlying characteristics of credits are different.<sup>55</sup> Taking into account this caveat, it is nevertheless useful to look at price-based indicators of integration, such as interest rate spreads, and to analyse their development over time. It is also useful to look at quantity-based indicators, such as cross-border investments, as additional indicators of integration.

<sup>55</sup> For instance, in the chapter on corporate bond market integration, we try to control for the intrinsic heterogeneity in the identity of borrowers and in the quality of credit in order to investigate whether yields, once corrected for differences in systematic risk, still depend upon the country the bond was issued in. This is, of course, not possible with data on average bank interest rates.

As for price-based indicators, Cabral et al. (2002) report average monthly retail interest rates and banks' margins between 1998-1999 and 2001-2002 and find a general decline in deposits and lending rates from the first to the second period. However, the reduction in the standard deviation of banks' margins across countries was much lower. This suggests, first, that markets are still segmented across countries and, second, that the convergence of retail interest rates could be mainly a consequence of the convergence of monetary policy. This seems to be more true for household lending margins than for corporate lending and deposit margins. Kleimeier and Sander (2002) assess the existence of a uniform euro area retail banking system through the existence of co-movement in interest rates among national credit markets in Europe. In their view, the concept of integration requires that interest rates exhibit a certain long-run equilibrium relationship, though deviations are possible in the short run. Starting their analysis in the mid-nineties, they found limited evidence of integration (that is, of cointegration) before 1999 and some signs of structural changes after the introduction of the single currency. As for the specific segments of the retail banking markets, they found increased integration (that is, stronger long-run equilibrium relationships) in corporate lending markets and less in consumer and mortgage lending markets. In a more recent paper on the euro area transmission mechanism, Angeloni and Ehrmann (2003) investigate whether there are signs of increasing integration and competition across countries in the retail banking sector. Such a scenario would suggest that the monetary transmission mechanism has become more homogeneous after 1999. In their analysis they find partial but significant progress towards integration when considering monetary transmission via the banking sector<sup>56</sup>. However, when they consider the "interest-rate channel", the convergence in (real) retail interest rates seems to have taken place largely before 1999.

The pricing behaviour of banks depends on the degree of competition and contestability in the different markets. A study by Corvoisier and Gropp (2001) showed that the increase in bank concentration stemming from the recent wave of bank mergers may have resulted in less competitive loan pricing by banks in the euro area during the years 1993-1999. Indirectly, this result may be seen as a symptom of the lack of integration within the different euro area markets. Evidence that the introduction of the euro has additionally affected bank pricing through the evolution of competitive forces in a large number of national retail markets can be found in De Bondt et al. (2002b). This happened, for instance, with the development of internet banking in the time deposit and mortgage markets.

Most of the studies reviewed above attempt to explain the reasons why retail banking markets appear to be more segmented than wholesale markets. The main reasons seem to be the following: retail lending products are less exposed to international competition pressures as proximity to customers is quite important and, for deposit taking, the focus is mainly domestic. Asymmetric information and the existence of switching costs are additional reasons for less competitive and integrated retail banking markets.

### 7.2.2 PRICE-BASED MEASURES OF BANKING INTEGRATION

For our analysis we use two different set of interest rates. A first set is based on interest rates, which were regularly published on the ECB website and which were available for different lending and deposits rates at the country level since the beginning of the nineties. These rates mainly refer to interest rates that banks charge on loans to, and pay on

<sup>56</sup> This is measured by the decline of the coefficient of variation of the impact and peak parameters across the euro area countries when calculating the reaction of retail bank interest rates to money market rates.

deposits from, personal customers (irrespective of the size of the customer).<sup>57</sup> A general caveat concerning the use of the data regards the comparison of levels of bank interest rates across countries, since the national interest rates are not completely harmonised. However, these are the only available interest rate series that go back to the beginning of the nineties for the time being. For this reason we use this first set of bank interest rates for an historical perspective – from the beginning of the nineties until the first quarter of 2003 – while for 2003 we use a second set of bank interest rates, which were recently released by the ECB (MIR statistics). Since December 2003, the MIR statistics have replaced the first set of bank interest rates used in this chapter. These new statistics are produced on the basis of harmonised national definitions. Consequently, cross-country comparisons of the levels of bank interest rates, such as those made in this chapter, are no longer affected by national statistical differences. At the moment, however, the new statistics start only in January 2003 and therefore cannot be used for historical analyses.<sup>58</sup>

To summarise, the first set of data on bank interest rates (“historical data”) will be used in the following sections (sections 7.2.2 and 7.2.3) to analyse in particular the convergence of bank interest rates in the euro area from the beginning of the nineties and to test whether the speed of convergence has increased after the introduction of the single currency. Development during 2003 and early 2004 will be analysed in more detailed in section 7.2.4 using the second set of statistics (MIR rates).

### 7.2.2.1 CROSS-SECTIONAL DISPERSION

As argued in the previous chapters, a rather simple indicator of financial integration is based on the cross-sectional dispersion of interest rates across countries. Under the hypothesis that financial integration should make the returns of comparable but not completely homogenous financial assets more similar, dispersion should decrease as integration across markets increases. Charts

23a-b plot the cross-sectional standard deviation since the beginning of the nineties, excluding Greece from the calculations. For our analysis, we distinguish between four lending rates (short-term and medium- and long-term loans to enterprises, and loans to households for consumer loans and mortgage loans) and one deposit rate (time deposit rates).

We distinguish between 3 sub-periods. The first period, 1990-1994, spans from the removal of short-term capital controls to the ERM crisis of 1992-93 and its aftermath. Interest rates were quite volatile during this period, as shown by the high dispersion of rates, which peaks around 92-93. This is particularly evident for lending rates to enterprises, for which the dispersion peaked at the end of 1992 due to high rate increases in Italy, Ireland and Spain for short-term lending and in Finland and Ireland for medium- and long-term lending. For lending to consumers, the high variability in the dispersion at the beginning of the nineties is mainly due to sudden changes in Irish and Spanish rates.

The second period, 1995-1998, covers a time when interest differentials were strongly affected by the so-called “convergence trades” in the financial markets, driven by expectations of EMU. The process induced a general convergence in interest rate levels during this period. Indeed, after peaking in late 1995/early 1996, the dispersion decreased substantially

<sup>57</sup> Consumer loans and mortgage loans to households are available for Belgium, Germany, Greece, Ireland, Spain, France, Austria, Portugal, Finland and the Netherlands. The series on mortgage loans also include Italy. With regards to corporate lending rates, we use the series short-term loans, which are available for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. Data for medium and long-term loans are available for Belgium, Germany, Greece, Spain, France, Ireland, Italy and Finland. For France the series are available only quarterly. In this case, the monthly data are just the corresponding quarterly value. For deposits, we use the series on time deposits for Belgium, Germany, Greece, Spain, France, Ireland, Italy, the Netherlands, Austria, Portugal and Finland. For more information on the dataset, see [http://webint.ecb.de/stats/nrir/rir\\_nrir.pdf](http://webint.ecb.de/stats/nrir/rir_nrir.pdf).

<sup>58</sup> For more information on the MIR statistics, see “New ECB statistics on MFI interest rates”, ECB Monthly Bulletin of December 2003, pp. 23-25.

until 1998<sup>59</sup>. Again, in the case of consumer loans the high level of dispersion is due to the persistence of high interest rates in Spain and Portugal, while rate differentials in the other euro area countries were diminishing at the same time. Similarly, Spanish rates highly influenced the dispersion of medium- and long-term term rates.

The third period, 1999-onwards, coincides with the first years of Stage Three of the EMU. With the removal of exchange rate risk within the euro area, we can expect the cross-sectional dispersion measure to be informative with respect to the degree of integration in this market segment during this period. In this last period, the dispersion seems to have decreased for medium- and long-term loans to enterprises and for mortgage loans, while remaining at roughly the same level or even increasing in the case of short-term loans to enterprises and loans for consumer credit.

#### 7.2.2.2 BETA CONVERGENCE

As explained in Chapter 3, the so-called beta convergence measure signals the speed at which convergence to a specific benchmark is taking place. Similar to Adam et al. (2002), we choose as our benchmark the bank interest rates in Germany. Thus, the panel regression<sup>60</sup>

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t} + \sum_{l=1}^L \gamma_l \Delta R_{i,t-l} + \varepsilon_{i,t} \quad (7.1)$$

is estimated using as dependent variable the change in the spread of the relevant interest rate in one country relative to the corresponding German rate. A negative  $\beta$  coefficient signals that convergence is taking place.

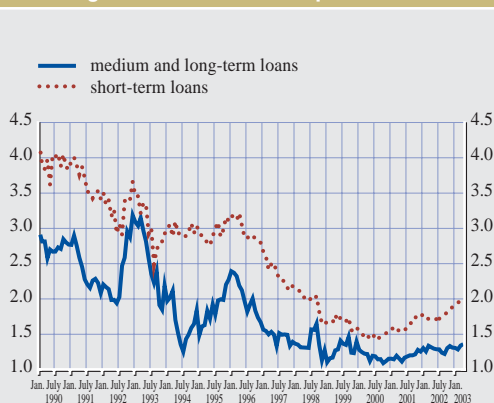
The (unbalanced) panel regression has been run with the four different lending interest rates and with the time deposit interest rate mentioned above, for the period January 1990 to April 2003. Due to a lack of data, the estimation period for some countries starts in 1995. Table 7 reports the values of the beta coefficients of a panel regression using fixed effects in the two subperiods before and after 1999. The third column reports whether the two coefficients before and after 1999 are statistically different from each other.

In all cases, the slope coefficient is negative, indicating convergence. However, if we split the sample, taking into consideration the pre- and post-EMU periods, we find that the speed of convergence increased for only two of the lending rates, namely interest rates for medium-

<sup>59</sup> This peak is in part explained by the fact that data for some countries are available only from 1995.

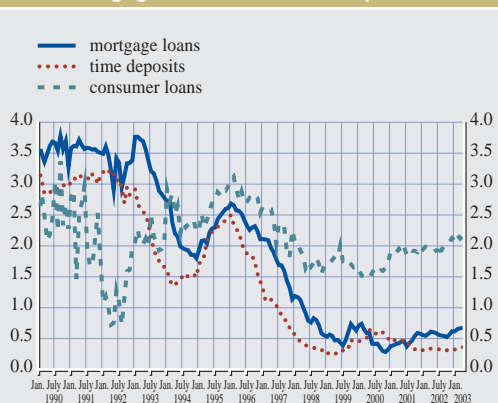
<sup>60</sup> This is equation 3.1 in Chapter 3.

**Chart 23a** Cross-sectional standard deviation of interest rates on short-term and medium- and long-term loans to enterprises



Source: ECB.

**Chart 23b** Cross-sectional standard deviation of interest rates on consumer and mortgage loans and time deposits



Source: ECB.

**Table 7 Beta convergence pre and post 1999 in selected euro area countries**

	$\beta$ pre 1999	$\beta$ post 1999	Statistically different?	Countries in the sample	N. of obs
<b>Lending rates</b>					
Short-term loans to enterprises	-0.022*	-0.013*	No	BE, ES, FR, IE, IT, NL, AT, PT, FI	1,359
Medium- and long-term loans to enterprises	-0.073*	-0.082*	No	BE, ES, FR, IE, IT, FI	456
Consumer loans to households	-0.029*	-0.017	No	BE, ES, FR, IE, NL, AT, PT, FI	1,077
Mortgage loans to households	-0.009*	-0.072*	Yes*	BE, ES, FR, IE, IT, NL, AT, PT, FI	1,299
<b>Deposit rates</b>					
Time deposits	-0.016*	-0.037*	No	BE, ES, FR, IE, IT, NL, AT, PT, FI	1,128

Notes: The dependent variable in the first row is the change of the spread of short-term lending rates, in the second of medium- and long-term lending rates, in the third of consumer credit rates, and in the fourth of mortgage rates. The specification includes a set of country dummies, one lag of the level and two lags of the dependent variable. The starred coefficient estimates are significant at the 10% level. The test for different convergence speeds is based on F-statistics.

and long-term loans to enterprises and for mortgage loans. Furthermore, the increase was only statistically significant in the case of interest rates for mortgage loans. It is interesting to note that Kleimeier and Sander (2002) found no evidence of any long-term equilibrium relationship for the latter rates, suggesting that, from the point of view of an individual borrower, there still exist unexploited arbitrage possibilities and, as such, further potential for market integration.<sup>61</sup>

### 7.2.2.3 MARGINS

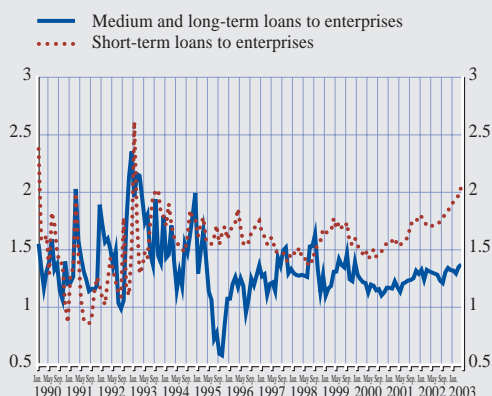
Bank interest rate levels reflect both macro and microeconomic factors. The macro factors refer to market interest rate levels while the micro factors relate more to banks' pricing behaviour and market power. As seen in Cabral et al (2002), a way to disentangle the impact of the two sets of factors is to calculate the spreads between bank interest rates and comparable market rates, which could be seen as a proxy for the banks' funding cost of loans and the opportunity costs of deposits. Convergence of these margins over time could be seen as signalling greater integration, while a decline in the level can be interpreted as a sign of increased competition. In the analysis that follows we have used as market rates the 10-

year government bond yields for medium to long term interest rates and the 3-month money market rate for the short term interest rates.

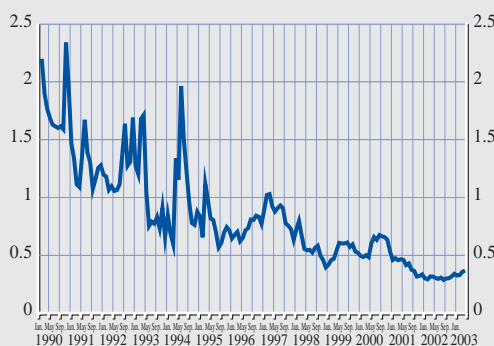
A way to assess the development of margins is to plot the cross-sectional standard deviation of margins over time. Charts 24a-c show high variability of the dispersion of margins at the beginning of the nineties and a stabilisation in the second half for lending rates to enterprises, although with an increasing trend for short-term loans. The same pattern is visible for consumer credit rates, while margins on mortgage rates have strongly converged since the second half of the nineties.

In the case of loans to enterprises, evidence of convergence seems to be less strong for short-maturity loans than for loans with longer maturity. Other studies have shown that, typically, the pass-through is incomplete, and its speed of adjustment is much slower for short-term loans than for long-term rates (see De Bondt, 2002a for euro area results and De Bondt et al (2002b) for country-level results).

<sup>61</sup> It should be noted that the usual caveat on the lack of harmonisation of the bank interest rates used in their analysis should be applied in the interpretation of their results.

**Chart 24a: Cross sectional standard deviations of banks' margins for lending to enterprises**

Source: ECB.

**Chart 24c: Cross sectional standard deviations of banks' margins for time deposits**

Source: ECB.

**Chart 24b: Cross sectional standard deviations of banks' margins for lending to households**

Source: ECB.

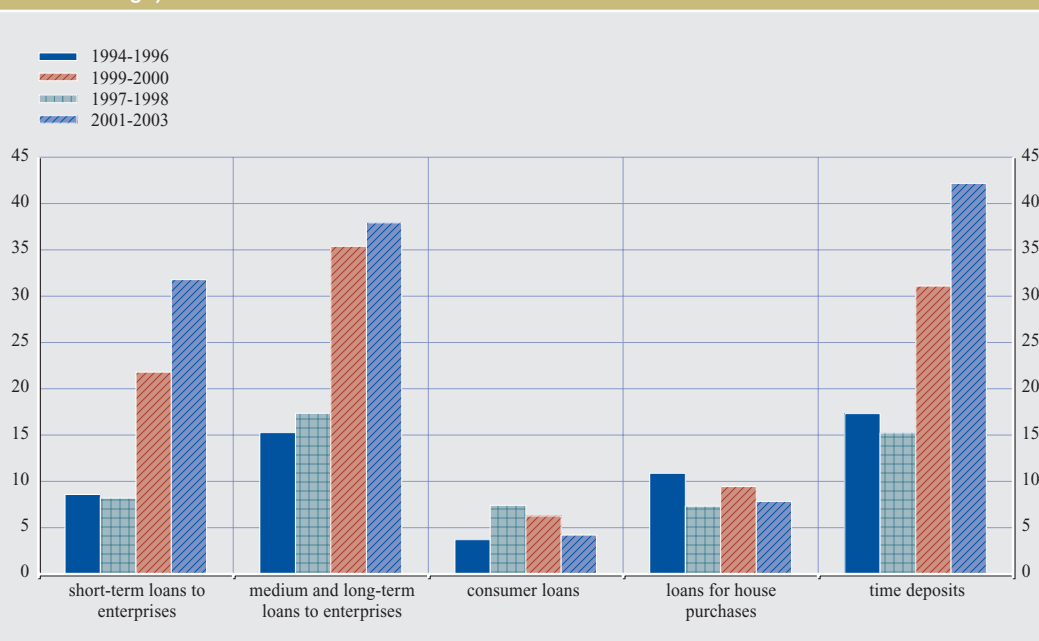
This could be explained by the fact that costs incurred by banks for information gathering and monitoring are higher in the case of short-term loans, since such loans in general are unsecured. As regards loans to households, margins have tended to converge more in the case of loans for house purchases than in the case of consumer credits. Indeed, interest rates for mortgage loans, which are normally collateralised, closely follow bond market developments, as confirmed also by results in the pass-through analysis.

### 7.2.3 NEWS-BASED MEASURES OF BANKING INTEGRATION

As explained in Chapter 3, one implication of full integration is that interest rates in individual countries should mainly react to common news (assuming identical systematic risk characteristics). In an environment without barriers to international investment, purely local shocks should not represent a source of systematic risk since they generally can be diversified away by investing in assets from different regions. Therefore, the proportion of interest rate changes that is explained by common factors provides an alternative measure of the degree of integration.

In the case of banking, we assume that all the relevant common news is reflected in the movements of market interest rates of a specific country, which could be considered as benchmark for the various segments. Thus, in equation (3.5) the dependent variable is now the change in the level of a specific bank interest rate in one country, while the explanatory variable is the change in the level of a comparable market rate in the chosen benchmark country. The regression model allows for time-varying country-specific intercepts and slope coefficients.

**Chart 25 Proportion of variance of various interest rates explained by common factors (euro area average)**



Source: ECB, authors' calculations.  
 Notes: The chart reports the average proportion of variance of short-term interest rates and time deposits explained by the German 3-month money market. For the medium- and long-term interest rates, the benchmark is two-year French government bond yields. For consumer loan rates we used two-year German government bond yields, and for mortgage loans five-year German government bond yields.

To assess the degree of integration across markets, we focus on the part of local bank interest rate changes not explained by common factors, i.e. the country-specific error term. To the extent that interest rates are sufficiently comparable across countries, this country specific error should become smaller as the degree of integration increases. Under full integration, common news should increasingly drive local interest rates, and the proportion of variance it explains should be close to 100 percent. Alternatively, when interest rates are driven purely by local factors, this proportion will be zero.

We run regression (3.5) for the four lending rates and for the time deposit rates. In order to determine which market rates are the most closely related to those bank interest rates, we rely, whenever possible, on the results of De Bond (2002a), which are based on correlation analyses between market rates at various

maturities and bank interest rates at the euro area level. For interest rates on short-term loans to households, we choose the 3-month money market rate, and for the medium- and long-term rates, we choose the 2-year government bond yield. As for loans to households, the correlation analysis suggests that the 2-year government bond yield should be chosen for consumer credit loans, while the 5-year government bond yield seems appropriate for mortgage rates. For time deposit rates the relevant market rate seems to be the 3-month money market rate. As for the choice of the benchmark country for the different maturities, we choose Germany, which usually has the lowest yields in the various maturity segments. However, in a recent study, Dunne et al. (2002) questioned this common choice. Basing their analysis on Granger-causality and cointegration techniques, they tested the hypothesis that prices of other bonds react to price changes in the benchmark bond. Their results suggest that

French and German bonds should be chosen as benchmarks for medium- and long-term maturities, while Italian bonds are more suitable for short-term maturities.<sup>62</sup> We check the robustness of our results based on German rates by re-running the regressions and re-calculating the variance ratios with French bonds as an alternative benchmark.

Chart 25 plots the average values for the proportion of local variance of the various bank interest rates explained by the common factors, i.e. the chosen benchmark market interest rates. In the case of short-term loans to enterprises, the average proportion of variance explained in the years 1994-1996 is on average around 9% and remains unchanged in the following two years. Thereafter, the proportion explained by common factors jumps to 32% on average.

For bank interest rates on medium- and long-term loans to enterprises, the average proportion of variance explained by the model is still quite low, although it has increased over time on average (to 38% after 2000, up from 15% in the mid-nineties).<sup>63</sup>

As expected, the variance ratios are very low in the case of both consumer credits and mortgage loans, and it seems that there is no change, on average, in the proportion of variance explained by the model. Overall, markets look quite segmented, with only 8-10% of the variance explained by a common factor.

By contrast, in the case of time deposit rates, the importance of common factors, as proxied by the 3-month money market rate, has increased a lot over time, as shown in Chart 25. Even when excluding Germany, the average ratio increased from 10% to 37% as of 1999.

#### 7.2.4 THE DEGREE OF INTEGRATION OF EURO AREA BANK CREDIT MARKETS AFTER JANUARY 2003

As explained above, the new MFI interest rate statistics introduced in December 2003 provide a more harmonised and comprehensive picture

of the interest rates applied by euro area banks than the preceding retail interest rate statistics. They cover interest rates that credit institutions and other institutions resident in the euro area apply to euro-denominated deposits from and loans for households and non-financial corporations. A total of 45 interest rates are collected on a monthly basis, starting with the reference month of January 2003. For our analysis we report the cross-sectional dispersion for four composite lending rates (short-term and medium- and long-term loans to enterprises, and loans to households for consumer loans and mortgage loans) and one deposit rate (time deposit rates). They are constructed by weighting interest rates across maturities and instruments with the corresponding new business volumes.<sup>64</sup> For instance, in the case of short-term loans to enterprises, each country's interest rate is calculated as the weighted average of the interest rates on loans to non-financial corporations with a floating rate and up to one year initial rate fixation (excluding bank overdrafts), taking into considerations both loans with amount up to and over €1 million.

Chart 26a reports the cross-sectional standard deviation for short-term and medium and long-term loans to enterprises. In the case of short-term loans, the dispersion has not changed very much during 2003, partly because interest rates levels remained broadly unchanged across the euro area. Bank interest rates, for medium and long-term interest rates on the other hand, have shown much more variability since the summer of 2003. This is mainly due to relatively strong changes in interest rates in Portugal and to a lesser extent in other small countries.

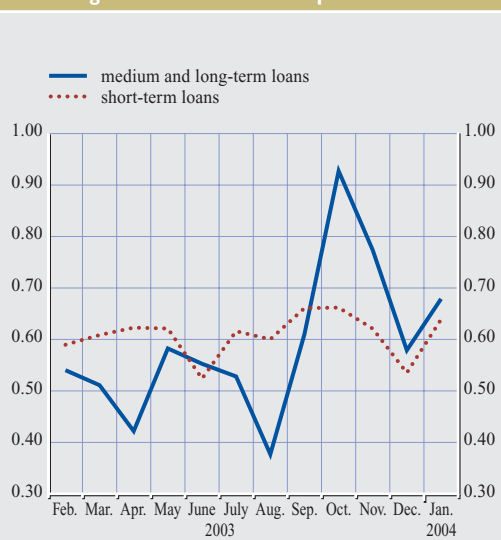
<sup>62</sup> It should be noted that their analysis is based on a very rich but rather short sample of data: all actual transactions made on Euro-MTS, which is the principal electronic trading platform for bonds denominated in euros, for the period October-November 2000.

<sup>63</sup> In the case where we choose two-year German government bond yields as our benchmark, the average variance is still rising over time but at lower levels (17% after 2000, up from 9% in the mid-nineties).

<sup>64</sup> The authors would like to thank Risto Herrala for the compilation of the data.

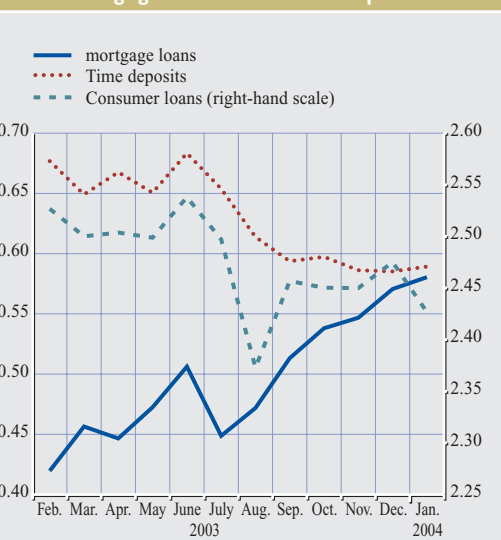


**Chart 26 a Cross-sectional standard deviation of interest rates on short-term and medium- and long-term loans to enterprises**



Source: ECB.  
Notes: the standard deviation is based on composite interest rates both for short- and long-term interest rates. For each country, interest rates on short-term loans are calculated as the weighted average of the interest rates on loans to non-financial corporations with a floating rate and up to one year initial rate fixation (excluding bank overdrafts) taking into considerations loans with amount up to and over €1 million. For long-term loans, the weighted average interest rates are based on those for loans to non-financial corporation with over 1 year and up to 5 years and over 5 years' initial rate of fixation with amount up to and over €1 million. In both cases weights are based on new business's volumes.

**Chart 26b Cross-sectional standard deviation of interest rates on consumer and mortgage loans and time deposits**



Source: ECB.  
Notes: the standard deviation is based on composite interest rates both loans to households and time deposits. For each country, interest rates on consumer credit are calculated as the weighted average of the interest rates on loans to households for consumer credit with a floating rate and initial rates fixation of up to one year, over 1 year and up to 5 years and over 5 years (excluding bank overdrafts). For mortgage loans, the weighted average interest rates are based on those for loans to households for house purchase with floating rate and up to one year initial rates fixation, over 1 year and up to 5 years, over 5 years and up to 10 years and over 10 years' initial rate of fixation. Time deposits include all time deposits excluding overnight and repos. In all cases weights are based on new business' volumes.

Chart 26b plots the cross-sectional standard deviation for interest rates on loans for households and on time deposits. Although this chart is not directly comparable with the previous ones with the historical perspective, it is nevertheless interesting to note that this measure broadly confirms the previous analysis. The dispersion of interest rates for loans for consumer credit is relatively high whereas those for time deposits are low and decreasing during 2003. At the same time, the dispersion for mortgage rates is low but it exhibited a rising trend during 2003.

### 7.2.5 QUANTITY-BASED MEASURES OF BANKING INTEGRATION

As mentioned before, integration in the euro area banking markets may be considered quite advanced from a legal perspective, but price

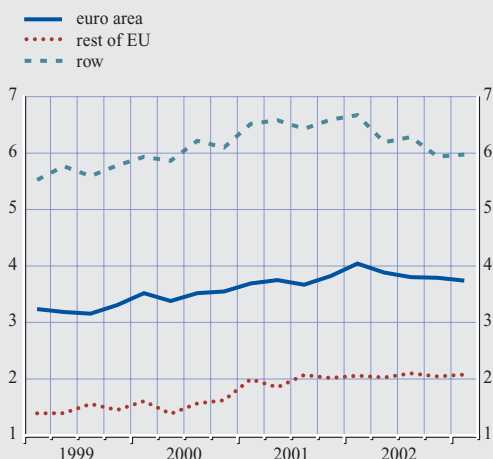
differentials remain quite high. An alternative way to assess the progress towards integration could therefore be to consider whether existing barriers to entry have been reduced over time.

As a quantity-based indicator, cross-border flows have been used in many studies to assess the degree of integration<sup>65</sup>. Charts 27a-d show data recently collected by the Eurosystem on cross-border loans to non-banks, starting in 1997. In particular, chart 27a plots the size of loans made by banks located in the euro area to borrowers in other euro area countries, in other EU countries and in other non-EU countries as a percentage of domestic loans. The chart shows that there has been an increase in euro area

<sup>65</sup> The reader may refer to Cabral et al (2002) and to Hartmann et al. (2003) for an analysis at the euro area level and to Angeloni et al. (2003) and Manna (2004) for an analysis at the country level.

Chart 27a Cross-border loans

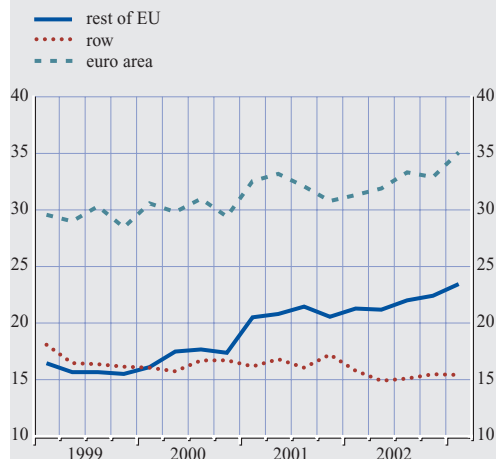
(as a percent of domestic loans)



Source: ECB.

Chart 27b Cross-border interbank loans

(as a percent of domestic loans)



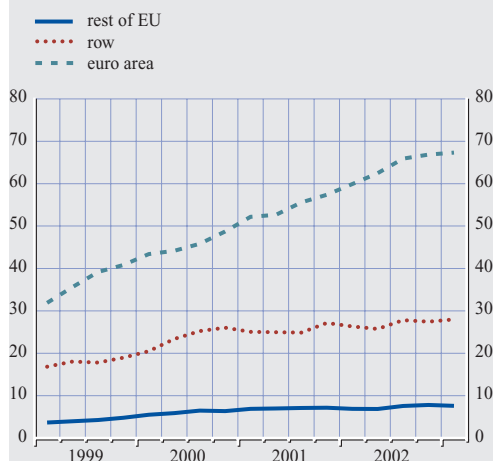
Source: ECB.

cross-border lending, which seems to be part of a general trend of increasing cross-border lending to non-euro area countries from about 10% to 11.9%. For interbank loans, however, the increase is considerably larger (Chart 27b). As noted in previous studies, it coincides with a

decline in cross-border interbank loans outside the euro area. As for bank holdings of securities, a very strong increase in cross-border activity within the euro area is recorded for securities issued by both banks and non-banks (Charts 27c and 27d).

Chart 27c Cross-border holdings of non-bank securities

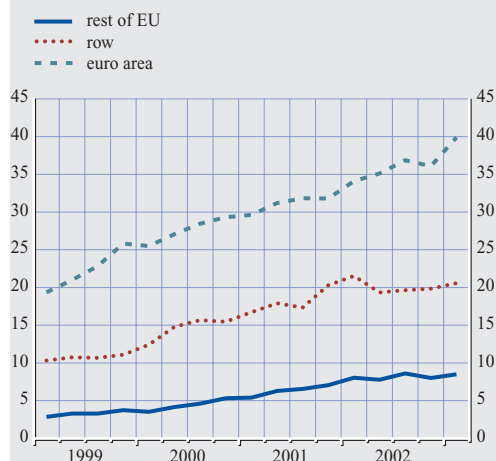
(as a percent of domestic holdings)



Source: ECB.

Chart 27d Cross-border holdings of bank securities

(as a percent of domestic holdings)



Source: ECB.

From a monetary policy transmission point of view, interbank integration could have an indirect impact on loan market integration since banks consider interbank funds an internal benchmark for pricing loans to non-bank customers. Along the same line of reasoning, banks' increased holdings of cross-border securities have direct implications for the transmission of monetary policy because banks' portfolios will be affected more homogeneously via changes in the value of the underlying securities.

### 7.3 SUMMARY

Integration in euro area banking markets may be considered quite advanced from a legal perspective, but price differentials remain relatively high. Using our set of integration measures, we find that integration varies in the different segments of the banking market. Using our first set on bank interest rates (those for the "historical perspective") in the corporate lending market, our measures detect a difference between short-term and medium- and long-term lending, with the former being more segmented. With respect to lending to households, mortgage loan rates seem to be more uniform across countries than they were in the past, while the consumer credit segment remains highly fragmented. These results are broadly confirmed when using the new set of harmonised bank interest rates, recently published by the ECB. It should be stressed, however, that the assessment for 2003 is rather preliminary and that sounder analysis on the degree of integration in the euro area bank credit markets and on its determinants could be done once sufficiently long time series become available. Furthermore, evidence from quantity-based indicators is in line with these results, suggesting that cross-border activities within the euro area are still limited in the retail banking segment. In this sense, there are clear signs of persistent home biases in the lending to and borrowing from smaller non-financial corporations and households.

## 8 EURO AREA EQUITY MARKETS

Euro area equity markets have, similarly to euro corporate bond markets, recorded considerable growth over the past decade. This chapter aims to assess whether this rapid growth has also coincided with a higher degree of equity market integration in the euro area.

Further integration of euro area equity markets can generate several potential benefits. First, there is considerable evidence that the cost of equity capital decreases as markets become increasingly integrated. The lower cost of capital in integrated equity markets is a result of better possibilities for international investors to eliminate country-specific risks by diversifying their portfolios across countries. A decrease in the cost of capital typically increases the number of productive investments and contributes to economic growth. Apart from this effect, households will also benefit from the greater risk-sharing possibilities associated with further integration because they will be better able to smooth their consumption relative to fluctuations in their income. This feature might become increasingly important in the future if more industrial specialisation occurs in individual countries. Further integration also means that corporations will typically have access to a much larger pool of funds, and that they no longer will be restricted by the supply of local financing.

The issue of integration of euro area equity markets is also of importance to the ECB and the Eurosystem. As equity markets grow in size, wealth effects on consumption become increasingly more relevant, resulting in a tighter link between stock market fluctuations and fluctuations in real economic variables. Increased possibilities for international risk sharing, on the other hand, should reduce the sensitivity of local consumption to local economic shocks. This may in turn contribute to less divergence in cyclical developments throughout the euro area. It is therefore important for monetary policymakers in the euro area to understand the dynamics of equity market integration.

This section is structured as follows. First, we briefly discuss the main developments in euro area equity markets. Second, we discuss the measures of equity market integration that were introduced in Chapter 3. The final section presents our conclusions.

### 8.1 MARKET DEVELOPMENTS

Continental Europe is often considered a bank-based system, as banks are the main source of industry financing. By contrast, the UK and the US are the main examples of market-based systems, as their corporations rely much more on market financing. While this taxonomy is still valid, euro area equity markets have grown substantially over the last decade, both in absolute value and relative to GDP. While the ratio of total market capitalisation to GDP for the euro area amounted to about 25 percent until the mid-1990s, this ratio had doubled by the end of 2003.

The fact that the euro area has seen a stronger increase in market capitalisation compared to other regions is partly explained by the relatively high amount of new equity issues in the euro area. While total issuance as a percentage of market capitalisation over the period 1998-2000 amounted to nearly 4 percent in the euro area, this ratio was typically lower than 2.5 percent in the other main markets (Japan, United Kingdom, United States). This brisk pace in Initial Public Offerings (IPOs) can be explained partly by the privatisation of a number of (partially) state-owned companies and partly by a large number of new listings of companies in the technology, media, and telecommunications (TMT) sector. The high number of IPOs caused a net increase in the number of publicly listed companies in euro area exchanges, despite a large number of de-listings due to consolidation in various industries. Even though the total value of new issues in the euro area decreased in 2001 and 2002 with the bear market, it continues to be considerably higher than in Japan and the United States. In addition, despite a large

number of de-listings in the TMT sector, the number of publicly listed companies in the euro area remained roughly the same over the period 2001-2002, whereas it decreased by more than 15 percent in the United States.

One potential consequence of the large number of euro area exchanges is that liquidity may be fragmented across markets. To assess this, we compare the turnover of the different stock exchanges across European countries and relative to the US and Japanese equity markets. One complication is that the individual equity markets use different ways to measure turnover. One group records turnover according to the “trading system view” (TSV), which counts only transactions that pass through the trading system of the exchange or which take place on its trading floor. The “regulated environment view” (REV), on the other hand, also takes into account off-market transactions in the turnover data. Therefore, turnover measured by REV is typically much higher than under TSV. Among the stock exchanges measuring their turnover according to the TSV method, the Frankfurt stock exchange had the highest ratio of turnover over market capitalisation (177 percent) during 2002, followed by the Milan and Helsinki stock exchanges. Interestingly, these markets record a higher turnover ratio than either the New York Stock Exchange or the Japanese stock exchange. NASDAQ has by far the largest turnover ratio among markets using the REV methodology, followed by the Milan and London stock exchanges. These results do not seem to suggest that the large number of stock exchanges in Europe (compared e.g. to the United States) has fragmented liquidity.

On the demand side, there is evidence that equity market participation by both households and institutional investors has increased considerably in recent years. As reported by the ECB (2001c), equity as a share of financial assets held by these two categories of investors almost doubled between 1995 and 1999. While the market downturn of 2000 induced many investors to shift a considerable proportion of their equity holdings to bonds, equity holdings

are still proportionally larger than they were in the first half of the 1990s. There are several reasons for this strong increase. First, the demographic trend towards an ageing population has induced households to supplement public pensions with personal retirement savings. Equity markets attracted a considerable part of these new investments. This is reflected not only in a large increase in the total assets managed by euro area pension funds, but also by a rising proportion of equity in their total portfolios. According to the ECB (2001c), the total assets in euro area investment funds increased from €1,017 billion in 1995 to €2,885 billion in 2000, an increase of 184 percent. Moreover, the proportion of equity holdings in the total increased dramatically, from 15 percent in 1995 to 40 percent in 2000. Second, the convergence of interest rates across euro area countries to historically low levels has prompted a reallocation of investments towards equity markets. Third, a number of European Union directives removed many of the remaining barriers to international equity investment, thereby facilitating investors’ access to international stock markets. Fourth, the rapid growth in the number of investment funds made it easier for small investors to construct well-diversified portfolios. Finally, while the previous reasons are structural in nature, the good performance of equity markets during the second half of the 1990s clearly contributed to the development of an equity culture in Europe.

As we will discuss at length further on, during the last few years, especially since the introduction of the single currency in 1999, there has been a structural shift in the portfolio allocation paradigm. Until recently, the first step in the asset allocation process was typically to decide upon an adequate geographical allocation. Thereafter, stocks were chosen according to some selection criteria within the pre-selected countries. More recently, however, investors became increasingly convinced that, at least within the euro area, the country orientation in the first step should give way to an industry or sector

orientation. In a similar vein, investors gradually decreased the proportion of domestic equity in their portfolios and pursued more and more pan-European or global asset allocation strategies. This is reflected in a surge in the number of euro area-wide or pan-European indices and the popularity of related derivative contracts.

The heightened interest in cross-border equity trading has led euro area stock exchanges to expand across their national borders. Consolidation among exchanges has so far been limited to the merger of the Amsterdam, Brussels, and Paris exchanges in September 2000, which now constitute Euronext. The newly founded exchange expanded further in 2001, when it acquired Liffe, the London derivatives trading platform, and agreed to integrate also the Portuguese exchanges of Lisbon and Porto. New entrants in the market are meanwhile attempting to create pan-European exchanges. For example, Virt-X, a joint venture of Tradepoint (a London-based electronic market) and the Swiss Stock Exchange, offers trading in all fully listed UK common stocks and in European blue-chip stocks. Before these two initiatives, merger talks between Deutsche Börse and the London Stock Exchange – to form iX (International Exchange) failed. The relatively low speed of consolidation in euro area equity markets is due to a number of factors, including the existence of cross-country and regulatory differences as well as the severe fragmentation of Europe's clearing and settlement systems. The latter is one of the main reasons why cross-border equity transaction costs remain considerably higher than for domestic transactions.

The overall conclusion of this section is that euro area equity markets have become more and more developed. At the same time, an equity market culture has developed in Europe, while cross-border investments have, at least within the euro area, become more common. However, further consolidation among stock exchanges, and especially clearing and settlement systems, may be a necessary condition for creating a

truly integrated European equity market (see e.g. the conclusions from the Giovannini Group).

## 8.2 MEASURES OF INTEGRATION

This section is structured as follows. First, we give a brief discussion of the available literature on (European) equity market integration. In the second part, we discuss measures of integration based upon the relative importance of sector and country effects. Third, we investigate whether the proportion of local equity market variance explained by common factors has increased. Finally, we provide some evidence suggesting a reduction of the equity home bias.

### 8.2.1 RELATED LITERATURE

A number of recent studies have analysed the degree of European equity market integration from various angles. One part of the literature investigates whether expected returns are determined by global rather than by local risk factors, based on some specific asset pricing model (see e.g. Bekaert and Harvey, 1995, Stulz and Karolyi, 2001). In two recent studies, Hardouvelis et al. (2002a, 2002b) investigate whether European stock returns are driven by local or by Europe-wide risk factors. They find that the relative importance of Europe-wide factors increased with the probability of joining EMU. This suggests a shift from a country-specific to a common European pricing kernel, in line with increased equity market integration in Europe. Reflecting the increased opportunities for international risk sharing, the risk premium, and hence the cost of capital, typically decreases when markets become more integrated. Hardouvelis et al. (2002a, 2002b) estimate a decrease in the cost of capital related to the increase in equity market integration of between 0.5 and 3 percent, depending on the sector.

An important disadvantage of this methodology is that the results seem to depend heavily on the specification of the asset pricing model, and

hence on the correct identification of the relevant risk factors. Chen and Knez (1995) propose a way of testing equity market integration that does not require specification of an asset pricing model. In this sense, they counter the critique that tests for integration are often joint tests of integration and an assumed asset pricing model. Using a very general arbitrage approach, they argue that integration can be measured by calculating the distance between the estimated stochastic discount factor implied in observed returns and the theoretical discount factor under full integration. Using this idea, Ayuso and Blanco (1999) find that the degree of integration in the largest stock markets has increased over the 1990s.

The main disadvantage of the approach of Chen and Knez (1995) is that it does not yield much information about the dynamics of the integration process, nor about the drivers of integration. Consequently, the literature has shifted from testing the law of one price to alternative tests that are indirectly related to the degree of integration.

First, Bekaert and Harvey (1997) showed that the proportion of local equity market variance that is explained by common news tends to be positively related to the degree of financial integration. Two recent papers have applied this methodology to European equity markets. Fratzscher (2001) finds that correlations between euro area markets have increased since 1996, and that this can be explained mainly by a reduction in exchange rate volatility and to some extent by monetary policy convergence. Similarly, Baele (2003) finds that the sensitivities of 13 European equity markets to aggregate European and US equity returns tended to switch from a low to a high spillover state already at the end of the 1980s.

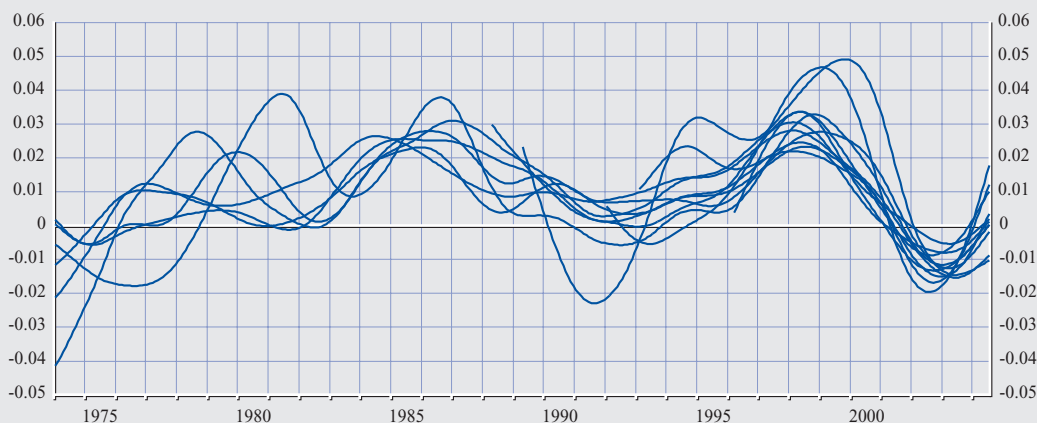
Second, a number of papers have studied the relative importance of country and industry effects in explaining equity returns. While the main aim of these papers is to decide whether portfolios should be allocated across countries or across industries, a decrease in the

importance of country effects is often interpreted as indicating increased equity market integration. Heston and Rouwenhorst (1995) find that even in economically integrated regions, such as Western Europe, country-specific sources of return variation are dominant. In a broader sample that includes emerging markets, Griffin and Karolyi (1998) find that global industry factors explain only 4 percent of the variation in national stock markets. However, some recent results indicate that the importance of country effects is declining. Baca et al. (2000) and Cavaglia et al. (2000) show that the importance of global industry factors has increased relative to country-specific factors. In fact, their results suggest that industry effects may even have become more important than country effects. Brooks and Del Negro (2002) show that the decrease in the relative importance of country effects persists when some of the (strong) assumptions underlying the original model are relaxed, and that the importance of global factors has increased somewhat.

Adjaouté and Danthine (2003) measure the relative importance of country and sector effects by simply calculating the cross-sectional dispersion in country and sector returns respectively. The higher the cross-sectional dispersion, the lower the correlations, and the higher the diversification potential. They find that over most of the 1980s and 1990s, country diversification has been superior to sector diversification. Interestingly, they also find that the potential of diversifying across sectors increased considerably at the end of the 1990, to levels even higher than those possible in country diversification. Ferreira and Gama (2002) confirmed these results using a different approach based on a decomposition of return volatility into sector and regional components.

Third, in addition to price-based indicators, quantity-based indicators may also convey interesting information about the dynamics of euro area equity market integration. A number of authors have interpreted the recent decrease in the equity home bias as evidence of further

Chart 28 EMU countries' HP-filtered equity returns



Source: Datastream and ECB calculations.

Note: This chart reports monthly Hodrick-Prescott filtered total returns over the period January 1973-July 2003 for the various euro area equity markets. All indices are compiled by Datastream.

integration. Adam et al. (2002) report data on international portfolio diversification for European investment funds, pension funds, and insurance companies. They find that while the share of foreign equity remained roughly constant over the period 1992-1998, a considerable rise has been observed since then.

Guiso et al. (2003) analyse the current state of equity ownership in several European countries. They find that while households' equity market participation has increased, there remain considerable country-specific differences. They conclude from this that euro area investors face different levels of participation costs, which suggests that there are still a number of barriers that need to be overcome before full integration is reached.

### 8.2.2 PRICE-BASED MEASURES OF EQUITY MARKET INTEGRATION

To analyse the integration of the various money and bond market segments, we calculated yield differentials and dispersion indices that were comparable across countries. In this section, as in Adjaouté and Danthine (2003), we start with some similar measures for equity returns.

The data used in this section consists of monthly dividend-adjusted market returns for stock indices of the 12 euro area countries, obtained from Datastream.<sup>66</sup> Chart 28 plots Hodrick-Prescott (HP) filtered return series<sup>67</sup> for the 12 EMU countries from January 1973 through January 2003. While HP-filtered returns vary widely across different countries during the 1970s and 1980s, returns appear to move more closely in step beginning in the early 1990s. This may suggest that equity returns across euro area countries have become increasingly determined by common euro area factors. We note, however, that the degree of convergence does not seem to have increased further in the last few years, despite the convergence of interest rates and the introduction of the single currency.

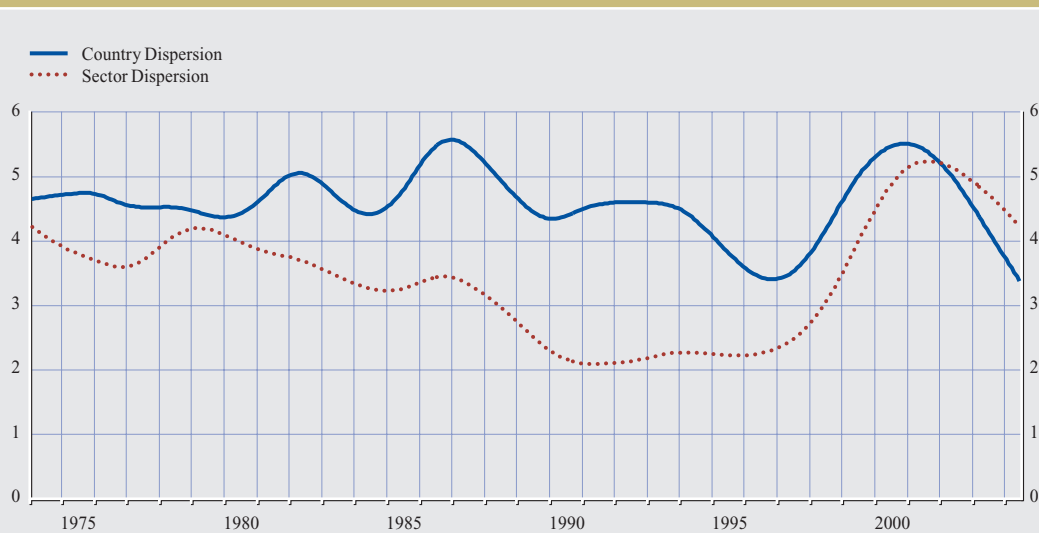
To investigate whether cross-country equity return correlations have changed over time, Adjaouté and Danthine (2003) compared correlations among country index returns in two different subperiods. They found that cross-

<sup>66</sup> We use Datastream's total market indices, as these typically cover at least 80 percent of the total market capitalisation of a country, as opposed to the country indices from MSCI, which only comprise about 60 percent of total market capitalisation.

<sup>67</sup> The Hodrick-Prescott filter is a smoothing method that is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series.



Chart 29 Hodrick-Prescott filtered country and global EMU sector dispersions



Source: Datastream and ECB calculations.

Note: This chart shows Hodrick-Prescott filtered cross-sectional dispersions in monthly euro area country and EMU sector returns. All indices are compiled by Datastream.

country return correlations are significantly higher during the “post-convergence” period of January 1995-August 2002 compared to the “pre-convergence” period of May 1987-December 1994. This suggests that the risk-reduction potential from geographic diversification within EMU has decreased. This may be explained in part by a further synchronisation of euro area business cycles and the convergence in macroeconomic fundamentals. At the same time, they show that correlations between EMU sector returns have decreased in the post-convergence period. These results, which persist when the dataset is updated up to July 2003 (own calculations), support recent findings by Baca et al. (2000), and Cavaglia et al. (2000) that there is now greater potential for sector diversification than for geographic diversification. However, these results seem to be sensitive to the choice of sample period. Moreover, as argued by Brooks and Del Negro (2004), part of the increase in sector diversification potential may be due to the technology bubble of the end of the 1990s.

The results above show that correlations are highly time-varying and that one should be

cautious when relating changes in return comovement with structural changes in the economic/financial system, especially in short samples. For instance, correlations are typically higher during periods of high volatility, which are often associated with business cycle troughs. Therefore, a rise in correlations may have been caused by the “cycle” rather than structural changes in the underlying economy and/or financial system. These cycles are difficult to uncover simply by looking at correlations in different sub-periods. Moreover, rolling correlations are vulnerable to the well-known overlapping data problem.

Adopting the approach used by Roulet and Solnik (2000) and Adjaouté and Danthine (2003), we calculate cross-sectional dispersion in both sector<sup>68</sup> and country index returns to investigate the structure of cross-country and sector correlations over time. More specifically, the cross-sectional dispersion, calculated as the cross-sectional standard deviation of all sector

<sup>68</sup> We use the EMU global sector indices provided by Datastream. Sector returns are calculated on a monthly basis over the period January 1997-July 2003, include (re-invested) dividends, and are denominated in euro.

or country returns, is inversely related to the degree of correlation: the less equity returns are correlated, the more they will tend to drift apart, and the higher the dispersion will be.

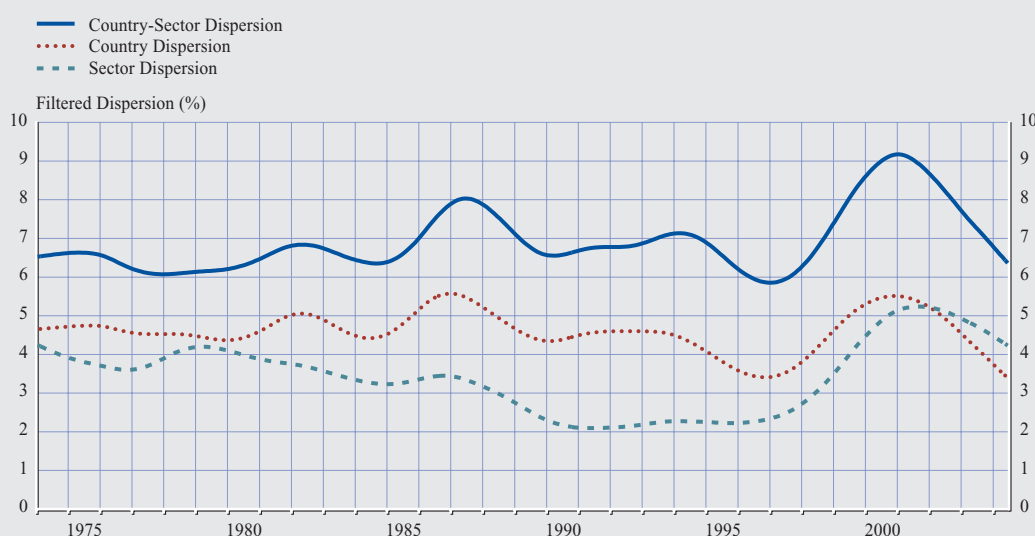
Chart 29 plots the country and sector dispersions over time. In order to focus on the slowly moving components, we report Hodrick-Prescott filtered dispersion series. Over nearly the entire sample, country dispersion has been higher than sector dispersion, implying that cross-country correlations were typically lower than cross-sector correlations. This confirms previous results showing that country diversification has been superior to sector diversification for most of the time. Interestingly, the difference between sector and country dispersion was reduced in the second half of the 1990s. Moreover, our measure of sector dispersion surpassed that of country dispersion in 2000, consistent with a possible shift in the asset allocation paradigm from country-based to sector-based strategies. This result is also confirmed by Ehling and Ramos (2002) using a mean-variance spanning test. They find that while country diversification has been superior to sector diversification over

most of the last three decades, both strategies yield nearly identical returns in the post-euro period.

However, one should note that, given the large variation in dispersions, one has to be careful when interpreting the results in terms of the relative advantage of sector diversification compared to country diversification. In fact, both sector and country dispersion increased in the second half of the 1990s, suggesting that the potential of geographic diversification actually improved relative to the period 1990-1995, before receding again later on. The rise in both country and sector dispersion may indicate that diversifying across sectors *and* countries may result in portfolios with a lower risk than those constructed on a country *or* sector basis only. To analyse this, we use country-sector indices over the same period to calculate cross-sectional return dispersions<sup>69</sup>. The results are depicted in Chart 30. In keeping with the findings of Adjaouté and Danthine, we find that

<sup>69</sup> Datastream provides a number of sector indices for each country. Here, we use the same sector classification as used in the previous graphs. In total, this yields us with 108 country-sector indices.

**Chart 30 Hodrick-Prescott filtered country, global EMU sector, and country-sector dispersions**



Source: Datastream and ECB calculations.

Note: This chart shows Hodrick-Prescott filtered cross-sectional dispersions in monthly euro area country, EMU sector, and country-sector returns. All indices are compiled by Datastream.

while the potential of sector diversification did increase considerably in the second half of the nineties, diversifying equity portfolios across both countries and sectors provided the largest risk reduction.

### 8.2.3 NEWS-BASED MEASURES OF EQUITY MARKET INTEGRATION

While country and sector dispersions are useful for uncovering structural changes in the aggregate euro area equity market, they are not very informative about such changes in individual markets. Moreover, this methodology does not allow us to uncover the underlying drivers of return co-movements. Instead, analysis of return variance proportions, as used elsewhere in this paper, allows for a more detailed examination of co-movements.

As described in Section 3.2, we assume that local equity returns react to two common factors, namely innovations in aggregate euro area (or the current euro area Member States prior to 1999) and US equity markets, which serve as a proxy for global factors. While all country returns share the same factors, they are allowed to have different sensitivities, or “betas”, to common shocks. These betas measure the intensity by which euro area and world return shocks are transmitted to local equity markets. We interpret the part of local returns not explained by the common factors as the return reaction to purely local news.

We are especially interested in how the betas change over time. Further economic, monetary, and financial integration is expected to lead to a convergence in both expected corporate profits and discount rates, and hence to a higher degree of equity return co-movement across countries. As a consequence, we expect the betas to increase over time.

To allow the betas to vary over time, we introduce three dummy variables that distinguish between different periods, relative to the basis period 1973-1985. Specifically, we

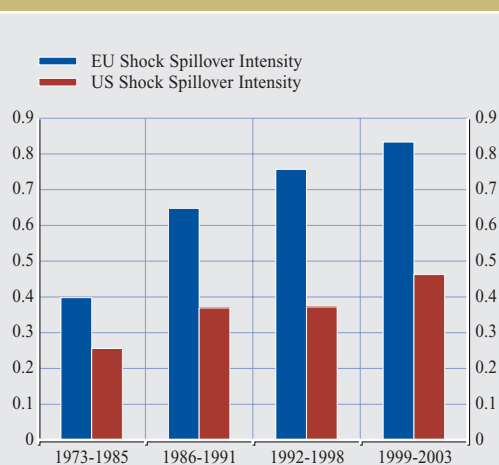
consider the following periods: the period following the Single European Act (1986-1992), the period between the Treaty of Maastricht and the introduction of the single currency (1992-1998), and the post-euro period (1999-2003). The specification for the betas is the given by  $\beta_{i,t}^{eu} = \zeta_{i,0} + \zeta_{i,1}D_t^1 + \zeta_{i,2}D_t^2 + \zeta_{i,3}D_t^3$

$$\beta_{i,t}^{us} = \psi_{i,0} + \psi_{i,1}D_t^1 + \psi_{i,2}D_t^2 + \psi_{i,3}D_t^3$$

where  $D_t^1$ ,  $D_t^2$ , and  $D_t^3$  are dummies for the three latter sub-periods listed above.

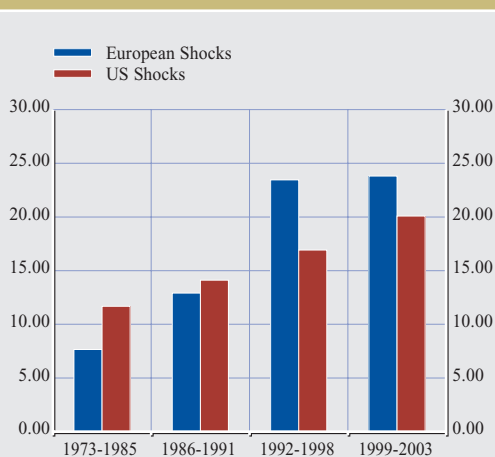
Chart 31 and Table 8 in Appendix 2 report the estimated sensitivities of local equity market returns to common euro area shocks. The average sensitivity to such shocks increased from about 0.40 in the period 1973-1985 to about 0.65 in the period 1986-1991, i.e. an increase of about 63 percent. The intensity increased a further 17 percent in the period 1992-1999 and an additional 10 percent in the period directly following the introduction of the euro. In nearly all cases, the shock spillover intensities are highly significant, as can be seen in Table 8.

Chart 31 Euro area and US shock spillover intensity



Source: Datastream and ECB calculations.  
 Note: For each period, the first column in this graph reports the unweighted average intensity by which euro area-wide equity market shocks, other than those from the US, are transmitted to local euro-area equity markets. The second column reports the unweighted average intensity by which U.S. equity market shocks are transmitted to local euro area equity markets.

**Chart 32 Proportion of variance explained by European and US shocks**



Source: Datastream and ECB calculations  
 Note: For each period, the chart's first column shows the unweighted average of the relative importance of euro area-wide factors, other than US equity market fluctuations, for the variance of individual euro-area countries' equity market index ("variance ratio"). The second column shows the unweighted average of the relative importance of U.S. equity market fluctuations for the variance of euro area equity markets.

US shock spillover intensities are reported in the second columns of Chart 31 and Table 9 in Appendix 2. As in the case of euro area shock spillover intensities, we find that the sensitivity of local return innovations to US shocks increases gradually over time, although the increase seems less pronounced than was the case for euro area shock spillover intensities. The joint rise in euro area and US shock spillover intensities suggests that the degree of integration has not only increased within the eurozone, but also globally among major world equity markets.

Chart 32 plots the proportion of local variance explained by euro area and US shocks. As for euro area shocks, the pattern is similar to that observed for the shock spillover intensities. During the period 1973-1986, only about 8 percent of local return variance was explained by common European shocks, but this proportion increased gradually to about 23 percent in the period 1999-2003. Countries with particularly high exposure to such common equity shocks include Belgium, France, Germany, the Netherlands, and Spain

(see Chart 39 in Appendix 2). Lastly, it is noteworthy that while the relative importance of US shocks in explaining local variance was higher relative to euro area shocks in the period 1973-1991, euro area shocks have become more important since 1992, reflecting the proportionally stronger increase in euro area shock spillover intensities since 1992. This suggests that regional euro area integration has proceeded more quickly than global market integration.

Chart 40 in Appendix 2 reports the proportion of variance explained by US shocks for each euro area country. This proportion is notably high and stable in the Netherlands. This is largely explained by the fact that the Dutch stock exchange is dominated by some large multinationals, such as Royal Dutch Shell and Phillips, which realise a considerable part of their cash flows overseas. The large increase for Finland is largely due to the rise of Nokia as a dominant player in that market.

#### 8.2.4 QUANTITY-BASED MEASURES OF EQUITY MARKET INTEGRATION

From the previous sections, it was clear that there are large benefits from diversifying equity portfolios across countries, sectors, or both. In reality however, investors seem to allocate a disproportionately large fraction of their equity holdings to domestic stocks. This finding, which has been widely studied and observed in nearly all countries, is denoted the "equity home bias" (see e.g. Tesar and Werner, 1992, and Lewis, 1999).

There are some reasons why one would expect the equity home bias to have decreased over time, especially within the euro area. First, further technological progress, especially in telecommunication, has made it easier for investors to be informed about stocks in foreign markets. Similarly, the competitive pressure on exchanges to attract foreign orders has increased the incentives for technological innovation, resulting in lower cross-border transaction costs and easier access to foreign trading systems. Third, the introduction of the

single currency has eliminated intra-euro-area currency risk and contributed to enhanced comparability of equity prices and transparency. Finally, currency-matching rules, which placed explicit restrictions on the ability of insurance companies and pension funds to invest in foreign-denominated assets, vanished with the introduction of the single currency<sup>70</sup>.

Recent evidence confirms the hypothesis that the equity home bias has been reduced, at least within the euro area. Adam et al. (2002) use data collected by FEFSI<sup>71</sup> to calculate the percentage of assets in eurozone equity funds that is managed according to a Europe-wide investment strategy. They find that over the period 1997-2001, this proportion increased substantially in nearly all countries, surpassing 50% in most countries by June 2001. Similar evidence is provided by the ECB (2002a). In a similar vein, Adam et al. (2002) use data from InterSec Research Corporation<sup>72</sup> to determine the percentage of foreign equity invested in pension funds in a number of European countries. They find that the proportion of foreign equity is constant over the period 1992-1998, but that it rises considerably in 1999 for most countries. This suggests that the introduction of the euro had an important impact on pension funds' investment strategies. They find a similar result for insurance companies, although the results differ more across countries.

In what follows, we update the results of Adam et al. (2002) where possible and provide a detailed discussion of the results. In this analysis, we consider investment funds, pension funds, and the insurance industry.

#### 8.2.4.1 INVESTMENT FUNDS

FEFSI classifies investment funds according to their international investment strategy and reports the assets under management for each category. This allows us to distinguish between funds that invest domestically, Europe-wide, or world-wide.

Chart 33 reports the share of equity funds that invest non-domestically over the period 1995-2003. In all euro area countries, this share increased over the period 1995-2003, and by 2003, the share of investment funds with a non-domestic strategy surpassed 75% in 6 of the 10 countries in the sample. Looking at the average for the euro area as a whole, the investment funds' share of non-domestic equity increased from about 40% in 1995 to close to 70% in 2003. Overall, Chart 33 shows strong evidence in favour of increased international diversification among euro area investment funds.

In Chart 34, we investigate whether the strong increase in cross-border equity holdings by investment funds is the result of a shift to Europe-wide investment or to global stocks in general<sup>73</sup>. While in 1997 the share of Europe-wide investment funds amounted to 18%, this proportion had increased to 29% by 2003. The total assets of such funds increased considerably over the period 1997-2003 in Belgium (from 32% to 56%), Italy (from 15% to 30%), and Germany (17% to 25%). However, substantial amounts are also invested outside the euro area. For example, while more than 80% of the assets of Dutch investment funds are invested non-domestically, the proportion invested within Europe is constantly low at around 17%. Overall, the conclusion of Chart 33 and Chart 34 is that the assets of euro area investment funds have become much more internationally diversified, but that this trend has not been restricted to European equity markets. This may in part be explained by the fact that euro area capital markets seem to be increasingly driven by common news, resulting in relatively higher correlations between euro area equity markets (see section 8.2.3.). Hence,

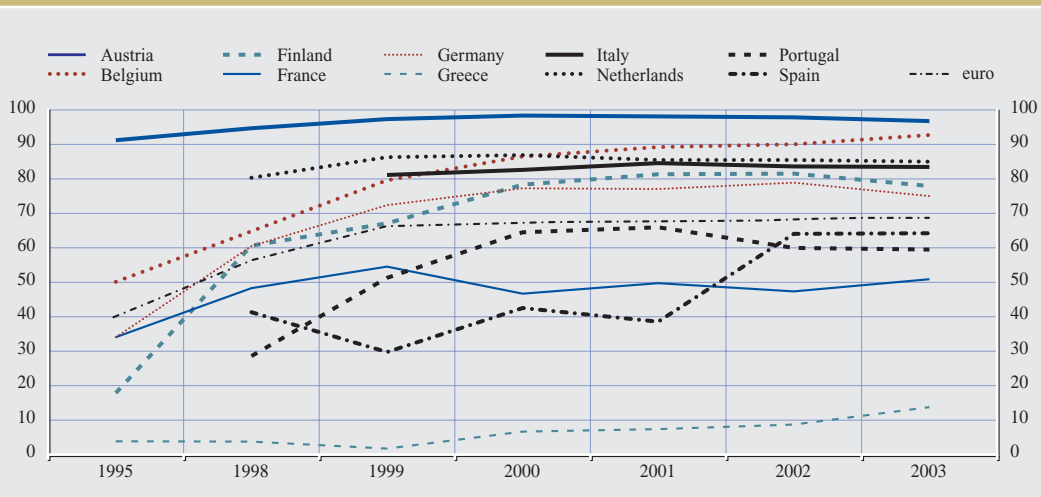
70 Notice, however, that institutional investors did not seem to reach their regulatory limits to foreign portfolio holdings (see Danthine et al., 2001).

71 Fédération Européenne des Fonds et Sociétés d'Investissement, see <http://www.fefsi.com>

72 InterSec is a consultant company that advises pension funds and insurance companies; see <http://www.intsec.com>

73 This breakdown is not available for France and Greece. In addition, the data only starts in 1997.

Chart 33 Asset share of euro area investment funds with non-domestic investment strategy



Source: FEFSI and ECB calculations.

to limit the risk of their portfolios, investors may look for diversification opportunities in regions that are less driven by common European or US shocks, such as Asian or Central and Eastern European markets (see Ng, 2000, Baele et al., 2003).

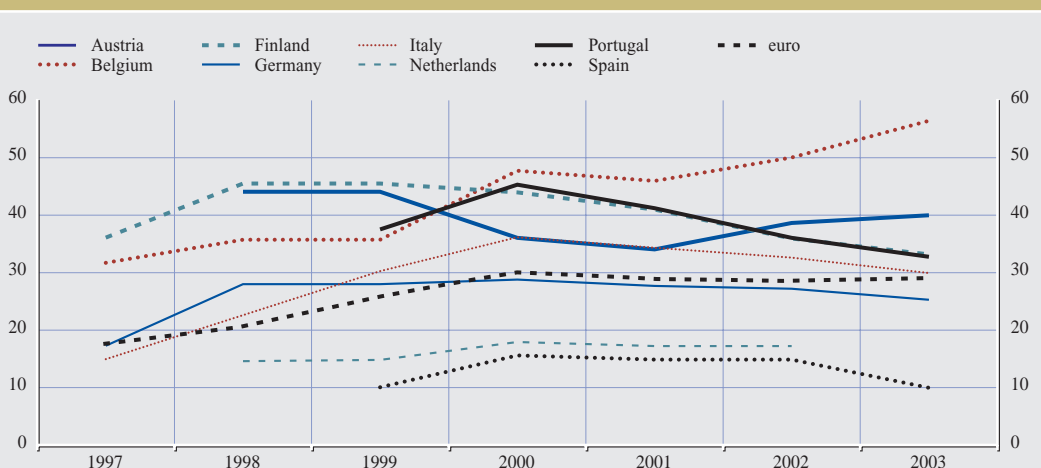
#### 8.2.4.2 PENSION FUNDS

The total assets managed by euro area pension funds have increased substantially in recent

years. Moreover, pension funds have gradually increased the proportion of equity investment in their portfolios. Because of these two reasons, pension funds have become important players on the demand side of equity markets.

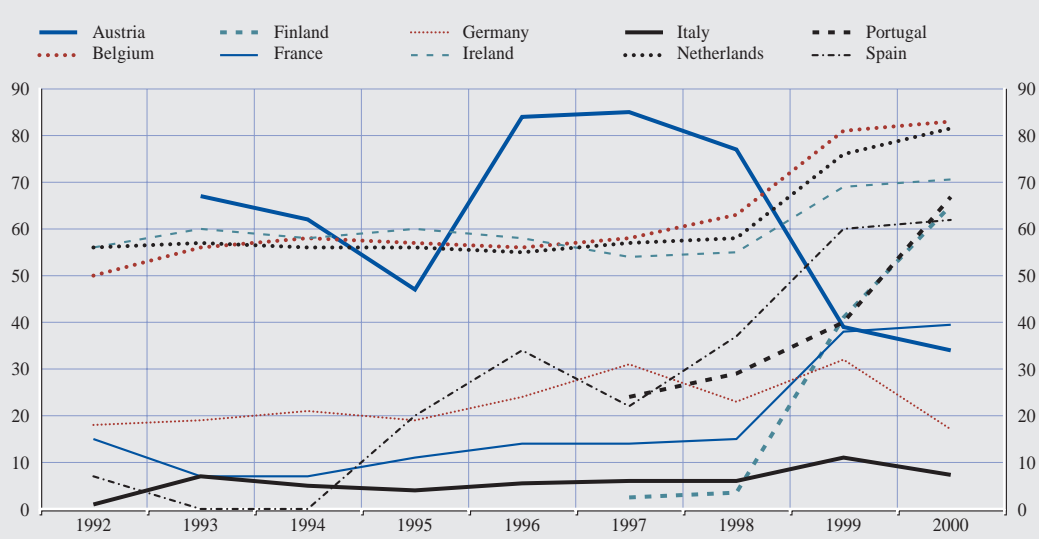
In this subsection, we investigate whether the home bias in the portfolios of euro area pension funds also has decreased recently. In Chart 35, we report the share of foreign equities as a

Chart 34 Asset share of euro area investment funds with European investment strategy



Source: FEFSI and ECB calculations.

**Chart 35 Share of foreign equity in pension fund sector total equity portfolios in available countries**



Source: Intersec Research Corporation and ECB calculations.

percentage of pension funds' total equity investments in the different euro area countries<sup>74</sup>. As pointed out by Adam et al. (2002), the share of foreign assets in euro area pension funds was fairly constant over the period 1992-1998, with a few exceptions. However, countries appear to fall into one of two categories with respect to their average fraction of foreign investments. In a group of "small" countries (Austria, Belgium, Ireland, and the Netherlands), pension funds' assets typically contain more than 50% non-domestic assets. Pension funds in a group of "larger" countries (France, Germany, Italy, and Spain), on the other hand, invest largely domestically.

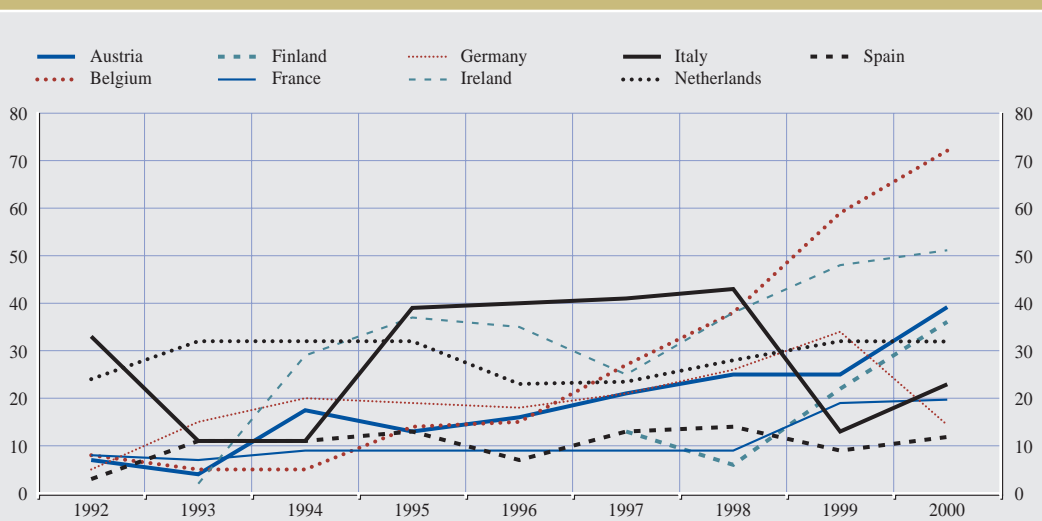
In all small countries except Austria, the share of non-domestic equity holdings increased considerably during 1999 and 2000. While during 1998 about 60% of pension funds' assets in Belgium, the Netherlands and Ireland were invested non-domestically, this percentage increased to more than 80% in the former two countries, and to about 70% in Ireland. Large increases also took place in Spain and France, whereas the shares stayed fairly constant in the two other large countries, i.e. Italy and Germany. However, the largest increase took

place in Portugal, where the share of non-domestic equity holdings increased from 24% in 1997 to 67% in 2000.

Overall, the data indicate that, similar to developments in the investment fund industry, the degree of home bias in pension funds has been significantly reduced in the last few years. However, the structural break in 1999 for pension funds, compared with the more gradual increase for investment funds, suggests that the introduction of the euro may have been more important in bringing about this change for the pension fund industry. This feature may in part be explained by the different ways in which investment and pension funds increased their proportions of non-domestic assets. While pension funds mainly achieved the increase by rebalancing equity holdings across borders, investment funds primarily accomplished their gradual internationalisation by creating an increasing number of funds with an international investment strategy (see ECB, 2001c).

<sup>74</sup> This data is provided by Intersec Research Corporation, a consultancy advising pension funds and insurance companies. Data for the period 1992-1999 is taken from Adam et al. (2002). The 2000 figures are directly provided by Intersec Research Corporation.

**Chart 36** Share of foreign equity in total equity portfolio of the life insurance sector in available countries



Source: Intersec Research Corporation and ECB calculations.

#### 8.2.4.3 INSURANCE COMPANIES

Similar to the analysis of investment and pension funds above, Chart 36 plots the insurance sector's proportion of non-domestic equity holdings as a percentage of total equity holdings in the various euro area countries.<sup>75</sup> Over the period 1992-2000, the share of total equity assets invested non-domestically increased in all countries except Italy. Particularly large increases were observed in Belgium (from 8% in 1992 to 72% in 2000), Ireland (from 2% to 51%), Austria (from 7% to 39%), and Finland (from 13% in 1997 to 36% in 2000). It is notable that these are all small countries with small equity markets, and that insurance companies in these countries seem to have used the increase in integration to exploit the large diversification benefits from investing outside the national borders. Only moderate increases were observed in France and Spain, while the share actually decreased in Italy (from 33% in 1992 to 23% in 2000).

Overall, in line with the results from the investment and pension fund industries, the home bias in insurance corporations' equity holdings appears to have decreased, especially in countries with a small equity market. However, contrary to the case of investment and

pension funds, domestic stocks still represent more than 50% of total equity investments in nearly all countries. This could indicate that insurance corporations still face some important barriers to international investment.

#### 8.3 SUMMARY

The measures of integration presented in this section all indicate a rising degree of equity market integration. First, since the end of 2000, the advantages of sector diversification have for the first time in the last 30 years surpassed those of geographical diversification. Second, equity returns in the various euro area equity markets are more and more determined by common news factors. Whereas in the first half of the 1980s less than 20% of local return variance was explained by aggregate European and US shocks, this proportion rose to more than 40% in the post-euro period. Finally, there is strong evidence that the home bias in the equity holdings of both insurance corporations and investment and pension funds has decreased considerably over the last few years.

<sup>75</sup> This data was provided by the Intersec Research Corporation.



## 9 SUMMARY AND CONCLUSIONS

This paper's main objective is to present a set of specific measures to quantify the state and evolution of financial integration in the euro area. With this objective in mind, we devise a common methodological framework built upon a precise definition of financial integration. This definition is based on the notion that integration in euro area financial markets is achieved when all economic agents in euro area financial markets face identical rules and have equal access to financial instruments or services in these markets. In practice, for the purpose of measuring the degree of financial integration in various market segments, we consider two broad categories of measures based on the law of one price. These involve investigating price or yield differences directly and examining the response of asset prices in individual countries to common factors (as proxied by benchmark yields or returns). Furthermore, the results based on these measures are complemented with information about euro area financial integration derived from quantity-based measures.

All in all, we consider five key euro area markets: money, government bond, corporate bond, banking/credit and equity markets. Our measures confirm that different market sectors have attained different levels of integration. They also largely verify general results found in earlier studies. Unsurprisingly, given the existence of a single monetary policy across the euro area, we find the money market to be the most integrated of the markets we consider. However, differences still remain between various sectors of the money market. For example, using a data set comprising interbank transactions and quotations in the market for unsecured short-term loans as well as repos, we find that the repo market remains less integrated than the unsecured segments of the money market. The most relevant factors underlying the less advanced state of integration in this market segment are likely to be differences in practices, laws and regulations as well as remaining fragmentation of the market infrastructure. Nevertheless, given that the repo market was generally considered substantially less integrated than the other segments

immediately following the introduction of the euro, our results indicate the degree of integration has improved since then. As for the unsecured lending market and the swap market, our results confirm not only that these segments became very highly integrated after the euro was launched, but also that this very high level of integration has remained an enduring feature of these markets in the period thereafter.

Turning to the euro area government bond market, our analysis indicates that the degree of integration in this market has been very high since the introduction of the euro. Not only have government bond yields converged swiftly in all countries, but yields have also become increasingly driven by common news, and less by purely local risk factors. However, we also find that yields on government bonds with similar, or in some cases identical, credit risk and maturity have not fully converged. Moreover, local factors continue to play a role, though small, in explaining yield movements in individual countries. Apart from imperfect integration, differences in perceived credit risk among bonds issued in different countries, along with liquidity considerations, may also explain this finding to some extent.

This paper is the first to analyse the state of integration in the euro area's rapidly expanding corporate bond market. Using methods that distinguish country effects from other possible systematic influences, we find that the euro area corporate bond market seems reasonably well integrated. Specifically, our results show that – once corrected for pervasive risk – country of issuance has only marginal power to explain the cross-section of corporate bond yield spreads. Instead, as could be expected in a well-functioning market, the level and evolution of corporate bond yield spreads in the euro area is largely determined by credit ratings. We also find evidence that throughout the last five years, the share of European-wide bond funds has increased dramatically, indicating a reduction in the home bias of bond portfolios (both government and corporate bonds) in the euro area.

Our analysis of the state of integration in euro area banking markets indicates that while this market may be considered quite advanced from a legal perspective, price differentials remain relatively high. Moreover, we find that the degree of integration varies in different segments of the banking market. In the corporate lending market, for example, our analysis indicates that the medium-/long-term segment is more integrated than the short-term segment. With respect to lending to households, mortgage loan rates seem to be more uniform across countries than in the past, while the consumer credit segment remains highly fragmented. Evidence from quantity-based indicators is in line with these results, showing clear signs of persistent home biases in lending to and borrowing of small non-financial corporations and households.

Finally, for euro area equity markets, our measures of integration indicate a rising degree of integration. For example, while the dispersion of equity index returns across individual countries typically have been higher than the dispersion across sectors, our evidence suggests that this feature of the data has been reversed in the last few years. This result is consistent with deepening equity market integration, as lower cross-country dispersion suggests that equity returns in euro area countries have become increasingly more correlated. In line with this result, we find that equity returns in the various euro area equity markets are increasingly determined by common news factors and less by country-specific factors. Moreover, there is evidence that the home bias in the equity holdings of institutional investors has decreased considerably over the last few years. However, despite these advances in euro area equity market integration, it remains among the least integrated of those we have examined.

## APPENDIX I: DESCRIPTION OF THE CORPORATE BOND DATASET AND FILTERS

For our analysis of corporate bond market integration, we gathered data on all bonds contained in the Merrill Lynch EMU corporate bond index, which incorporates euro-denominated investment-grade bonds with a minimum size of issue of €100 million. Bonds rated below investment grade and asset-backed bonds are excluded from the analysis. In addition, we exclude all bonds with less than one year to maturity and bonds which were traded less than once per week in a given four-week time interval. We allow a bond's liquidity pattern to vary during its lifetime, and therefore exclude or include it in the sample depending on the observed liquidity at each point in time. Finally, we eliminate two outliers from our data sample, for which yields differ notably from yields of bonds within the same rating class, maturity and country.

Given our focus on the euro area, we eliminate all euro-denominated bonds not issued in a euro area country. Moreover, in order to obtain meaningful estimates for the country parameters, we eliminate data for countries that do not have at least 10 corporate bonds at every time interval. This leaves us with 6 countries in the sample: Austria, France, Germany, Ireland, The Netherlands, and Spain. The Netherlands has the largest number of bonds (222 on average), followed by France (103) and Germany (96). Austria, Ireland, and Spain typically have on average less than 20 bonds.

Our data sample covers the period January 1998-May 2003 and consists in total of 2,215 bonds.<sup>76</sup> We use 8 rating categories, including subdivisions to distinguish between plus and minus-rated bonds<sup>77</sup>, and monitor rating changes over the time period. Adopting Merrill Lynch's approach, we use a composite measure of Moody's and Standard & Poor's ratings.

<sup>76</sup> Bonds were denominated in domestic currencies of corresponding euro-zone members during pre-EMU period.

<sup>77</sup> We discriminate between 8 subcategories: AAA, AA+, AA, AA-, A+, A, A-, BBB.

## APPENDIX 2: ESTIMATION RESULTS FOR EUROPEAN AND US EQUITY SHOCK SPILLOVER INTENSITIES

Table 8 Estimation results for EU shock spillover intensities

	EU Shock Spillover Intensity			
	73-85	86-91	92-98	99-03
BELGIUM	0.402 <i>0.0543</i>	0.556 <i>0.0768</i>	0.664 <i>0.1105</i>	0.7273 <i>0.1982</i>
GERMANY	0.1069 <i>0.0327</i>	0.5789 <i>0.1237</i>	0.7898 <i>0.1411</i>	1.0272 <i>0.1879</i>
GREECE		0.8506 <i>0.3226</i>	1.1739 <i>0.169</i>	0.9708 <i>0.3663</i>
SPAIN		0.2046 <i>0.0858</i>	0.4414 <i>0.0856</i>	0.5051 <i>0.1259</i>
FRANCE	0.5277 <i>0.0856</i>	0.82 <i>0.0954</i>	0.9901 <i>0.1510</i>	1.1231 <i>0.2177</i>
IRELAND	0.7778 <i>0.1003</i>	0.8746 <i>0.1010</i>	0.7847 <i>0.1616</i>	0.5014 <i>0.2510</i>
ITALY	0.4139 <i>0.1022</i>	0.6386 <i>0.1212</i>	1.2673 <i>0.1982</i>	0.9626 <i>0.2748</i>
LUXEMBOURG		0.841 <i>0.0459</i>	1.151 <i>0.0538</i>	0.9544 <i>0.1041</i>
NETHERLANDS	0.5437 <i>0.1022</i>	0.4624 <i>0.0400</i>	0.7208 <i>0.0825</i>	0.9063 <i>0.1483</i>
AUSTRIA	0.0315 <i>0.0247</i>	0.8109 <i>0.1942</i>	0.5917 <i>0.2069</i>	0.2703 <i>0.2421</i>
PORTUGAL		0.7968 <i>0.0952</i>	1.1366 <i>0.136</i>	0.9882 <i>0.1874</i>
FINLAND		0.3381 <i>0.1623</i>	1.1128 <i>0.1165</i>	1.063 <i>0.2857</i>
<b>AVERAGE</b>	<b>0.398</b>	<b>0.648</b>	<b>0.757</b>	<b>0.833</b>

**Table 9 Estimation results for US shock spillover intensities**

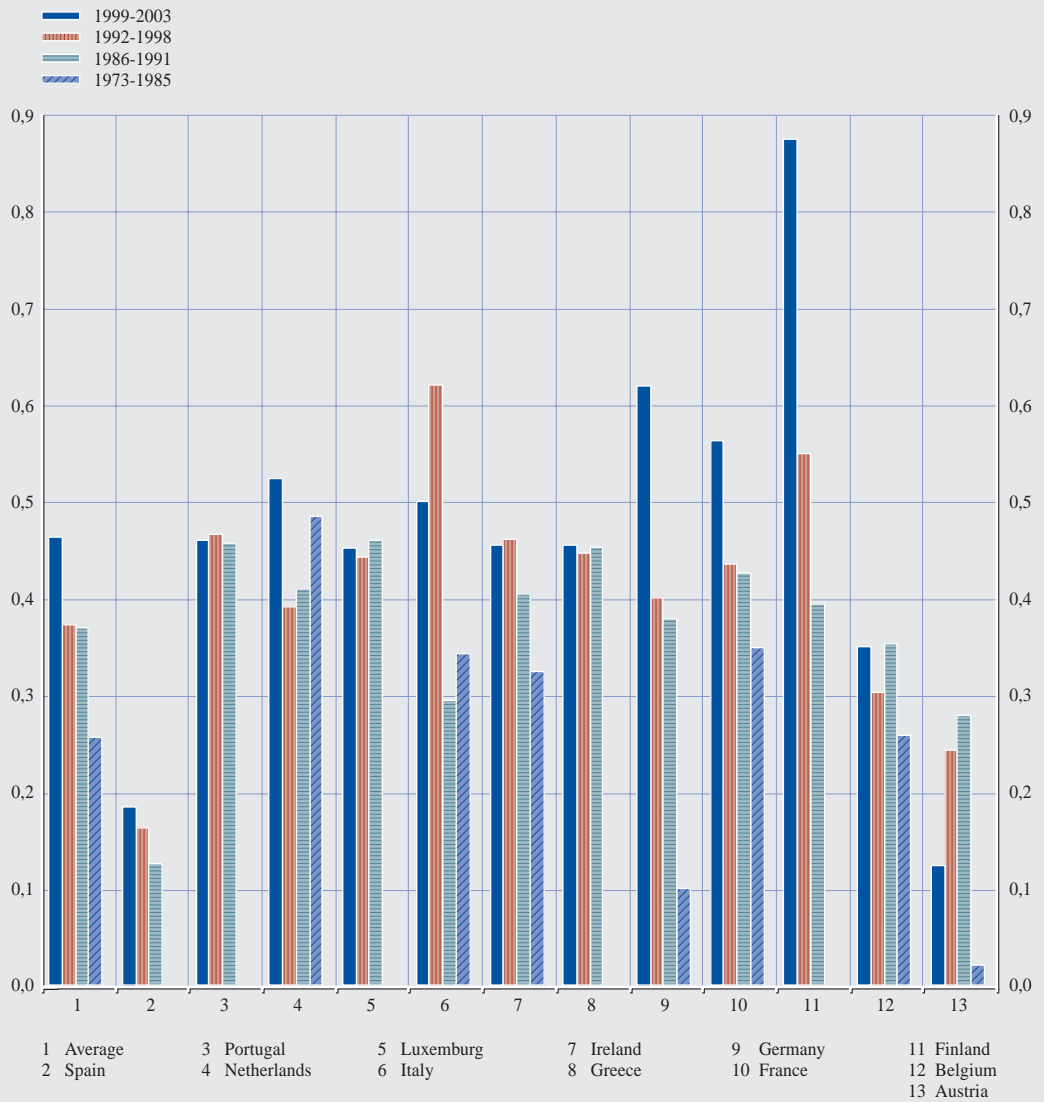
	US Shock Spillover Intensity			
	73-85	86-91	92-98	99-03
BELGIUM	0.2579 <i>0.0336</i>	0.3531 <i>0.1968</i>	0.3023 <i>0.2397</i>	0.3496 <i>0.3186</i>
GERMANY	0.0999 <i>0.0243</i>	0.3787 <i>0.0600</i>	0.3998 <i>0.0693</i>	0.6188 <i>0.0906</i>
GREECE		0.4526 <i>0.2174</i>	0.4462 <i>0.1028</i>	0.4547 <i>0.2474</i>
SPAIN		0.1258 <i>0.0521</i>	0.1625 <i>0.0467</i>	0.1839 <i>0.0755</i>
FRANCE	0.349 <i>0.0485</i>	0.4255 <i>0.0447</i>	0.4353 <i>0.0781</i>	0.5624 <i>0.1179</i>
IRELAND	0.3237 <i>0.0565</i>	0.4037 <i>0.0608</i>	0.4602 <i>0.0933</i>	0.4541 <i>0.1421</i>
ITALY	0.3424 <i>0.0624</i>	0.2938 <i>0.0539</i>	0.6196 <i>0.1010</i>	0.4992 <i>0.1503</i>
LUXEMBOURG		0.4594 <i>0.1573</i>	0.4421 <i>0.1401</i>	0.4519 <i>0.1785</i>
NETHERLANDS	0.484 <i>0.0364</i>	0.4096 <i>0.0245</i>	0.3912 <i>0.0529</i>	0.5229 <i>0.0854</i>
AUSTRIA	0.0211 <i>0.0161</i>	0.2791 <i>0.0787</i>	0.2433 <i>0.0883</i>	0.1233 <i>0.0990</i>
PORTUGAL		0.456 <i>0.046</i>	0.4657 <i>0.0526</i>	0.4591 <i>0.0734</i>
FINLAND		0.3932 <i>0.077</i>	0.5486 <i>0.0642</i>	0.8736 <i>0.131</i>
<b>AVERAGE</b>	<b>0.2559</b>	<b>0.3692</b>	<b>0.3720</b>	<b>0.4628</b>

Chart 37 EU shock spillover intensities



Source: Datastream and ECB calculations.  
 Note: This graph reports the intensity by which EMU-wide equity market shocks, other than those from the US, are transmitted to the local euro-area equity market, plus an unweighted average of the local market intensities, for four different periods.

Chart 38 US shock spillover intensities



Source: Datastream and ECB calculations.

Note: This graph reports the intensity by which U.S. equity market shocks are transmitted to the local euro-area equity market, plus an unweighted average of the local market intensities, for four different periods.

Chart 39 Proportion of return variances explained by European shocks

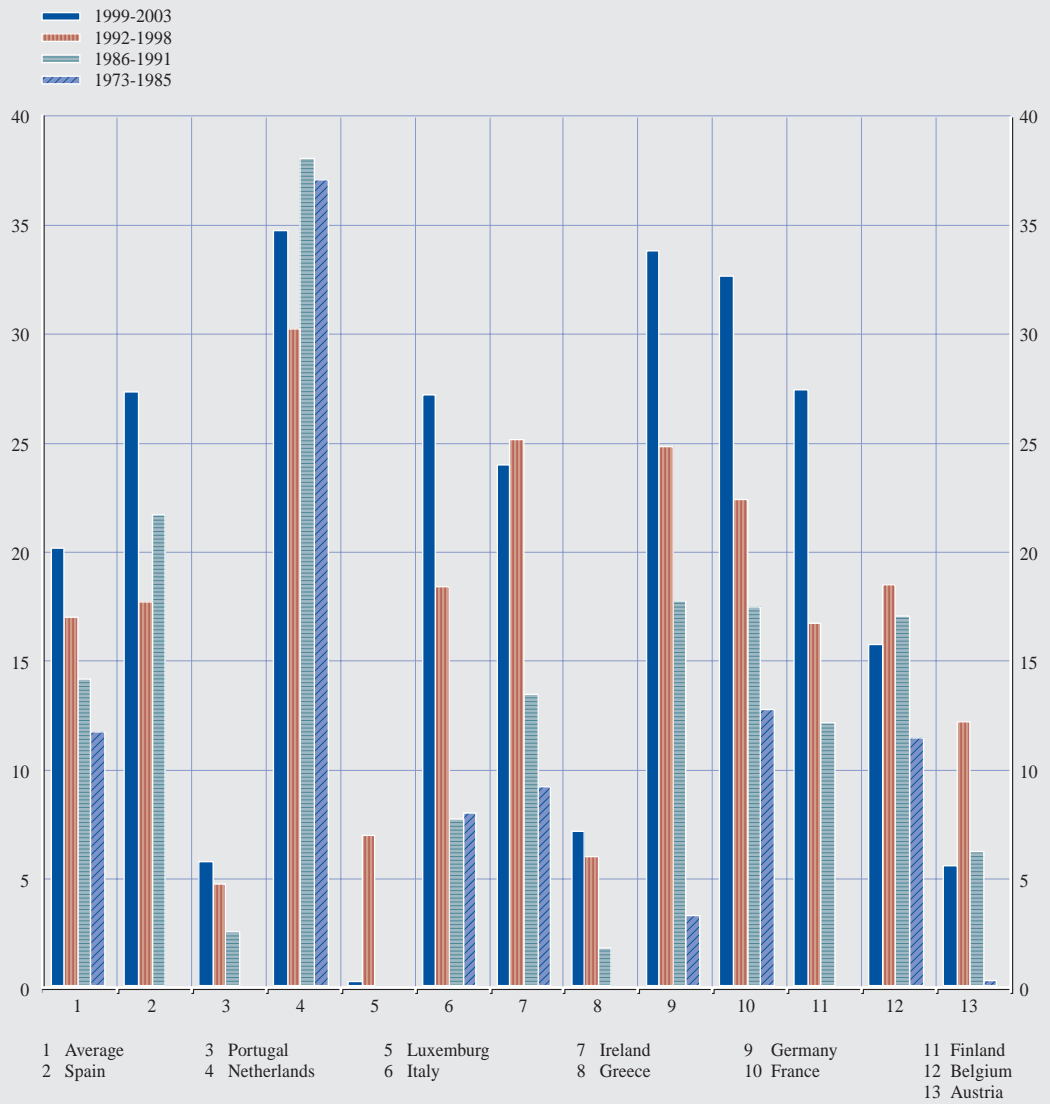


Source: Datastream and ECB calculations.

Note: The chart shows the relative importance of euro-area wide factors other than US equity market fluctuations in the variance of each euro-area country's equity market index ("variance ratio"), plus an unweighted average of the country variance ratios, for four different periods.



Chart 40 Proportion of return variances explained by US shocks



Source: Datastream and ECB calculations.

Note: The chart shows the relative importance of U.S. equity market fluctuations in the variance of each euro-area country's equity market index ("variance ratio"), plus an unweighted average of the country variance ratios, for four different periods.

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