The effect of Emu on bond market integration and investor portfolio allocations

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THE EFFECT OF EMU ON BOND MARKET INTEGRATION AND INVESTOR PORTFOLIO ALLOCATIONS:

An Empirical Study of Factor Decomposition and Diversification in European Bond Returns

Mary Margaretha Anna Pieterse-Bloem

THE EFFECT OF EMU ON BOND MARKET INTEGRATION AND INVESTOR PORTFOLIO ALLOCATIONS

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Universiteit van Tilburg op gezag van de rector magnificus, prof.dr. Ph. Eijlander, in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de aula van de Universiteit op vrijdag 13 mei 2011 om 14:15 uur door

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	prof.dr. H.P. Huizinga
	prof.dr. R.J. Mahieu

To my precious family: my husband Folker and
our children Femke, Roderick and Ophelia Pieterse.
To my parents: Jan and Coby Bloem

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For some, the creation of the European Economic and Monetary Union (EMU) constitutes a watershed event for fixed income markets. For others, it is the mere culmination of a long-established trend of increasingly liberalized and globalized financial markets. If forced to choose, I find myself more comfortable in the revolutionary rather than the evolutionary camp. Perhaps the root cause of this point of view is that I witnessed the momentous impact of the irrevocable locking of national currencies to the Euro on bond markets and its participants from my desk on one of many fixed income dealing rooms in London. As a Euro bond strategist, my task had been to advise market practitioners on the changeover to the single currency since roughly the middle of the 1990s. As Chairman of the ECU/Euro Bond Committee of the European Federation of Analysts' Societies (EFFAS), I worried together with my fellow strategists over the technical aspects of this changeover. Many hours were spent on the detail of the harmonization of bond conventions and the redenomination of bond contracts, alongside ongoing work on the provision of benchmark bond indexes. The bond investor community, though initially skeptical, started to turn their attention to the arrangement of their investment portfolios when the political momentum got serious. It was this more forward-looking debate on strategies for portfolio allocations best suited for a bond market with certain assumed hypothetical properties that I enjoyed most of all. For several years following the immediate transformation of national bond markets to the single currency, I remained a practitioner in the Euro bond markets, now as an advisor to sovereigns on the positioning of their debt in the newly created market. As such I continued to gather first-hand experience of the ongoing changes EMU brought about, to the fixed income markets at large and the behavior of investors therein. My privilege has been to assume the part of academic researcher and study the impact of EMU on the bond markets. I do so with the benefit of hindsight and market data, and out of an ongoing desire to learn more about the operations of our financial markets. This research remains true to my background and interests, for it is a fusion of market practice and theory.

It has been an exciting journey which has taken me nearly five years from start to finish. I would not have been able to complete it without the support from various corners. I am especially indebted to Prof.dr. Sylvester Eijffinger and Prof.dr. Dick van Wensveen for their initial faith in my ability to succeed and their ongoing enthusiasm for my research as it was progressing. Their comments and guidance have proven invaluable throughout. I am grateful to Prof.dr. Pjotr Hesseling and dr. Norman Schreiner from the Faculty Club of the Erasmus University in Rotterdam for pointing me in their direction as possible promotores. The Faculty Club remained supportive even as my virtual desk transferred from Erasmus University to Tilburg University. I am much obliged to both universities for providing me with the necessary facilities.

One of my most beneficial and lasting learning experience I obtained from my cooperation with Prof.dr. Ronald Mahieu on the empirical study. I thank him for his patience and encouragement as I brushed up my rusty econometric modeling skills. His input in this stage of my research proved its worth many times. I would also like to thank the other members of my committee for their comments on the manuscript and their support: Prof.dr. Frans de Roon, Prof.dr. Lex Hoogduin and Prof.dr. Harry Huizinga.

During the theoretical stage, several institutions opened their doors to me in and gave me an opportunity to stay in touch with market practice. Sociéte Generale granted me an internship and I had the pleasure of working on my thesis in their fixed income dealing room in London for several months. This internship happened to be at the most turbulent time for financial markets that certainly I have seen in my short career. It was exciting for me to be there among the action and to experience the tremors in the bond markets. I am grateful to Ciaran O'Hagan and Vincent Chaigneau of the fixed income research group at Societe Generale for arranging my internship. I also spent a month at the Financial Research division of the ECB in Frankfurt which was as enjoyable as it was motivating. I thank dr. Philipp Hartmann for extending the invitation and Simone Manganelli of the ECB and visiting researcher Marta Gómez-Puig from the University of Barcelona for our interesting sessions on the Euro bond markets. I thank Age Bakker at the IMF for arranging a week's schedule of meetings for me with his colleagues in Washington at the time the IMF had itself just published a report on the integration of Europe's financial markets. Equally, I thank Istvan Szekely and John Berrigan at the European Commission, whom I visited in Brussels, to receive their comments on a first draft of my review on the economic literature on international financial integration.

Every researcher knows that good data is half the job done. Bloomberg, Morgan Stanley, EFFAS and Dealogic all need special thanks for allowing me to work with their data. The technological assistance from IT Couple Emil and Katie Glownia was pure magic and transformed my copious amount of eurobond data into a format that could be fed into MatLab.

I mention my precious family last, but they come of course first in all this. They deserve special thanks. The truth is that this thesis would never have seen the light of day without the initiative of my husband Folker. He has been a beacon of encouragement and support from start to finish, allowing me to overcome what seemed to me insurmountable obstructions. Our wonderful children, one of whom was just born when I started work in earnest on this thesis and the other right in the middle of it, have been incredibly patient with me. I dedicate this thesis to my precious family and to my parents.

Mary Margaretha Anna PIETERSE-BLOEM

Tilburg, The Netherlands
13 May, 2011

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CHAPTER 1
Introduction

1. Motivation

The integration of financial markets and optimal portfolio allocations and diversification strategies remain subjects of theoretical debate among economists. Given the potential implications for market practice, the debate is followed with sincere interest and occasionally contributed to by its various quarters. Among those are monetary authorities, economic policymakers, financial regulators and of course fund managers. All stand to benefit from new findings.

The subjects of international financial integration and portfolio diversification are strongly interrelated. Integrated financial markets are a prerequisite for diversified international investment portfolios. In turn, the extent in which portfolios are diversified is indicative for the degree of financial integration that has been achieved. The desire to increase financial benefits from better portfolio allocations is often a leading force in the further breakdown of any remaining barriers between national financial markets. In this sense, there is an ongoing dynamic interaction between financial integration and international diversification. Despite this strong interrelation, the two subjects are contended with in near dichotomy within economics. International financial integration has been analyzed mainly within the realm of macroeconomics and international portfolio diversification within the realm of financial economics. It is only recent that a number of studies have crossed over into each other's territory to much effect in the dual study of international financial integration and benefits of international portfolio diversification. This thesis is positioned in this new and fertile common ground. It concentrates on the bond markets, a part of the financial markets where I gained my market experience and the area where more academic research is required.

This thesis studies investor behavior with respect to their portfolio allocations and diversification opportunities in the bond markets and in the context of the increased integration of these markets in Europe. It takes the position that the formation of the economic and monetary union (EMU) marks a momentous event with significant immediate and ongoing implications for the constitution and operation of European bond markets and the scope of investment opportunities therein. In the immediate aftermath of the event, financial studies provide mostly a descriptive analysis of the impact of EMU on financial markets and portfolio allocations. The focus hereby often includes fixed income markets where the direct changes are most visible. Theoretically driven empirical analysis is mostly reserved for equity markets though.

My overall research question is as follows: How have investor portfolio allocations and diversification opportunities in the European bond markets evolved in the transition to the single currency, and what does this in turn offer in terms of evidence of the process and state of the financial integration of these markets? A wealth of economic literature provides a multiple of different methodologies in which this subject can be approached. I arrive at my chosen methodology in three stages. In the first stage, an extensive review of the measure-based literature on international financial integration results in an analysis of the course of the integration of fixed income markets in Europe. The initial conditions offered by macroeconomic theories that are most effective in quantifying financial integration have been mostly applied to the short end of fixed income markets, i.e. the money markets. Here, the barriers to full capital mobility for assets that are highly substitutable can be relatively easily identified. When attention shifts to the long end of fixed income markets that are the bond markets, as this thesis does, additional factors come into play and the analysis becomes richer. The second stage descends from this more theoretical analysis to a market-based analysis of the fundamental way in which these markets have changed and an account of vanishing and emerging investment opportunities for bond investors due to EMU. The logic in this sequencing of stages is that both render important insights into the *ability and opportunity* of bond investors to make uninhibited allocation choices. This ability and opportunity is chiefly in reference to prevailing market barriers and the fusion of fixed income markets under the Euro. Once this is established, I turn to an analysis in the third stage which incorporates beyond the ability the *willingness* of investors to seize the opportunity to benefit from changing diversification opportunities in European bond markets.[1] This willingness is chiefly in reference to the actual behavior of investors. The chosen methodology is to analyze this investor behavior with the use of European bond returns in the assumption that investment decisions are led by risk-reward benefits in returns. I do this first by determining which factors (country and industry) best describe European bond returns. I then use *spanning* and efficiency tests to analyze what the effect of this is on portfolio diversification strategies for fund managers with a mean-variance performance objective.

At the third stage, the thesis could have taken different turns. The study could have adopted a qualitative approach. This could have been fulfilled through a survey of institutional investors to uncover patterns of changing investment flows, bond portfolio compositions and diversification strategies in Europe. This was indeed my original idea. However, in the course of stage one (Chapter 2) and as I gain a much better understanding of the vast set of methodologies that have been developed in the field, I become drawn to a more quantitative approach. By means of a quantitative approach, this thesis could have taken the direction of a study into the home bias in European bond portfolios. Home bias is well

[1] Note that the terms *ability* and *willingness* are used in a broader sense than in Chapter 2 where they are used to describe international financial integration from the perspective of the theory and conditions on interest parity deviations only.

known to stand between the ability and the willingness of fund managers to optimally diversify their portfolios. A variety of methodologies have been developed to analyze this phenomenon in asset portfolios which in adopted form could have been applied here. However, specifically as regards the prevalence of home bias in European bond markets, the second stage (Chapter 3) compounds evidence, albeit incomplete, that EMU has elevated national home bias to a Euro home bias in bond portfolios. A quantitative study of home bias seems therefore more appropriate for the study of the integration of the Euro-denominated bond market with that of the rest of the world.

As such my thesis has culminated neither into a qualitative survey into bond fund management practices nor into a quantitative study into home bias. Instead, I resolve to utilize methods from a new niche that emerges from my review of the literature on international financial integration (Chapter 2). This niche is where the traditional macroeconomic methods of measuring market integration cross over and draw on financial economic methods for determining the importance of country and industry effects in return variation and as a base for portfolio diversification. The general proposition is that with better integrated markets under EMU country effects decline. If financial markets in the Euro zone are completely integrated, then country effects are merely the result of differences in the creditworthiness of EMU sovereigns. These differences exist because each sovereign remains in control of its own political-economic and above all fiscal policy, though the latter supposedly within the bounds of the Growth and Stability Pact. Even so, since the single market incorporates the free flow of capital, goods and labor, it can be expected that the national economies of EMU countries will integrate further. Hence, the determination of the course of the importance of country effects is a measure of financial ánd economic integration. Furthermore, if the ex ante predicted industry specialization in countries takes place under EMU, the importance of industry effects should rise.

The standard decomposition model first introduced by Heston and Rouwenhorst in 1994 allows for a direct specification of the importance of country and industry effects in return variation for a preselected time period. This is the first methodology I wish to use. If indeed the importance of country effects diminishes in bond returns and the importance of industry effects rises from the period before EMU to the period thereafter, then a shift in portfolio allocation from country to industry may result in a better mean-variance performance. Econometric tests developed by Huberman and Kandel (1987) and De Roon and Nijman (2001) allow for a direct comparison of the mean-variance performance of country and industry portfolio return indexes. This is the second methodology I wish to use. Both methodologies combined will effectively determine the importance of country and industry effects in bond return variation, thereby implicitly indicate the financial and economic integration achieved under EMU and validate either as a bond portfolio diversification strategy.

Financial markets lend themselves well to empirically verify whether ex ante integration assumptions have become real. Unfortunately, return index series dissected by geography and industry sector typically required for this type of research are not readily available for European bond markets. I suspect that this has deterred other authors from going down this path. My own experience as a bond market practitioner allows me to overcome this hurdle and to gather a wide-ranging database. The empirical analysis starts from individual eurobond price series; 6,440 in total are sourced from Bloomberg and Morgan Stanley. These are calculated to (outright) returns and converted into USD through exchange rates obtained from Datastream. They cover the period from May 1990 to March 2008 and are by design adequately long either side of the inception of EMU in 1999 to justifiably determine its effect. By means of each eurobond issuer's information on country origin and industry base, obtained from the same sources, each USD return series can be classified accordingly. The information contained within the data set allows for further classification into liquidity and life-to-maturity brackets. While the industry groups include government institutions and thereby incorporate eurobonds from (quasi-) sovereign issuers, they serve as a proxy for the real government sector in this stage of the analysis. In a further addition, when the analysis moves to the level of portfolio indexes, return index series for domestic government bonds are obtained from EFFAS/Bloomberg to allow for the comparison between these two segments of the European bond markets. Here, excess returns are also required, calculated from the risk-free interest rate for which an appropriate proxy is obtained from Datastream.

The empirical research that flows from this in the third stage (Chapters 4 and 5) is the heart of this thesis and my unique contribution to the research field. To my knowledge, this is the first empirical study that analyzes both the factor decomposition and portfolio diversification strategies for European bonds over such a long period. The results amount to largely consistent conclusions on the evolution of the importance of country, industry and other effects such as liquidity and maturity in the risk variation of European bond returns and in the design of optimally performing portfolios from before to after EMU. These results can be indirectly verified with findings elsewhere in the thesis on the state of financial integration of bond markets in Europe under EMU and evidence from market practice on shifting bond allocations. Beyond that, they render important insights into the perceived course of economic integration at the national-economic and industry level within the Euro zone as observed by the bond markets.

2. Overview of chapters

The three-stage set up of my research and described in my motivation is emulated in the chapters.

Chapter 2 is a review of a large quantity of research that has been produced in the field of international financial integration over the past four decades. It is structured around a focus on theories that are able to measure the process, degree and state of integration. An eclectic approach is adopted that organizes the more than fifty articles judged to have been the most defining into four strands: deviations from interest parity, savings-investment correlations, consumption growth correlations and determinants of capital controls. It is described how each strand produces its own specific conditions for the quantification of international financial integration and it is demonstrated how these conditions are theoretically linked. By virtue of a discussion of the empirical evidence each strand has produced, the strengths and weaknesses of the various conditions come to light. This discussion initially takes on a global perspective, but in the course of the chapter gradually converges on the integration of fixed income markets in Europe, the focus of this thesis. It is uncovered that by the time EMU commences and under its new reality, the measures of international financial integration discussed in the chapter so far are up for renewal. Some recent studies in the field have reached out to the field of financial economics to draw on methods for the study of equity return variation for inspiration of new integration measures for the Euro zone's capital markets. This is described as a new direction of research and one that is identified as appropriate for the purpose of my own empirical research.

Chapter 3 is a descriptive account of the evolution, and in some aspects even revolution, fixed income markets have undergone as a result of EMU. The account is based on indications from market practice including securities volumes and trading statistics and anecdotal evidence from investor surveys. It otherwise relies on similar descriptive articles in the finance literature. A detailed picture emerges of how EMU has succeeded in creating a large, deep and largely harmonized domestic fixed income market in Europe and has encouraged the emergence of hitherto underdeveloped sectors, first and foremost the credit bond market. In the context of these transformations in the landscape of fixed income markets in Europe, the changing asset allocation and diversification opportunities for bond portfolio managers are discussed. There is sufficient empirical evidence on the broader geographical diversification of European bond portfolios but only circumstantial empirical evidence as regards their larger credit diversification. The latter has, due to the lack of comprehensive data on bond portfolio compositions in Europe, remained understated in the finance literature.

These first two material chapters provide the context for my empirical research; the first one (Chapter 2) from a theoretical point of view and the second one (Chapter 3) from a market practice point of view. Henceforth, the thesis concentrates on the empirical study of bond returns in Europe. It is again divided over two chapters.

Chapter 4 is my empirical study into the factor decomposition of European eurobond returns in primarily country and industry effects and secondarily liquidity and maturity effects. It is based on the decomposition methodology of Heston and Rouwenhorst (1994). Within financial economics, theirs is adopted as the standard decomposition model. The creation of a data set of individual eurobond returns that is used for the purpose of the empirical analysis in this chapter and the next is described in detail. In the methodology section, the main decomposition model and its extended version following Varotto (2003) are outlined. The empirical results of both models for the entire sample period and the two subperiods around EMU are analyzed in detail. This study establishes the importance of country versus industry effects in European eurobond returns over the course of my sample period of May 1990 to March 2008, providing another perspective on the economic and financial integration achieved in Europe. It allows for first indications, based on the risk-contributing properties of factors, of whether eurobond portfolios constructed from a country allocation or an industry allocation have better merit and whether this has changed following EMU. In the course of this analysis, it is found that the common factor in eurobond returns is high. This is analyzed separately.

Chapter 5 is my empirical study into the risk and reward properties of bond portfolios based on a country and industry allocation. Further to Huberman and Kandel (1987) and De Roon and Nijman (2001), mean-variance tests of spanning and efficiency are used to compare the performance of the two different types of bond portfolios. The methodology employed in this chapter complements that of the previous chapter and allows for more indications on whether a diversification strategy based on either country or industry yields better results in Europe, this time in a mean-variance framework. Results from the decomposition analysis of the previous chapter are utilized in this chapter, as country and industry portfolios constructed directly from eurobond returns and after decomposition are compared in their test results. As mean-variance tests are typically performed at a portfolio index level, indexes that represent the domestic government bond sector in Europe are included in this analysis.

Chapter 6 provides a summary wherein it binds the analysis from the previous four chapters together. It summarizes the main conclusions in light of my overall research question and the concepts of ability and willingness introduced in the motivation of this chapter. Chapter 6 ends with a contemplation of the main results, drawing out their wider economic implications and their relevance for current events in financial markets. Final reflections in this are forward-looking.

CHAPTER 2
International financial integration and EMU: Theory and evidence

1. Introduction

With the use of some powerful theories, initially developed in macroeconomics, this chapter gives an overview of the evolution of thought on international financial integration. The focus is on theories that have come forward with methods for the measurement of this integration. In the review of the empirical evidence of these theories and measures, initially an international perspective is adopted and financial markets in a broad sense are discussed. Gradually, this hones in on the process and degree of integration of the fixed income markets in Europe and within that the bond markets. By virtue of knowing of what has proceeded in terms of this academic debate, new directions of research are uncovered and also outlined in this chapter.

The 1980s sees a surge among macroeconomists to measure the degree, the process and the speed of international financial integration. Four specific strands of theory emerge from this effort, which continues in the 1990s and beyond. Three strands adopt a unique approach to the subject as regards the quantification of financial integration: deviations from interest parity, savings-investment correlations and consumption growth correlations. This chapter reviews the theoretical foundations of each of these strands and the conditions they put forward for the measurement of international financial integration. In this more theoretical discussion in the early part of this chapter, these conditions are unraveled to show what type of integration they imply and how they are interlinked. This discussion also shows up the strengths and weaknesses of the various theoretical conditions and their appropriateness for measuring financial integration. Following on from this, the chapter gleans the empirical evidence these theories and their related conditions have brought forward on the financial integration of capital markets, both internationally and in Europe specifically.

The debate on capital controls among international macroeconomists, which commences in the aftermath of the gold standard and proceeds with vigor alongside, is also reviewed for this purpose as a fourth strand. The latter focuses more on “prerequisites for” rather than “consequences of” financial integration, which is rather the focus of the three strands that are first discussed. The debate on capital controls further differs from the earlier strands in that it is largely a qualitative debate on the desirability of free capital movements and financial integration. Nevertheless, the small part of this debate that takes on a more quantitative approach and attempts to measure and identify the determinants of capital controls provides yet further insights.

Further to that, the debate on capital controls lends a historical perspective into the movement towards more liberalized and more integrated financial markets among industrialized countries post-WWII. This is taken on with accelerated effect in the 1980s under the up and coming laissez-faire spirit. In Europe specifically, the European Economic Community (EEC) makes a firm pledge by the end of the 1980s to create a single market within its territory. As such, capital controls are lifted by 1990. When in 1992 the Maastricht Treaty is signed the roadmap to EMU is laid down, culminating of course in the Euro in 1999. With that, the measurement of the integration of financial markets takes on a new meaning. Various European bodies are keen to establish the state of integration of the capital markets within the Euro zone. Capital markets have grown more complex by the start of the new millennium and in recognition of this, measures are considered for its various sectors. It is described in this chapter how this effort leads to the assembly of a set of new measures on financial integration.

This chapter demonstrates that the cross-fertilization of the tried and tested measures from the macroeconomics field with methods borrowed from the field of financial economics, to date predominantly applied to equity markets, provides fertile ground for these new measures. It is shown that the end result is two-fold. The integrated set of old and new measures comprehensively attests to largely integrated financial markets in Europe under EMU. This high level of integration is shown to exist particularly in the fixed income markets, but with some notable differences across its various segments. Besides this significant verification, the cross-over territory between macroeconomics and financial economics is identified as a new and exciting direction of research. It provides a productive and constructive way forward in the empirical phase of my research into investor portfolio allocations and diversification opportunities in the European bond markets in the context of the increased integration of these markets.

The remainder of this chapter is organized as follows. Section 2 discusses why international financial integration matters, in general and specifically for the purpose of this research. Section 3 gives an overview of the main strands of macroeconomic theories on international financial integration. It outlines the definition of international financial integration each inherently adopts and the type of financial integration they refer to. It also discusses in detail the support and the criticism each have drawn and presents their empirical evidence on international financial integration. Section 4 then considers the application of these theories to Europe, pre and post-EMU. As the constitution of capital markets changes dramatically under the Euro, available measures of financial integration are shown to be limiting in scope, giving rise to new measures derived from the literature of financial economics on equity return variation. Other new directions of research in the field are also discussed in this section. Section 5 concludes this analysis on the theory and evidence of international financial integration and EMU and looks forward to the next chapters.

2. Why the integration of financial markets matters

From a theoretical perspective, open market economics rooted in neoclassical theory proclaims many benefits to the free movement of capital between countries, both at the macroeconomic and the microeconomic level. At the macroeconomic level these benefits are mainly derived as an extension to the benefits of the free trade of goods. The most important one of these benefits is the prediction of a more optimal global capital allocation as international financial integration frees capital to seek its most profitable use. Gains to capital generated in the capital exporting country will in theory more than compensate for any potential losses to labor and vice versa for the capital importing country. This results in higher economic growth in both countries. Positive economic growth effects from a more optimal capital allocation also arise through the channel of greater financial development. This occurs for example when funds for investment opportunities increasingly flow to more productive regions, in turn contributing to the efficiency of their financial system. Baele et al. (2004) refer to several studies that provide evidence that financial development positively effects economic growth. At the microeconomic level, financial integration offers opportunities for economic agents to share risk and to smooth consumption intertemporally. In the aggregate, this not only protects the domestic economy from shocks (provided that it is too small to influence the world economy), but this also implies that economic growth is not limited by a scarcity of domestic savings. Hence, any evidence to the contrary – i.e. that markets are not integrated financially, that capital is not perfectly mobile and/or that institutional, legal, tax or other barriers exist - sits very uncomfortable with this branch of international economics. Not only because it has produced many contributions based on the assumption of free movement of capital, but also because of the wealth implications from the inability of capital to move freely.

It has to be noted that the debate among economists on capital controls reveals some possible less desirable effects too of financial integration, often to do with a reduced ability of governments to control the effect of their economic policy. This brings the perspective of the policymaker out to the foreground. In the monetary sphere, Obstfeld (1998) labels this the ‘open-economy trilemma’. It means to say that a country cannot simultaneously maintain fixed exchange rates and an open capital market while pursuing a monetary policy oriented toward domestic goals and governments can effectively only chose two. Applied to the world’s developing countries, Montiel (1994) describes among the macroeconomic implications of financial integration that under a fixed exchange rate regime neither fiscal nor monetary policy can influence the terms for domestic borrowing and lending. Other policy implications are that financial integration influences the economy’s steady-state inflation rate, as even under weak financial integration domestic agents have means to escape an inflation tax. Staying with the topic of taxes but crossing over to the fiscal policy sphere, taxes on capital generally are harder to collect the more financial markets are integrated because capital funds can leave the domestic economy more easily. The latter is indeed an often heard fiscal price that open economies pay for financial integration, with possible adverse income distribution effects (Obstfeld, 1998).

Yet from the perspective of monetary authorities and indeed market practitioners, financial integration is often positively attributed with an inherent ability to enhance the efficiency of financial systems as a whole. Better functioning financial systems reduce uncertainty over asset prices and trading, allow for pooling of risks and optimal diversification of investment funds, mobilizes savings and provides the opportunity to institutions, firms, consumers and countries alike to borrow cost-efficiently. Greater international competition among financial service providers improves the price-quality of financial intermediation, aided by advances in financial technology and adopted methods of asset pricing and risk assessment. Von Furstenberg (1998) cites studies where this attribute of financial integration globally renders capital-saving properties. It also has the ability to improve productivity in the many non-financial businesses that are economically linked to the financial services industry. For monetary authorities in particular, financial integration is channel facilitating a smooth and effective transmission of monetary policy. The ECB has consistently advocated the importance of this channel in the case of monetary policy for the Euro area countries (ECB, 2005). But this financial market openness as a result of financial integration may also come at a price for financial stability. Faruqee (2007b), for instance, emphasizes risks of contagion. Closer financial integration increases the chances that developments in one financial market spill over to another and act as a transmission channel for shocks.

The debate on the relation between capital mobility and financial stability is one in its own right in international economics. It dates from a time in the 1980s and 1990s where often the opposite view is propagated, mainly with regard to the effectiveness and desirability of capital controls or to stem excess market volatility. Eichengreen, Tobin and Wyplosz (1995) famously contribute to this debate by proposing to throw ‘sand in the wheels of international finance’. They suggest a global transactions tax to deter speculators and return some national autonomy to monetary and macroeconomic policy. Though this contribution, written in the aftermath of the ERM crises in the early 1990s, concedes that monetary unification would solve the problem of excess (foreign exchange) market swings for Europe, they propose that it will not solve this problem for the world as a whole where the costs of these capital flows lie in its diversion from more fundamental macroeconomic policy targets. In the same vein, Obstfeld (1998) asks whether the global capital market is indeed ‘benefactor or menace’. And though this second contribution is written in the aftermath of the Asian financial crises in the late 1990s, observations such as the following seem as relevant and poignant in light of events in financial markets from the sub-prime credit crisis since mid-2007: these “episodes again underline the need for more effective monitoring and regulation of the asset and liability structures of financial institutions [.., and] also underline the difficulty in discerning the true risk characteristics of institutions' assets and liabilities." (Obstfeld 1998, p 25). Section 3.3 provides a more elaborate discussion on capital controls but it is highlighted here that economists are by no means united in the view that integrated capital markets only bring benefits, for financial stability or indeed the economy as a whole. New research born out of the research on financial integration is again focusing on wealth effects and veers in the direction of financial stability aspects for which I refer to Section 4.3.2.

As regards Europe specifically, post-WWII efforts have focused on political, social and economical integration, which, as far as the latter is concerned culminates in the Single Market Act of 1990 and in EMU in 1999. There is no doubt that financial integration has played, and continues to play, a major role in this process. De Grauwe (2007) even goes as far as linking the success of financial integration with that of EMU itself. Arguing that the role of risk sharing is crucial in dealing with the unpleasant consequences of centrifugal forces in a monetary union, the ideal risk sharing mechanism would be the centralization of national budgets. In the absence of that, De Grauwe identifies the full integration of financial markets as the other main mechanism. Integrated stock, bond, mortgage markets and banking sectors work as an insurance system, as a shock in one country is then shared by all other countries. Though it is conceded that mainly the affluent with an ability to hold a diversified asset portfolio are likely to benefit and that ultimately some form of centralized budget needs to be put in place to fully safeguard EMU, it does not take away from the important role financial markets can play in maintaining or restoring stability.

In sum, one way or another and depending on the perspective, much hinges on the openness of capital markets and their financial integration. But however intriguing this debate, it is beyond the scope of this research to study the benefits (and risks) of financial integration any further. The objective here is to merely point out the importance and relevance attached to its prevalence as a context for the theory and evidence in the empirical literature of the extent to which financial integration has advanced in Europe.

3. Main macroeconomic theories and empirical evidence

The state and process of international integration of the world's financial markets has been a topic of much debate among economists, with policy makers and market practitioners taking a keen interest in its practical implications. This section aims to provide an overview of the main macroeconomic theories that are developed with the specific aim to quantify international financial integration. I will also elaborate on the support and criticism they have drawn to put these theories further in perspective. Finally, some important empirical evidence is highlighted, in summarized form, to get a sense of the extent of financial integration globally.

3.1. Three major strands of theories

Eijffinger and Lemmen (2003a) bring together two volumes of classic and contemporary articles on financial integration. This selection is arguably the most defining in shaping the debate to date on the determination and measurement of international financial integration. I follow them in their eclectic approach to present three major strands that have been most influential in bringing forward theory-based methodologies to measure international financial integration: deviations from interest rate parity; savings-investment correlations; and consumption-growth correlations and international risk sharing. The main purpose of this section is to demonstrate definitions of financial integration, conditions and underlying assumptions that these theories are based on and the empirically testable conditions they produce for its measurement. Each strand is discussed in more detail in turn for this purpose. Furthermore, I will show how these theories are conceptually linked which will prove to be insightful in the subsequent discussion of their empirical evidence.

3.1.1. Definition of financial integration

The debate on international financial integration shows that the notion itself is not analytically straightforward. What exactly is meant with international financial integration? Unfortunately, there is no unambiguous definition in the literature and each is intrinsically linked with the specific strand of theory. The most far-reaching definition of (perfect) international financial integration is that there is perfect international capital mobility and perfect international asset substitutability, such that investors face no barriers to instantaneously change their portfolios. Further clarification arises from the disintegration of these two essential building blocks of capital mobility and asset substitutability into six types of barriers that need to be absent for this state of perfect international financial integration to exist:

- Transaction costs (*TC*): refers to the differential cost of trading otherwise known as the bid-ask spread. Beyond that, it can refer to costs related to information gathering, including the costs associated with operating in a different language, time zone, and differences in financial reporting across countries.
- Capital controls (*CC*): refers to any policy designed to limit or redirect capital account transactions that may take the form of price controls (e.g. taxes) or quantity controls (e.g. quotas) and can be applied either to residents purchasing foreign assets (capital export controls) or foreign residents purchasing domestic assets (capital import controls).
- Asset-specific risks (*AR*): refers to differences in characteristics of assets, such as default and liquidity risks, tax treatment and eligibility for discounting at the central bank.
- Political risks (*PR*): refers to the risk that capital controls are imposed in future periods.

- Exchange rate risks (*ER*): refers to the risks associated with the currency denomination of transactions. These arise if the forward rate is not an unbiased predictor of future spot exchange rates.
- Purchasing power risks (*PPP*): refers to the risk that expected inflation differentials between countries are not offset by nominal exchange rate movements.

Capital mobility, which is the ability of investors to adjust their portfolios, essentially depends on the absence of the first two types of barriers of transaction costs and capital controls. Asset substitutability, or the willingness of investors to adjust their portfolios, depends on the absence of all six types of barriers. While international financial integration defined as a state, referring to the existence of perfect or, in the opposite case, zero financial integration, is of theoretical interest to define a benchmark, practical interest focuses on measuring the degree of financial integration. International financial integration defined as a process refers to the gradual dismantling of the above barriers, affecting the degree of international financial integration (Eijffinger and Lemmen, 2003b). I now turn to each strand of theory to further determine the definitions of financial integration that are incorporated, the conditions and means of measurement they propose in practical sense.

3.1.2. Deviations from interest rate parity

This strand of theory fits into the price approach to financial integration for which the departing point is that the law-of-one-price holds. This law dictates that if markets are financially integrated then identical securities should be priced identically in them all, leaving no further room for market participants to arbitrage for profit. Tests on international financial integration based on interest parity conditions each give a different meaning and interpretation to the notion of identical prices.

The international money markets provide a setting in which the assumption of identical risk instruments is best satisfied and transaction costs are minimized. Prices from these markets are the cleanest test of financial integration. Closed interest parity is the relation between nominal interest rates on domestic instruments and instruments denominated in the domestic currency traded abroad, in the international offshore markets. Its synthetic approximation of covered nominal interest parity (*CIP*) is derived for identical (or otherwise comparable) instruments traded in the domestic market and in a foreign onshore market but denominated in a different currency. *CIP* conditions that any nominal interest rate differential thus observed is covered entirely by the forward premium. This measures the degree of international financial integration between (domestic and foreign) onshore markets. *CIP*, otherwise referred to as perfect (international) capital mobility of *Type I*, implies a zero covered interest differential, or a zero country premium. Deviations from *CIP* reflect transaction costs (*TC*) and capital controls (*CC*) barriers to the integration of financial markets across national boundaries and is therefore a measure of the ability of investors to adjust their portfolios. The second type, *Type II*, of capital mobility is ex ante uncovered nominal interest parity (*UIP*) and holds if expected nominal interest rate differentials on identical domestic and foreign instruments are zero except for the currency denomination. If exchange rate expectations are held with certainty or investors are risk-neutral, then the forward premium in *CIP* may be replaced by the expected future spot exchange rate to yield *UIP*. Perfect capital mobility of *Type II* implies a zero country premium as well as a zero exchange risk premium. The latter reflects the willingness of investors to move funds across borders. Finally, capital mobility of *Type III* is ex ante real interest parity (*RIP*) and holds if expected domestic and foreign real interest rates are equal. *RIP* assumes that ex ante purchasing power parity holds continuously, i.e. $PPP = 0$, and that the expected change in the exchange rate in *UIP* may be replaced by the expected inflation differential between the domestic and the foreign territory. Perfect capital mobility of *Type III* implies not only a zero country and foreign exchange rate premiums, but also a zero expected real exchange rate change or in other words a zero deviation from ex ante *PPP* as well. For this reason it is often seen as measure of both international financial and non-financial capital mobility, where the latter is referred to as the mobility of goods and services and the mobility of the production factors labor and physical capital or technology (Frankel and MacArthur, 1998).

Conditions of deviations from interest parity can be formally written (omitting time and maturity subscripts for simplicity). For closed interest parity as:

$$i = i^{euro}, \quad i^* = i^{*\,euro} \tag{1}$$

where i is the domestic nominal rate of interest, *euro* denotes the rate observed in the offshore euromarkets and the asteriks * denotes foreign. For covered nominal interest parity (*CIP*) as:

$$i = i^* + (f - s) \tag{2}$$

where f is the forward exchange rate and s is the spot exchange rate. For ex ante uncovered nominal interest parity (*UIP*) as:

$$i = i^* + (E_s - s) \tag{3}$$

where E_s is the expected spot exchange rate. For ex ante real interest parity (*RIP*) as:

$$E_r = E_r^*, \text{ with } r = i + (E_p - p) \tag{4}$$

where E_r is the expected real return and $E_p - p$ is the expected inflation rate (Eijffinger and Lemmen, 2003b). Table 2.1 summarizes these formal conditions, states the assumptions they are based on and what they measure. As expectations are difficult to observe, they are often assumed to be estimated with rational expectations, i.e. based on past information, and the ex ante *UIP* and *RIP* conditions are converted into ex post conditions for statistical measurement.

3.1.3. Savings-investment correlations

In 1980, Feldstein and Horioka publish an influential paper, arguing that with perfect long-term capital mobility, there should be no relation between domestic savings and domestic investment: "saving in each country responds to the worldwide opportunities for investment while investment in that country is financed by the worldwide pool of capital. Conversely, if incremental saving tends to be invested in the country of origin, differences among countries in investment rates should correspond closely to differences in savings rates." (1980, p 317). This condition of no correlation between domestic savings and investment has become known in the literature as the Feldstein-Horioka condition (hereafter FH condition). As this approach focuses on net transfers of real resources across national borders, it falls within the quantity-based theories of international financial integration.

Compared to the deviations from interest rate parity conditions, Feldstein and Horioka offer a deliberate distinction between short and long-term capital mobility. While part of the world's capital stock is held in liquid form and mobile to arbitrage short-term interest rate differentials, perfect capital mobility should also measure such arbitrage type activity among long-term investments. Their analysis yields a very basic direct and easy to measure relation:

$$\left(\frac{I}{Y}\right)_k = \alpha + \beta\left(\frac{S}{Y}\right)_k + \varepsilon_k \qquad (5)$$

where $\left(\frac{I}{Y}\right)_k$ is the ratio of gross domestic investment to gross domestic product in country *k* and $\left(\frac{S}{Y}\right)_k$ the same for gross domestic savings. In the extreme case of perfect capital mobility and for a country *k* that is infinitesimally small, the FH condition is that β, or the FH coefficient, would be zero. This is because an increase in the savings rate in that country would cause an increase in investment in all other countries in the world (including in country *k*) but the distribution of this extra capital would positively depend on the size of the initial capital stock (and the elasticity of the country's marginal β should only be in the order of magnitude of its share of world capital). Statistical tests of this type of capital mobility result in testing the null hypothesis (H_0) that β is statistically different from zero among a set of countries and for different

Table 2.1
Deviations from interest parity conditions

Theoretical conditions:	Assumptions:	Elimination of:	Measures:	Cross-border flows:
Closed Interest parity $i = i^{euro}$, $i^{*} = i^{*euro}$	*TC=0,* *CC=0*		financial integration - ability	domestic onshore and euro offshore markets
Perfect capital mobility of Type I: CIP $i = i^{*} + (f - s)$	*TC=CC=0* *AR=PR= 0*	country premium	international financial integration ability	domestic onshore and euro offshore markets
Perfect capital mobility of Type II: UIP $i = i^{*} + (E_s - s)$	*CIP +* $ER = (f - s) - (E_s - s) = 0$	country premium, FX premium	international financial integration ability and willingness	domestic onshore and euro offshore markets
Perfect capital mobility of Type III: RIP $E_r = E_r^{*}$ *where* $r = i + (E_p - p)$	*UIP +* *PPP = 0, i.e.* $(E_s - s) - (E_p - p) + (E_p^{*} - p^{*}) = 0$	country premium, FX premium, PPP holds	international financial and non-financial integration ability and willingness	domestic onshore and foreign onshore markets

Notations:

- *i* is the domestic nominal rate of interest, *f* is the forward exchange rate, *s* is the spot exchange rate, *r* is the domestic real rate of interest, p is the price level in the home country. *euro* denotes the rate observed in the euromarkets. *E* denotes expectations. The asteriks* denotes foreign. For simplicity time and maturity subscripts are omitted from these notations.
- *CIP* is covered nominal interest parity. *UIP* is ex ante uncovered nominal interest parity. *RIP* is ex ante real interest parity. *PPP* is purchasing power parity.
- *TC* is transaction costs. *CC* is capital controls. *ER* is exchange rate risk. *FX* is foreign exchange.

Based on Eiffinger and Lemmen (2003b, Figure 2,p *xi*; and 1995, Table 1, p 5) and own extensions.

confidence intervals. Failure to reject the alternative hypothesis can be interpreted as evidence that there are substantial imperfections in the international capital market because a very large share of domestic savings tends to stay in the home country. Since the basic equation can also be interpreted in terms of foreign investment flows, where the excess of gross domestic investment over gross domestic savings $(I - S)_k$ is equal to the net inflow of foreign investment (except for the statistical discrepancy) and where it follows from national income identities that the current account balance $(CA)_k$ is equal to that net inflow of foreign investment, a regression of $\left(\frac{CA}{Y}\right)_k$ on $\left(\frac{S}{Y}\right)_k$ should have a coefficient of $\beta - 1$.[1] Testing the alternative hypothesis H_1: $\beta = 1$ in such equations tests that international capital flows do not depend on domestic savings rates and is an alternative measure of low world-wide capital mobility (Feldstein and Horioka, 1980; Feldstein, 1983).

To demonstrate the link with interest parity conditions is to show that the FH condition requires some additional assumptions to the most strict of interest parity conditions, the *RIP* condition. Dooley et al. (1987) propose that three conditions must hold in their framework before no correlation between savings and investment can be expected. First, investment must depend on a representative real rate of return r but not on other variables that are correlated with savings. So if there is an assumed linear relation, say $\left(\frac{I}{Y}\right) = a - hr + \varepsilon$, then the error term must be purely random and uncorrelated not only with the national rate of return but also with national savings. Secondly, the foreign expected rate of return, r^*, must be determined exogenously. In other words, the country cannot be large enough in world financial markets to influence the world interest rate. Thirdly, the domestic and the expected real rate of return relevant for real investment and savings conditions must be equal, $r = r^*$. If the capital account balance *CA* is a function of the differential in these returns, $CA = q\,(r - r^*)$, then the hypothesis is that q is infinite. Using this framework, the covariance between investment and national savings can be separated into three components:

$$cov\left(\frac{I}{Y}, \frac{S}{Y}\right) = cov\left(\varepsilon, \frac{S}{Y}\right) - h\, cov\left(r^*, \frac{S}{Y}\right) - h\, cov\left(r - r^*, \frac{S}{Y}\right) \qquad (6)$$

The first term on the right-hand side is an expression of the endogeneity of investment and savings, the second term can be referred to as the small country assumption and the third as the *RIP* condition.

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[1] Feldstein (1983) demonstrates that the basic equation can be rewritten as $\left(\frac{S-I}{Y}\right)_k = -\alpha - (\beta - 1)\left(\frac{S}{Y}\right)_k - \varepsilon_k$. Since the national income accounts divide the excess of domestic savings over domestic investment into net foreign investment (*NFI*) plus the statistical discrepancy in the savings-investment account (*SDS*) and by stating that *NFI* is conceptually equal to the balance on the current account (*CA*), this equation can be rewritten as $\left(\frac{CA}{Y}\right)_k = -\alpha - (\beta - 1)\left(\frac{S}{Y}\right)_k - \left(\frac{SDS}{Y}\right)_k + \varepsilon_k$. If $\left(\frac{SDS}{Y}\right)_k$ is uncorrelated with $\left(\frac{S}{Y}\right)_k$ then the β in this equation would be the same as the β in the basic equation.

Dooley et al. further state that if any one of these covariances fails to hold, then there is no reason to expect a zero correlation between the savings and investment rate. But this is only true of course insofar as any non-positive covariance is not equally offset by the other two covariance terms. It is now no longer difficult to see that the FH condition may reflect imperfect integration in goods and/or factor markets (imperfect non-financial integration) just as well as imperfect financial integration. In other words, the FH condition examines net financial and non-financial capital mobility (Eijffinger & Lemmen, 2003).

3.1.4. Consumption smoothing and risk sharing

Born initially out of an attempt to reconcile opposing empirical evidence resulting from the interest parity deviations and FH condition tests on the degree of international financial integration and a critique that neither is effectively underpinned by a benchmark model of an efficient world economy, Obstfeld (1986, 1989, 1994) lays the foundations for a third alternative. This strand of macroeconomic theory uses intertemporal consumption patterns across countries as a measure of capital mobility. As with the strand based on savings-investment correlations, this strand falls within the quantity-based approach to international financial integration. Obstfeld utilizes the Euler equation characterization of optimal consumption behavior to devise essentially two tests on international financial integration: if markets are integrated then residents across countries will have access to the same set of financial instruments leading to testable restrictions on intertemporal marginal substitution rates (*Test I*) and on the comovement of consumption growth rates (*Test II*). I shall elaborate further on each test.

First, *Test I*. Here, Obstfeld's Euler equation test implies that if residents of two countries have access to the same risk-free asset, then their expected marginal rate of substitution between current and future units of the home and the foreign currency must be equal. Typical intertemporal consumer utility maximizing behavior subject to budget constraints in the stochastic setting of certainty forces the consumer's plan for future consumption to obey the following expected marginal equality:

$$E_t\,[R_{t+1}\, m_{t+1}] = 1 \qquad (7)$$

where R_{t+1} denotes the return on any asset between time t and $t+1$, and m_{t+1} the marginal rate of intertemporal substitution, which in turn is determined by a subjective discount factor β and the utility of consumption at time t and $t+1$. Now consider two countries, a home and a foreign country (denoted with an asterisk) and a world of integrated capital markets. A representative consumer in each country has access to the same risk-free one-period bond that carries a nominal interest i_t which is part of the time-t information set.

Let

$$R_{t+1} = (1 + i_t)\ P_t/P_{t+1} \qquad (8)$$

where P is the price level. Let R_{t+1} be corrected for exchange rate X if denominated in a foreign currency. Obstfeld shows that in such a world the following equation holds for the home country bond:

$$1/(1+i_t) = E_t\ [(P_t/P_{t+1})\ m_{t+1}\ ] = E_t\ [(X_t P^*_t/X_{t+1} P^*_{t+1})\ m^*_{t+1}] \qquad (9)$$

and similarly for the foreign bond. Assume that consumers in each country are alike in terms of preferences and endowments so that consumption in the two countries can be aggregated. Further assume that preferences are identical across countries so that the reciprocal of the intertemporal elasticity of substitution, α, is the same in both countries and $\beta = \beta^*$. Then $E_t\,(\eta_{t+1}) = 0$ becomes observable ex post for different assumed values of α (if η_{t+1} is a function of aggregate consumption C, the price level P and the exchange rate X, all at times t and $t+1$ and in both countries). Similarly, for η^*_{t+1}. The conditions $E_t\ (\eta_{t+1}) = 0$ and $E_t\ (\eta^*_{t+1}) = 0$ can be falsified if discrepancies in marginal substitution rates at time $t-1$ can explain future discrepancies, leading to bond market segregation.

Hence, Obstfeld estimates regression equations for different values of α of the form:

$$\eta_t = \gamma_0 + \sum_{i=1}^{N} \gamma_i\ \eta_{t-i} + \upsilon_t \qquad (10)$$

and equally for η^*_t. Error term υ is orthogonal to information dated $t-1$ or earlier. The empirical test entails to accept the null hypothesis H_0: $\gamma_0 = \gamma_1 = \ldots = \gamma_i = 0$ for $i=1 \ldots N$ periods. This would imply perfect financial integration with respect to the risk-free asset in the home country, and acceptance of H_0^* equally for the risk-free asset in the foreign country. This *Test I* is therefore a joint test of perfect financial market integration (in the sense that the law-of-one-price holds for risk-free assets) and intertemporal consumption-smoothing behavior.

Before proceeding with the second test, it is informative to establish the link between this *Test I* and the deviations from interest rate parity conditions. In the above model the Euler equation for the consumers in the home country of its domestic risk-free bond yields:

$$E_t\ [(1+i_t)\ (P_t/P_{t+1})\ m_{t+1}] = 1, \text{ where } m_{t+1} = \beta\, U'(c_{t+1})\ /\ U'(c_t) \qquad (11)$$

where U' is the marginal utility of individual consumption c. Now equally for the consumer of the home country of the foreign country's risk-free bond:

$$E_t[(1+i^*_t)(P_t/X_t)/(P_{t+1}/X_{t+1})\, m_{t+1}] = 1 \quad (12)$$

Obstfeld rewrites the equality of these two conditions to establish the following relation between the nominal interest rate differential and the exchange rate as:

$$(1+i_t)/(1+i^*_t) = E_t(X_{t+1})/X_t \;*\; Q_t$$
$$\text{where } Q_t = \{1 + [cov_t((U'(c_{t+1})/P_{t+1}), X_{t+1})]/E_t((U'(c_{t+1}))/P_{t+1})E_t(X_{t+1})]\} \quad (13)$$

and where cov_t denotes a covariance conditional on time-t information. This expression shows that the nominal interest differential is determined by the expected depreciation of the exchange rate and a covariance term which may be interpreted as a consumer risk premium: the greater the covariance between the future marginal domestic consumption and the future exchange rate, the better serves the foreign currency bond as a hedge against this consumer risk and such a rise in the covariance leads to a fall of the foreign nominal interest rate relative to its home domestic counterpart. Clearly, when the consumer risk premium is zero, interest rates are linked to the uncovered interest parity (*UIP*) condition, which relates interest rate differentials to the expected exchange rate moves.

Secondly, *Test II*. Here Obstfeld's Euler equation test develops a general method for analyzing international consumption comovements when there is cross-border trade in a complete set of state contingent assets. With perfect financial integration, insurance of consumption risks against any state of the world is traded on the financial markets where the set of securities that can be purchased freely as insurance is complete, then the result is that the marginal rates of substitution of different consumers must be perfectly correlated. Assume a world with many countries, a representative infinitely living consumer in each and with finitely many states of nature starting at time t with state s_t which transitions to the next state s_{t+1} following a Markov probability law. If individual consumption utility in each country k, $k=1.....N$, is now also a function of the state the world is in, then so are marginal rates of substitution m_k. Obstfeld derives the Euler equation as:

$$E[m_k - m_j \mid v_{t+1}, s_t] = 0 \quad (14)$$

where v denotes all verifiable events. He then demonstrates that with complete markets where all states are verifiable, i.e. can be insured against, the marginal rates of intertemporal substitution must be equalized, hence:

$$m_k\ (\beta_k,\ C_k(s_t),\ C_k(s_{t+1})) = m_j\ (\beta_j,\ C_j(s_t),\ C_j(s_{t+1})) \qquad (15)$$

Now further assume that there is free international trade in a complete set of Arrow-Debreu securities, that countries share a common risk aversion factor ρ in their individual iso-elastic utility function, then the following model condition emerges:

$$log\ C_{kt} = log\ C_{jt} + log\ (C_{k0}/C_{j0}) + log\ (\beta_k/\beta_j)(t/\rho) + 1/\rho(\vartheta_{kt} - \vartheta_{jt}) \qquad (16)$$

A main implication of this condition is that national per capita consumption should move ex post in equal proportion, if time-preference rates coincide so that $\beta_k = \beta_j$ and if there are no differential preference shocks between countries so that $(\vartheta_{kt} - \vartheta_{jt}) = 0$. Similarly, if C_{wt} denotes the world per capita consumption such that $C_{wt} = \sum n_{jt}\ C_{jt}$ and n_{kt} is the country k's share in the world population, then:

$$log\ C_{kt} = log C_{wt} + log C_{k0} + (log \beta_k)(t/\rho) + \{\vartheta_{kt}/\rho\text{-}log\,[\sum_j \beta_{jt}/\rho\ exp(\vartheta_{jt}/\rho) n_{jt}\ C_{j0}]\} \qquad (17)$$

If there are no preference shocks and no population shocks, this condition implies proportional movement between the consumption of each country and world consumption. For reasons of avoiding incorrect statistical inferences (resulting, for example, when country and world consumption time series are not cointegrated), Obstfeld recommends that the above condition is tested with log-differences. Hence for the latter condition, one obtains the following estimate equation:

$$\Delta log\ C_{kt} = \alpha + \beta\, \Delta log\ C_{wt} + \varepsilon_t \qquad (18)$$

The test of perfect financial integration or full risk sharing is a test of whether the coefficient β is statistically close to unity, i.e. $H_0\!: \beta = 1$. This *Test II* is therefore a joint test of perfect financial integration and complete markets.

3.2. Evidence and critique

Each strand of theory has yielded many contributions with empirical evidence to establish the degree and speed of international integration of the capital markets for different subsets of countries in different time periods. It is impossible to discuss each and every contribution. I have therefore chosen a broad enough selection to allow for general conclusions and a discussion of the criticisms each strand of theory has drawn. I will also highlight, where appropriate, further modifications that have been proposed that have led to yet more empirical results.

The inconvenient truth is that not all evidence on financial integration uniformly points in the same direction and in some cases appear even outright incompatible, giving rise to a number of puzzles. In the words of Mussa and Goldstein (1993, p 260) who provide their own survey of the literature: “Even though there is by now a burgeoning literature that addresses directly the measurement of international capital market integration, it has proven difficult to reach firm and clear conclusions about the degree – if not the trend – of integration. This ambiguity reflects the fact that no single method of measuring the degree of integration is completely free of conceptual and technical difficulties that cloud its interpretation.” It is demonstrated below that their view on reaching a firm and clear conclusion on financial integration is probably too pessimistic and that results are often more congruent and compatible then they may appear at first sight. The key lies indeed with the interpretation of the measure of financial integration and that very careful consideration needs to be given to what exactly is being measured. With this in mind, the main empirical evidence that has been produced under each strand of theory is discussed in the following section.

3.2.1. Evidence of deviations from interest parity

The main advantage of measuring financial integration by means of testing interest rate parity conditions is that it is the cleanest method of all. It is exactly known what and which market segment is being measured so as to leave little room for misinterpretation. It is intuitively easy to understand and based on long-established economic laws of price competition among rational agents: if markets are open then the prices of similar goods (in this case financial instruments) between markets will be the same and if prices are not the same then barriers of some sort (e.g. capital controls) must exist. This is why this strand of theory is most widely preferred. Eijffinger and Lemmen (2003b, p *xiv*) for instance state that “the law-of-one-price definition of international financial integration is theoretically preferable, [but that] the measurement of international financial integration has often relied on broader concepts.” This strand has therefore drawn the most numerous empirical tests. But not all interest parity conditions have yielded equally good results and positive support from its users. Frankel (1992, p 197) for instance claims that only the covered interest parity (*CIP*) condition is "an unalloyed criterion for capital mobility in the sense of the degree of financial market integration across national boundaries". Referring to earlier studies he conducted in 1989 and 1991, he concludes on the basis of *CIP* calculations for a panel of 25 countries that barriers have been low in eight developed countries at least as far back as 1982. Based on estimates of a time trend in the absolute value of *CIP* differentials, ten countries have a rate of decrease in the magnitude of the barriers that is statistically significant at the 1% level. Frankel (1992) also discovers that calculations based on real interest (*RIP*) differentials for the same data panel yield different and sometimes anomalous results and offers the explanation that a substantial currency premium appears to drive real interest rates away from zero. The same evidence is brought in Frankel and MacArthur (1988) for a set of 24 countries, including seven less developed countries for the period 1982 to 1987. A high degree of capital mobility is found for most G11 countries and Hong Kong and Singapore when based on *CIP* but not to the same degree, if at all, when based on *RIP*. The differing results on the basis of *CIP* and *RIP* are not inconsistent: financial integration of markets can be achieved in the sense that a country premium is eliminated but where a currency premium remains.

It is important to note that these early studies of interest rate parity differentials use money market rates series which are often consistently available for a large number of countries. Therefore, these studies measure the integration of international money markets only and are silent on other financial market segments. Eijffinger and Lemmen (1995) also present an empirical analysis of money market integration in Europe between 1979 and 1992. From mean (absolute) deviations from *CIP* for ten countries vis-à-vis Germany based on 3-month domestic interest rates, they conclude that with regard to the degree of financial integration, the size and variability of country premiums decline significantly after 1987. The same calculations based on *UIP*, however, provide dissimilar results for certain countries (e.g. the UK) and the failure of *PPP* and thereby also *RIP* is evident for an even greater set of countries. As with Frankel's studies, these results are neither inconsistent as *UIP* violation can be attributed to expectation errors or an exchange risk premium, which for *RIP* are compounded with the violation of ex post *PPP*.

Mussa and Goldstein (1993) generalize these results from interest parity conditions for short-term financial integration from a wider range of studies with four main observations. First, *CIP* holds to close approximation for most short-term money markets in industrialized countries. Secondly, *CIP* differentials decline during the 1980s signifying closer integration. Thirdly, *UIP* does not tend to hold and that assets denominated in different currencies are regarded as imperfect substitutes. Fourthly, *RIP* is even rarer as this also implicitly requires close integration of the goods markets. At best, studies based on *UIP* and *RIP* show in the presence of significant differences a declining trend in size and variability (e.g. Eijffinger and Lemmen, 1995). In periods of substantial exchange rate volatility, real interest differentials are more accounted for by currency premiums than by country premiums (e.g. Frankel and MacArthur, 1988; Frankel, 1992).

Whereas this strand of theory starts off with the financial integration of money markets, subsequent efforts extend the scope of integration to include different asset classes. Three studies in particular are notable. The first one is from Popper (1993), who extends the interest parity strand to the longer end of the fixed income markets. Using currency swaps for five developed countries versus the US for the period 1985 to 1988, Popper is able to establish that mean absolute *CIP* deviations are not too dissimilar for five and seven year government bond maturities compared to 3-month money market maturities. She concludes that short-term integration extends with the wider use of swaps to long term integration in the late 1980s. Another within the realm of fixed income markets is from Montiel (1994), who extends it to the domain of less developed countries. Estimating mean absolute deviations from *UIP* for 6-month deposit rates of 48 such countries versus 6-month US Treasury bills, Montiel finds that results are very mixed but that at least six countries can be identified as having high capital mobility. Dividing the sample period in half reveals that capital mobility increases in eleven countries. Both these studies highlight the inherent problem of interest parity studies of finding comparable assets when venturing into the longer or the higher yielding end of fixed income markets where assets are less substitutable. Finally, Mussa and Goldstein (1993) report that yet another branch extends the scope of integration enquiries to equity markets, where one approach is to examine premiums observed in closed-end country mutual funds but the more common approach is to consider correlations of stock price indexes and returns across countries. Results thus far are mixed, with these first studies showing that a number of country funds have significantly decreased premiums over the 1981 – 1989 period but the second studies showing that correlations of stock market movements across industrial countries are moderate in size and had not increased in the previous twenty years or so. This could again be an indication that in the equity markets, stocks in different currencies are regarded as imperfect substitutes. Overall, devations on interest parity studies that venture beyond the money markets remain somewhat of a rarity in the literature.

Notwithstanding the attractiveness of using interest parity conditions to measure the degree and the process of international financial integration, which they are clearly very capable of doing, particularly for short-term fixed income markets, this review also reveals a number of implicit shortcomings of this strand. These shortcomings can be summarized as follows. First, while *CIP* is the condition that holds most often, the risk with interest parity conditions based on *CIP* is that one possibly presents a tautology. From the practices of market participants it is evident that *CIP* is closely monitored at all times, because traders in the foreign exchange and currency swap market continuously use interest rate differentials to set the price of forward rates and vice versa. Secondly, evidence is strictly limited to the integration of specific segments of the financial markets only, mostly money markets. These are also markets that tend to be the most liquid and widely traded by large, sophisticated financial institutions. If, as suggested by Von Furstenberg (1998) international financial integration should also contribute to economic welfare by succeeding in integrating the market for a large number of diverse financial services, then interest parity conditions applied in this sense are of limited value. Thirdly, interest parity studies are prone to measurement error as the quality and reliability of measuring financial market integration with parity conditions depends heavily on the comparability and substitutability of assets. Differences in default risk, term to maturity and liquidity reduce substitutability and can lead to measurement error. To circumvent other sources of measurement error, it is important that the timing of interest rate data corresponds with the timing of exchange rate and other data necessary for the calculations. Fourthly, interest rate parity studies based on *UIP* and *RIP* are a joint test of financial integration and rational expectations, where their failure can be attributed to either or both. If realized exchange rate changes are a bad proxy for future exchange rate changes then *UIP* will not hold, and the same for expected price changes in the case of *RIP*.

3.2.2. Evidence of the FH condition, puzzle or misinterpretation?

Feldstein and Horioka (1980) controversially provide evidence of weak or low capital mobility among industrialized countries based on their FH condition of no correlation between domestic savings and investment. They conduct cross-country estimates of the regression of their basic equation (Eq. (5) in Section 3.1.3.) for a sample of 16 OECD countries for the period 1960 – 1974. This gives an estimate of β of 0.89 for the entire sample period.[2] The coefficient proves statistically significantly different from one but is also incompatible with the hypothesis that the true value of β is zero. In their interpretation: “the evidence strongly contradicts the hypothesis of perfect world capital mobility and indicates that most of any incremental savings tends to remain in the [domestic] country”. (1980, p 321). Feldstein (1993) repeats the same finding for an extended sample to the late 1970s, with an estimate for β of 0.865 for this latter period and 0.80 for the entire sample period. Though lower than for the initial sample, indicating a higher degree of capital flows among industrialized countries in the second half of the 1970s, their earlier finding seems to be confirmed. Given the importance of Feldstein and Horioka’s findings of savings-investment correlations, they are listed in Table 2.2.

These results from Feldstein and Horioka fly in the face of findings from interest parity deviations and the general convention that financial markets in the 1980s are more open and integrated following widespread deregulation. This is known in the literature as the FH puzzle. To add to the puzzle,

[2] This is in case where gross savings and investment are used. Feldstein and Horioka also provide results in case net savings and investment are used. In general, values of β tend to be even higher but also less reliable as net values are derived using an estimate of depreciation which tends to bias β upwards. I therefore only report values of β based on gross savings and investment.

Table 2.2
The relation between gross domestic savings and investment ratios

Sample period	Constant	FH coefficient (β)	R^2
1960 – 1974 *	0.035 (0.018)	0.887 (0.074)	0.91
1975 – 1979 **	0.046 (0.042)	0.865 (0.185)	0.57
1960 – 1979 **	0.057 (0.028)	0.796 (0.112)	0.75

Standard errors are shown in parentheses.
* From Feldstein & Horioka 1980, Table 2, p 321
** From Feldstein 1993, Table 2, p 135

Feldstein and Horioka (1980) report that the finding of a high value for β remains valid when incorporating the rate of population as an exogenous variable in the basic equation to deal with the possible impact of a third variable when β is permitted to vary with a measure of the openness of the economy, or if indeed the basic equation is re-estimated using 2SLS to deal with the endogeneity of the savings ratio. Feldstein (1993) demonstrates that the result is consistent with a portfolio model. Furthermore, the main FH finding of high savings-investment correlations remains remarkably robust in many empirical studies that follow, both in cross-section and time-series studies (mainly of OECD countries) and has become one of those stylized facts of economics.

Feldstein and Horioka's proposition is that their finding is compatible with international mobility of short-term capital, because "a small part of the total world capital stock is held in liquid form and is available to eliminate short-term interest rate differentials, [while] most capital is apparently not available for such arbitrage-type activity among long-term investments" (1980, p 328). This provides little comfort to other scholars in the field. A flood of articles follow in an attempt to resolve the FH puzzle. While it is impossible to review them all, I rely on Coakley et al. (1998) for a summary of the various reactions to the FH puzzle. They divide the line of enquiry in the FH puzzle into two: ones to do with measurements of the savings-investment correlation and others to do with providing alternative interpretations to its result.

Indeed the initial response is to target errors of measurement to explain the FH finding. As regards data errors, focus is on sample sensitivity. The FH finding proves to be pretty robust in many repeat tests that immediately follow, with the exception of three results clouding the FH finding. First, differences resulting from the inclusion of less developed countries. Dooley et al. (1987) are one of the first to report evidence of a statistically different effect when they examine 62 countries of which 48 are developing countries and 14 are OECD countries. They find in OLS regressions that relate the savings and investment ratios, that the coefficients are higher for the industrial countries than for the developing countries, although they also find that the difference in these coefficients is not statistically significant when the entire sample is pooled. Montiel (1994) provides what is widely regarded as the definitive proof of the development effect when he calculates estimates of β on the largest sample to that date, for 62 developing countries for the period 1970-1990, and finds a surprisingly high degree of capital mobility according to this measure. The finding of higher FH capital mobility for many less developed countries than for industrial countries with more highly developed capital markets and fewer explicit capital controls, however, only adds to its controversy. Secondly, differences resulting from the inclusion of large countries or country blocs. This possible effect is alluded to by Feldstein and Horioka. When a country large enough to affect world financial market conditions experiences a fall in national savings, it might drive up interest rates and crowd out investment everywhere in the world. Dooley et al. (1987) attribute their development effect to a large country effect as they notice that their sample of developing countries contain small countries which cannot influence world interest rates. Coakley et al. (1998) report that several studies indeed find evidence of a country size effect, producing statistically significantly higher β values for large country groups than for small country groups. Jansen (1996) also finds such evidence with the estimation of his error correction model for 40 OECD countries over 40 years, namely that the large countries in his sample (USA, Japan), the EEC and the OECD have estimates of β close to one. Thirdly, differences resulting from regional effects. Contrary to the previous two, these have been supportive of the FH finding. For example, Bayoumi and Rose (1993) use data for eleven regions in the UK for the period 1971-1985 and do not find a positive correlation between savings and investment in FH style regressions, which they deem consistent with the FH hypothesis. Coakley et al. (1998) report that other regional studies find similar results.

As regards econometric errors, the focus is on misspecification (common factors that can explain movements in savings and investment have been omitted), simultaneity bias (savings and investment are endogenous variables), financial and non-financial integration (the explanation is insufficiently integrated goods markets or markets of (non-traded) physical capital such that real interest rates are not equalized), cointegration (in the long run savings and investment are tied together, for example by the intertemporal budget constraint) and related to this, non-stationarity (the null of a unit root in national savings and investment rates cannot be rejected). Dooley et al. (1987) are one of the first to confront the endogeneity problem with an instrumental variables approach, including military expenditure over GNP and a dependency ratio in the basic FH equation, but this does little to clear up the FH puzzle. They ultimately attribute the FH finding to the breakdown of real interest parity conditions. Indeed, Coakley et al. (1998) report that the employment of various instrumental variables does not seem to alter the thrust of the FH finding. Exploring evidence of cointegration is a more useful exercise. Kroll (1986) finds evidence that a country's intertemporal budget constraint biases results against capital mobility when using time-averaged data as Feldstein and Horioka do. Using annual data for 1962 – 1990 for 21 OECD countries instead and controlling for country size and international business cycle effects, Kroll's evidence suggests that capital is mobile internationally. Jansen (1996) also finds that savings and investment hold together in the long run by an intertemporal budget constraint in several countries, the EEC and the OECD as a whole. Correcting for this and for the notion that the current account converges to a constant in the long run, he finds a low β

value for eight countries and an average β value over the whole sample of 0.57, which is significantly below Feldstein and Horioka's finding (see Table 2.2). Furthermore, Coakley et al. (1998) confirm that several studies find that time-series of savings and investment are non-stationary and the problem with this is, as Ghosh (1995) points out, that the correlation between them then becomes meaningless: "either savings and investments are co-integrated, in which case their asymptotic correlation is unity, or they are not co-integrated in which case their asymptotic correlation is zero." (1995, p 108). De-trending the data or expressing it as fractions of GDP does not resolve this econometric problem.

Another major line of enquiry is to provide an alternative interpretation to the FH finding and to reconcile it within specific economic models. Here, several authors construct theoretical models that simultaneously incorporate savings-investment correlations and perfect or high capital mobility. Coakley et al. (1998) state that these include general equilibrium models, real business cycle models and intertemporal models of the current account. Obstfeld (1986) is an example of the first, developing a life-cycle model of consumption and growth in the world economy in which countries' savings and investment are correlated though capital is perfectly mobile. It is demonstrated through simulated regression analysis that this theoretical model is capable of producing results similar to those reported by Feldstein and Horioka. This particular line of enquiry subsequently produces its very own measure of international financial integration based on cross-country consumption growth correlations (see Section 3.1.4.). Ghosh (1995) provides an example of the latter when he compares the variance of an optimal consumption smoothing current account assuming perfect capital mobility with the consumption smoothing component of the actual current account to determine capital mobility. He finds that for five major industrialized countries between 1960 and 1988, for all apart from the US this variance is higher, pointing to excess capital flows. Coakley et al. (1998) report that the general results of these contributions are actually opposing the FH finding with the one exception of Barro-style modified neoclassical growth models in which human capital is immobile.

Taken together, this barrage of literature forms a pretty damning criticism of the savings-investment correlation strand as an appropriate measure for international financial integration. Coakley et al. (1998, p 171) sum the whole discussion up perfectly when they note that "despite the apparent robustness of the FH result of a high savings-investment association, the FH view or interpretation that the FH coefficient (β) can be identified as a measure of international capital mobility has been widely challenged since it is not obvious what structural parameters this equation measures."

3.2.3. Evidence of consumer risk sharing, an accurate test for financial integration?

The previous section notes that one specific type of general equilibrium models rests on intertemporal consumption-smoothing and optimizing behaviour and grows out to produce its very own, alternative measure of international financial integration, namely consumption correlations. Overall, the results from this approach are closer in spirit to the ones from savings-investment correlations than the ones from deviations from interest parity conditions, although this strand does not reject full capital integration nearly as often as saving-investment correlations do.

Obstfeld (1989) uses a particular model of intertemporal consumption choice and derives a test for perfect capital market integration by comparing marginal rates of substitution between consumption on different dates. Recall from Section 3.1.4. that this *Test I* estimates regression equations for different values of α of the form $\eta_t = \gamma_0 + \sum_{i=1}^{N} \gamma_i \eta_{t-i} + \upsilon_t$ and that acceptance of the null hypothesis H_0: $\gamma_0 = \gamma_1 = \ldots = \gamma_i = 0$ *for* $i=1 \ldots N$ is seen as evidence of perfect integration. Obstfeld (1989) conducts this test for (only) two country pairs, Germany and Japan each with the US, resulting in a rejection of the null hypothesis for the sample period 1962 – 1985 as a whole. Splitting the sample period at 1973 produces the result that the null hypothesis is still rejected in both sample periods, but at a lower significance level in the first than in the second subsample. Obstfeld interprets this result as consistent with increased capital market integration in the early 1970s, though he admits that the test result is weak in the Germany-US case and only somewhat stronger in case of Japan-US. Further tests of underlying parameter specifications yield mixed support for the model and a more detailed specification analysis is needed before firm conclusions can be drawn.

Obstfeld (1994) develops a related test to determine cross-country consumption co-movements when there is international trade in a complete set of state-contingent assets. Recall from Section 3.1.4. that this *Test II* estimates a regression like $\Delta log\ C_{kt} = \alpha + \beta \Delta log\ C_{wt} + \varepsilon_t$ where a coefficient β statistically close to one indicates perfect international integration. While this test can indeed be conducted for cross-country pairs, Obstfeld prefers to perform a regression of a country's consumption growth to that of the (rest of the) world. He does so for seven industrial countries for the periods 1951 – 1972 and 1973 – 1988. Results are poor for the first subperiod, but reveal that for all countries other than the US and Canada, the β coefficient on world consumption rises, usually sharply, in the second subperiod. Over the period 1973-1988 the hypothesis that $\beta = 1$ is rejected only for the US, but this is attributed to the fact that the US makes a sizeable fraction of world consumption. So the regression equation is re-estimated using rest-of-world consumption levels. This yields similarly poor results. Including a measure enabling to distinguish whether domestic consumers benefit more from domestic or world consumption growth confirms a picture for 1951-1972 of an industrial world in which financial markets provide no insurance, while post-1973 markets become more internationally integrated (while still falling short of providing evidence of complete integration) for all apart from Canada.

Bayoumi and MacDonald (1995) propose a more robust specification of Obstfeld's (1994) test that enables to distinguish market failure from a lack of access to the domestic or the international market. This new specification is tested for cross-country consumption growth correlations for 15 countries between 1971-1992 with an estimate for non-durable consumption per capita. The results indicate that Japan is the only industrialized country in the sample for which national consumption appears to be fully integrated with the rest of the world. The excess sensitivity of consumption to local income is the main source of failure for the remaining countries. For the EEC countries, failure mostly occurs due to the failure of real interest rates to equalize with world interest rates. The authors admit that one needs to be careful with drawing too strong conclusions from the test as the power of explanation has proven to be quite weak.

In general, the results, which are repeated elsewhere, seem to indicate that though markets appear to have become more integrated, consumption growth of countries are not completely correlated and that consumption risk is not fully insured in the international market. This gives rise to the international consumption correlation puzzle or otherwise known as the international risk sharing puzzle. Though this puzzle has not nearly drawn the same number of reactions as the FH puzzle in the literature, one contribution explains the persistence of this puzzle by separating between tradeable and non-tradeable leisure or goods and the effects of capital market restrictions on consumption risk sharing (Lewis, 1996).

The weakness of explanation power often found in the empirical results of consumption correlation tests already indicates that this strand is fraud with difficulties. These are both related to data issues and the underlying model, although much more fundamental in the latter case. Data issues that may yield misleading inferences in test results include the fact that published consumer series include expenditure on durable goods and non-tradeable goods and services, are seasonally adjusted, incorporates information that accrues over time, which are all contrary to the model specification. Also, in the model unconditional distributions of economic variables are kept constant while their conditional distributions may change over time and this would be incorporated into the consumption data. These data issues can all, to some degree, be mended. The more major drawback of this strand, however, is that the general equilibrium model of intertemporal consumption smoothing is mainly theoretical in nature, relies on a very strong set of assumptions which bear little relation to the real world and generally lacks supporting econometric evidence. Obstfeld (1989, p 144) himself remarks: "A more fundamental question is whether the model underlying the tests [..] has any claim to empirical validity. Because the tests are joint tests of certain propositions about capital mobility and a particular model of consumer behavior, test results have no implications about capital mobility if the model is wrong." Unfortunately, as Obstfeld also concedes, much of the evidence in support of the underlying model is discouraging. Therefore, and as with the FH coefficient, one can seriously question what consumption correlations actually measure, leading to serious interpretation issues.

3.3. Capital controls and structural determinants

Before proceeding with a review of what the capital controls debate brings in evidence of their existence, it is useful to put it in context with the strands of literature that have been reviewed so far. Von Furstenberg (1998) splits definitions of international financial integration into two categories: those relating to "prerequisites for" and those based on "consequences of" such integration. So far, only the second class is presented, which deals with testable consequences of financial integration deduced from atemporal rate arbitrage and intertemporal optimization models. Indeed, the capital controls discussion belongs to the first class, for this approaches the subject of integration from the perspective of necessary preconditions. It implies that international financial integration would be complete were it not for the existence of capital controls and other barriers.

The debate on capital controls goes back longer than attempts to measure international financial integration. The Tobin tax is for example already proposed in 1978. The desire to measure the degree, speed and process of capital mobility in the 1980s and 1990s is born out of the discussion on capital controls. All the while though, capital controls continue to be vigorously debated alongside, but where this debate takes on a distinctly different character. The capital controls discussion focuses primarily on qualitative issues: the desirability and effectiveness of capital controls; the form that these capital controls should take; their feasibility and likely effects on the economy; special macroeconomic and political circumstances in which capital controls may be justified; and how capital controls are positively reconciled in a general-equilibrium framework.[3] For the purpose of this research, to obtain evidence on the extent of the integration of financial markets, I leave this qualitative part of the capital controls debate aside and rather focus on the evidence this strand has produced on the existence of capital controls and any measures of quantifying this.

Evidence of the existence of capital controls is generally quantified through the construction of indexes for a panel of countries with the help of IMF annual reports on exchange arrangements and exchange restrictions. The IMF publishes this report since 1950 and for a great many countries reports whether restrictions on capital account transactions are in place, special foreign exchange rates apply for some or all capital transactions or invisibles. Epstein and Schor (1992) are among the first to calculate such an index for 16 OECD countries over the period 1967–1986. The index represents the number of restrictive

[3] For a flavor of this qualitative debate on capital controls, see Eichengreen et al. (1995), Garber and Taylor (1995), Edwards (1999) and Epstein and Schor (1992), wherein each of these arguments features.

practices in place in each country in each year with a maximum of two. Epstein and Schor (1992) observe that the motivation for capital controls seems to be closely linked to political and institutional factors but leave this notion otherwise unexplored. This is instead further elaborated on in Alesina et al. (1994) who empirically investigate the relation between the presence and the removal of capital controls with the structural economic and political features of countries. This type of research has become known in the literature as the structural determinants of capital controls. Alesina et al. (1994) use a sample of 20 OECD countries for the years 1950 to 1989 and with the same IMF data construct a capital controls dummy (which takes the value of one when capital controls are in place and zero otherwise). They then perform a (probit model) regression of this capital controls dummy on a set of possible explanatory variables that include dummy variables for when a fixed exchange rate regime is in place and others to indicate government strength and central bank independence. The evidence reveals an a priori expected result, which is nevertheless interesting: that capital controls are more likely imposed by a strong government and when the central bank is less independent. The latter relates to the fact that governments benefit from an inflation-tax with higher seigniorage revenues from imposing capital controls. In these circumstances capital controls are able to keep real interest rates artificially low. This is linked with the deviations from interest parity discussion and this should then show up in such calculations but Alesina et al. (1994) unfortunately do not perform this test. They do find instead that capital controls are more likely at times when a fixed exchange rate regime is in place and in countries where the agricultural sector is bigger for which a variable is also included.

Milesi-Ferretti (1998), part of the set of authors of the original article, then extends the Alesina et al. (1994) analysis to a broader panel data set of 61 industrial and developing countries for the period 1966 to 1989. Further extensions of his study are threefold. First, splitting the capital control dummy into two dummy variables, one for each type of restriction the IMF provides data for in its annual reports. Secondly, including a whole range of novel explanatory variables. Thirdly, using a slightly modified estimation model (a logit as well as a probit regression model) and in addition to the annual series also five year non-overlapping averages to reduce serial correlation and to smooth out temporary shocks. Milesi-Ferretti’s results confirm the Alesina et al. results in many ways and particularly that capital controls are more likely to be in place when monetary policy is more firmly under the government’s control. Additional findings are that poorer countries and countries with larger governments are more likely to adopt capital controls.

Given that only the IMF data on the use of capital controls is on offer for a wide range of countries and over a relatively long period of time, the indexes are probably the best that can be produced in terms of a measure of the extent of capital controls. They are comparable and easy to interpret. But the limitations of the IMF data also translate to the limitations of the indexes. Edwards (1999) notes in this respect that the indexes are very general, do not measure the intensity of capital restrictions, fail to distinguish between the type of flows that is being restricted and ignore the fact that legal restrictions are easily circumvented. Epstein and Schor (1992) further note that a drawback of the IMF definition is that it does not include some practices of countries which might reasonably be considered capital controls. A possible alternative approach is shown by Lemmen and Eijffinger (1996) who measure the intensity of capital controls with closed interest parity deviations. Here any positive (negative) deviations are associated with capital import (export) restrictions. The drawback of this approach is that it can only make the distinction between these two broad types of capital control but cannot be more specific than that. Furthermore, it is assumed that all interest deviations are due to capital controls. An alternative route is for any researcher of capital controls to compile her own data on capital controls that have been employed in countries with a more detailed categorization of capital controls rather than rely on the limited IMF data. This is very costly and time-consuming indeed.

3.4. Other determinants: legislation and information

The previous section identifies certain economic, political and institutional factors as structural determinants of capital controls. Beside these structural determinants, the literature on international financial integration points to the legislative framework of countries and information asymmetries on countries as other significant determinants of financial transactions. Put differently, and in the context of the "prerequisites for" definition used at the start of the previous section, legislation and information equality are other necessary preconditions for international financial integration. Their asymmetry or inequality can severely impair the free flow of capital.

The importance of legal determinants is studied by La Porta et al. (1997) who, among 49 countries in the mid-1990s, try to assess the ability of firms in different legal environments to raise external finance through debt or equity. They pose the frequency and size of equity and debt financings in a specific country as a function of the origins of their laws, the quality of legal investor protection and the quality of law enforcement. They find strong evidence that the legal environment has large effects on the size and breadth of the capital market. Countries with poorer investment protection as measured by the character of legal rules and the quality of law enforcement, have smaller and narrower capital markets. Common law countries (UK, US) protect investors the most, French civil-law countries the least, and German and Scandinavian civil law countries somewhere in between. A closer look at the micro data also reveals that the largest firms appear to get external finance in all countries, even those where smaller firms do not. La Porta et al. (1998) are able to confirm these results for the same set of countries with the use of a wider set of variables. They offer the additional insight that share ownership in the largest public companies is negatively related to investor protection. This result is consistent with their hypothesis that small diversified shareholders are unlikely to be much present in countries that fail to protect their rights.

Information asymmetries have long been identified as a possible source for the breakdown of efficient markets.[4] Portes et al. (2001) find that informational asymmetries are responsible for the strong negative relation between asset trade and distance. The gravity model, which explains trade flows of goods between two countries by two masses (GDPs) and distance, is one of the best established empirical regularities in international economics. It explains international transactions in financial assets at least as well. Distance comes up strongly negative, i.e. the further two countries are geographically removed from one another, the less they trade each others' financial assets. Portes et al. hypothesize that in the case of financial assets, distance is really a proxy for asymmetric information. They test if other variables for bilateral information flows are significant and if distance is less significant for asset classes where the information requirement is less, such as government bonds. Results from regressions of foreign residents' transactions in US equities, corporate bonds and Treasury bonds over the period 1988-1998 and vice versa, on distance variables confirm their hypothesis.

Studies on determinants such as these serve as an important reminder that not just capital controls per se, but also the economic-political, institutional and the legal framework in which capital markets operate influence how much flows in and out of markets and influences their integration. Moreover, their transparency and the availability and equality of information determines to what extent investors from home and abroad operate as equals among each other in various country's home markets.

4. The theory applied to Europe

This section explores evidence from the various macroeconomic theories and applied research on the extent, degree and the process of international financial integration in Europe. Since the introduction of the Euro marks such a substantial change for the integration of capital markets, I divide the discussion in the period before EMU, in Section 4.1, and the period thereafter, in Section 4.2. Before EMU was even on the agenda, this is largely a discussion of capital controls and the limitations currency fluctuations pose to financial integration. Though this may seem ancient history now, but it is only with an understanding of this history that the much better situation financial markets in Europe are in now can be appreciated. With the new reality of largely liberalized and much better integrated financial markets, particularly in Europe, academic research also adapts and branches out in new directions. This is discussed in Section 4.3.

[4] Akerlof G., (1970. The market for lemons: quality, uncertainty and the market mechanism. The Quarterly Journal of Economics 84 (3), 488-500) is among the first to demonstrate the role of information asymmetries in markets, in this case in the second-hand car sales market where agents do not know a priori whether they are sold a lemon.

4.1. Financial integration before EMU

With the volume and the range of international financial transactions traded freely every day nowadays in the liberalized capital markets of industrialized countries that with the support of IT technology and integrated trading platforms and payment and settlement systems are executed relatively swiftly, it is perhaps hard to imagine that not so long ago capital controls in various forms and disguises ruled the day. By means of a summary, it will be seen that EEC ministers agree to a complete removal of capital controls by 1990. Various measures of financial integration observe an EEC effect, i.e. that within this economic area markets become noticeably better financially integrated in the 1980s and especially the early 1990s. By then efforts to create a single market (based on the Single Market Act) are well underway. The Maastricht Treaty comes into effect in 1993 which sets Europe on course for monetary unification. In the meantime though, it remains a collage of markets with their own national currencies whose internal volatility is tried to be contained through the European Monetary System (EMS) and the ERM. Studies based on interest parity deviations in particular detect that currency premiums remain the principal source of interest rate differentials in Europe at this time.

4.1.1. Capital controls until EMU

From Epstein and Schor's (1992) historical account of capital controls in the OECD up to the 1990s, the distinct impression is obtained that capital controls have come and gone in waves over the past decades, coinciding with the prevailing economic intellectual climate.[5] A bird's eye review based on their analysis of the ebbs and flows of capital controls over six decades up to the 1990s renders the following:

1930s & 1940s:	Exchange and other controls are introduced in most of the countries which later become part of the OECD, with the exception of the US and Canada, and remain in place in the early post-war period. An early victory for (predominantly US) free movement of capital visionaries is when the IMF's Articles of Agreement (entered into force on 27 December 1945) adopt the view that controls should be removed as soon as possible, though there is no mechanism of enforcement.
1950s:	After 1952, restrictions on the current account and the use of foreign exchange are reduced substantially and rapidly and by the end of 1958 convertibility in Europe is established. There is less progress on the easing of controls on capital. In 1957, the Treaty of Rome commits the EEC to a liberalized environment for capital as well as goods and services.

[5] Epstein and Schor (1992) describe for example the influence of Keynes on the UK and indeed the European stance in favor of capital controls necessary for national policy and political autonomy, as opposed to the US stance which was more firmly rooted in neoclassical free market thinking.

1960s: In the early 1960s, the EEC passes two directives to liberalize capital movements which are followed by a marked reduction in restrictions. Nearly all countries ease restrictions on non-residents accounts and curbs on repatriation of income are reduced. Capital markets are virtually totally freed in Germany, Switzerland, the Netherlands and Belgium. Italy, France, Austria and Japan liberalize to varying degrees. The main exception is the UK, which raises restrictions on capital outflows in 1961. By 1965 progress to liberalize markets is halted when the US faces large capital outflows and adds restrictions on overseas borrowing and lending. This prompts measures by various European countries to limit inflows. A third EEC directive on free capital movement is introduced in 1967, but not implemented for another ten years.

1970s: The breakdown of Bretton Woods' parities leads many countries to enact capital controls to avert foreign exchange crises. Most are removed once calm has restored to foreign exchange markets following the Smithsonian Agreement. However, the oil shock early on in this decade, labor unrest and worldwide recession lead to a sharpening of controls in many countries. By 1979, the tide moves against capital controls again. Japan and the UK lift all restrictions in 1979.

1980s: A general move towards deregulation and laissez-faire prevails in the 1980s, which leads to a sustained period of progressive dismantling of capital controls. In 1988, this culminates in an agreement by EEC ministers to a complete removal of capital controls by 1990. This action is taken in conjunction with the more general trade liberalization proposed for 1992.

Broadly speaking, the progressive (but sometimes slow) dismantling of capital and exchange controls has been virtually uninterrupted now among the major industrial countries since the 1980s. Mussa and Goldstein (1993) note that this has been accompanied by a broader based liberalization and reform of countries' financial sectors. In their observation, the offshore markets and the banks lead the way prior to the second half of the 1980s, but since then the reformed domestic markets and securities markets have provided much of the momentum. They give a detailed overview of the various and numerous financial liberalization measures taken in the US, Canada, France, Germany, Italy, Japan and the UK from 1964 to 1992 that attests to this observation.

In Europe specifically, the winds of deregulation are also felt in the 1980s, but controls do not completely disappear from the landscape. Epstein and Schor's (1992) capital control index gives a score of ten for all 16 countries examined (out of a maximum score of 32) in 1980-1983. Half of this score is accounted for by the four countries in his sample that would be among the first EMU entrants (Austria, Belgium, France and Italy). Only Germany and the Netherlands show the best possible performance in this respect. Beyond this limited measure of capital controls, Kenen (1995) also notes that in the early years of the EMS, established in 1979, a number of countries control capital transactions by their residents. Banks and financial institutions cannot lend freely to foreigners, not even to their affiliates in the international currency markets. Residents are not allowed to hold foreign currency assets freely, not even bank accounts in other European countries. These controls are deemed essential to the successful functioning of the EMS until 1992. It is believed that they reduce the amount of intervention needed from central banks to keep their exchange rates within the narrow EMS band defined by the ERM. When the German Bundesbank negotiates a devaluation of the Italian Lira in 1992, this is followed by severe pressure on more currencies and the exit of the English pound from the system famously on black Wednesday (16 March 1992). This is widely regarded as the collapse of the ERM as it had functioned until then. The wider fluctuation bands of the ERM officially adopted in August 1993 remove the need for capital controls. With the Maastricht Treaty entering into force in that same year (1 November 1993), Europe's quest for a monetary union to start before the turn of the millennium is accompanied by a drive to create a single financial market in Europe in conjunction with the Single European Act (signed in February 1986 and entering into force on 1 July 1987) which sets a deadline for the creation of a single market by 1992.

4.1.2. Evidence of financial integration in a Europe with national currencies

Beyond the more descriptive account of capital controls in European countries prior to EMU, the evidence from measures of financial integration of each strand of theory discussed in Section 3 is now discussed. Eijffinger and Lemmen apply all strands of theory to the European Union in separate contributions. Their work is gleaned to surmise evidence on the state of the integration of financial markets in Europe prior to the Euro's introduction.

First and to continue where the previous section left off, consider evidence from the measurement of capital controls and its determinants in Europe. Here, Lemmen and Eijffinger (1996) extend the analysis of Epstein and Schor (1992) and Alesina et al. (1994). Instead of relying on a capital controls index which provides limited information, they compute deviations from (3-month) closed nominal interest parity to measure the intensity of capital controls. Unfortunately, their study does not provide details of the extent of financial integration under this measure or how it evolves over the period under investigation. The focus is rather on the identification of the fundamental determinants of capital controls. They apply a pooled cross-section time-series approach with additional explanatory variables for this purpose. This analysis is carried out for 11 EU countries for the period 1974-1993 (averaging the country time-series for five-year periods). The regressions show that the realized inflation rate explains the intensity of capital controls most significantly, in line with results from Alesina et al. (1994) that inflation is a strong motivator for capital export controls. Government stability is the next most significant influence for the intensity of capital controls depends negatively on the frequency of significant government changes. Gross fixed capital formation gives some moderate explanation. The other variables, on the state of the economy and political-institutional indicators, are not found to be significant in the explanation of this measure of the intensity capital controls.

Secondly, consider results from the application of interest parity deviations in Europe. Here Eijffinger and Lemmen (1995) assess the degree of money market integration in Europe by estimating the size and variability of mean (absolute) deviations from *CIP*, ex post *UIP* and ex post *RIP* of ten countries vis-à-vis Germany. The sample period of March 1979 to August 1992 is split in September 1987 when the Basle-Nyborg agreement promotes better exchange rate stability in the EMS. Empirical results indicate that the size and variability of *CIP* declines after this date and that increased capital mobility of *Type I* is therefore evident. Eight countries in Europe have average country premiums of 32 basispoints or less per year in the October 1987 – March 1992 period and only Portugal and Greece have country premiums of 55 basispoints or more. Ex post exchange risk premiums remain rather persistent, even after 1897, and the Netherlands is the only country with a relatively small exchange risk premium (19 basispoints) vis-à-vis Germany. On this measure, non-core EMS countries do show higher exchange risk premiums than core EMS countries. Eijffinger and Lemmen conclude as a result that “exchange rate volatility is the principal source limiting money market integration in Europe.” (1995, p 17). As regards ex post deviations from *UIP*, the Dutch money market is again the most integrated with that of Germany in both periods. The money market of the UK is not very well integrated according to the *UIP* condition, which is in contrast with results from the *CIP* condition for the UK. This, and the fact that no further conclusions can be drawn from the *UIP* condition highlights that the interpretation of this more stringent interest parity condition is more complicated. The failure of ex post *PPP* in the short run is evident for most European countries, though the size and variability decline from 1987. Ex post currency premiums remain rather persistent in Europe and are the main source of real interest rate differentials. There is a marked decline in deviations from *RIP* after the Basle-Nyborg agreement. From regressions of absolute interest deviations against a constant and a time trend to determine the speed of money market integration in Europe, Eijffinger and Lemmen detect a significant negative trend coefficient for all European countries for the absolute deviation from *CIP* and a catching up effect: those countries starting from a higher geographical segmentation from Germany in the beginning of the sample most rapidly integrated financially during the 1980s.

Thirdly, consider findings from the Feldstein-Horioka condition for Europe. Here Lemmen and Eijffinger (1995) perform both a cross-section and a time-series analysis of savings-investment correlations for all EEC countries (excluding Luxembourg) within the OECD for the period 1967-1990. For the cross-section analysis the sample period is split at 1979 to take account of the establishment of the EMS and the EEC into an EC6 representing the core countries and an EC9 including Ireland, Italy and Spain. On the whole, lower values for the FH coefficient (β) are found than is usually the case in these types of studies, though none of the β-values are significantly different from zero. The result for the EC9 countries indicate an increasing degree of capital mobility of this type over time and that EC6 countries are more financially integrated than the EC9 countries. Contrary to expectations, the results for EC6 countries show a rise in the value for β over time, but Lemmen and Eijffinger explain that this may be due to the fact that these markets became so integrated that capital flows with the rest of the world diminishes. Results from time-series using cointegration techniques are mixed and allow for one firm conclusion only and that an increasing degree of capital mobility in the 1980s in the EEC. It is also interesting to note the results from Jansen (1996) in this respect, who uses a specific error correction model to estimate the FH coefficient over time for 23 OECD countries over the period 1951-1991, because he also detects a similar and notable EEC effect. His results show that the OECD and the EEC as a whole have correlations close to one which suggests that the liberalization of capital movements has concentrated on financial flows among EEC countries. This is indeed the same conclusion that Lemmen and Eijffinger (1995) reach on the EEC.

Fourth and finally, consider what Euler equations tests have produced for Europe. Here Lemmen and Eijffinger (1998) explore the relationship between returns on financial assets and consumption growth rates across countries for the EU. They perform three Euler equation tests, the two standard tests discussed in Section 3.1.4. and a new test (*Test III*) which predicts that real interest deviations are linearly related to expected consumptions growth rates in countries were perfect financial integration is achieved. All three tests are performed on 14 European countries for the period 1963 – 1992. The sample is again split at 1979 to reflect the start of the EMS. *Test I* gives spurious results because financial integration seems to be stronger in the earlier period but the explanatory power of this test is also low. The main finding from *Test II*, which is performed for all country pairs, is that cross-country consumption correlations are typically higher during the latter period. Lemmen and Eijffinger take this as an indication of closer financial integration in 1979 – 1992 in the EU. All coefficients are substantially below one. *Test III* is performed for all countries with Germany as the reference and with respect to short and long-term bonds and stocks. Perfect financial integration is rejected in a number of cases. This result is somewhat confusing and is attributed to the low explanatory power of the test and to deviations from ex ante *PPP*, which possibly influence the results. At best, Lemmen and Eijffinger are able to conclude that the Euler equations tests may indicate closer financial integration in the EU after 1979, but they are clearly not taken with this as a substantive measure of financial integration. Bayoumi and MacDonald (1995) fare a little bit better. Notwithstanding the low explanatory power of their adaptation of *Test II* (with the inclusion of domestic income in cross-country consumption correlations), they are able to detect an EEC effect in their results. They find for 15 industrial countries over the period 1971-1992 that all the countries that produce evidence of a lack of real interest rate equalization are European and are continental members of the EEC. They conclude that the world appears to be divided into two zones: the UK and countries outside the EEC appear well financially integrated with the rest of the world but their consumption is often excessively sensitive to income, and within the EEC excess sensitivity to income is also important but their financial markets appear not so well integrated with the rest of world. Note the similarity of this finding with the conclusions from the Feldstein-Horioka condition. Sørensen and Yosha (1998) attempt to identify evidence of international consumer risk sharing in the OECD and specifically among EEC countries during 1966-1990. Their results contain three interesting findings. First, income smoothing via capital markets is lower in the EEC than in the US, which suggests that (private) capital markets are less integrated in the EEC than in the US in this period. Secondly, for the period 1981 – 1990, the fraction of shocks to GDP smoothed via international transfers is much lower in the EEC than in the US. Thirdly, for the period 1966 – 1990, about 40% of shocks to GDP in EEC countries is smoothed at the one year frequency via savings and half of that through national government budget deficits (and the other half though corporate savings). Apart from the overall conclusions on the state of financial integration of markets in Europe, another important policy conclusion of these findings relate to the financial stability and sustainability of further integration. In the absence of larger structural funds or an EU budget and in the presence of constrained budget deficits, capital market integration at the private market level needs to be severely enhanced to allow for better risk sharing.

4.2. Financial integration after EMU

Upon the introduction of the single currency on 1st January 1999, capital markets change over swiftly from legacy currency to Euro. Especially the fixed income markets - comprising of the foreign exchange markets, money markets, bond markets and derivatives thereof - are quick to adopt the new currency of the monetary union. With only a few exceptions, outstanding securities' contracts are smoothly redenominated to Euro and new securities are issued, quoted, traded and settled in Euro with harmonized conventions, business days and more synchronized government auction calendars from the first days of the inception of EMU. The impact of the Euro on Europe's equity markets is more on the economic factors that drive share prices than on the structure of the trading of equity securities.

As will be shown in this section, the distinction between the various segments of the Euro zone's capital markets is relevant, as various degrees of financial integration can be observed in each. By means of a summary, several studies and indicators show a cascading of different levels of integration of different Euro market segments eight years into the monetary union. These differing degrees of financial integration between various markets in the Euro zone is expressed in Figure 2.1 on a spectrum between fully integrated and highly fragmented:

Figure 2.1
Euro financial markets on the spectrum of integration

	Fully integrated →			→ Highly Fragmented
Money markets:	Unsecured bank market	Commercial paper	Short-term securities from private issuers	Repo market
Derivatives:	Interest rate swaps			
Bond markets:	Government bonds	Corporate bonds		
Equity markets:		Listed stocks		
Retail finance:	Time deposits	Loans to enterprises	Mortgage loans	Consumer loans and deposits

4.2.1. Measuring financial integration within the Euro zone

The instant changeover of European capital markets to the Euro is a tremendous result and often cited as one of the success stories of EMU. Following this initial euphoria, attention turns to what extent market participants are utilizing their ability to freely trade capital market securities within the Euro zone and what barriers to this free trade remain across the various segments of the capital markets. In other words, to what extent are the Euro capital markets truly integrated? The European Commission commissions a study to measure the evolution of capital market integration in the Euro area and in the European Union as a whole. The resultant report, from Adam et al. (2002), draws on the methodologies and indicators proposed in the academic literature and reviewed in this chapter so far. A prime objective of their study is to identify suitable indicators for the frequent monitoring of financial integration in the Euro zone.

In their selection of possible measures, Adam et al. (2002) distinguish price-based measures (that make use of the law-of-one-price) from quantity-based measures (that are mainly stock and flow measures). They state a preference for price-based measures for reasons of data availability and accuracy. However, rather than relying on the deviations from interest parity conditions as price-based measures, Adam et al. (2002) propose to rely on concepts derived from the economic growth literature and adapted for measuring financial market integration which they label β-convergence and σ-convergence. Specifically, they propose to estimate the following equation:

$$\Delta i_{ct} = \alpha_c + \beta\, i_{ct-1} + \sum_{n=1}^{N} \gamma_n \Delta i_{ct-n} + \varepsilon_{ct} \qquad (19)$$

where $(\Delta) i$ is the (change in) interest rate in country *c* at time *t* (and *n* periods back), α_c the country dummy and ε_{ct} an error term capturing exogenous shocks that force interest rates to differ across countries. The theory is that interest rate deviations tend to return to the long run equilibrium value over time and that dispersions are small, taking into account that financial prices are non-stationary. A β-value of zero indicates no convergence and a non-zero β indicates convergence. The magnitude of β denotes the speed of convergence. If the cross-sectional distribution of interest rates decreases over time then so-called σ-convergence occurs. This is when countries tend to become more similar over time in terms of deviations from the long run equilibrium value. Whereas β-convergence offers a measure of the speed of financial integration, σ-convergence indicates the degree of financial integration.

Adam et al. (2002) do not explicitly motivate their decision to ignore interest parity deviations measures, which had dominated the academic literature on international financial integration so far, in favor of their measures of β and σ-convergence. A possible motivation could be that these more conventional measures have proven their use mostly for a specific subset of the capital markets only; the money markets where instruments are short-dated. Measures are sought for the wider set of capital markets for which interest parity conditions seem less appropriate. Furthermore, interest parity conditions are less suitable in the case of a single currency area if one considers that *CIP* and *UIP* collapse back to a measure of closed interest parity. This is because the irrevocably fixed exchange rates within the Euro zone renders the difference between the forward or the expected future exchange rate and the spot exchange rate nil. Any deviation between the forward or the expected future exchange rate and the spot exchange rate would rather indicate that the market anticipates that a Euro zone country were to adopt its own legacy currency again and would therefore constitute a measure of EMU break-up risk. Therefore, assuming that EMU prevails, under the conventional deviations from interest parity measures one ends up measuring either the one extreme of closed interest parity or the other extreme of real interest rate parity (*RIP*). The accuracy of the first as a measure of financial integration is immediately linked with the ability to find securities with the same risk characteristics that are traded inside and outside the domestic Euro zone country and whose prices are taken at the same time which is challenging, while the second as a measure of financial integration has widely been shown not to hold and is more difficult to interpret. Adam et al.'s concepts of β and σ-convergence are instead more general measures of economic and financial convergence of markets within the Euro zone. It has to be noted that these measures inherently capture the convergence of the economies of Euro zone countries, because economic convergence is reflected in the risk characteristics of the chosen securities for measurement, the more so the longer the maturities. Other factors, such as maturity and liquidity risks also come into play, which are inherently captured by such more broad measures of financial ánd economic integration.

To determine the degree and the speed of capital market integration, Adam et al. (2002) separate credit and bond markets from the equity markets and further propose measures to determine the effect of financial integration on household and corporate decisions and the role of legal institutions. They conclude that within the credit and bond markets on their measures of β and σ-convergence, there is fastest integration in the interbank loan market and government bond markets and slower integration in the mortgage loan and corporate loan markets. On quantity-based measures, integration of credit and bond markets is largely weak, though a Euro effect in the international portfolio composition of money market and bond funds is noticeable. This is also true for equity portfolios, but on all other measures the integration of equity markets is less than for credit and bond markets. As regards household decisions, there is evidence of increasing savings-investment correlations, but not of correlations of consumption growth rates. As regards corporate decisions, there is mixed evidence of increased cross-border M&A activity. Finally, the role and influence of legal institutions is largely unchanged.

In the spring of 2002, shortly after the Adam et al. (2002) report, the ECB and the Center for Financial Studies (CSF) start up a research network on 'Capital Markets and Financial Integration in Europe'. Comprehensive work on the measurement of financial integration of the Euro area by the new network culminates in an ECB paper by Baele et al. (2004). Baele et al. group their various measures into price-based, news-based and quantity-based measures. Within these overall categories, appropriate measures are devised for the bank credit markets, fixed income markets and equity markets. Here, the measures proposed for the fixed income markets, which are further segregated into the money markets, government bond markets and the corporate eurobond markets are of interest. In the definition of Baele et al., price-based measures capture discrepancies in prices or returns caused by their geographic origin. As such, prices of fixed income assets with similar risk characteristics can be directly compared in the case of the money markets and their yields be compared relative to a well-chosen benchmark in the case of government bonds (such as German Bunds). Adam et al.'s concepts of β and σ-convergence are also adopted as adequate price-based measures of integration for which government bond yield are again used. Baele et al. borrow from the field of financial economics to introduce a new price-based measure for fixed income assets with dissimilar risk characteristics. Specifically for corporate eurobonds, they follow in the tradition of Heston and Rouwenhorst (1994, 1995, 1999) and propose a novel measure to extract the proportion of cross-sectional return variance explained by country effects. Baele et al. argue that the lower the country effects in eurobond returns, the higher the integration of this market in the Euro zone. The second category contains news-based measures. These isolate the proportion of asset price changes explained by relevant news common to assets across all countries as reflected in the price movements of a benchmark asset. For government bonds, the following regression is run to separate common from local influences:

$$\Delta y_{ct} = \alpha_{ct} + \beta_{ct}\, \Delta y_{bt} + \varepsilon_{ct} \qquad (20)$$

where Δy_{ct} denotes the change in yield on the asset in county *c* at time *t* and Δy_{bt} that of the benchmark asset, α_{ct} is a time-varying intercept, β_{ct} a time-dependent beta with respect to the benchmark asset and ε_{ct} a country specific shock. Indications of increasing integration are if α_{ct} converges on zero and if β_{ct} converges on one. The average distance of all country betas to one serves as an integration measure for the overall Euro market. Beside price and news-based measures, Baele et al., like Adam et al., propose the use of a third category of quantity-based measures, though often different from the ones proposed by Adam et al (2002). Baele et al. abandon to measure the indirect effect of financial integration on household and corporate decisions (and therefore do not calculate savings-investment and growth consumption correlations for instance) and the effect on legal institutions, but instead focus directly on various segments of the capital markets.

Indeed the merit of the Baele et al.'s effort is in the consistent application of their proposed measures to many more different market segments to assess financial integration for each individually, reflecting the now growing (complexity of the) Euro capital markets. Beale et al.'s longer list of price, news and quantity-based measures more or less still confirms the earlier findings of Adam et al. on the state of financial integration of the various Euro zone markets. A high and almost complete level of integration is observed for the Euro money markets, a high but not complete level of integration for the government bond markets, a smaller but increasing level of integration of the corporate bond markets and equity markets and a low level and slow integration of bank credit markets.

Not long after the publication of Baele et al.'s (2004) study, in September 2005, the ECB publishes its first report entitled 'Indicators of financial integration in the Euro area'. It adopts more or less the full range of measures of financial integration from Baele et al., some quantity-based measures from Adam et al., such as cross-border M&A activity and some new infrastructure measures on securities and settlement systems and retail payment systems. The ECB announces that this report is henceforth published annually and that the series of measures are to be updated and published bi-annually.

Based on the above studies and his own observations, Haas (2007) comes to what is, just before the sub-prime credit crises, the widely accepted view on the state of play on the integration of Europe's financial markets in a similarly titled IMF publication. For the various segments of the Euro's capital markets this view is as follows:

Money markets: The uncollateralized bank market is basically fully integrated. The repo market and the market for short-term securities, especially those issued by corporate and financial institutions, remains fragmented along national domestic lines. The market for commercial paper is Euro-wide and growing.

Government bonds: The public debt market is largely integrated and liquidity has improved. There is a clear convergence of yields to within a very narrow band. The transformation of

	market infrastructures, particularly the widespread use of MTS as the inter-dealer trading platform and its related primarily dealerships, has facilitated this integration.
Corporate bonds:	The market for corporate debt has expanded rapidly and there is some, though inconclusive, evidence that industry factors play a more important role in the investment of bond fund assets.
Securitized bonds:	Securitization is largely absent in the mid-1990s and has expanded rapidly but remains underdeveloped compared to the US. Covered bond markets have a stronger footing in Europe.
Interest rate swaps:	Since EMU, interest rate derivatives develop significantly and are all based on a common Euro rate.
Equity markets:	Integration trends in the equity markets remain less clear cut. Equity prices across countries are more correlated and there is a convergence of premiums. The consolidation of trading infrastructures is proceeding but remains largely fragmented.
Retail finance:	Retail financial services, for individual and small and medium sized enterprises, remain highly fragmented.

4.3. New branches of research on financial integration in Europe

The research field on international financial integration in the 2000s branches out in different directions. While it is impossible to encapsulate all, I highlight three important ones: (i) application to specialized sectors of the capital markets; (ii) risk sharing and welfare effects of financial integration, and (iii) cross-fertilization with financial economics studies on equity returns. In the description of each of these new directions of research in the sub-sections below, I stay with studies that focus on Europe. This is for reasons that EMU provides special empirical testing ground for research due to the uniqueness of its economic and monetary integration in the world and for reasons that it complements the evidence of financial integration of Section 4.2. It will be shown that the third branch provides a compelling way forward in the dual study of the integration of European bond markets and portfolio diversifications. It is therefore dealt with last, but also in more elaborate fashion than the other two branches.

4.3.1. Application to specialized capital market sectors

Macroeconomic studies on international financial integration that employ interest parity conditions focus to begin with on the money markets as this market sector provides for securities that are most similar in terms of their characteristics. Furthermore, prices for money market instruments are readily available in high frequency to researchers. Occasionally studies venture into the longer-dated spectrum of the fixed income markets, using government bond and currency rate swap data (e.g. Popper, 1993). Lemmen and Eijffinger's (1998) study is notable for the use of short and long-term bonds as well as stocks to compute real interest rate parity deviations and to perform their Euler equation test of financial integration from consumption growth correlations theories. This remains a rare example at the time when European markets are still divided along national currency lines. Jump forward six years and note that Baele et al.'s (2004) compilation of measures for financial integration, extensively discussed in Section 4.2, includes price-based measures not only for the money markets and for government bonds, but also for various other sectors of the capital markets including the market for bank credit, corporate bonds and stocks. Therefore, Baele et al.'s study on the overview of financial integration measures already provides an important hint that the field of research has in the meantime moved on to different sectors of the wider capital markets.

Indeed, due to the growing complexity of capital markets, the literature in the field of international financial integration increasingly reflects that each sector merits its own approach. Here, I would like to highlight two studies that have each focused their attention exclusively on one particular segment to demonstrate the individual approach that is adopted: Stephens (2000) on the convergence of mortgage systems in Europe and Allan and Song (2005) on the effect of EMU on the integration of the financial services industry.

Stephens (2000) is intent on assessing the impact of EMU on mortgage system convergence. His study demonstrates that in the prevalent situation of very diverse mortgage finance systems in the European Union that it is challenging to directly measure price differences. Stephens therefore resorts to a more qualitative approach and devises a mortgage typology with three possible states of convergence: divergent, fully competitively convergent on a narrow definition of efficiency and fully convergent on a wide definition of efficiency. Stephens concludes that the first, divergent, state exists in the European Union. European mortgage systems differ in several respects, including the types of intermediary, the cost of funds, the mortgage products, the crude price of mortgages and the price of mortgages adjusted for contractual differences and risk allocation. The mortgage market in the European Union therefore lacks efficiency both in a narrow sense, defined as intermediation efficiency of the mortgage delivery system, and in a wide sense, defined as the economic efficiency of the housing finance system. Stephens anticipates that the Euro will provide a strong push towards the state of financially competitive convergence, as the single currency enhances price transparency of mortgages and creates greater competition in the savings market. Note that Baele et al. (2004) find some evidence of this prediction, as their price-based measure of mortgage rates shows signs of convergence, albeit slow.

Allan and Song (2005) study the effect of EMU on the integration of the financial services industry. They use data on announcements of mergers and acquisitions (M&A) within the industry for Europe as well as the Americas and Asia to disentangle the EMU effect from a globalization effect. The sample period is June 1998 to May 2003 and is subdivided into three periods to mark the different stages of EMU. A more focused analysis is also conducted within Europe, to enable a comparison of EMU with non-EMU countries. One of the main findings of the study is that EMU enhances the regional integration of the financial services industry within Europe. At the regional level, first, EMU has little effect on non-EMU European integration but appears to have reversed the trend of declining integration within the Euro zone area. Secondly, financial institutions tend to be acquirers rather than targets in cross-EMU M&A activity following the introduction of the Euro. Thirdly, there is more M&A activity among commercial banks and investment banks rather than insurance companies with the Euro zone. The other major finding is that EMU does not seem to facilitate the entry of non-European institutions into the European financial industry. Taken all together, there is some evidence that EMU has helped the integration of the financial services industry.

4.3.2. Consumer risk sharing and welfare effects of financial integration

The consumer growth correlation model produces weak results for international financial integration and draws widespread criticism as an appropriate measure for it, as discussed in Section 3.2.3. As a result, the straightforward application of this model peters out relatively quickly after its introduction in the late 1980s. It does, however, produce two off-shoots: risk sharing and regional industry specialization as related measures of financial integration, and the study of consumer welfare consequences of financial integration.

As regards the first, the notion of consumption sharing to smooth idiosyncratic risk, and perfect capital market integration providing the mechanism thereto, is extended to the notions of income and production sharing. I highlight two studies whereby the focus is on regions. Kalemni-Oznan, Sørensen en Yosha (2003) concentrate on the smoothing of regional output fluctuations and devise two mechanisms, income and consumer risk sharing, which are by extension each a measure of (perfect) financial integration. If income is perfectly insured within the risk-sharing group (of regions or countries), the personal income of each grows at the same rate as the group's aggregate personal income and is not affected by idiosyncratic fluctuations of GDP, and the same for consumption. Ekinci, Kalemni-Oznan and Sørensen (2007), based on the prediction that with fully integrated capital markets capital will flow to regions with the highest productivity, produce a measure of 'diversification' finance and 'development' finance for the degree of financial integration within and between European countries. Diversification finance examines whether the change in the ratio of output to income is positive for regions with high growth. Development finance examines whether the level of this ratio negatively depends on the level of output, which would be the case if formerly poor regions experience catch-up growth. Though again little evidence results on any of these measures of capital market integration, both studies bring out other interesting results. From Kalemli-Oznan et al., that risk sharing among regions within federations is higher than risk sharing among countries, particularly so in the EEC, and that regions are more industrially specialized than countries. From Ekinci et al., that regions with the EU where confidence and trust is high are more financially integrated.

As regards the welfare consequences of financial integration, Von Furstenberg (1998) writes that "the definition of worldwide financial integration must refer to its welfare-relevant functions or consequences." (1998, p 53). Now welfare is a very broad concept that can be taken to mean a number of different things. In the case of Von Furstenberg (1998), the welfare opportunity is in the contribution financial integration has to make to the equalization of trading opportunities as represented by the real cost of financial services. Various (highly liquid and frequently traded) market segments may indeed proof to be highly integrated (by interest parity deviations studies for example), but if such integration does not succeed in integrating the market for a large number of diverse financial services used by consumers and non-financial businesses, then its contribution to economic welfare is hampered. This is argued on the basis that intertemporal optimization conditions deduced from its real cost will be distorted. Von Furstenberg thus pleas for detailed industry studies of the international pricing of financial services in order to better understand the limitations of financial integration and how the international integration of 'high finance' can be brought down to market access for all. The literature has been spared a tidal wave of industry studies, but the call for the welfare enhancing properties of international financial integration has remained on the notions that capital mobility is underpinned by intertemporal consumer optimizing behaviour and international consumer risk sharing.

This particular off-shoot from consumer growth correlations model produces better results compared to the previous one and also points to new research avenues for the future. Van Wincoop (1994) is an early and prime example of a study that uses the theory of consumption risk sharing to compute yet unexploited welfare gains associated with the reduced variability and better international pricing of consumption streams. For 20 OECD countries between 1970 and 1988 it is shown that the average welfare gain across countries (given realistic risk free rates and rates of relative risk aversion) is equivalent to a permanent increase in consumption by 1.8-5.6%, which amounts to one to three times the size of the entire securities services industry in the US. More recently, research on the welfare consequences of financial integration concentrates on the role of banks and how they contribute to interregional risk sharing. Acknowledging from prior studies that the most integrated market within the European Union is the unsecured money market or the interbank market, Fecht and Gruner's (2005) study show how financial integration can nevertheless be welfare improving. They model a complex interbank market game. Allowing for constraint efficient risk sharing among banks, their model outcome shows that international integration is preferable to a world with non-integrated bank markets if the expected benefits – insurance against liquidity shocks – outweigh the expected costs – risk of financial contagion. It is also shown that further welfare gains can be obtained if the interbank market, beyond the initially assumed simple arrangements, would allow for cross-country mergers, which can improve interregional insurance against liquidity shocks. In an extension of this study to a multi-regional setting to include the secured bank market and the retail market and relying on direct revelation mechanisms, Fecht et al.'s (2007) study brings three further results. One, for a sufficiently small integrated financial area, a system relying on secured interbank lending is preferable because it does not entail financial contagion. Two, a financial area of intermediate size benefits most from an unsecured lending mechanism. Three, the larger the financial area becomes, the less the interbank market (whether secured or unsecured) is capable of providing efficient risk sharing, whereas the cross-border penetration of retail banking markets can. For Europe's monetary union in other words, the Fecht et al. study underlines the importance of integrated retail banking markets to consumer welfare and financial stability, which can be achieved through cross-border transactions and bank mergers. Indeed, through the notion of risk of contagion in the interbank market, this new strand of research veers in the direction of the financial stability of EMU.

4.3.3. Cross-fertilization from equity returns studies

It is discussed in Section 4.2.1 that the macroeconomic measures that bring out the clearest results and as such emerge from the debate on international financial integration relative unscathed are the deviations from interest parity conditions. These conditions find best application in financial markets where assets are highly substitutable. Studies on their empirical validity therefore test these conditions predominantly on money market instruments. Money markets represent the short end of fixed income markets. The application of interest parity conditions at the longer end of fixed income markets is rare for reasons that asset substitutability is reduced and this then interferes with any observation on the breach of these conditions. Whenever such studies do apply to the longer dated segment (e.g. Popper, 1993), it is with respect to government bonds where instruments are most alike. Beyond that, the empirical application of interest parity conditions grinds to a halt. Corporate eurobonds, marred by risk characteristics that are just too dissimilar, tend not to be studied in the framework of interest parity. Section 4.2.1. also describes how the field of financial economics provides inspiration for new integration measures to fill this void for the bond markets. It highlights methods to determine the importance of country effects in the variation of returns of bonds with dissimilar risk characteristics as one such integration measure. Such a measure can for once find application with the corporate eurobond markets, as Beale et al (2004) indeed have done.

In order to obtain a better understanding around the methodologies that provide inspiration for such measures, it is useful to lay out the territory of financial economic research on asset return variation in some more detail. From this, it can also be seen where otherwise cross-fertilization with the traditional macroeconomic measures of international financial integration has been and where the best scope for further research lies for the European bond markets that comprises both the government and corporate sector.

In the field of financial economics the relevant debate is on patterns of equity market return volatility and its sources and less on financial integration per se. Catao and Timmerman (2010) provide a highly summarized overview of the distinct literatures that have emerged since Robert F. Engle's work on volatility modeling in the early 1980s. The first strand of literature asks whether and why equity return volatility is time-varying. Using a range of econometric models capable of estimating rich asset pricing dynamics, these studies typically find that stock returns from broad stock indexes are strongly time-varying. A second body of literature decomposes such time-varying equity return volatility into its country, industry sector and firm-specific components. Using firm-level data instead, the econometric model assigns the importance of the variation in equity returns over a set time period to country and industry characteristics. Heston and Rouwenhorst (1994) are considered the founders of this strand. Theirs and many other studies in this vein typically conclude that country effects explain a larger portion of cross-sectional variation in stock returns. In Europe, around the introduction of EMU, several studies detect a rise in the importance of industry factors in stock returns, but this is not convincingly confirmed as a long-term trend. Underlying the early studies of this literature is the assumption that factors have fixed and constant betas over time. More recent studies overcome these limitations by relaxing either or both. Time-varying betas are for example incorporated on a dynamic arbitrage price theory model or within a GARCH framework. A third strand of literature studies, in view of evidence that country effects play a dominant role in equity return variance, their correlation and covariance structure is studied over time. These studies also go in search of answers to optimal international diversification. Covariances, like is true for correlations, are also found to be time-varying. Other studies from this branch show that distance, information, common institutions and macroeconomic factors play a role in the explanation of equity return comovements between countries. Though not explicitly referred to by Catao and Timmerman, I include studies in the third strand that otherwise build on the importance of country versus industry effects in equity returns in the comparison of mean-variance performance of portfolios diversified either way. Mean-variance tests of spanning and efficiency are applied in Moerman (2008) and in Eiling et al. (2006), and style analysis in the latter study and in Eiling et al. (2010) to effectively determine whether country or industry diversification strategies have more optimal performances. Studies from the third strand tend to use returns data from stock indexes rather than individual assets.

Cross-fertilization between the macroeconomic debate on international financial integration and the financial economics debate on equity returns has been rare, but there are some exceptions. A good example is a recent study from Hardouvelis et al. (2006) taking elements from macro and financial economics to study the integration of stock markets under EMU. They pose that following the adoption of the Euro, money markets and to a high degree the bond markets are fully integrated and ask if similar integration took place in the stock markets of individual Euro zone countries in the 1990s. Theirs is a typical example of the common factor approach that has conventionally been followed for stocks returns to determine financial integration, but use interest rate and currency rate deviations in the explanation of time-varying integration. Specifically, Hardouvelis et al. examine the evolution of the influence of EU-wide risk factors over country-specific risk factors on required rates of returns during the 1990s. They estimate a conditional asset-pricing model where each Euro zone country has its own time-varying degree of stock market integration which is conditioned on a broad set of monetary, currency and business cycle variables. Among them are forward rate and nominal interest rate differentials with Germany, inflation differentials with the EU average and local currency volatilities relative to the Deutschemark. The data sample includes all Euro zone countries (except Greece) plus the UK from 1992 to 1998. The estimation results indicate that in the second half of the 1990s stock markets already integrate to a point where individual Euro zone stock markets appear to be fully integrated into the EU market. The two main drivers of this integration are the evolution of the probability of a country joining the single currency and the evolution of inflation differentials. These results are reinforced by the observation that the UK does not show any signs of increased integration.

Note that Hardouvelis et al. (2006) borrow from the macroeconomic literature on international financial integration to study Euro stock market integration. Cross-fertilization in the opposite direction also occurs, resulting in the study of Euro bond market integration. Examples include Beale et al. (2004) and Varotto (2003). Baele et al. borrow from the second strand of literature of equity return decomposition models to devise a novel measure for the integration of corporate eurobond markets, as already mentioned in Section 4.2.1. They way in which they do this is deserves some attention. Following Heston and Rouwenhorst (1994), Beale et al. aim to identify the country component in individual corporate bond yield spreads over government bonds with the argument that the smaller these country effects, the higher the level of integration. However, rather than decomposing country effects directly, it is defined as a residual and estimated in a second-stage after differences in risk characteristics of corporate eurobonds (such as maturity and rating) have been accounted for. Beale et al. (2004) thus find for a sample of Euro zone corporate eurobond yields for 1998 to 2003 that the country-specific spread is statistically significant but relatively small in economic terms. Varotto's (2003) study of corporate eurobond returns stays much closer to the standard Heston and Rouwenhorst decomposition model. In contrast, he finds that country effects dominate in corporate eurobond spread returns, though for a sample period that unfortunately does not include EMU.

While studies of country versus industry effects in eurobond return variation remain scarce and their evidence of their importance inconclusive, they do point in a new direction in the study of the integration and diversification opportunities of bond markets that is both compelling and convincing. The decomposition methodology that separates the importance of country effects from industry effects in bond return variation is straightforward yet powerful and can include the eurobond sector beyond that of government bonds. It is above all meaningful in the context of EMU where such effects can be expected to have undergone distinct changes. The analysis has the ability to incorporate bond-specific effects, as Varotto (2003) shows with the inclusion of credit rating, maturity and seniority of eurobonds. This adds to the attractiveness of the analysis. The decomposition analysis can be extended to methods used in mean-variance portfolio analysis. Particularly the spanning and efficiency tests can further determine whether country-based or industry-based portfolios are to be preferred. Again, this is a meaningful analysis in the context of Europe. Spanning and efficiency tests are effectively applied to European stock returns, e.g. by Eiling et al. (2006), but hitherto not to bonds. Mean-variance testing expands the study of the integration of European bond markets based on a decomposition of country and industry effects into a study on the benefit of either as a base for allocation for international portfolio diversification.

5. Conclusions

The literature on international financial integration from the past four decades is numerous and wide in scope. It is surveyed in this chapter from the viewpoint of its measurement. From the overview of theories that have this more quantitative focus and their empirical application, the aim is to resolve the process, degree and state of financial integration, particularly in Europe. The eclectic approach adopted in this chapter starts off by organizing macroeconomic theory-based methodologies into three strands. The first uses deviations from interest parity to test if financial markets are internationally integrated. The second uses savings-investment correlations on the basis of Feldstein and Horioka’s condition that with perfect capital mobility, no relation between domestic savings and domestic investment should be apparent. The third uses consumption correlations derived from intertemporal consumption smoothing behavior and risk sharing across countries as measures of perfect financial integration.

In the review of each of these theories and the conditions they bring forward, it transpires that deviations of interest parity are in the category of price-based measures and measure financial integration in the narrowest sense. Often applied to specific instruments and to the short end of fixed income markets, it measures the financial integration of the markets they are traded in, such as onshore and offshore money market securities. Imperfect financial integration is interpreted as evidence that capital controls, transaction costs, exchange rate and other such barriers between these markets still exist. The broadest among these conditions, real interest parity (*RIP*), is a measure of both financial and non-financial integration. It is shown that the Feldstein-Horioka condition of no correlation between savings and investment is yet broader that *RIP*. It requires in addition the assumption of endogeneity of savings and investment and exogenously determined world interest rates. As such it is a measure of financial and non-financial integration in a net sense and therefore no longer of the price-based but of the quantity-based variety. Tests resulting from the theory on consumption correlations are also very broad and quantity-based. They rely on even stronger assumptions, namely that of perfect financial market integration and prefect intertemporal consumption smoothing behavior according to the model specification or complete markets.

Knowing the theoretical foundations and assumptions underlying the various measures of financial integration, it is logical that in the review of the evidence of their empirical study the interest parity conditions bring out the clearest results. Covered nominal interest parity (*CIP*) holds to close approximation for most short-term markets in the industrialized world already in the 1980s. Uncovered interest parity (*UIP*) often tends to break down and the interpretation given to this result is that financial assets denominated in different currencies are imperfect substitutes. It is even rarer for real interest parity (*RIP*) to hold between countries. Empirical studies based on the Feldstein-Horioka (FH) condition of no correlation between domestic savings and investment consistently find evidence of weak financial integration among industrialized countries. In the discussion of the various responses to this so-called FH puzzle it becomes apparent that savings-investment correlations are widely challenged as an appropriate measure for international financial integration. Consumptions correlations also suffer from such interpretation issues and produce altogether weak results. Though empirical studies from this strand do seem to indicate (weak) evidence that markets are integrating, consumption growth of countries are by far not completely correlated and consumption risks not fully insured in financial markets. In light of the weak and conflicting empirical evidence the savings-investment correlations and consumption correlations provide, they become further discarded in the theoretical debate because of questions around the structural parameters they measure.

The debate on capital controls, discussed as a fourth macroeconomic strand, proceeds alongside all the while. It has insofar as real measures of financial market integration are concerned focused on the quantification of the structural determinants of capital controls. From this, it is found that capital controls are more likely imposed by strong or large governments with less independent monetary authorities and are more likely also in poorer countries. A historical account of capital controls in the OECD confirms a well-known fact; that industrialized countries have progressively dismantled capital and exchange controls since the 1980s to the extent that financial markets are almost completely liberalized in this sense. In Europe, on which the analysis is focused henceforth in the chapter, EEC ministers agree to the complete removal of capital controls by 1990. While the course to a single market is set, national currencies remain a reality for the rest of nearly the whole decade. Evidence from financial integration measures in that period do detect a positive EEC-effect.

Following EMU and the successful transition of capital markets to the Euro, the assessment of their financial integration is reinvigorated. It is shown that the measures of financial integration discussed so far in this chapter are not given priority in the selection of tools to be applied to the new constitution of markets under the Euro. It is speculated that this is because some measures are clearly redundant (such as determinants of capital controls) and others have proven to be too difficult to interpreted in practical sense (such as savings-investment and consumption growth correlations). The remaining and most credible of measures, the interest parity conditions, have proven their use mostly in short-term money markets but rarely beyond that. In the new setting of European markets, with the elimination of intra-market currency risk, they either measure the one extreme of closed interest parity, already broadly shown to hold, or the other extreme of real interest parity, rarely shown to hold. Thus instead new measures are adopted borrowing from the economic growth literature and from financial economics studies on equity returns. With this, inherently the scope shifts from measuring financial integration in a narrow sense (if one considers the interest parity conditions) to measuring economic ánd financial integration. The comprehensive set of measures reveal a cascading of different levels of integration of different segments of the Euro capital markets. An almost complete level of integration is observed for the unsecured money markets (the repo market remains fragmented), a high level of integration for the government bond markets and related derivatives markets, a lower but increasing level of integration for the corporate bond markets and equity markets and the lowest level of integration for bank credit markets.

The ability of investors to make uninhibited asset allocation choices in fixed income markets in Europe is thus shown to have significantly improved pre to post-EMU. Pre-EMU, capital controls are abolished and the degree of integration of the money markets, the foundation of fixed income markets, is already significant. Currency volatility in the Exchange Rate Mechanism (ERM) in the 1990s is shown to be the largest remaining obstacle to further integration. For this reason alone, EMU has by virtue of its elimination of intra-market currency risk a severe positive impact on financial integration. Post-EMU, a comprehensive set of measures show that this integration within the fixed income markets of the Euro further extends itself beyond the unsecured money markets to the bond markets. Within the bond markets, the government sector enjoys a higher level of integration than that of corporate eurobonds.

Lastly in this chapter three new avenues of research that are emerging from the literature are pointed out. In recognition of the growing complexity of capital markets, I note that one branch is concerned with the application to specialized sectors of the capital markets, such as mortgages. The second branch is an off-shoot from consumer growth correlations models and studies risk sharing and industry specialization as measures of financial integration. It also incorporates separately the study of the consequences of financial integration for consumer welfare. The third branch combines methods from macroeconomics on international financial integration with methods from financial economics on equity return variation. Cross-fertilization between these two fields has to date been rare but examples of studies that do for the wider set of bond markets that include eurobonds look promising. The decomposition methodology enables the determination of country and industry effects in bond returns and offers a new perspective on financial and economic integration under EMU. These results can be expanded on in a study of the mean-variance performance of bond portfolios allocated on a country and industry basis through the methodology of spanning and efficiency tests. The two methodologies put together provide fertile ground to further study the scope for the financial integration of bond markets in Europe and best portfolio diversification before and after EMU. The empirical analysis described in Chapters 4 and 5 sits in this fertile cross-over territory. Before this is embarked upon, Chapter 3 provides indications from market practice on changing bond allocations as a result of EMU to provide further background to this empirical research.

CHAPTER 3
Bond markets and bond portfolio allocation before and after EMU: Indications from market practice

1. Introduction

The aim of this chapter is to provide a descriptive account of the impact of EMU on fixed income markets in Europe, both immediate and over the years to follow. This is done mostly in comparison to the ways in which markets had operated before national currencies were irrevocably locked to the Euro. A portrayal of evidence from market practice cites the fundamental and lasting changes the monetary union has brought about to the financial markets it incorporated. Securities volumes and trading data is put together with evidence from the finance literature and anecdotal substantiation to give testimony to the evolution of fixed income markets in Europe from the early 1990s to more or less the present day. Once the context of the changing landscape of fixed income markets in Europe is adequately described, the chapter turns its attention to changing asset allocation and diversification opportunities for bond portfolio managers.

Prior to the creation of EMU, bond markets in Europe are segregated along national currency lines. This segregation of markets is more than by currency alone as issuance practices, trading conventions, settlement arrangements and the like tend to differ between markets even for similar types of securities. Not only is the bond market itself, but also the infrastructure underlying this market highly dispersed. In addition to these supply-side factors, there are important factors on the demand-side that cause the operations of the European bond markets in those days to be a largely national domestic affair. Institutional investors are often constrained by national regulations on their investment portfolio purchases, through currency matching rules among others, which make them strong natural buyers of domestic government debt.

It is described in this chapter that the establishment of EMU implies significant changes to this constitution of markets. The various impacts of EMU are categorized into direct and indirect effects. Financial markets in Europe directly adopt the single currency with a Big Bang. In the bond markets, outstanding issues are redenominated and new issues are for the vast majority issued in Euro. Bond conventions are harmonized and EMU sovereigns coordinate and synchronize issuing and trading practices of their debt. These direct effects irreversibly transform the patchwork of national European bond markets to a more harmonized and large domestic bond market denominated in one and the same currency almost immediately. These direct effects are by now well known and in the finance literature universally attributed to EMU. What gives more ground for dispute among financial economists is to what extent the subsequent changes that can be observed in Europe's financial markets can be indirectly attributed to EMU.

In this chapter it is argued with respect to the fixed income markets at large and the bond markets therein, that the indirect impact of EMU has also been considerable in many ways. Through an abundance of fixed income securities data, mainly from the Bank of International Settlements (BIS) and Dealogic, it is demonstrated that following the launch of EMU, the Euro markets quickly sum up to more than its parts. The new market environment strongly encourages the growth of the credit sector. A more liquid and transparent domestic government bond sector where internal prices differences are on a downward trend leads to much higher corporate and financial institutions issuance. The elevation of the fixed income markets to a pan-European level strongly contributes to this and to other developments, which altogether give rise to a new landscape of fixed income markets in Europe and which continues to be shaped by these developments. It is a market that, as will be seen, also remains segregated in some ways. With the benefit of hindsight of approximately a decade of data, the contours of this new landscape can be accurately drawn. This is done in the first part of this chapter.

The latter part of this chapter then focuses on the way in which the new fixed income market environment created directly and indirectly by EMU has caused bond investors to respond with respect to their portfolio allocation decisions and strategies. Again, indications from market practice are taken to create as accurate an account as possible. As consistent and comprehensive data on portfolio flows and compositions are not readily available, evidence on this from the finance literature and investor surveys are pieced together. From this, the picture emerges that bond investors indeed have responded along with the new ability and opportunities for diversification that the Euro bond market offers compared to the old set of markets. It is shown in this chapter that this goes in broadly two directions. The first is a more 'international' composition of bond holdings, as the fading of borders results in a more even spreading of portfolios. The second is a broader 'credit' composition of bond portfolios, as investors have the intention to incorporate more corporate eurobonds. Particularly this latter change, for which the evidence to date seems merely circumstantial and incomplete, leads to further questions on whether bond investors in Europe have changed their diversification strategy in tow.

The remainder of this chapter is organized as follows. To start with, in Section 2, the landscape of Europe's fixed income markets pre and post-EMU is compared in detail. This data rich section demonstrates the development of various segments of the Euro bond market and also contains market data supporting fundamental shifts in the investment opportunity set for bond portfolio managers. Section 3 cites anecdotal evidence from market practice on the response from investors with respect to this new market environment. Section 4 surveys the finance literature for theoretical guidance on optimal asset allocation strategies in Europe for bond investors. Finally, Section 5 concludes.

2. The changing landscape of Europe’s fixed income markets

The impact of the introduction of the single currency on 1 January 1999 on Europe’s fixed income markets was immediate and profound in a number of ways. Overnight, the currency risk of the securities of the participating nations vis-à-vis each other vanished and the ECB assumed responsibility for the Euro bloc’s monetary policy. One set of key short-term interest rates in Euro anchors the money markets, 3-month implied futures contracts and the very short end of government yield and interest rate swap curves. These two direct and immediate effects of EMU are undisputed. But there are a number of other transformations on or shortly after the launch of the Euro which contribute to the creation of one large domestic fixed income market. Though not immediately mechanically the result of EMU, they are strongly encouraged by and carefully prepared for the event. One such transformation is due to the decision by participating sovereigns in the course of 1998 to redenominate the vast majority of outstanding bond contracts and to harmonize bond conventions on top of an earlier decision in 1995 to issue all new fungible sovereign debt in Euro as of 1 January 1999.[1] These actions create instant volume and depth of liquidity in all maturity segments of the new domestic government sector. It encourages private sector issuers to also raise debt in Euro, even though it is technically still feasible to issue in legacy currency for another two years[2]. The installation of the TARGET payment system immediately facilitates and speeds up cross-border payments.[3] With prices of fixed income securities now quoted in one currency, price transparency is greatly improved leading to a reduction in transaction costs. Though a lively discussion had taken place in the months leading up to EMU over the best benchmark candidates, the market actually decides relatively quickly: EURIBOR (instead of Euro LIBOR) for the money market, a combination of French BTANs and OATs (at 5- to 7-year maturities) and German Bunds (at 10-year maturities) for government bonds, the more homogenous Euro interest rate swap curve for new issuance, and the 10-year Bund contract in the futures market. The German exchange DTB had already drawn most of the trading volume in 1998 at the detriment of LIFFE and its 10-year Bund futures contract has now decidedly emerged as the benchmark for the Euro area (Cantillon and Yin, 2007). DTB merges into Eurex in 1998, signifying a wider trend among the exchanges to become increasingly centralized in the years following EMU. This happens often through a series of cross-border mergers and takeovers stimulated by the more open and competitive environment of the Euro. Trading of

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[1] See Pieterse-Bloem and Lamedica (1998) for an accurate reflection of the state of the discussion on the redenomination of bond contracts and harmonization of bond conventions in the run-up to EMU, and Danthine et al. (2000) on the reality of the redenominations after EMU is implemented. With some minor exceptions in Austria and Finland, all sovereigns had redenominated their debt by January 1999.

[2] On 1st January 1999 the Euro is introduced for commercial and financial transactions. Euro notes and coins circulate only from 1st January 2002 and until that time it would have been feasible to conduct financial transactions in Euro legacy currencies still.

[3] The first-generation TARGET system started operations in January 1999. By May 2008, it was replaced by an enhanced second-generation system. The main enhancement was from a technically decentralized structure made up of several systems to one based on a single technical platform (ECB 2010, p 94).

fixed income securities migrates to electronic and central platforms, particularly so in the government sector where EuroMTS becomes the central B2B trading platform (and later, to a lesser extent, EuroCreditMTS for covered bonds). The desire among sovereign issuers to have their bonds quoted and traded on MTS by primary dealers induces larger size issuance, as only bonds of certain minimum size (€5 billion in the case of EuroMTS) are allowed onto the platform.

Though the fixed income market in the Euro zone through these transformations becomes much more homogenous, instantly and gradually over the years, it has remained segregated in some ways. The segregation is most visible in the government bond market, where yield curves, though strongly converging after the elimination of currency risk, remain distinct. This is in reflection of national inflation and credit risk differentials, as Euro zone governments continue to preside over their fiscal policy and intra-EMU fiscal transfers remain limited. The introduction of the Euro initiates a process of consolidation of post-trading infrastructure of debt securities in the Euro area across borders in case of the exchanges. Euroclear, founded in 1968 in response to the eurobond market, through its partnership with Euronext (resulting from the merger of the stock exchanges of Amsterdam, Brussels, Lisbon and Paris) is able to acquire their local central securities depositaries (CSD) and through further acquisitions gains significant capability in the UK and Ireland, Sweden and Finland. Otherwise, post-trading infrastructure consolidation is mainly taking place domestically and only rarely at an EU level. As a consequence, post-trading infrastructures at a cross-border level remain largely fragmented. From the moment a fixed income security changes hands to the moment it is finally settled in Europe, it goes through a complex web of fund managers, brokers, trading platforms, central counterparties (CCPs), custodians which may or may not also be central securities depositories, of which there are more than 40 in Europe in 2009, which may or may not also be part of an international CSD such as Euroclear. This is an altogether costly affair. Table 3.1 reproduces the costs of post-trading services provided by European CSDs when acting as custodians and for clearing and settlement for a report prepared for the European Commission. Costs for post-trading services are still high in 2006 and remain so in the following two years. The only bright spot for fixed income securities is that clearing

Table 3.1
Costs of domestic and cross-border post-trading services in Europe, provided by CSDs

	Equities		Fixed income	
	Domestic	Cross-border	Domestic	Cross-border
Account provision and asset servicing				
2006 (bp)	0.16	0.38	0.20	0.29
2008 (bp)	0.15	0.36	0.18	0.39
Clearing and settlement				
2006 (€/transaction)	0.35	2.33	0.60	0.38
2008 (€/transaction)	0.25	2.88	0.62	0.42

Source: 'Monitoring prices, costs and volumes of trading and post-trading services', report for the European Commission, Oxera, 2009 and settlement for cross-border trades is lower than for domestic trades. This is largely because the ICSDs are able to lower their costs by consolidating all of the processing platforms into one, used by the international and national CSDs.

National differences in the regulation of fixed income securities also continue to exist. Several regulatory initiatives have been initiated in recent years to overcome these infrastructural and regulatory barriers to integration, mostly in the form of EU legislation enacted under the auspices of the European Commission's Financial Services Action Plan (FSAP) and through a fresh industry code of conduct in the field of clearing and settlement.[4] The European Commission is currently preparing a Securities Law Directive (SLD) with the aim to transpose it into member states' law by the end of 2013. Work on TARGET2-system (TS2), a single technical platform for the settlement of European securities transactions in central bank money and which is thought to greatly improve the harmonization of securities settlements, aims to start operations in 2013. As of 1st January 2011, the new European supervisory framework based on two newly founded centralized EU bodies, the European Systemic Risk Board (ESRB) and the European Supervisory Authorities (ESAs) has become operational. These initiatives are all in various stages of implementation and their full effect on the Euro zone's fixed income markets, though bound to be positive for further integration, will still need to be realized. Even less visible but certainly not less important an obstacle to complete financial integration in the Euro area are national differences in tax treatment of fixed income securities. These may prove altogether harder to overcome.

Many studies review the impact of the Euro on Europe's financial markets, leading up to the event[5], in its immediate aftermath[6] and in monitoring the evolution throughout the years thereafter[7]. I refer to these studies for the granularity and detail of the events and processes in the Euro fixed income markets already described. Here, the focus is on four major changes that emerge out of these studies induced by EMU. These are its indirect effects and have severely affected the market environment European fixed income portfolio managers operate in:

i. the elevation of a set of national markets to a pan-European market from which currency risk is eliminated;

ii. the size of the Euro market that quickly becomes larger than the sum of its parts;

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[4] The ECB (2007, pp 63-65) cites five such pieces of legislative initiatives – the prospectus directive of 2003, transparency directive of 2004, directive on markets in financial instruments of 2004, directive on undertakings for collective investment in transferable securities of 1985 which has recently been amended, and the collateral directive of 2002 – as well as the clearing and settlement code of conduct agreed in 2006.

[5] Note various articles in Temperton, P. (1998) and in Dermine. J., Hillion, P. (1999).

[6] Danthine et al. (Dec 2000), Adjaoute et al. (April 2000, Nov 2000), Galati & Tsatsaronis (2001) and BIS (2004) are good examples of fairly comprehensive studies that are quick off the block and which contain insightful analyses on fixed income markets.

iii. the alteration in the dominance and supply of different types of fixed income securities and in particular the surge of the Euro credit bond market; and

iv. the change in risk-reward relationships of established and upcoming market segments.

I detail each major change separately and describe how they have fundamentally altered the opportunity set of investments for fixed income fund managers.

2.1. A pan-European fixed income market

The Euro causes the elevation of the fixed income market to a pan-European level and playing field in many (but not all) respects. While the European Commission's Second Banking Directive and Investment Services Directive should have already created a single European market in financial services by the late 1990s, in practice obstacles remained. One such obstacle are the so-called currency matching rules, or national regulations bearing on the portfolios of pension funds and insurance companies to restrict holdings of assets denominated in foreign currency (and other assets that were deemed risky). Table 3.2 lists the currency matching rules for the assets under managements of pension funds and life insurance companies that prevail in the late 1990s in the eleven first EMU-entrant countries. Together with restrictions on the size of equity and property holdings and the prudent man rule oftentimes originating from the same regulations, the currency matching rules made these funds, whose asset base is very substantial in many countries in Europe, strong natural buyers of domestic government debt. Much is made of the impact of

Table 3.2
Currency-matching rule for European pension funds and insurance companies[8]

	Pension Funds	Life Insurance
Austria	50%	80%
Belgium	No	80%
Finland	80%	80%
France	No	No
Germany	80%	80%
Ireland	n.a.	n.a.
Italy	33.3%	80%
Luxembourg	n.a.	n.a.
Netherlands	No	80%
Portugal	No	80%
Spain	No	80%

Source: Danthine et al (2000, Table 3.2) who cite the European Commission (1997), IMF (1997) and the OECD (1998) as sources

[7] Apart from the ECB, who through various reports (2004, 2007, 2010) has continued to describe the changes in the Euro bond markets, studies such as Cappiello et al. (2006) and De Santis and Gerard (2006) set up a more analytical framework.

[8] The figures provided in Table 3.2 are broadly over various asset classes. Adjaoute et al. (2000, Table 2.4) also outline the national restrictions of portfolio investments of life insurance companies and pension funds but for fewer Euro zone countries (Germany, Spain, France, Italy, and the Netherlands only) from which it is evident that many countries have a limit on the allowable percentage of foreign assets held but that this limit may differ per type of asset.

EMU on the currency matching rule, as the adoption of the single currency means that under the same rules the government debt and other securities from the Euro zone immediately come within the scope of these funds. There is evidence that portfolios holdings of domestic government bonds of these institutional investors shifts away from their home currency to a diversified cross-holding of government debt within the monetary union, as indeed is the case for other investors operating under fewer restrictions.[9] The flip-side of the same coin also causes national debt management agencies to rethink the market position of their government debt and loss of privileges that come with being the main supplier of risk-free debt in their home currency. National treasuries become more keenly aware that in a post-EMU environment they need to compete more for the same "domestic" investor base. They start to better coordinate issuing calendars to avoid being in the market at the same time, but at the same time revise issuing strategies to make their debt more attractive. The latter involves in the majority of Euro area countries the offering of better liquidity through larger size issues and designated primary dealers, lengthening of the maturity profile and in some cases the offering of special products such as inflation-linked bonds.[10] With that, sovereign issuers play to the demand of institutional investors whose funds under management face upward pressure from an ageing population and desire to match long-term liabilities with assets, in part indexed to inflation. The ECB calculates that the outstanding Euro-denominated public debt securities as a percentage of all public debt securities actually also increases slightly from 2000 to 2002 for all Euro countries apart from Finland, from 74.5% to 77.7% for the Euro area as a whole (ECB 2007, Table 5).

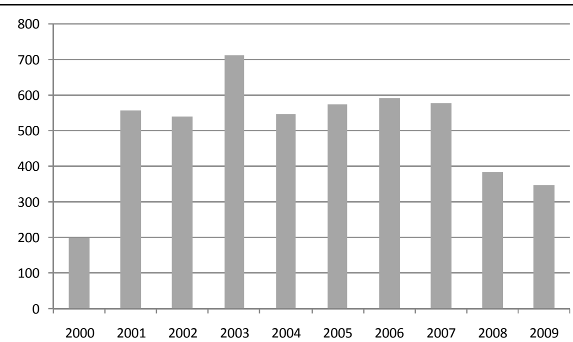
The Euro-denominated bond market, led by the government bond sector, gains instant momentum. The quick redenomination of existing government bonds into the new single currency creates a critical mass of Euro securities. This is added to by a larger size and stock of domestic bonds from participating sovereigns. These are issued in a more harmonized fashion. Central trading platforms such as MTS, the activity of primary dealers and a more seamless link with the derivatives markets all result in more liquid trading conditions than before. There is anecdotal report that the Euro bond markets gained as much in liquidity as it did in its overall size in the early years under EMU. In the words of the ECB who publishes a first comprehensive study on the Euro Bond Market in December 2004, the Euro-denominated bond market "has since [its inception] become much larger and more liquid than the national markets of the

[9] Galati & Tsatsaronis (2001, pp 20-21) state that in the absence of a complete matrix of flow-of-funds statistics on international portfolio shifts any evidence can only be partial, but are nevertheless able to detail that German institutional investors and Italian mutual funds appeared to have increased their purchases of Euro-denominated foreign securities between 1995 and 2000. For German investors, Euro-denominated assets account for more than 70% of the € 175 billion of total gross outward portfolio investment for the two year period 1998-99 and 60% for 2000. For Italian mutual funds, the share of Euro area bonds in the overall bond portfolio increases from 8% in 1995 to 23% at the end of 2000.

[10] The ECB states that in the segment of debt securities with a maturity of over ten years, public sector issuers account for more than 50% of these instruments in the years 2003-2006. Some countries like France are already issuing domestic inflation-linked bonds prior to EMU, but bonds linked to Euro zone inflation become more popular instruments thereafter, in particular in France and Italy and occasionally even in Germany and Austria (ECB 2007, p 14).

participating member states were in the pre-EMU era" (ECB 2004, p 8). Due to the more esoteric nature of the bond markets, where securities rarely trade via a stock exchange, there is unfortunately no single set of statistics that capture this better liquidity. The limited data that is available for European bonds is patchy and mostly in terms of turnover and trading volumes and bid-ask spreads. Galati and Tsatsaronis (2001) cite turnover data from Euroclear for selected European government bonds. This data shows that the average daily turnover of the most actively traded bonds from the French, German and Dutch governments noticeably increases between 1998 and 2000. The establishment of MTS as the B2B trading platform for Euro government bonds forces larger size and hence more liquid issues. Also the volume on most of its platforms increases, at least in the first half-decade of EMU. This can be seen from Table 3.3, where annual trading volumes on the domestic MTS markets and EuroMTS are compared for 2001 and 2005. The MTS markets in Belgium, France and Germany have all grown. MTS Italy and EuroMTS appear to have gone somewhat in reverse, but both are due to lower volumes in Italian long-dated government bonds (BTPs) which distorts the picture somewhat. MTS Germany is small by comparison to MTS Italy and that is because the preferred inter-dealer platform is Eurex Bonds. On this platform, which trades mostly German government securities but also German covered bonds and other European government and agency bonds, the average daily volume is on an upward trend between 2001 and 2007. This is shown in Figure 3.1. The existence of successful futures and options contracts, again on Eurex, has provided investors a low cost margin based trading mechanism for German government bonds. Trading volumes thereof provide another piece of evidence on enhanced market liquidity. Figure 3.2 shows that the annual volume traded in the Euro Bund 10-year future contract rose strongly between 1998 and 2007, as did the average annual openinterest on Eurex-traded futures and options on Euro-denominated debt securities (reported in Table 3.4). This highlights another special feature of the European bond markets, which is that the liquidity

Figure 3.1
Daily average volume, single-counted, traded through EUREX Bonds (€ mn)



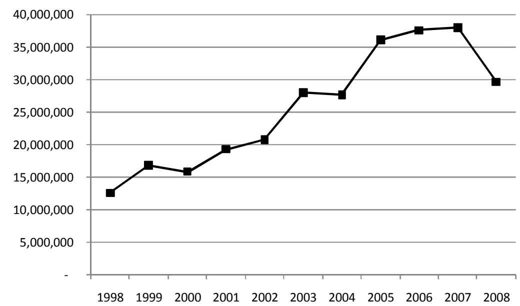
Source: Eurex Bonds (figures read from a chart and reproduced)

Table 3.3
Annual(ized) trading volume, single-counted, on MTS markets and EuroMTS

(in € mn)	Jan'01 – May'02	2005
MTS Belgium	174,458	178,213
MTS France	166,278	212,811
MTS Germany	50,744	143,271
MTS Italy	2,411,100	1,595,838
EuroMTS	654,866	302,940
MTS Spain	n/a	101,415
MTS Portugal	n/a	146,690
MTS Netherlands	n/a	79,673

Source: Cheung et al (2005, Table 3) for 2001-2002 figures, ECB (2007, Table 14) for 2005 figures

Figure 3.2
Annual volume in traded contracts in EUREX-traded Euro-Bund Future (€ mn)



Source: Eurex

Table 3.4
Average annual open interest on EUREX-traded derivatives on Euro debt securities

(in € bn)	Futures	Options
2002	194	146
2003	221	210
2004	297	203
2005	369	235
2006	450	278

Source: ECB 2007, Table 11 (Eurex)

of Euro government bonds is not just in the real securities markets but also in its related derivatives markets, and increasingly so according to the data shown here. Lastly, a further study on the Euro bonds and derivatives markets by the ECB in 2007 claims on the basis of declining bid-ask spreads that liquidity conditions have improved significantly. This study calculates that the bid-ask spread of Euro government bonds declines from around 0.08% in 2003 to 0.05% in 2006 and quoted spreads of corporate eurobonds from 0.38% to 0.24% over the same period (ECB, 2007). Each piece of data needs to be treated with caution when looked at in isolation.[11] Taken together though, they are consistent with a broader, deeper and more liquid bond market under the Euro, certainly compared to the situation in Europe before the single currency. The growing liquidity in the Euro bond market invites others to join in with their issuance. The securities data in the next section will show that the market grows quickly as a result.

Though the majority of Euro government bond supply is placed through auctions, occasionally syndications of banks are deployed by sovereigns for two reasons. First, to keep banks incentivized to act as good primary dealers and secondly to reach a broader investor distribution. Hence investment banks that are not from the home turf are deliberately included in the syndicate to reach investors in the far corners of the Euro zone. This marks a sharp diversion from practice under the old legacy currency markets. The same trend occurs among non-sovereign issuers who rely exclusively on syndications of underwriters for the placement of their international bonds with investors. Overall, while in the years between 1996 and 1998 40% of the volume of bond underwritings issued by borrowers of a specified nationality in the Euro area and denominated in Euro (legacy) currency are won by bookrunners of the same nationality, that percentage drops to 18% in 1999-2000 (Galati & Tsatsaronis, 2001, Table 3).

[11] The clearing of bond transactions is highly dispersed in Europe and while there has been consolidation of clearing activity, an increased turnover on Euroclear may also partially reflect an increase in its market share. MTS is an inter-dealer trading platform and growing volumes can also be due to reduced voice-broker activity. Eurex Bonds has added securities to its trading platform over the years and increased volumes are likely to partially reflect this.

Table 3.5
Bookrunners of Euro Liquid Bonds: 2007 versus 1999

	Q1-4 1999				Q1-4 2007		
Rank	Deal Value (€ mn)	No.	% Share	Rank	Deal Value (€ mn)	No.	% Share
1. Deutsche Bank	47,642	245	10.7	1. Deutsche Bank	65,259	196	9.2
2. Dresdner Kleinwort	30,991	177	7.0	2. Barclays Capital	46,598	151	6.6
3. BNP Paribas	28,455	104	6.4	3. Societe Generale	39,482	100	5.6
4. ABN AMRO	28,014	146	6.3	4. Citi Group	38,901	108	5.5
5. Intesa Sanpaola	27,079	185	6.1	5. JPMorgan	35,949	104	5.1
6. Unicredit Group	20,618	168	4.6	6. BNP Paribas	35,301	105	5.0
7. Commerzbank	19,867	136	4.5	7. ABN AMRO	30,855	92	4.6
8. JPMorgan	17,487	76	3.9	8. HSBC	32,537	99	4.4
9. Morgan Stanley	17,184	77	3.9	9. UBS	28,867	85	4.1
10. UBS	17,021	65	3.8	10. Merrill Lynch	26,881	69	3.8

Source: Dealogic

Attracted by the much larger and more liquid market and lower barriers to entry, it soon becomes economically attractive for non-European banks, particularly US banks with a substantial investment banking division, to build up capacity and presence in EMU's fixed income markets. Table 3.5 shows that whereas in 1999 the first seven places in the bookrunner league table for liquid Euro bond issues are occupied by large European banks, in 2007 two American banks break through to the top five of the same ranking.

Thus the advent of the Euro raises the level of fixed income markets that are segregated along national currency lines to a Euro-wide level. For investment funds portfolio constraints are relaxed and the investment opportunity is broadened. Likewise for borrowers, who had both previously been more confined to their national markets, the investor base is widened. This creates a pan-Euro level playing field for all and the investment banks who serve them.

2.2. The Euro bond market: more than the sum of its parts

The size and the constitution of the fixed income market within the Euro zone changes post-EMU. By this is meant that the Euro market as a whole becomes a viable contender to the US dollar market and that at the same time the structure of outstanding supply of its varying segments alters. In the years following EMU, its fixed income market has really proven to be more than the sum of its components. International debt securities markets worldwide have grown substantially over the last fifteen years and far more than world GDP. According to BIS figures[12], international fixed income markets globally grow nearly 18% on average per annum between 1993 and 2008. The share of Euro-denominated securities in that period rises from 24% at the start (compared to 43% for the US dollar) to 48% by the end of that period (compared to 36%

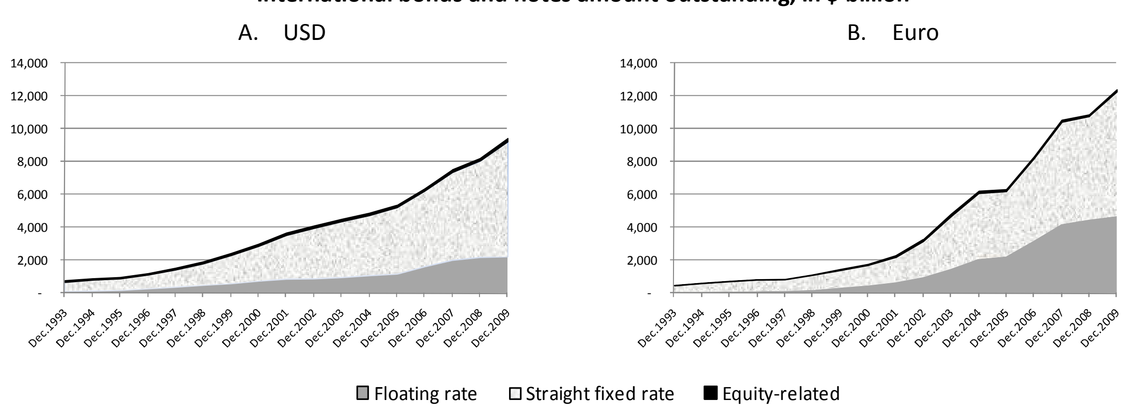
[12] for the amount of US Dollar outstanding of international bonds and notes and money market instruments, Tables 13A and 13B (BIS Quarterly Review, December 2009)

for the US dollar). The surge in the Euro share is particularly notable from December 1998 when its share is still only 27%. Figure 3.3 shows the development in the amount outstanding in international bonds and notes and compares the US Dollar and Euro-denominated market between 1993 and 2009. In December 1998, on the eve of EMU, Euro bonds and notes constitute just below 60% of that outstanding in US Dollars ($1,137 billion versus $1,955 billion). But by the same measure, in 2003 the Euro has overtaken the US Dollar ($4,828 billion versus $4,535 billion) and its international fixed income market would continue to grow faster than its US Dollar equivalent. By the end of 2009, the Euro international debt market is 1.3 times the size of the US Dollar international debt market. The data strongly suggest that the Euro is able to attract issuers in volumes that the sum markets of its legacy currencies were not able to do before.

In the international money markets, not included in Figure 3.3, the picture is the same. According to BIS figures, the amount outstanding in international money market instruments in December 1998 in Euro is 30% of that outstanding in US Dollar ($135 billion versus $40 billion), but this situation is already reversed by the end of 2002 ($178 billion versus $145 billion). In 2009, the Euro international money market is 1.4 times larger than its US Dollar counterpart. While money markets were small in each of the legacy currencies of the Euro in the 1990s, the Euro quickly establishes itself as an attractive currency for short-term funding with international borrowers.

A further dissection of the international bonds and notes data indicates that the growth in the Euro market can be attributed to an increased issuance activity by corporate and financial institutions. Figure 3.4 depicts the moving average in net issuance of international bonds and notes of the proceeding four quarters. The left panel shows that the share of the Euro in the net issuance of international bonds in all currencies rises strongly in the period 1999-2003, precisely when there is a strong expansion of its market.

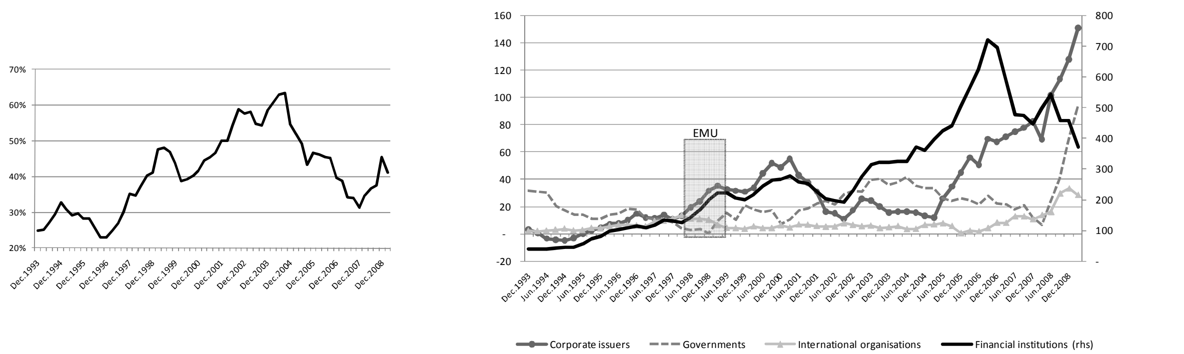
Figure 3.3
International bonds and notes amount outstanding, in $ billion



Source: BIS Quarterly Review, December 2009
Notes:
- International bonds and notes are from tables 13B. Euro before 1.1.1999 is the sum of ECU and Euro legacy currencies.
- The moving average is over the next fourth quarters.

Figure 3.4
Four quarter-moving average of net issuance in international bonds and notes in $ billion

A. Share of Euro in all currencies
B. All currencies



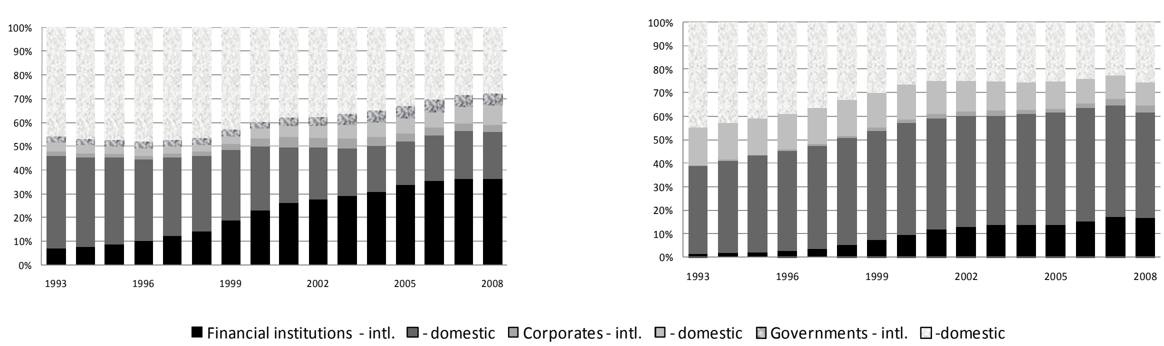
Source: BIS Quarterly Review, December 2009
Notes:
- International bonds and notes are from tables 13B. Euro before 1.1.1999 is the sum of ECU and Euro legacy currencies.
- The moving average is over the next fourth quarters.

In that time, the net issuance of corporate and particularly financial institutions accelerates, as can be seen from the right panel.

This is first evidence of what is by now a well-know fact, that the Euro spurs the growth of its credit market. Being introduced at a time when EU15 government budget positions had consolidated to -2.3% and net issuance from Euro zone governments would decline from €112 billion in 1998 to €96 billion in 2000 (according to ECB numbers), there is ample room for European corporates and financial institutions to diversify their borrower base away from bank lending to bond investors. The latter can be more easily tapped in size in the Euro market and investors themselves are keen on the spread offered by such issues

Figure 3.5
International and domestic securities amount outstanding by sector, in percent of annual total

A. United States
B. Euro zone



Source: BIS Quarterly Review, December 2009
Notes:
- International debt securities are from BIS tables 12 and are by sector nationality of issuer. Domestic debt securities are from BIS tables 16 and are by sector and residence of issuer. Euro zone is created from the sum of the first twelve member states but has no data available for Luxembourg for tables 16. Both tables BIS 12 and 16 are in USD billions but expressed here as breakdown in percentage of the total for each year.

over the low yielding government bonds (10-year German Bund yields were at 3.8% on the first trading day of EMU).

Figure 3.5, which now also takes the domestic alongside the international debt securities market into account, shows that the share of corporate and financial institutions rises much faster from a smaller base in the Euro zone than in the United States. This is at the detriment of the government sector. The constitution of the fixed income market, government versus corporate and financial sector, changes markedly in the Euro zone; from a near 50:50 market in 1998 to a 33:67 market by 2008.

The statistics shown in Table 3.6 of the various computations on the BIS securities data, neatly sum up the points made in this section:

- While international fixed income markets globally grow on average nearly 18% between 1993 and 2008, the Euro currency roughly doubles its market share. The surge of the Euro fixed income market happens almost immediately after EMU, which makes it evident that the Euro-denominated market quickly becomes more than the sum of its constituent markets.
- The Euro fixed income market with its larger and growing market soon becomes a true contender with the US Dollar market for size. Both in international money markets and bond markets, the ratio of the Euro to the US Dollar outstandings turns over.
- While BIS data does not provide a breakdown of type of issuer by currency, it can be derived that the surge of the Euro is driven by corporate and financial institutions. Not only coincides the larger share of the Euro currency in net issuance of international bonds and notes with a much higher share of net issuance of these private institutions, also within the Euro zone itself, the share of corporate issues nearly doubles and that of financial institutions grows from an already high base.

Table 3.6
Summary statistics of BIS Data on Global Fixed Income Markets

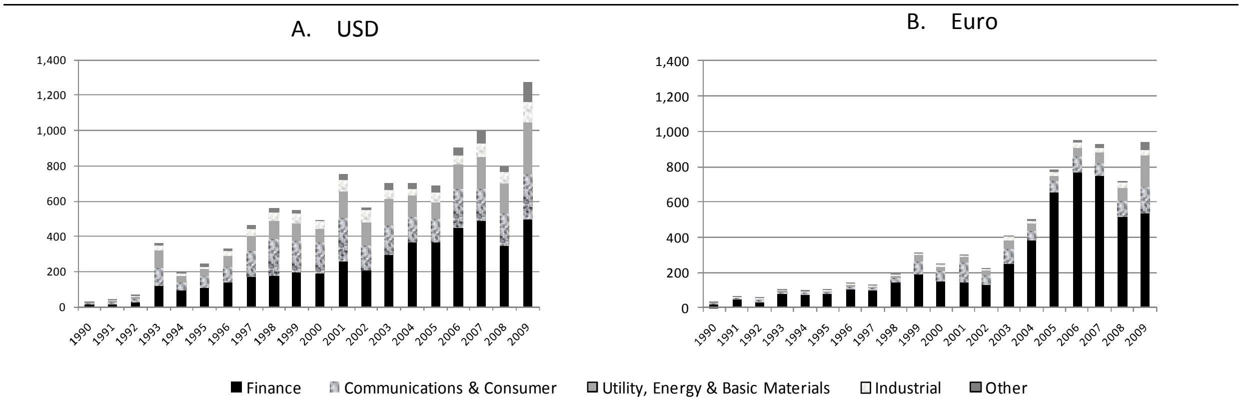
	Dec. 1993		Dec. 1998		Dec. 2003		Dec. 2008	
A. International Fixed Income Markets - amount outstanding globally								
Size ($bn)	2,108.032		4,409.94		11,701.16		23,861.61	
Growth rate (average last five years)	n/a		16.0 %		21.6 %		15.7 %	
Share of the Euro currency	24.0 %		26.7 %		43.6 %		47.7 %	
Share of USD currency	43.2 %		47.4 %		40.2 %		36.0 %	
B. International Fixed Income Markets - ratio of EUR to USD in two sectors								
Money Markets	0.12		0.30		1.63		1.38	
Bonds & Notes	0.60		0.58		1.06		1.32	
C. Net Issuance of Intl. Bonds & Notes - share (average forthcoming four quarters)								
Euro currency	24.9%		41.9%		58.7%		45.6%	
Corporates and Financials	9%		95%		89%		85%	
Government	42%		0.2%		10%		10%	
D. Domestic and International Fixed Income Markets – percent of total amount outstanding								
	US	EMU	US	EMU	US	EMU	US	EMU
Financial Institutions	38.7	46.0	50.6	45.9	60.3	49.4	61.6	55.9
Corporates	16.7	5.8	16.1	4.9	14.3	9.6	12.6	11.1
Governments	44.6	28.2	33.3	49.2	25.4	41.0	25.8	32.9

Source: BIS Quarterly Review, December 2009

2.3. The rise and rise of the corporate eurobond market

In the previous section, the course of coporate issuance is derived from BIS securities data. Considering corporate issuance alone from the main source consulted by the BIS, Dealogic, it can be directly established rather than merely derived how it develops over the years, before and after the Euro. This Euro corporate issuance data is compared to that in US Dollar and further dissected by sector (neither of which the BIS data provides). Note that the definition of corporate issuance now includes financial institutions. Annual corporate issuance in the sum of currencies that would enter into EMU was low on the whole in the 1990s rarely exceeding $100 billion, as can be seen in Panel B of Figure 3.6. In the US Dollar market, corporate issuance was approximately three times that amount on average between 1993 and 1997. In 1998, corporate issuance in Euro starts to surge as large institutions vie to establish their name with investors in the large European market that is to be created by the new currency. Issuance jumps up further in the first year of the Euro. Between 1997 and 1999, Euro corporate annual issuance grows by a factor of 2.5. Though annual corporate issuance remains substantially higher in US Dollar, in the years to follow the level of Euro corporate issuance catches up, particularly from 2003. The one marked difference between the two markets is that in the Euro market corporate issuance is very much driven by the finance sector whose share up until 2007 remains high. In the US Dollar market corporate issuance is from a more diverse range of industry sectors. Also in terms of credit rating of new corporate issues, the Euro market is much less diversified than the US Dollar. The Euro corporate issuance sector has a much higher share in the

Figure 3.6
Corporate issuance by currency and parent general industry group, in $ billion



Source: Daelogic
Notes:
- Corporate issuance is both investment grade and high yield and is the deal value (proceeds) in USD-equivalent at issuance.
- Euro is the sum of the legacy currencies of the initial eleven member states, the ECU and the EUR.
- Industry groups are merged such that finance includes insurance and closed end funds; communications is telecommunications, computers & electronics and publishing and consumer is consumer products; utility & energy includes oil & gas and basic materials is construction/building, chemicals, metal & steel and mining; industrial is machinery, transportation, aerospace and defence, retail, auto/truck, real estate/property, leisure & recreation, dining & lodging, textile and agribusiness; and other includes healthcare, holding companies, professional services and government.

Table 3.7

Effective credit rating at launch of corporate issues, in percent of total

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Euro									
AAA	28.5	30.3	19.6	21.4	26.9	19.9	14.2	18.3	21.5
AA	16.9	17.8	16.7	21.3	24.5	36.6	25.0	26.2	27.2
A	24.7	32.8	38.8	28.6	29.8	25.4	46.2	43.8	25.3
B	1.0	1.1	0.9	0.7	1.4	2.0	1.3	1.8	1.0
Other	28.9	18.1	24.0	28.0	17.5	16.2	13.3	9.9	25.0
US Dollar									
AAA	5.6	6.4	6.6	15.0	8.7	7.3	9.2	6.5	9.1
AA	16.5	13.8	12.9	19.3	20.5	26.9	28.8	32.2	31.3
A	34.7	48.0	39.9	29.8	26.0	22.5	25.2	23.2	23.4
BBB	19.6	17.9	28.0	23.3	22.2	18.9	18.3	18.0	17.5
BB	5.5	3.3	5.2	4.4	6.8	7.3	7.1	7.8	6.3
B or less	12.2	6.0	6.2	7.5	14.3	14.8	10.3	11.5	11.3
Other	5.9	4.5	1.2	0.8	1.7	2.4	1.1	0.9	1.2

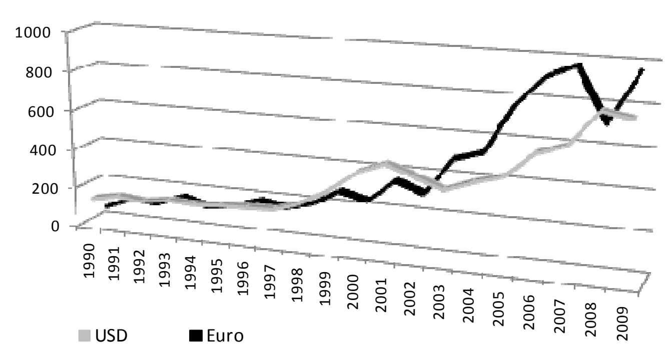
Source: Dealogic

highest rating categories, triple-A in particular, and very few with a single-B rating compared to new US Dollar corporate issues, according to the figures from Dealogic presented in Table 3.7.

Nevertheless, the much increased debt offerings by institutions other than the sovereigns in the new pan-European market significantly adds to the menu of options for European fixed income fund managers. Not only is the breadth of the new market in Europe enhanced, also its depth improves markedly by at least one measure, the average size of new issuance. Figure 3.7 illustrates the development of the average size of the corporate issuance shown earlier between 1990 and 2009. In line with the trend of larger issue sizes witnessed among the Euro zone sovereigns in their new domestic market, the average size of Euro corporate issuance also strongly rises, from $200 million in 1999 to double that size in 2003.

Figure 3.7

Average size of corporate issuance, in $ million



Source: Dealogic

Notes:

Calculated from the corporate issuance which is both investment grade and high yield and is the deal value (proceeds) in USD-equivalent at issuance, divided by the number of issues. Euro is the sum of the legacy currencies of the initial members, the ECU and the EUR.

By that time, it exceeds that of the much larger US Dollar corporate market. The average issue size continues to rise in both markets, to reach nearly $1 billion in the Euro market by 2007, and after a short-lived dip, again in 2009.

The credit sector encompasses more than corporate sector issuance alone. By the time of the creation of the Euro, Europe already has a very large covered bond sector. In the European context, covered bonds incorporate predominantly the (German) Pfandbriefe-type securities backed mostly by pools or public sector loans and mortgages according to strict legal requirements. The covered bond sector has traditionally been large in Europe, though concentrated in a handful of countries. Table 3.8 and Figure 3.8 provide main statistics on the European covered bond market, based on data from the European Covered Bond Council (ECBC). In 2003, the Euro-denominated covered bond market is a €1.8 trillion market, roughly 35% of the total international fixed income market in Euro and 4.3 times larger than the Euro corporate (including financial institutions) eurobond market. By 2008, presumably due to the overall growth of the Euro market and in particular corporate issuance, covered bonds constitute a smaller but still substantial 16% of the international fixed income market in Euro, now 2.4 times bigger than its corporate market.

However, despite the size of the covered bond market investors have found diversification opportunities in the Pfandbriefe sector to be limited. Their low default risk as a result of the (legally proetected) collateral structure translates into small additional yields (typically no more than 30 basispoints) over government bonds and highly correlated price moves. If a yield pick-up of more than the normal size can be achieved, it tends to be the result of the illiquidity of the covered bond. In that case, it

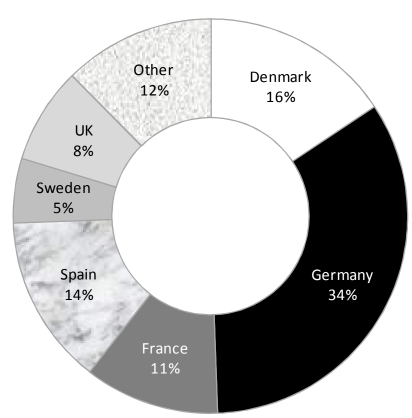
Table 3.8
Size of the European covered bond market

Outstanding denominated in €:	2003	2008
Outstanding in USD billion	1,783.7	1,894.1
Compared to international fixed income market in Euro	0.35	0.16
Compared to international corporate bond market in Euro	4.3	2.4

Source: European Covered Bond Council, BIS & Dealogic

Notes:
- Statistics before the year 2003 are not available from the ECBC
- Amount outstanding is provided by the ECBC, in EUR million and ihave applied the average USD/EUR rate to convert to USD
-Figures for the international fixed income market in Euro are from BIS
- Figures for the international corporate bonds in Euro are from Dealogic

Figure 3.8
European covered bonds - outstanding in 2008 by country of origin



Source: European Covered Bond Council

represents a buy-and-hold opportunity to investors. Besides, the lion's share of the European covered bond market has traditionally originated from Germany, and to a lesser extent from Denmark, offering littlegeographic diversification. Germany's legal framework for Pfandbriefe serves as the leading model for other European countries to copy in the latter part of the 1990's and the early 2000's. Within the Euro zone, covered bonds from France and Spain are now also sizeable. But even in 2008, Germany's share of all Euro-denominated covered bonds outstanding still amounts to around one-third.

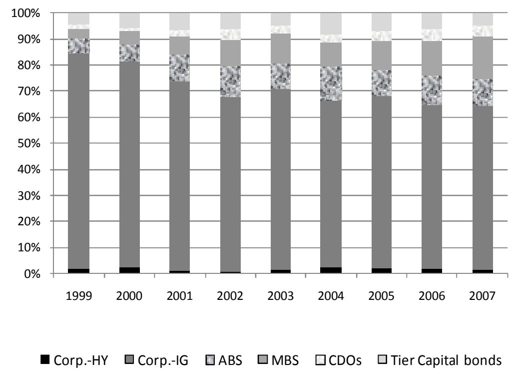
It is also well-documented that under the Euro other segments of the fixed income credit market than corporate eurobonds flourish. These other segments include asset-backed securities (ABS), collateralised debt obligations (CDO) and tier capital bonds from financial institutions. Their significance have rarely been put into perspective though so Figure 3.9A stacks the annual issuance of each of these types of credit securities as a percentage of their total in the nine years following the inception of EMU. It shows that more than 80% of new issuance in all these credit sectors combined is from the corporate eurobond sector in the first two years of EMU. While other sectors expand thereafter, most notably the ABS sector, in 2007 corporate eurobond issuance still amounts to more than 60% of the total. Also bonds and notes issued in Euro off an MTN-program originate predominantly from corporates and banks, by around 90% throughout (see Figure 3.9B). Thus it seems that diversification opportunities in the Euro zone for fixed income investors are primarily with corporate eurobonds, even while the market further matures and other credit sectors arise.

From a survey conducted by the Bond Market Association (currently part of SIFMA) in September 2006 among the top 20 bookrunners for European bonds a rare glimpse can be obtained of the primary investor distribution of government, high-grade and high-yield bond issues. Results of the survey are reproduced in Table 3.9. On primary distribution at least it appears that in 2005 and 2006 investors from within the Euro zone are the largest purchasers of government and investment-grade bonds. For the latter, which presumably incorporate corporate eurobonds of a sufficiently high credit rating, Euro zone investors account for a 55% share. This is even more than for government bonds where their share of the uptake is also high at 45%. Participation in European high-yield bonds by Euro zone investors is not as large as to occupy first place. For these lower rated corporate bonds, their participation is outflanked by UK investors who also show a keen interest in European investment-grade bonds. Otherwise remarkable is the interest of Asian investors in European government bonds at that time. In large part these are likely to be central banks, who see an opportunity to diversify their growing foreign reserves away from US Treasuries. Central banks (and other public entities) fund managers have been the main buyers of European primary investment-grade bonds followed by insurance companies and pension funds, while fund managers and hedge funds partake most in the more risky European high-yield primary issues.

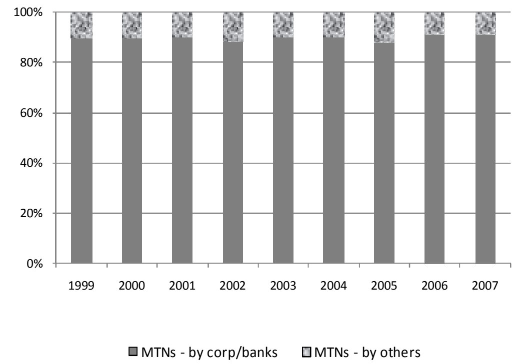
Figure 3.9

Euro-denominated eurobond annual issuance by sector, in percent of total

A. Corporate, ABS, CDOs and Tier Capital



B. Medium Term Notes (MTNs)



Source: Dealogic

Notes:

- Corp.-HY and Corp.-IG stands for high yield and investment grade corporate issuance respectively. ABS stands for asset-backed securities. MBS stands for mortgage-backed securities. CDOs stands for collateralized debt obligations.
- MTNs stands for medium-term notes.

Table 3.9

Percentage investor distribution of primary issues in the European bond market 2005-2006

	By Investor Region			By Investor Type			
	Gov	IG	HY	Gov	IG	HY	
Euro zone	45%	55%	34%	25%	5%	1%	Central Banks & other public entities
UK	15%	26%	45%	12%	16%	13%	Insurance / Pensions Funds
Switzerland	5%	5%	4%	26%	32%	15%	Banks
Europe other	3%	4%	3%	24%	31%	41%	Fund Managers
North America	6%	3%	10%	10%	11%	27%	Hedge Funds
Middle East & Africa	4%	2%	0%	1%	2%	0%	Corporate Funds
Asia	21%	5%	3%	2%	3%	3%	Private clients / Retail

Source: Securities Industry and Financial Markets Association (BMA Primary Market Distribution Survey, September 2006)

Notes:

- Gov stands for the government bond market, IG for the investment grade bond market and HY for the high-yield bond market.
- The percentages for investor region do not all add up to 100%. The difference is accounted for by "overall other".

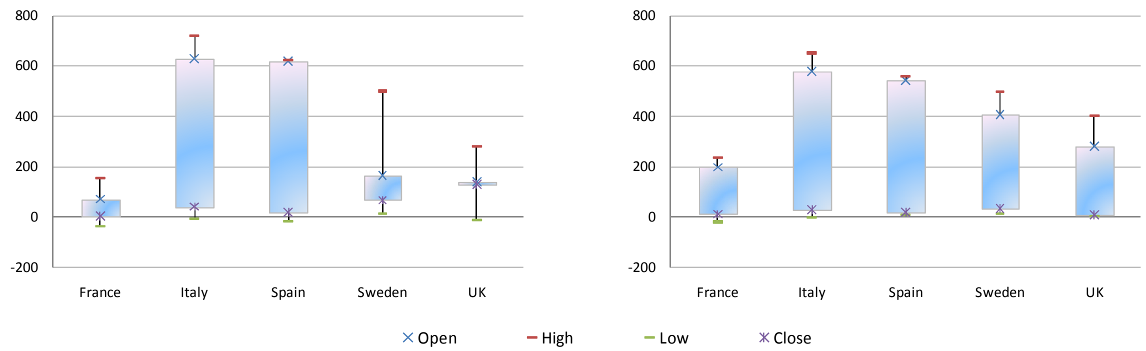
2.4. Converging Euro government bonds crowd in eurobonds

The advent of the monetary union causes bond yields of those sovereigns believed to be among the first entrants to converge. Exchange rate risk had traditionally been an important component of intra-European market risk, in particular for longer dated bonds. During the multiple ERM crises of 1992-93, some of the highest spreads to Germany are recorded, over 580 basispoints for Italy and even 130 basispoints for France for 10-year bond maturities. However, also during other periods of turmoil in the 1990s, long

Figure 3.10
Daily generic government bond spreads over Germany, in basispoints

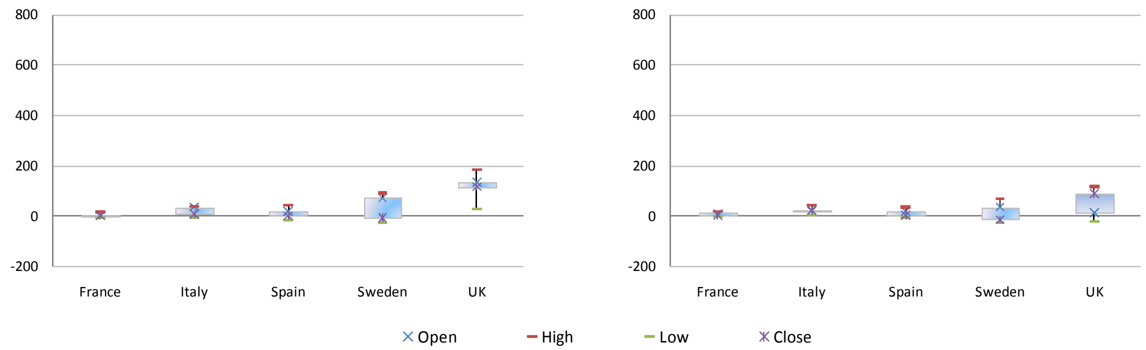
A. 1 Jan 1990 – 31 Dec 1998

i. 5-year ii. 10-year



B. 1 Jan 1999 – 1 May 2008

i. 5-year ii. 10-year



Source: Bloomberg
Notes:
- Calculated from the difference in yield of the generic government bond of the respective country and the yield of the German generic government bond of the same maturity.
- On 2 Jan 1990, generic yields were only available for 10-year Germany, France and the UK. All other series commence later: 10-year Sweden on 2 Jul 1990, 10-year Spain on 4 Jan 1993, 10-year Italy on 7 May 1993, 5-year Germany and France on 19 Feb 1991, 5-year UK on 31 Dec 1991, 5-year Sweden on 2 Jan 1992, 5-year Spain on 4 Jan 1993 and 5-year Italy on 7 May 1993.
- The 'Open' and 'Close' represent the spread level at the start and the end of the (available data) period and the 'High' and the 'Low' represent the highest and the lowest spread level achieved during the (available) data period.

after the ERM bands have widened, spreads diverge periodically in order to contract again in calmer times.

Overall, as is demonstrated in Figure 3.10, the difference between the highs and the lows in European benchmark government bond spreads are considerable in the pre-EMU years. They range from -35 basispoints for French 5-year spreads to 625 basispoints for Italian 5-year spreads to Germany. By the end of the period, just before the irrevocable locking of exchange rates, the government bond spreads of France, Italy and Spain all had come in significantly relative to Germany. Spreads of EMU-ins on the eve of EMU are well below that of Sweden and the United Kingdom who opt to remain outside of the Euro[13]. The elimination of intra-Euro currency risk has kept sovereign spreads in a tight range, at least up until

[13] With the exception of the 10-year UK-Germany spread due to the fact that the UK had an inverted yield curve in December 1998.

Table 3.10
Correlations between generic government benchmark yields
(5-year are below the diagonal and 10-year above) – (correlations that have decreased are in italics)

	A. 1 Jan 1990 – 31 Dec 1998							B. 1 Jan 1999 – 1 May 2008					
	GE	**FR**	**IT**	**SP**	**SW**	**UK**		**GE**	**FR**	**IT**	**SP**	**SW**	**UK**
GE	1	.9834	.9267	.9334	.9212	.9598	**GE**	1	.9980	.9919	.9925	.9430	*.8200*
FR	.9759	1	.9563	.9675	.9414	.9577	**FR**	.9978	1	.9955	.9971	*.9392*	*.8096*
IT	.8614	.9437	1	.9945	.9543	.8815	**IT**	.9934	.9953	1	.9954	*.9149*	*.7970*
SP	.8818	.9601	.9944	1	.9615	.8798	**SP**	.9924	.9951	.9963	1	*.9330*	*.7891*
SW	.8586	.9228	.9643	.9641	1	.9104	**SW**	.9064	*.9069*	*.8946*	*.8942*	1	*.7263*
UK	.8638	.8578	.7704	.7224	.7722	1	**UK**	*.8219*	*.8141*	.8089	.8173	*.7323*	1

Source: Bloomberg (same series as for Figure 3.10)

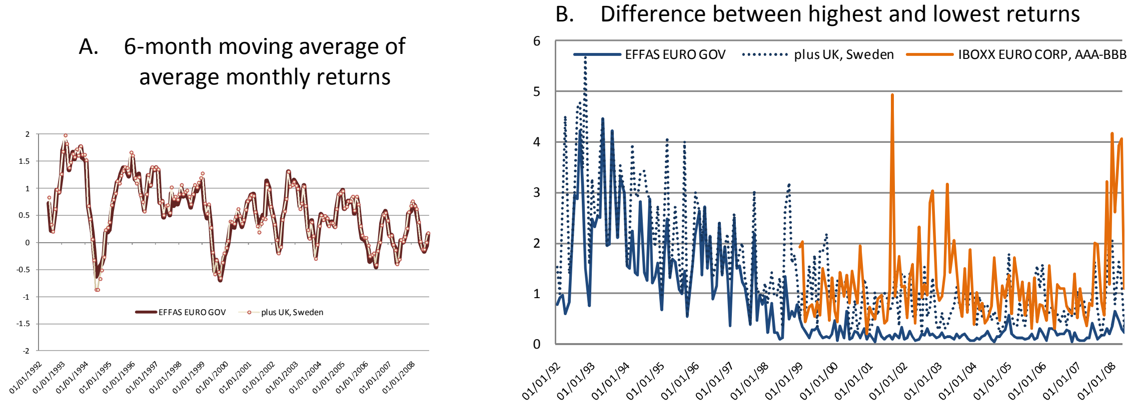
May 2008.[14] The comparison of sovereign spread divergences in the nine years before and after EMU is striking, even for Sweden and the UK. Sovereign spreads in Europe have moved in a much closer range, of no more than 55 basispoints for the EMU-ins and 215 basispoints for the EMU-outs since the Euro began.

Even though yield spreads diverge and converge significantly at times in the near decade before EMU, the comovement of sovereign bond yields is quite high. Table 3.10 lists the correlation coefficients of the benchmark government bonds yields used for the displays in Figure 3.10. Over the entire 1990-1998 period, these are above 0.90 for the EMU countries, with the exception of the correlation between 5-year Italy and German yields and 5-year Spanish and German yields. Correlations of 5-year UK yields with all other countries are generally among the lowest, but the same correlations of UK yields are quite a bit higher for 10-year maturities. The 1999-2008 period sees the already high correlations among EMU sovereigns rise above 0.99 without exception. This implies very strong comovement of 5- and 10-year government bond yields within the Euro area indeed. Interestingly, while the bond spreads of Sweden and the UK to Germany oscillate in a narrower range in this time, the comovement of their yields with the Euro zone generally declines.

All in all, the convergence in sovereign spreads in Europe and the very high comovement of bond yields within the Euro zone following the creation of the Euro leads to much reduced diversification opportunities in the government bond sector. The single currency fundamentally and irreversibly alters the risk-reward relationships in this segment of the fixed income markets in Europe. The implications for prospective returns on portfolio investment are already visible in the months leading up to the institutional change that the monetary union signifies. Figure 3.11, Panel A illustrates that average monthly returns on a portfolio of Euro zone government bonds (comprising Belgium, France, Germany, Italy, the Netherlands,

[14] Sovereign spreads start to widen following the start of the financial crises from the collapse of the sub-prime mortgage sector in July 2007 and have widened significantly further in the period after May 2008. I am deliberately not including the months after May 2008 because the data sample used for empirical research in the next chapters also ends around that time.

Figure 3.11
Evolution of Difference between the highest and lowest monthly returns, in percentage



Source: Bloomberg for the EFFAS indices, Datastream for the IBOXX indices
Notes:
- Panel A is calculated from the moving average of the previous 6 months of the average monthly returns on EFFAS domestic government bond total return indices for the entire market (maturities > 1 year) of Belgium, France, Germany, Italy, the Netherlands and Spain, denoted EFFAS EURO GOV, and the UK and Sweden include.
- Panel B is calculated from the difference between the maximum and minimum monthly returns on EFFAS domestic government bond total return indices for the entire market (maturities > 1 year) of Belgium, France, Germany, Italy, the Netherlands and Spain, denoted EFFAS EURO GOV, and the UK and Sweden included; and the difference between the maximum and minimum monthly returns on IBOXX Euro corporate financials and corporate non-financials AAA, AA, A and BBB total returns indices.
- Start date for the EFFAS indices is 31 Dec 1991 and for the IBOXX indices 31 Dec 1998. Monthly returns are missing for IBOXX Euro corporate financials BBB between Jan 1999 and Feb 2001, for the IBOXX Euro corporate non-financials AAA between Jan – Jul 1999 and April – Nov 2001, and the IBOXX Euro corporate non-financials BBB between Jan – Jul 1999.
- Returns are in percentage in local currency.

and Spain) and another one including Sweden and the UK are on a trend downwards. Furthermore, as can be seen in Panel B of the same figure, the difference between the highest and the lowest monthly holding period return in the Euro zone government sector is around 3% in the early 1990s, close to 2% in the mid-1990s and steadily declines further to reach a paltry 0.5% in 1998. The dying out of the variation of returns, to around 0.25% only after 1999, is an immediate reflection of the disappearing diversification opportunity among Euro zone government bonds. Some higher variation can still be achieved by adding Sweden and the UK to the portfolio, but also that strategy appears to have its limitations.

The diversification opportunity has to be sought elsewhere and the surging corporate bond sector offers it. The return variation between a portfolio of corporate financial and non-financial institutions of different credit rating classes between triple-A and triple-B will for the majority of times be considerably higher. This is clearly what attracts European fixed income fund managers to participate in the new corporate eurobond issues, and what encourages further supply in this sector.

With the enlarged segment of corporate eurobonds in European fixed income portfolios there is a need for corporate benchmark indexes to measure the performance of such holdings. Prior to EMU, corporate indexes for the individual European eurobond markets are virtually non-existent. However, with the rapidly growing scale of the Euro corporate eurobond market it becomes economically viable for investment banks to add credit research, trading and sales capability in their fixed income department. A number of them start to calculate and publish Euro corporate benchmark indexes already in the course of 1999 and shortly thereafter.

3. Response from portfolio managers in their allocation strategies

Comprehensive data on portfolio compositions of institutional investors is unfortunately lacking, especially in Europe where this is further hampered by the dispersion of this investor base and their regulators. Even so, from the analysis in the previous section it can be derived that prior to EMU, the composition of European bond portfolios is predominantly in the government bond sector. These are in the majority of cases allocated according to their country weight in benchmark government bond indexes. This can be concluded from the fact that in those days the investment opportunity as well as benchmark portfolio measures are largely confined to this sector. The non-sovereign bond sector is small and far less liquid by comparison and their credit risk poorly researched and understood by investors. Besides, yield spreads between European government bonds offer sufficient diversity, certainly with the overlay of the currency volatility incorporated in the investment decision. Thus an allocation of bond portfolios from the most liquid sector of government bonds and allocated on a country basis is perfectly sensible in Europe at that time.

Investors are initially rather skeptical on the European monetary unification project, as the treacherous ratification of the Maastricht Treaty and volatility of some currencies within the ERM in the 1992-1993 years is still fresh in their minds. Even the European Council's decision in December 1995 that the third stage of EMU would commence on the 1st of January 1999, that the name of the European single currency would be "Euro", that ECUs would convert 1:1 into Euros and that a three-phase scenario would be implemented for its introduction, fails to instantly convince investors. This lack of conviction is evident from benchmark spreads of fixed income securities to Germany, which remained high for many countries, and the prevalence of the ECU parity diversion.[15] But, as the conception of EMU becomes an increasingly accepted reality by the investor community, price behavior in the fixed income markets starts to reflect this also. Certainly from around 1997, more and more investors participate in what is then known in the markets as "EMU convergence plays". As a result of these convergence plays, the ECU parity divergence

[15] The European Currency Unit (ECU), the predecessor of the Euro, was defined as a frozen basket of underlying European currencies. The value of the ECU currency traded in the foreign exchange markets was commonly thought of being equal to the basket but because there was no means of officially converting one into the other, a difference between the two would sometimes occur. It is this difference, expressed in a percentage, what is referred to as the ECU parity divergence.

narrows and the bond yields spreads of those governments believed to be among the first EMU-ins are driven down relative to those of Germany.

Brookes (1999) demonstrates that the impact of higher return correlations between national government bond markets that occurs in tandem with this bond convergence is to reduce the tracking error of a duration-neutral portfolio of European government bonds from an estimated 50 basispoints in January 1994 to 37 basispoints in January 1998. This reduction is accompanied by a corresponding reduction in the ability to outperform the benchmark from 30 basispoints to a mere 7 basispoints. Therefore, the focus of fixed income fund managers in Europe starts to shift away from this traditional allocation strategy, leaving them to consider three possible alternatives (or a combination thereof) to mitigate the loss of diversification benefits in the government bond sector: (i) continue to manage a portfolio of European government bonds but manage the duration of various holdings more actively and more aggressively, i.e. duration diversification; (ii) continue to manage a portfolio of government bonds but include a higher allocation to non-Euro zone markets such as the US, Japan, the UK and Eastern Europe, i.e. international diversification; and (iii) continue to manage a European portfolio but incorporate investments further down the credit risk spectrum, such as corporate eurobonds, alongside government bonds, i.e. credit diversification.

In the equity fund management industry, alongside the need to reduce home bias in European equity portfolios and to which EMU is expected to provide impetus[16], a shift from a country to an industry sector allocation of portfolios of European stocks is broadly advocated by analysts, widely discussed in the financial literature and mostly accepted by portfolio managers as best-practice. In this respect the results of the Goldman Sachs/Watson Wyatt EMU Survey of June 1998 are often quoted. This survey indicates that fund managers expect that 64% of European equity portfolios would be managed along a sector basis post-EMU as opposed to only 9% on a country basis (reported in Brookes, 1999). Many analysts separately advocate a shift away from country to a sectoral allocation of equity portfolios.[17]

Such an impending change in investment allocation strategy is not so outspoken in the case of bonds. One of very few concrete pieces of evidence of the intentions of European bond portfolio managers can be gathered from a survey conducted by bank Paribas in the first quarter of 1998. In this survey 98 portfolio managers in the US and 55 in Europe are questioned on the expected impact of EMU on their asset allocation process. In terms of international diversification the results are minor and mostly with US

[16] See Biais (1999, pp 242-247) for a discussion on the prevalence of home bias in European equity portfolios and his prediction that a possible short-term effect of EMU might be an increase in foreign equity holdings in countries adopting the Euro.

[17] See also Brookes (1999, pp25-29) and Young (1998, p 312) for evidence of analysts' recommendations of a diminished role for country selection in European equity portfolios following the implementation of EMU, which is also noted by Rouwenhorst (1999, p58) and by Adjaoute and Danthine (2003, pp 32-34). The latter refer to this phenomenon as the 'shift in the (equity) asset allocation paradigm'.

portfolio managers increasing their proportion of Euro holdings by January 1999 (from 12% to 19%). European portfolio managers' only notable intended change is to increase their holdings of Eastern European countries (from 0% to 3%). The more significant changes are with respect to non-sovereign holdings, both in the US and in Europe. Of the two, European bond portfolio managers cite the greatest willingness to diversify their credit risk: of the 85% of European funds who anticipate changes in their EMU non-sovereign holdings, 70% expect an increase of the share of European corporate and bank bonds by an average of 21% (Pieterse-Bloem and Lamedica, 1998, pp 286-288).

The incorporation of a substantially larger portion of non-sovereign holdings in European bond portfolios leads into the possibility that fund managers in fixed income are also intent on a shift from a country-based to an industry-based allocation, similar to their counterparts in equity. For a portfolio consisting in the main of government bonds is confined to this one sector only and diversification can only be achieved through an allocation across countries. But with the incorporation of more industry sectors as corporate eurobonds increasingly enter into the portfolio, the opportunity arises to allocate the portfolio also on an industry sector basis. The surge of corporate bond issuance in Euro in the immediate aftermath of EMU and the introduction of Euro corporate bond indexes by various providers, as discussed in Section 2, clearly ties in with this shift. Such an allocation shift would be further encouraged if the convergence of bond yields witnessed in the government bond sector is interpreted as an indication of inferior performance of bond portfolios that are allocated on a country basis. The next section asks what empirical evidence there is from the finance literature to the effect of shifts in bond portfolio allocations in Europe.

4. The finance literature on bond portfolio allocation shifts

The part of the finance literature that addresses the impact of EMU on bond portfolio allocations focuses mostly on the potential for international diversification. The possible effect of currency matching rules for pension and insurance company funds, discussed in Section 2, are contemplated under the new constellation in Europe. It seems that these regulatory constraints are often not tested to their full limits even in the old constellation in Europe (Adjaoute and Danthine 2003, pp 5-6). This brings the wider question of the persistence of a strong home bias in European bond portfolios in perspective and the possible effect of EMU thereon.

When the IMF brings out the Coordinated Portfolio Investment Survey (CPIS)[18] in which countries report on the size of foreign currency holdings of their residents of equity, long-term and short-term debt securities for end-1997, extends it for end-2001 and again for end-2003, the data is seized on. A number of

[18] I refer to the "Coordinated Portfolio Investment Survey *Guide*, Second Edition" of October 2001 which is available on the IMF website for more details on the survey data.

academics use the CPIS data to study the home bias in equities and, for the first time, also for bonds across countries. Given the pre and post-EMU dates of the CPIS surveys, it allows to seek for an EMU effect for the Euro area countries. Varying measures of home bias[19] put it in a range of 82% (De Santis & Gerard, 2006) to 87% (Fidora et al, 2006) for bond portfolios in the EMU countries at the end of 1997. [20] In both cases this is well above that detected for equities at that time (respectively at 77% and 80%). Comparing 2001 with 1997, a decline is observed in the home bias of equities portfolios of EMU countries in the range of 12-14%, but a much sharper decline for bond portfolios of 18-37%, neither of which are matched in any other region (Cappiello et al., 2006; Fidora et al., 2006; and De Santis and Gerard, 2006). When compared with the results for 2003, it is evident that the largest shift in the Euro zone takes place between 1997 and 2001 and the trend continues thereafter but not at the same pace (Fidora et al., 2006; Lane, 2006).

At first sight, the scale and the timing of the decline in home bias appears to be driven by the Euro area itself, particularly for bonds. This is confirmed in three different ways. First, when it is revealed that the decline in home bias for bonds between 1997 and 2001 is much less if the Euro area is treated as one bloc (De Santis and Gerard, 2006).[21] Secondly, by Lane (2005, 2006) who finds that in 2001 and 2003 respectively 62.2% and 63.8% of Euro area aggregate 'international' bond holdings are invested in other member countries and further empirical evidence to substantiate the claim that EMU countries disproportionately invest in each others' bonds. Thirdly, by De Santis (2006) who finds that the portfolio transactions among the Euro area member states in the period 1997-2001 amounts to 51% of the 'international' bond assets held by these member states and further empirical evidence that EMU provides a significant positive catalyst effect in the allocation of portfolio capital among Euro area member states, which is stronger for bonds than for equities. The important conclusion from this is that the domestic home bias in bond portfolios is, to a large degree, superseded by a Euro zone home bias.

Whereas the 'internationalization' of European bond portfolios can thus be verified through the CPIS survey data, any other means of diversification cannot be established. This is of course because CPIS reports in effect holdings of residents at an aggregate country level of other countries' equities and debt securities. It only breaks down the debt securities by term but not by sector. Therefore, CPIS data cannot be

[19] Discrepancies in the calculation of home bias arise for at least three important reasons. First, CPIS only reports on holdings of residents of non-residents' securities, therefore the domestic holdings of residents need to be derived from external market capitalization data for which different sources can be used. Secondly, a number of important investment countries are excluded from the 1997 CPIS, notably Germany, and different approximate values from external sources may or may not be used to reinsert these countries. Finally, CPIS does not capture final holdings properly thereby misrepresenting figures for financial centers such as Luxembourg and Ireland and these countries may or may not be excluded from the set of EMU countries.

[20] Not precise, measured from Figure 2 on page 45 in the case of De Santis and Gerard (2006) and from Graph 1 for Euro area economies in the case of Fidora et al. (2006, p 35).

[21] On their measure, the home bias in bonds of 10 EMU countries individually but taken together as a group is approximately 82% in 2001 and 43% in 2007 but the home bias of the Euro zone area excluding intra-Euro zone trade is 89% in 2001 and 70% in 1997, signifying a much lower decline in home bias when the Euro area is treated as one bloc (De Santis and Gerard, 2006, Figure 2, p 45).

used in the investigation of changing portfolio compositions across industry sectors of the issuers of the respective debt securities for instance. I am not aware of any other source either that publishes this sort of data consistently and comprehensively for European bond holdings. It is understandable that in the absence of such data, there is a hiatus in the finance literature of empirical studies on bond portfolio re-allocations in Europe along the credit spectrum.

5. Conclusions

The analysis of the market securities data, investor surveys and findings from finance articles presented in this chapter on the subject of bond markets and bond portfolio allocations pre and post-EMU results in the following conclusions. First of all, the event of EMU irreversibly changes the landscape of fixed income markets in Europe in direct and indirect ways. Beyond the immediate technical implications of one currency and one monetary policy, direct effects are shown to include several that are immediately induced by EMU. These are the decision by participating member states to harmonize bond conventions and issuance proceedings and to issue in the new single currency from January 1999. Especially the decision to redenominate outstanding bond contracts lends instant critical mass to the Euro bond market. Market participants decide in lieu to quote and trade all securities in Euro. Single benchmarks for pricing in the primary and secondary markets across various segments of the fixed income markets are also decided on quickly.

EMU has moreover had a number of indirect effects and as such has continued to be an instigator of change in the years to follow. Among these indirect effects is the elevation of markets to a pan-European level. On the demand-side, currency matching rules for institutional investors are lifted. On the supply-side, borrowers now face increased competition to position their debt. Both are important mechanisms to change the scope of financial operations from markets previously divided along national currency divides to the new Euro market. The instant momentum provided to the Euro bond market encourages other participants to enter and the market enjoys a stronger interest from non-European investors and likewise from all types of issuers to raise debt in Euro. This indirectly induced effect of EMU causes the Euro bond markets to become more than the sum of its part in its first few years. This is evident from an array of fixed income securities data from the BIS, Dealogic and other sources. The credit sector in particular enjoys great expansion under the Euro and within that eurobonds from corporate and financial institutions.

Thus EMU leads to the creation of a larger, deeper and more liquid bond market under the Euro. However, this chapter also shows that the Euro bond market remains segregated in a number of ways. This is most visible in the government bond segment with the continued existence of separate yield curves though in a closer spectrum under the Euro compared to the years before. The continued dispersion of post-trading infrastructure, including clearing and settlement arrangements, as consolidation is slow is less visible but not less important and impacts on transaction costs. The latter are shown to remain significant for Euro-denominated bonds. National differences in the regulation of fixed income securities also segregate the Euro zone markets. Initiatives by the European Commission to address these differences start late and while currently under implementation, still await their effect. National differences in tax treatment also continue to exist and may prove altogether harder to overcome.

Overall, the changes in the landscape of European bonds markets caused directly and indirectly by EMU is such that the ability for bond investors to freely allocate funds is significantly enhanced. Barriers for investors are lowered to now seek opportunities across the pan-European market. The new environment in Europe, which is already largely anticipated by bond portfolio managers in the months leading up to the monetary union, causes them to rethink and to shift their portfolio composition. Indications from market practice in this chapter, though mostly circumstantial, are that bond holdings are predominantly in the government sector pre-EMU. Finance studies otherwise provide evidence, albeit not conclusively, that a strong home bias prevails in bond portfolios beyond the constraints of currency matching rules certain institutional investors have to abide by. CPIS survey data from the EMF, published at regular intervals from 1997 on cross-national holdings of assets, find that the international diversification of European bond portfolios improves post-EMU. These studies also show that this better international diversification remains confined to the Euro zone though.

There is otherwise some evidence from market practice that a further type of diversification of European bond portfolios has taken place. This is a diversification away from the traditional government bonds into the corporate eurobond sector. Converging yields in the government sector provide ample encouragement for investors to benefit from higher spreads and yields of corporate eurobonds. It is argued that the eurobond sector could not have emerged with the force seen from the securities data if the new supply would not have been keenly emersed into instutional investors' portfolios. The publication of benchmark indexes for the corporate eurobond market from 2000 onwards further attests to this. The allocation shift is confirmed by anecdotal evidence from investor surveys. In anticipation just prior to EMU a reallocation towards corporate eurobonds is intended. Whereas CPIS survey data is able to highlight changes in the non-national diversification, such changes in the credit risk diversification of country holdings cannot be detected. Evidence from market practice seems to point in this direction, but remains on the whole circumstantial. Data limitations, beyond the CPIS survey data, on bond portfolio compositions by sector have so far inhibited the possible portfolio allocation shift along the credit spectrum in Europe from being studied extensively.

With this account of the evolution of bond markets in Europe and the significant impact of EMU thereon, the ability in market practice for European bond investors to allocate their portfolio more freely and among a broader set of securities is established, albeit one that ventures rarely beyond the Euro zone. The willingness to diversify geographically is empirically confirmed through studies on international investment holdings based on CPIS survey data from the IMF. The willingness to diversify along the credit spectrum is established merely anecdotally as an intention on the part of investors and can possibly be derived from developments directly observed in the European bond markets, particularly the surge of the corporate eurobond market under the Euro. To what extend this has become reality and whether the larger incorporation of eurobonds in European bond portfolios has led to a shift in diversification strategy from a country allocation to an industry allocation is a matter for further research. The empirical research in the following two chapters, which is in essence a study into the diversification opportunities and benefits in European bond returns along the two main dimensions of country and industry, sets out to provide a part of the answers.

CHAPTER 4
The importance of country and industry factors in European bond markets

1. Introduction

It is beneficial to recapture what has been established by means of the previous two chapters before the empirical analysis in this chapter is introduced. In the course of a detailed review of theory and its empirical evidence on international financial integration, it is shown that fixed income markets in Europe have increasingly integrated in the run-up to EMU. The degree of integration of the money markets, already large before the Euro, is with the removal of intra-market currency risk further improved and extends itself to the bond markets, government securities before eurobonds. From the analysis of market practice it is seen that following the creation of the monetary union, the European bond markets rapidly integrate further to one large, homogenous and liquid market, though one that also remains segregated in certain ways. While the Euro-denominated fixed income markets as a whole are considered to be largely integrated, measures that are able to focus on its different segments testify to differences in the degree of integration. Measures that take inspiration from financial economics and focus on the reaction of prices of bonds with similar risk characteristics to common news and of bonds with dissimilar risk characteristics to country effects are thus able to establish that the government bond sector is better integrated than the corporate eurobond sector. The difference is not very large though and the overall the ability for bond portfolios managers to allocate their portfolios more freely across the entire bond markets within the Euro zone is established, certainly compared to the pre-EMU era.

Beyond the immediate effect that EMU has had on the integration of bond markets in Europe, it is further established that EMU drives fundamental changes in the investment opportunity set for fund managers in these markets. One of the main factors through which the investment opportunity is enhanced is precisely through the corporate eurobond sector, an area of the European bond market that experiences strong growth under the Euro. Beyond the mere ability to allocate bond portfolios, this enters the territory of the willingness of bond portfolio managers to seize such new investment opportunities. Here it is established European bond portfolios diversify geographically within the Euro zone. There is also an outspoken intention to incorporate a larger portion of corporate eurobonds in portfolios henceforth. While there is support that portfolios are heavily skewed towards government bonds with a strong national bias prior to EMU, the creation of a pan-European market and the intended reallocation to eurobonds gives rise to bond portfolios with an altogether broader geographical and credit diversification. Through the incorporation of a more diverse set of industry sectors in European bond portfolios than the government sector alone post-EMU, this is accompanied by a better opportunity to choose between a country-based and an industry-based diversification strategy.

The ability and willingness to change the portfolio composition and diversification strategy in European bond markets in the context of their enhanced integration pre to post-EMU can be investigated through the expected, or ex ante, benefits such changes would bring to fund managers. This is done ex post through the return structure of European bond markets. This chapter is the first of two empirical chapters and determines which factors best describe European bond returns. For equities a strand of literature has focused on the benefits of country and industry sector diversification strategies for decades. As described in Chapter 2 (Section 4.3.3.), Heston and Rouwenhorst (1994) is the benchmark study in this field and has inspired new methods to measure the integration of Euro zone bond market. This research is appropriate, for it provides a powerful econometric method whereby the risk contribution of each factor in returns can be separated and ranked in order of importance for certain time periods.

This chapter follows in the decomposition tradition and aims to determine the importance of country and industry effects in European bond markets. Due to the nature of the methodology and available data, this analysis is from individual eurobond returns; 6,440 in total. These eurobond returns are from ten country origins, mostly European, and seven industry groups including one for government institutions. This data covers the period between May 1990 and March 2008 and when split at the time of the introduction of the Euro results in two subperiods sufficiently long to study any change in their relative ranking EMU may have caused. If indeed it is confirmed that country effects dominate industry effects in return variation of European eurobonds prior to EMU, as has been empirically established for European equity returns, then one would expect a priori that EMU results in reduced country effects and increased industry effects. Diminishing country effects would be an immediate consequence of the enlarged financial and econometric integration that can be expected to take place among the Euro zone countries. The regional industry specialization that is predicted by the Krugman school of international trade economists to occur within the monetary union would result in reduced industry effects. Varotto (2003) has confirmed that country effects dominate industry effects in eurobonds from European and other markets but for a sample period from before EMU. The aim of this analysis is to separately verify these findings and to extend the sample period post-EMU. Varotto’s study also demonstrates factors other than country and industry may impact on the analysis in the case of eurobonds. Following this, the standard decomposition model in this chapter is extended to include liquidity and life-to-maturity, though only as second order effects. If one of the main results from the analysis from market practice of Chapter 3 of a larger and deeper bond market under the Euro is reflected in European eurobond returns, then liquidity and maturity effects can be expected to diminish pre to post-EMU.

The remainder of this chapter is organized as follows. Section 2 discusses a selection from studies that the decomposition literature has produced for methods and main empirical results. As will be seen, these studies focus their attention predominantly on equity returns and cross-fertilization to eurobonds has to date been rare. The empirical analysis conducted in this chapter is positioned in this field. Section 3 discusses the type of data that is typically used for similar studies on equity returns. The purpose of this section is to demonstrate how in the absence of this for bonds, a comprehensive data set of 6,440 individual eurobond returns is gathered. Details of the sources, cleansing and preparation of this data set for the econometric models are described in detail. Section 4 then proceeds to propose the main decomposition model and its extension to suit the purposes of eurobonds. Sections 5 and 6 show and discuss the results of the decomposition of European eurobond returns over the full sample period of May 1990 to March 2008 and the two subperiods around EMU's commencement from the main model and the extended model respectively. Section 7 concludes.

2. Finance literature on country versus industry factors

The history of research on the importance of country and industry effects in return variation and their benefits for international diversification is longer and richer for stocks than for bonds. First research papers that study the factors driving the covariance and volatility in equity returns across countries can be traced back to the late 1960s. Yet, the proper decomposition of pure country and industry effects on equity returns is generally seen to start with the influential research paper of Heston and Rouwenhorst (1994). They look for an explanation of the low correlation between international equity markets' returns and volatilities, and the influence of industry factors on country index returns as previously documented. They ask themselves whether the benefits of international equity portfolio diversification stems predominantly from a pure country or industry selection of stocks.

Heston and Rouwenhorst's procedure is novel in that they entirely separate country from industry effects as sources of return variation and in their applied methodology decompose equity returns into industry and country components. The employed econometric apparatus consists of cross-sectional regressions of individual companies' equity returns on a set of country and industry dummy variables for each time interval. As these dummies are orthogonal in each cross-section, their estimated coefficients represent the return associated with the country and the industry sector they belong to in excess to the average of the entire market. The contribution of each factor is then computed by the time series' variance of the coefficients estimated in the successive cross-sectional regressions over fixed or rolling time windows of arbitrarily specified lengths.

2.1. On equity returns

Not only is Heston and Rouwenhorst's model straightforward to estimate on equity returns more or less readily available from easy to access databases (such as Datastream), it also yields strong results which are intuitively appealing. In their case, that in Europe in the period before the Maastricht Treaty is signed (1978-1992), country effects explain most of the cross-sectional variation in equity returns. Over the whole sample period, they find that the ratio of the average variance of twelve country effects to the average variance of seven industry effects is roughly 4:1. Consequently, Heston and Rouwenhorst conclude that country diversification is a more effective tool than industry diversification for achieving risk reduction in stock portfolios in Europe. This is a powerful result for fund managers of European equity.

Heston and Rouwenhorst's model and results initiate a lively debate in the finance literature which is still unwavering. Their work forms the basis of many studies that replicate their model, either in its entirety or in adapted form, over data samples varying in geographic scope and time span. The literature is too wide to survey here in its entirety. I restrict myself to a review of the main studies that follow Heston and Rouwenhorst to discern a pattern from their results, specifically in Europe and with respect to the impact of the Euro.

Griffin and Karolyi (1998) apply the Heston and Rouwenhorst methodology to a data set that allows a much finer division of industry sectors. Neither is it restricted to Europe, but covers many more countries and for the subsequent period of 1992-1995. The Heston and Rouwenhorst result that country effects dominate industry effects in equity returns by a ratio of around 4:1 is largely replicated, but with two embellishments. First, it is with the finer industry classification of 66 categories that this result is obtained. The ratio of country effects to industry effects increases to 12:1 when firms are re-arranged into nine broad industry groups. Griffin and Karolyi find that country effects explain a larger proportion of the variation in their index returns with industries that produce goods that are traded internationally, which they are able to separate from industries that do not. Secondly, this much higher ratio of 12:1 than Heston and Rouwenhorst (1994) find on a comparable industry grouping is due to the fact that Karolyi and Griffin's 25 countries include emerging countries. Both add-ons of Griffin and Karolyi to Heston and Rouwenhorst's main result are early discoveries of sample bias influencing the outcome of the importance of country effects versus industry effects. This sample bias is confirmed in other studies from more causes than industry grouping and country selection alone and is reverted to below.

The result from Griffin and Karolyi of consequence for my purpose is that the more homogeneous the set of countries, the lower the country effects. This result serves as a prelude of what can be expected for European stock markets under EMU. Indeed as Europe's monetary union draws closer, and the economies of prospective member states converge and become more integrated, speculation increases that country effects in European equity returns will diminish. This is precisely what motivates Rouwenhorst (1999) to re-examine their original result for the same set of twelve European countries, of which it is now known that seven will enter EMU, with the inclusion of the post-Maastricht Treaty period of 1993-1998. Rouwenhorst concludes that “despite the convergence of economic policies and interest rates of EMU countries following the Maastricht Treaty, no evidence exists that industry effects have become more important than country effects in European stock returns” (1999, p 63). With the benefit of hindsight, this conclusion is perhaps too strong and his results do show early signs of a turning point. It is true that over the whole sample period of 1978-1998 as well as in each of the four equally long subperiods, the average absolute value of country effects remains dominant over that of industry effects and that country effects are larger for the prospective EMU countries than for the non-member countries. However, the 36-month moving averages of the absolute values of country and industry effects also show a trend-decline of country effects from their peak in the late 1980s and mostly so among the future EMU members. Industry effects start to pick up significantly from 1997, breaching the top of their 1988-1998 range by the middle of 1998.

The reversal in the importance of country and industry effects in stock returns from 1997 is detected by subsequent studies that use the Heston and Rouwenhorst model, such as Cavaglia et al. (2000) and Baca et al. (2000) whose sample periods include 1999. Both studies provide evidence that industry effects are growing in relative importance and that country effects no longer dominate equity return variation. Both studies are also based on equity returns from firms in developed countries in Europe and elsewhere. They therefore conclude that the increasing relative importance of industry sector effects is a global phenomenon that is explained by the increased integration of capital markets and cross-border activity of firms.

Galati and Tsatsaronis (2001) focus exclusively on Europe and apply the Heston and Rouwenhorst methodology to the FTSE Eurotop300 stocks for the period 1990-2000. They find that industry effects have started to outpace country effects since the middle of 1998. Following the creation of EMU, a number of studies set out to determine the effect of the Euro on country versus industry effects in stock markets, including Flavin (2004), Ferreira and Ferreira (2006) and Phylaktis and Xia (2006). Flavin (2004) employs a slight adaptation on the Heston and Rouwenhorst model with a panel data (or pooled regression) approach. Though average absolute country effects are larger than average industry effects over the whole sample period of 1995-2002, rolling 48-month windows again demonstrate a reversal in the importance of these effects around 1998. The effect is a Europe-wide effect, as it seems to apply equally to the eleven EMU countries as to the four other European countries’ stock returns. Ferreira and Ferreira (2006) resort to the Heston and Rouwenhorst model for the eleven first EMU countries’ stock markets for the years between 1975 and 2001 and ascertain that post-EMU industry effects are similar in magnitude to country effects. Phylaktis and Xia (2006) apply the dummy variable regression framework of Heston and

Rouwenhorst to a much wider sample of countries for the period 1992-2001 and find on the whole that there is a major shift in industry effects since 1999. When they group countries together, this effect is especially noticeable in Europe, but also in North America.

On the whole, the inference from these studies is that country effects dominate industry effects in explaining the cross-sectional variation of equity returns up to the late 1990s and that since then industry effects have noticeably increased. The turning point is discernible to 1997-1999. Brooks and Del Negro (2004) is one of the few studies to confirm the ongoing dominance of country effects with a sample extending into the new millennium. However, since an examination of the sensitivity of stocks' exposure to industry and country-specific shocks (the betas) finds that industry-betas are much more heterogeneous than country-betas, the separate inclusion of a global factor in their latent factor model alongside the country and industry factors could well be a contributing to the small role of industry effects.[1] Estimations of the model over four subperiods reveal that global factors increase in importance over the last subperiod of 1997-2002, while country and industry factors remain roughly the same over time. In a cyclical upswing or downswing, the importance of the global factor and country factors are amplified due to homogeneous country-betas, but industry factors are de-amplified due to heterogeneous industry-betas. Brook and Del Negros' result of the overall dominance of country factors in equity returns can likely be ascribed to the selection of their model.

So the overall conclusion remains that country effects are more important than industry effects for the variation of stock returns until the late 1990s and that industry effects have grown substantially in importance since then. The conclusion is often conjured up in studies that include a survey of the decomposition literature, like in Catao and Timmermann (2010). Whilst it is accepted as the common ground, the many studies that have emulated the Heston and Rouwenhorst methodology also find that the results obtained from it are subject to sample bias in a number of ways. Everything else being equal, the inclusion of stock returns from emerging market countries tends to increase the importance of country factors, a finer industry classification tends to lower the industry effects, and the conversion of stock returns to one common currency tends to increase country effects. Furthermore, results are sensitive to the length of the sample period under selection. De Moor and Sercu (2009) test the robustness of the main results from the Heston and Rouwenhorst methodology for the size of firms included in the sample, but fail to detect a significant sample bias in this sense. Several authors also find that results are robust to periods of high stock price volatility in certain sectors, such as the IT-bubble in the early 2000s.

[1] Brooks and Del Negro relax the restriction that the exposure to country or industry effects, whenever it is non-zero, is the same across all stocks. This turns the fixed effects model into a latent factor mode. Brooks and Del Negro then introduce a global factor alongside the country and industry factors to explain stock returns. Their latent factor model nests the fixed effects model of Heston and Rouwenhorst.

The timing of the reversal of the importance between country and industry effects in stock returns coincides with the creation of the single currency in Europe. EMU may well have been a driving force for this region. However, evidence of an EMU-effect is not conclusive since the reversal has also been noted elsewhere. Furthermore, there is no evidence that the surge of industry effects is sustained. According to my knowledge, there is no study of European stock returns based on the Heston and Rouwenhorst decomposition method on a sample that extends beyond 2002. Therefore, no conclusion can be drawn as to the importance of country versus industry effects in equity returns in recent years.

2.2. On bond returns

As outlined in the previous section, the results from the Heston and Rouwenhorst decomposition of equity returns into country and industry effects are replicated several times and are more or less consistent. How do they translate to bonds? Bonds are a separate asset class from equities and it is not obvious at all that the same results of largely dominating country effects until the late 1990s and surging industry effects thereafter should emerge. Bond returns will need to be examined on their own merit as to whether country or industry associations play a larger role in the variation of their returns. As with stocks, the results are of more than academic interest with potentially strong implications for bond portfolios, which are often managed separately in practice.

Unfortunately, similar studies on the bond markets are rare with Varotto (2003) only one of the few exceptions. The lack of similar studies is probably due to more esoteric nature of bond markets compared to equity markets and the lack of readily available time series data on bonds to academics. Bonds are mostly traded over-the-counter, while stocks are exchange-traded for which prices are officially recorded, time-stamped and publicly available.

Varotto (2003) puts the Heston and Rouwenhorst methodology to use on the returns of corporate eurobonds. Varotto realizes that the diversification of corporate eurobond portfolios is analyzed only partially and sporadically and sets out to fill the void with his study which extends the Heston and Rouwenhorst model especially to suit a set of 2,984 corporate eurobond returns provided by Reuters. His data set of eurobonds cover the period January 1993 to February 1998, are issued by 633 firms from nine countries, including five from Europe, and are assigned to eight broad industry sectors. Being mainly concerned with the credit risk diversification of corporate eurobond portfolios, Varotto uses excess returns, which is the portion attributed to credit spread changes (of the corporate eurobond to its local government bonds). Portfolio volatility is reduced through diversification of so-called locally systemic risk factors as represented by country, industry, maturity, seniority and rating characteristics of the eurobonds, estimated as deviations from the average market return. The residual risk is interpreted as idiosyncratic, which cannot be diversified away. Varotto finds that country diversification is best for reducing eurobond portfolio credit risk. This is in line with results for equity returns from the same period. However, in the case of eurobonds, industry effects are not only less important than country effects in the explanation of the variance of their returns, they are also overtaken by maturity and credit rating effects (while the effect of seniority is very small and the least significant).

Varotto's finding from the performance of the Heston and Rouwenhorst model on eurobonds that country effects also seem to dominate industry effects for eurobond returns in the 1990s is significant. Unfortunately, his is only one study and his sample just stops short of the introduction of the Euro. Besides addressing my overall research question, an empirical analysis of eurobond returns in Europe into the effects have been the most influential in explaining cross-sectional variance and to determine the impact of EMU fills a void in the research field. The remainder of this chapter centers on the setup, performance and results of such an analysis.

3. The data

The objective is to gather monthly holding period returns on corporate eurobonds for as many EU countries that joined the Euro on 1st January 1999 as possible and for at least two that did not to form a meaningful EMU control group. Ideally, the returns series should start early in the 1990s so as to have data for approximately the same length of period prior to the start of EMU and following this date. This section details the sources for my data set and methods used to cleanse and prepare the data for incorporation into the econometric models.

3.1. Sources and downloads

For the Heston and Rouwenhorst (1994) style studies on equity returns typically a set of country indexes from one data source provides the total or holding period return on a monthly (sometimes weekly) basis. By virtue of the fact that the composition of the relevant country indexes into individual stock components is known, stocks can be assigned to an industry category based on an industry classification from either the same or an alternative source. The analysis can also be performed at the level of the indexes as opposed to individual stocks, provided that the set of industry indexes spans the country indexes (e.g. Griffin and Karolyi, 1998).

Unfortunately there is, to the best of my knowledge, no set of corporate eurobond indexes available for the European eurobond markets that dates back to the early 1990s and that otherwise suits the purpose of this research. Mostly, corporate bond indexes for Europe start only after 1999 and virtually nothing is available prior to this date, let alone a further breakdown into industry sectors, which even today is a rarity in the bond markets. Corporate bond indexes are typically divided over credit rating categories. In the absence of this, I resort to collecting a comprehensive set of individual European eurobond prices from which monthly holding period returns can be calculated.

Corporate eurobond price data is partly obtained from Bloomberg and partly from Morgan Stanley. Bloomberg is one of the most comprehensive sources available (among the very few) to have stored corporate eurobond price data for the European markets for the long period under consideration. In order to indiscriminately obtain all available corporate eurobond price series from Bloomberg, the bond search function is utilized to create portfolios using the same broad criteria for each market: fixed-rate, bullet bonds issued by corporations (corporate guaranteed) from all countries of all industry groups and including the bonds that have already matured. The search can only be conducted by currency and the currency markets of the eleven first EMU-entrants are selected plus that of the ECU, the British Pound and the Swedish Krona.

Bloomberg relies on market makers to input prices, on a real-time basis during the day for highly liquid securities and at the close of the business day for less liquid securities. It receives its day-to-day price information from a broad range of intermediaries, the quality and quantity of which varies per market and even submarket, from time to time and depends on the market activity and interests of the respective intermediary. In order to capture the best prices across their range of price providers, Bloomberg has what is called a generic price source, Bloomberg Generic (BGN). The price source is set to BGN for all corporate portfolios and indicate specific intermediaries as the preferred other choice, access allowing, which are deemed the most active in each currency market.

For each corporate eurobond in each portfolio the historic price series with a daily frequency is requested from January 1990 using the bond's unique ISIN code; bid prices if available otherwise mid or ask prices. These are clean prices, i.e. the price in which the accrued interest is not incorporated. Through the Bloomberg corporate eurobond portfolios, a sufficiently broad selection of price series is obtained over the requested sample period for the following currency markets: Deutschemark (DEM), French Franc (FRF), Italian Lira (ITL), Dutch Guilder (NLG), European Currency Unit (ECU), Spanish Peseta (ESP), Belgium or Luxembourg Franc (BEF), British Pound (GBP) and Swedish Krona (SEK). For some of the Euro legacy currency markets that could not ultimately be included – the Austrian Schilling (ATS), Portuguese Escudo (PTE), Finnish Marka (FIM) and Irish Pound (IEP) - data downloads were made but yielded insufficient series and therefore dropped out. This is a reflection of the reality that in the pre-EMU period a thriving eurobond market is only present in the largest countries. For one such market, the Austrian Schilling (ATS), sufficient corporate eurobond price series are left, but only from June 1999 onwards and are therefore also altogether excluded from the analysis. The Euro (EUR) set, which naturally starts only on 1st January 1999, includes the ECU eurobonds and those from the legacy currencies that are absorbed in the new single currency, as the redenomination of bond contracts happens almost instantly. The Euro set also includes all the new corporate eurobonds that are quickly issued in the newly created and much larger Euro market. Following EMU, the corporate eurobond market grows rapidly in Europe and this is also reflected in the data.

Apart from the historical price series, the following descriptive information of the eurobonds is obtained: amount issued, amount outstanding, announcement date, country of the issuer, coupon rate, coupon frequency, currency, final maturity, industry sector of the issuer, industry subgroup, issue date, issuer name, Moody's issuer rating of foreign currency debt, Moody's issuer rating, Moody's rating of long-term foreign currency debt, and S&P rating of long-term foreign currency issuer credit.

No separate Bloomberg corporate portfolio is created for the Euro for two reasons. For one, the overlap with the portfolios of the legacy currencies is considerable and the Bloomberg Euro portfolio is automatically populated with those from the Euro legacy currency portfolios for the bonds that continue to run after 1st January 1999. More importantly, the fixed income research desk of Morgan Stanley in London provides a set of European corporate eurobond price series and similar descriptive information from their proprietary database. The Morgan Stanley data set contains 2,484 of mainly EUR but also GBP (and the occasional USD and CHF) corporate eurobonds. As Morgan Stanley built its database for the European eurobond market only after the Euro market is created, the vast majority of price series do not start much before 2000. The Morgan Stanley data set provides a good complement to the Bloomberg eurobond data.

I obtain end-of-month exchange rates of the various local currencies congruent with the portfolios of eurobonds that are ultimately included into the analysis versus the US Dollar (USD) from Datastream.

3.2. Data cleansing and preparation

When historic price series are requested, Bloomberg provides a series for each and every ISIN code among the selection, irrespective of whether the series holds zeros, non-available or real price values. Even if the series contains real price values, this may not be for the entire period and/or the same price value may reoccur for more than one trading day. When a bond is issued, it is allocated with a unique ISIN security code and Bloomberg then captures this security for its system (to allow their users to apply its quantitative tools to it) and starts to build a historic time series. But not all eurobonds are traded every day and even if they are traded, the trading desk of the intermediary may not give the price input to Bloomberg. The latter is not so much a problem anymore nowadays because the links (called "feeds") between trading systems and the Bloomberg terminal are automated, but in the beginning of my time period Bloomberg was much more reliant on manual inputs from traders. If a price input is provided for a particular bond on a particular trading day, but not for the subsequent day(s), then Bloomberg automatically copies the value over from the previous day. This is an important difference with Morgan Stanley's proprietary database, which does not show a value if no input has been given for that trading day.

To extract end-of-month prices from the daily price series from Bloomberg which may or may not contain prices that have been held constant for a number of days, the monthly prices series are constructed according to the following rule: replace a value that has been held constant from the previous trading day(s) with a linearly interpolated value and allow for such interpolation only if the value has been left constant by less one calendar month and otherwise to eliminate the price value. The assumption is that bond prices move every trading session, even if the specific bond did not trade that day. Therefore, if on day $t=0$ a fresh price input is given but then not for x number of days, and then on day $t=x+1$ a new price input is given, then if the end of the month date falls within that range and provided that $x+1$ is not longer than one calendar month, it is preferable to take the linear interpolation between the prices on days $t=0$ and $t=x+1$ rather than the constant price value from day $t=0$.

The data sets from Bloomberg and Morgan Stanley are integrated according to the following rule: give preference to Bloomberg as a source and add a Morgan Stanley eurobond price series to the data set only if it is not already incorporated from the Bloomberg series. These would only be eurobonds from the Morgan Stanley source that are not initially part of the Bloomberg set or are among the Bloomberg series but drop out because it contains all zeros or non-available values.

Bloomberg's downloads picks up government bonds in the corporate eurobond portfolios. This is acceptable if it concerns other sovereigns than the one presiding over the respective currency (e.g. the Kingdom of Belgium issuing in DEM is a 'corporate' eurobond) but otherwise not and need to be eliminated (e.g. Kingdom of Belgium issuing in BEF is a domestic government bond). In the Morgan Stanley portfolio this problem does not exist, but it does have the occasional USD and CHF bond which too are eliminated.

Three final adjustments are made in the descriptive information that Bloomberg provides for each individual corporate eurobond. This concerns the identification of the country base and industry sector of the issuer, and missing issue dates. Bloomberg populates the country field with the country of the issuing entity. There are several occasions where the mother company is based in one particular country but issues a eurobond through its entity in a different country (often for tax reasons) and then the latter country is recorded. For example, Deutsche Bank AG from Germany issues through its finance vehicle Deutsche Finance N.V. in the Netherlands. The country base indicator is manually overridden to reflect where the mother company as the ultimate guarantor of the issuer is based. Equally, Bloomberg gives the industry sector of the issuing entity. Again, if a company issues through it finance vehicle, the industry indicator provided by Bloomberg would be 'financial' even though the corporate business of the mother company is better described as something else. Also in the case of the industry indicators, it is manually overridden to that of the mother company. The country and industry fields are used to create the country and industry bond portfolios in the next phase of my empirical analysis and thus quite important.

For a number of eurobonds from the Bloomberg source certain descriptive information is missing. Missing fields invariably include amount issued, the issue date and final maturity date. An issue date can be manually inserted, since it does otherwise not matter for the calculation of returns. The applied rule is to consider the first date a price record appears in the historic price series of the respective eurobond and then to work back from the first price record date to the next anniversary of the maturity date. For example, if for a eurobond the final maturity date is 1/1/1998 and the first price record date is 28/2/1995, then an issue date of 1/1/1995 is inserted. This manual input is performed for 153 eurobonds. As regards the missing fields of amount issued and final maturity date no manual inputs can justifiably be given. These eurobonds are excluded from the data set.

Thus, I arrive at a data set of 6,440 eurobonds whose price series cover the period May 1990 to March 2008 though starting and ending at different times within that period. Table 4.1 lists how the total number of eurobonds is divided over the ten currencies of issuance that make up the sample. The largest currency market is not actually GBP, because the EUR market will also in fact incorporate the eurobonds originally issued in Euro legacy currency that continue to run after 1st January 1999. The GBP eurobond market is nevertheless a very sizeable market because of its long history of corporate and financial institution issuance. Within the Euro zone, the DEM market is the largest in the sample, followed by

Table 4.1
Database of eurobonds by original currency of issuance, from domestic and Euro zone issuers

Currency of issuance	Number of eurobonds	% of total	From domestic issuers*	% of total in respective currency	From Euro zone issuers**	% of total in respective currency
BEF/LUF	466	7%	125	27%	360	77%
DEM	607	9%	528	87%	558	92%
ESP	105	2%	6	6%	36	34%
EUR	1,274	20%	802	63%	802	63%
FRF	483	8%	222	46%	316	65%
GBP	1,927	30%	716	37%	525	27%
ITL	399	6%	65	16%	226	57%
NLG	526	8%	424	81%	509	97%
SEK	529	8%	348	66%	98	19%
XEU	124	2%	44	35%	44	35%
Total	6,440					

* with 'domestic issuer' is meant the issuing entity based in the country belonging to the respective currency. In the case of the EUR and XEU issuing entities based in any of the eleven countries that first enter EMU have been taken. The supranational issuers have been ignored in all figures in this column.
** with 'Euro zone issuer' is meant the issuing entity based in any of the eleven countries that first enter EMU. The supranational issuers have been ignored in all figures in this column.

the NLG, which is larger in terms of number of eurobonds to both the FRF and ITL markets. The second largest currency market outside the Euro zone is the SEK market. Table 4.1 also shows that some currency eurobond markets are more "domestic" by the nature of their supply than others. The Deutschemark and Dutch Guilder markets are both for more than 80% populated with eurobonds from issuing entities from the home country. This contrasts with the ESP and ITL markets where the majority of issuers are foreign. For the Euro currency, 63% originates from issuers with the Euro zone. For the non-Euro markets, the GBP market is clearly more open to non-EU issuers than the SEK market.

3.3. Deriving holding period returns

Let's denote the data set as consisting of *N* eurobonds. Local currency total returns for the n^{th} eurobond at the end of month *t* for all *t = 1,…,T*, where the re-investment of the coupon until the rebalancing at the beginning of the following month is assumed, are derived from:

$$R_{n,t}^{LC} = \frac{(P_{n,t}+A_{n,t}+G_{n,t})}{(P_{n,t-1}+A_{n,t-1})} - 1 \qquad (1)$$

where LC denotes local currency,

$P_{n,t}$ = clean price (for the n^{th} bond at month *t*),

$A_{n,t}$ = accrued interest (for the n^{th} bond at month *t*), calculated from [2]

$$A_{,n,t} = coupon\ rate * \frac{(number\ of\ days\ from\ t\ to\ the\ last\ coupon\ date)}{(365/coupon\ frequency)}$$, and

$G_{n,t}$ = value of the coupon received between *t* and *t-1.*

These local currency total returns are converted to one common currency using spot exchange rates as proposed by Heston and Rouwenhorst (1994, p 6), through:

$$R_{n,t}^{CC} = (1 + R_{n,t}^{LC})\ (S_t / S_{t-1}) - 1 \qquad (2)$$

where CC denotes common currency,

[2] Note that the assumption is made of one and the same daycount method for all bonds of actual/365. See Fabozzi, F. J. (2005, 7th ed., Handbook of Fixed Income Securities. McGraw-Hill, p 82) for the formula of accrued interest.

S_t = spot exchange rate of the common and local currency at month t (the amount of local currency that can be obtained for one unit of common currency).

The common currency for the monthly returns is the US Dollar (USD). These USD returns obtained from the clean prices through Eqs. (1) and (2) provide the input for the decomposition models, both the standard and the extended model.[3]

4. Decomposing eurobond returns

In order to allow a close comparison of the results for bonds with the ones obtained originally by Heston and Rouwenhorst (1994) and ensuing studies using their standard decomposition model for equity returns, I will first follow their model and approach as closely as possible. This is the main model in Section 4.1. In the second instance, I propose a Varotto (2003) style extension based on what the information in my data set allows. This is the extended model in Section 4.2.

4.1. The main model

Suppose we have K countries and J industries. Furthermore, we have $n = 1, \dots, N$ eurobond returns which are measured over the period $t = 1, \dots, T$. Note that I do not have a complete panel of eurobond returns as not all eurobonds n are traded over all time periods t . Let $r_{njk}(t)$ be the time t return on eurobond n that is related to industry $j = 1, .., J$ and country $k = 1, \dots, K$. The basic cross-sectional decomposition that Heston and Rouwenhorst (1994) propose can be written as:

$$r_n = \alpha + \sum_{j=1}^{J} \phi_j I_{nj} + \sum_{k=1}^{K} \psi_k C_{nk} + \varepsilon_n \qquad (3)$$

where the dependence of time is suppressed and where the vector r_n consists of all eurobonds r_{njk}. I_{nj} and C_{nk} are dummy variables defined as

[3] Note that in this chapter both the standard and the extended decomposition is performed on outright returns. Heston and Rouwenhorst (1994) use the term ‘excess returns’, but in their case it refers to the return relative to the average market but decomposition is performed on outright (equity) returns. Varotto (2003) uses excess returns instead of outright (bond) returns as the data input for his extended decomposition model. These excess returns are derived from the contractual cash flows of the bond in question discounted by the risk-free rates derived from its zero government benchmark curve. Whenever the term ‘excess returns’ is used in this chapter, it has the meaning Heston and Rouwenhorst assign to it. Empirical results from the decomposition based on excess returns as the data input, calculated from the 1-month USD deposit rate, are very similar to results obtained from outright returns. These results are not shown in this chapter but can be provided upon request.

$$I_{nj} = \begin{cases} 1, & \text{if bond } n \text{ belongs to industry } j \\ 0, & \text{otherwise} \end{cases}$$

and

$$C_{nk} = \begin{cases} 1, & \text{if bond } n \text{ belongs to country } k \\ 0, & \text{otherwise} \end{cases}$$

This decomposition needs to be performed for every time period *t = 1, … , T*. The coefficients ϕ_j and ψ_k capture the returns that can be assigned to specific industries and countries, respectively.

The decomposition in Eq. (3) shows that a eurobond return r_n can be decomposed into a general global component α, industry components ϕ_j (*j = 1 ,.. , J*), country components ψ_k (*k = 1, … , K*), and an idiosyncratic term ε_{njk}. Note that the coefficients ϕ_j and ψ_k are not identified, unless additional restrictions are imposed. Heston and Rouwenhorst add the following restrictions:

$$\sum_{j=1}^{J} w_j \phi_j = 0 \qquad (4a)$$

$$\sum_{k=1}^{K} v_k \psi_k = 0 \qquad (4b)$$

where w_j (v_k) are the value-weights of industry *j* (country *k*) in the total universe of eurobonds.[4] All the weights sum to unity:

$$\sum_{j=1}^{J} w_j = \sum_{k=1}^{K} v_k = 1$$

The USD-equivalent of the amount issued is used as an indicator for the market value weight of each eurobond.[5]

The cross-sectional regressions subject to its restrictions are performed over all eurobonds that are present at time *t*. The industry and country coefficients, ϕ_j and ψ_k, do not depend on the individual eurobonds *n*. Rather, the systemic part of the returns that can be assigned to these effects is obtained from the fitted values of the returns from the regressions and represented by the resulting estimated coefficients $\widehat{\phi_j}$ and $\widehat{\psi_k}$.

This estimation procedure allows a decomposition into country and industry indexes in the following way (see *Appendix A* for the derivation). Let's focus on the country indexes first introducing

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[4] By construction all individual weights are larger than or equal to zero: $w_j \geq 0$ and $v_k \geq 0$.

[5] The discussion focuses on value-weighting the returns. The same logic can be applied to the case of equal-weighting the returns. The latter can be achieved by giving each eurobond an equal weight in the computations.

weight $p_{n\mathcal{K}}$ that is the weight a particular eurobond *n* has in country $\mathcal{K}$ from set *k = 1, … , K,* then the sum over the eurobonds results in:

$$R_{\mathcal{K}} \equiv \widehat{\alpha} + \sum_{j=1}^{J} \widehat{\phi}_J \sum_{n=1}^{N} p_{n\mathcal{K}}\, I_{nj} + \widehat{\psi_{\mathcal{K}}} \tag{5}$$

The value-weighted index return of country $\mathcal{K}$ can be decomposed into a component that is similar to all countries, $\widehat{\alpha}$, the average of the industry effects of the eurobonds that make up its index, and its country-specific component, $\widehat{\psi_{\mathcal{K}}}$.

For the industry indexes, a similar decomposition can be made if $p_{n\mathcal{J}}$ is the weight a particular eurobond *n* has in industry $\mathcal{J}$ from set j *= 1, … , J* and a summation over the eurobonds yields:

$$R_{\mathcal{J}} \equiv \widehat{\alpha} + \widehat{\phi_{\mathcal{J}}} + \sum_{j=1}^{J} \widehat{\psi_k} \sum_{n=1}^{N} p_{n\mathcal{J}}\, C_{nk} \tag{6}$$

The construction of the decompositions in Eqs. (5) and (6) is repeated for every time period *t = 1, … , T*, giving indexes $R_k(t)$ and $R_j(t)$ for countries and industries respectively on which the underlying sources of variation can be determined.

To investigate whether the country effects are in part induced by the conversion of local currency returns into common currency, affecting all eurobonds of that country equally, the methodology proposed by Heston and Rouwenhorst (1994) is followed. Suppressing time dependency, the currency components of common currency returns on the value-weighted country indexes of country $\mathcal{K}$ from set *k = 1, … , K* relative to the total market, denoted $FX_{\mathcal{K}}$, is given by:

$$FX_{\mathcal{K}} = S_{\mathcal{K}} - \sum_{k=1}^{K} v_k\, S_k\,, \tag{7}$$

where $S_{\mathcal{K}}$ is the percentage change of the local currency of country $\mathcal{K}$ vis-à-vis the common currency and $\sum_{k=1}^{K} v_k = 1$. $\sum_{k=1}^{K} v_k\, S_k$ is the weighted-average change of all local currencies that make up the total market (including the local currency of country $\mathcal{K}$) to the common currency (a sort of 'basket'), weighted by the size of their component in the total market. The calculation of the currency component through Eq. (7) is repeated for all *t* in the time period and for all countries *k* (where v_k varies at each *t*) so as to obtain a time series for each, $FX_{\mathcal{K}}(t)$, which is then regressed on the estimated country effects obtained earlier, $\widehat{\psi_{\mathcal{K}}}(t)$ in the following manner:

$$\widehat{\psi_{\mathcal{K}}}(t) = \delta_{\mathcal{K}} + \gamma_{\mathcal{K}}\, FX_{\mathcal{K}}(t) + \varepsilon_{\mathcal{K}} \tag{8}$$

The null hypothesis H_0: $\gamma_{\mathcal{K}} = 1$ is accepted for those currency components and country effect pairs that are fully correlated. The $R^2_{\mathcal{K}}$ of the regression for each country $\mathcal{K}$ further indicates how much of the variance of country effects is explained by currency movements. The interpretation of this analysis is that it seeks out the part of the country effect that can be attributed to the fluctuation of the currency of that country to the common currency that has affected all businesses in that country equally, thereby leading to a common bond price move of entities located in that country. If this is the case then the macroeconomic situation and/or policy decisions in countries induce a strong correlation between eurobond returns and exchange rates beyond a mere currency conversion effect.

4.2. The extended model

Thee major differences between stocks and bonds influence the investment return made on a portfolio of each type of security and ought to be considered in the analysis. First, stocks have an infinite life (with the exception of those that are delisted) and bonds have a finite life (with the exception of perpetual bonds but these are excluded from my data set). The remaining life of the bond at the time of the investment is an important decision for an investor. It determines where along the yield curve one invests and this has a bearing on anticipated return prospects. The time horizon of the investment matters for bond and equity investors alike (as it is well-known in finance that uncertainty and return volatility increase with time), but bonds are by their nature more sensitive to the term structure of interest rates. Varotto (2003) finds a significant effect for maturity as a separate strategic portfolio investment allocation decision for corporate eurobonds that is more important even than industry diversification. My data set allows for the separate testing of the maturity effect in a Varotto-style extension of the Heston and Rouwenhorst model.

The second important difference between stocks and bonds is that debt holders in general and bond holders among them rank above equity holders in terms of priority for repayment in case of the bankruptcy of a company. Where risk distribution of a company's default probability is virtually binary in the case of equities, it is more graded for bonds. In order to assist bond holders in the assessment of default risk, companies as issuers of bonds and their individual bonds are often credit rated. This issuer and bond credit rating indicates the probability that a corporate issuer will make a timely and full payment on its outstanding debt liabilities under the contractual obligations of the bond in question. The credit rating, in conjunction with an investor's own assessment of an issuer's default risk, may change during the life of the bond but is at all times reflected in its market price and thereby its investment return prospects. Credit rating is therefore a contributing strategic investment decision for the composition of corporate eurobond portfolios. Varotto finds a significant effect for credit rating in eurobond returns, though not as significant as maturity but again more significant than industry sector as a means of risk diversification. Though it would be interesting to separately test for a credit rating effect, my data set does unfortunately not allow for it. The credit rating information on the individual eurobonds is static (recorded at the issue date) and not dynamic as with Varotto's database and is above all incomplete. Related conditions of the bond, such as its seniority, have a bearing on the return prospects in case of a default situation because the level of seniority among different types of bond issues determines the priority repayment privilege the respective holders have. As the eurobonds are pre-selected on the basis that they are senior unsecured, my database is not able to pick up on the point of seniority as a separate means of risk diversification. This less worrying though, as Varotto finds a very small effect for seniority, the least significant of all.

The third important difference between stocks and bonds concerns liquidity. Companies generally list only on one stock exchange so there is one unique price record for one stock from one company in the market place. Companies tend to issue a multiple of bonds which are not exchange traded but trade over-the-counter (OTC), resulting in multiple price records in different places in the market for multiple bonds from one company. This is the basic reason why liquidity differences are greater for corporate bonds than for equity, and hence matter more as an investment decision in the case of eurobonds. Varotto acknowledges the importance of liquidity differences for bonds but decides against picking this up as a separate strategic diversification choice on the basis that liquidity is indirectly accounted for in the weighted-least squares estimation. In line with recent research (see e.g., Lin, H., Liu, S., Wu, C., 2009; Fontaine, J., Garcia, R., 2008; De Jong, F., Driessen, J., 2007) that liquidity premiums are a significant element in the determination of credit bond yield spreads, the liquidity effect is included in the extended Heston and Rouwenhorst model.

Based on the above discussion, the following modifications of the model defined under Eq. (3) are adopted:

$$r_n = \alpha + \sum_{j=1}^{J} \phi_j I_{nj} + \sum_{k=1}^{K} \psi_k C_{nk} + \sum_{l=1}^{L} \lambda_l \, Q_{nl} + \sum_{m=1}^{M} \mu_m \, X_{nm} + \varepsilon_n \qquad (9)$$

where dummy variables I_{nj} and C_{nk} remain as before and new dummy variables are incorporated to capture the liquidity effect, Q_{nl} for *l = 1, …, L*, and remaining life-to-maturity effect , R_{nm} for *m = 1, … , M*, which are defined as

$$Q_{nl} = \begin{cases} 1, & \text{if bond } n \text{ belongs to liquidity bracket } l \\ 0, & \text{otherwise} \end{cases}$$

and

$$X_{nm} = \begin{cases} 1, & \text{if bond } n \text{ belongs to maturity bracket } m \\ 0, & \text{otherwise} \end{cases}$$

Additional restrictions are incorporated to define the model, where u_l and z_m are the value weights of liquidity type *l* and remaining maturity type *m* in the total value-weight market.

$$\sum_{j=1}^{J} w_j \phi_j = 0 \quad (10a)$$

$$\sum_{k=1}^{K} v_k \psi_k = 0 \quad (10b)$$

$$\sum_{l=1}^{L} u_l \lambda_l = 0 \quad (10c)$$

$$\sum_{m=1}^{M} z_m \mu_m = 0 \quad (10d)$$

and $\sum_{j=1}^{J} w_j = \sum_{k=1}^{K} v_k = \sum_{l=1}^{L} u_l = \sum_{m=1}^{M} z_m = 1$

Similar to Eqs. (5) and (6), the value-weighted index excess returns for the portfolios selected along the two main dimensions of country and industry sector are each decomposed as follows[6]:

$$R_{\mathcal{K}} \equiv \widehat{\alpha} + \sum_{j=1}^{J} \widehat{\phi_J} \sum_{n=1}^{N} p_{n\mathcal{K}} I_{nj} + \sum_{l=1}^{L} \widehat{\lambda_l} \sum_{n=1}^{N} p_{n\mathcal{K}} Q_{n\mathcal{L}} + \sum_{m=1}^{M} \widehat{\mu_m} \sum_{n=1}^{N} p_{n\mathcal{K}} X_{nm} + \widehat{\psi_{\mathcal{K}}} \quad (11)$$

$$R_{\mathcal{J}} \equiv \widehat{\alpha} + \sum_{j=1}^{J} \widehat{\psi_k} \sum_{n=1}^{N} p_{n\mathcal{J}} C_{nk} + \sum_{l=1}^{L} \widehat{\lambda_l} \sum_{n=1}^{N} p_{n\mathcal{J}} Q_{n\mathcal{L}} + \sum_{m=1}^{M} \widehat{\mu_m} \sum_{n=1}^{N} p_{n\mathcal{J}} X_{nm} + \widehat{\phi_{\mathcal{J}}} \quad (12)$$

whereby $p_{n\mathcal{L}}$ and $p_{n\mathcal{M}}$ are the weights of each bond *n* in liquidity sector $\boldsymbol{\mathcal{L}}$ from *l = 1, … , L* and maturity sector $\boldsymbol{\mathcal{M}}$ from *m = 1, … , M*. Terms $\widehat{\psi_{\mathcal{K}}}$ and $\widehat{\phi_{\mathcal{J}}}$ continue to represent the pure country and industry effects. In the country index decomposition, the term $\sum_{j=1}^{J} \widehat{\phi_J} \sum_{n=1}^{N} p_{n\mathcal{K}} I_{nj}$ continues to represent the value-weighted sum of industry effects in the portfolio of country $\mathcal{K}$ and is added to by the value-weighted sum of its liquidity ($\sum_{l=1}^{L} \widehat{\lambda_l} \sum_{n=1}^{N} p_{n\mathcal{K}} Q_{n\mathcal{L}}$) and maturity ($\sum_{m=1}^{M} \widehat{\mu_m} \sum_{n=1}^{N} p_{n\mathcal{K}} X_{nm}$) structure. Similarly for the industry sector portfolios, $R_{\mathcal{J}}$. The repeated estimation of Eqs. (11) and (12) gives time series for these effects.

5. Empirical results from the main model

The empirical results from the main decomposition, as outlined in Section 4.1, on my data set of 6,440 eurobond returns are discussed in this section. Eurobonds are classified into countries and industry sectors

[6] One could equally construct decomposition liquidity and maturity indexes. I refrain from doing so because liquidity and maturity are not typically first-order considerations on the basis of which bond portfolio asset allocations are made. Liquidity and maturity are rather treated as second-order decisions in portfolios otherwise allocated along country or industry lines.

and the variance of each of these factors in their returns is determined through a series of cross-sectional regressions. This is initially done for the whole sample period of May 1990 to March 2008, and subsequently for two periods around the start of 1999 to see if EMU has any impact on results.

5.1. Summary and performance statistics

The 6,440 eurobonds are, by virtue of their issuing entity, assigned to one of ten origins ('countries') and to one of seven broad industry groups. The ten country categories are: Belgium/Luxembourg, France, Germany, Italy, Netherlands, Spain, Sweden, United Kingdom, supranationals and other. The seven industries are: financials and funds, government institutions, consumer, communications and technology, basic materials and energy, industrials and utilities. Table 4.2 shows that the distribution of the sample over these countries and industries is uneven. According to Panel A more than half of all the eurobonds originate from one of four countries: Germany, the United Kingdom, France and the Netherlands. Since supranational institutions cannot be related to one country in the same way as other issuers, a separate category is created for eurobonds from these entities. The category non-EU is numerous because it captures eurobonds from issuers from the rest of the world that entered into the sample as they issued in the currencies of selection (see Section 3.1.). Panel B shows that the most dominant industry group by number of issues is financials and funds. This sector accounts for more than half of the sample. This is an accurate reflection of the composition of the corporate eurobond market in Europe where it is known that financial institutions are the majority of issuers, a feature discussed in Chapter 3. The government institutions sector, which contains all non-domestic sovereign and quasi-sovereign issuers, is also well represented. The other industry groups' numbers each account for less than 10% of the total.

According to Panels C and D, each country has at least one eurobond in each industry (with the exception of the supranationals which by nature all fall under government institutions). This indicates that the spectrum of corporate eurobonds included in the sample provides diversification opportunities. Some patterns of industry concentration in Europe can be observed, but the level of concentration is not very high: France in the industry sector; Italy in the government sector; Germany and Sweden in the government and the consumer sectors; and the United Kingdom in the consumer and utility sectors. All countries have a high number of financial institutions eurobonds, but the BENELUX the most vis-à-vis other sectors. When the eurobonds are value-weighted, only the 'live' eurobonds are counted. Now Italy emerges as the largest country due to the heavy weight of its government institutions. The supranational institutions and Sweden, which have either exclusive or high concentrations in the government sector, also increase in weight. Those countries with high concentrations in the financials and funds industry, such as the BENELUX countries,

Table 4.2

Country and industry composition

Panels A and B give for each country and industry, the number of eurobonds included in the total sample and as a percentage of the total number of eurobonds. Panel C gives for each country by industry the number of eurobonds included in the total sample. Panel D gives the average weight of the (live) eurobonds in the country by industry cross-sector in the total value-weighted market over the whole sample.

A. By country (number and percent of total)				B. By industry (number and percent of total)			
Belgium/Luxembourg:	BL	192	2.98%	Financials & Funds:	FF	3,716	57.70%
France:	FR	720	11.18%	Government Institutions:	GI	1,140	17.70%
Germany:	GE	1,313	20.39%	Consumer:	CO	517	8.03%
Italy:	IT	203	3.15%	Communications & Technology:	CT	276	4.29%
Netherlands:	NE	720	11.18%				
Spain:	SP	94	1.46%	Basic materials & Energy:	BE	208	3.23%
Sweden:	SW	445	6.91%				
United Kingdom:	UK	900	13.98%	Industrials:	IN	258	4.01%
Supranational:	SN	432	6.71%	Utilities:	UT	325	5.05%
Non-EU:	OT	1,421	22.07%				
Total		6,440		Total		6,440	

C. Number of eurobonds by country and industry

	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	139	13	2	5	15	7	11	192
France	401	58	57	48	31	80	45	720
Germany	912	193	76	32	28	43	29	1,313
Italy	95	47	18	15	3	6	19	203
Netherlands	610	5	19	27	21	18	20	720
Spain	44	14	8	12	4	1	11	94
Sweden	198	134	49	21	13	14	16	445
United Kingdom	480	20	157	55	34	33	121	900
Supranational	0	432	0	0	0	0	0	432
Non-EU	837	224	131	61	59	56	53	1,421
Total	3,716	1,140	517	276	208	258	325	6,440

D. Average weights in the total value-weighted market

	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	0.34	0.31	0.00	0.10	0.08	0.07	0.14	1.03
France	4.33	2.04	0.72	1.04	0.27	1.07	0.80	10.28
Germany	8.39	2.49	0.80	0.55	0.28	1.02	0.57	14.11
Italy	0.87	13.72	0.25	0.38	0.06	0.13	0.16	15.58
Netherlands	6.13	0.02	0.18	0.21	0.25	0.29	0.21	7.24
Spain	0.38	1.86	0.05	0.15	0.10	0.00	0.23	2.75
Sweden	4.91	1.85	0.06	0.06	0.02	0.01	0.11	7.02
UK	7.78	0.66	2.28	1.22	0.48	0.61	1.91	14.90
Supranational	0.00	13.04	0.00	0.00	0.00	0.00	0.00	13.04
Non-EU	6.63	4.15	1.02	0.59	0.61	0.34	0.70	14.05
Total	39.77	40.14	5.32	4.30	2.16	3.47	4.84	100.00

Percentages may not add up to precisely 100.00 or the number given as the total due to rounding.

tend to fall back. Because financial institutions issue frequently but in smaller size, their dominance is reduced on a value-weighted basis. This is reflected in the drop for this sector as a whole to just below 40% on a value-weighted basis from almost 60% on an equal-weighted basis.

Table 4.3 lists the mean return and its standard deviation for eurobonds allocated by country (in Panel A) and by industry (in Panel B). These are considerably lower to what is typically observed for equities as a manifestation that eurobonds are less risky securities. The table shows that although country and industry sector returns are very similar with no great outliers, the variation in the average return and return volatility is larger among the country than among the industry sectors. Considering the value-weighted statistics, the high-low range of mean returns is 0.27% for the countries versus 0.16% for the industries. The range in standard deviations of the returns is 0.85% for the countries and 0.27% for the industries. In general correlations between the industry indexes appear to be higher than between the country indexes and there is greater variation in the country return correlations than the industry sector return correlations. The lowest correlation among the industry sectors (0.898, between communications and technology sector and government sector) is higher than the lowest of the country correlations (0.713, between Spain and Italy). This implies that diversification gains are expected to be higher among countries than among industries. Judging from the value-weighted mean returns, the above-average performing countries are Spain, the United Kingdom and the supranationals, and the above-average performing industries are the government sector and utilities. Low performing countries are Germany and France, and industrials among the industry sectors. The difference in return statistics between the value-weighted and the equal-weighted are not great and do not change these observations.

The foreign currency return statistics in Panel A of Table 4.3 show that there are large discrepancies in the average impact of USD-denominated exchange rates. While the core-EMU bloc appreciates on average by just over 0.10% per month, the southerly EMU countries suffer a depreciation of just over 0.03%. Fortunes also differ for those EU countries that chose not to participate in EMU, with the Swedish Krona recording a monthly decline of 0.36% on average and the British Pound a 0.05% rise against the US dollar. The volatility of currency returns among the countries is again remarkably similar though.

In sum, there are four main observations from the sample distribution over country and industry sectors and their performance statistics. First, in reflection of the composition of the European eurobond market, the sample is skewed towards the financial sector by numbers, but less so when value-weighted. Secondly, there is some concentration of industries within European countries but it is not heavy. All industries are represented in all real countries. Thirdly, the difference in average country and industry returns is not big, but the variation of these returns and of their correlations is larger among countries than among industries. Fourthly, the conversion of returns from national currency to the US Dollar can potentially have a significant effect on returns overall.

Table 4.3

Summary performance statistics

Panel A (B) summarizes the mean and the standard deviation of the equal-weighted (EW) and the value-weighted (VW) monthly returns by country (industry sector). All returns are in US Dollars and expressed in percent per month. The currency return is the proportional change in the exchange rate of the respective country vis-à-vis the US dollar, where a positive number indicates an appreciation. In the correlation matrices, the coefficients above the diagonal refer to the value-weighted returns and below the diagonal are between the equal-weighted returns.

A. By country

	EW return		VW return		Currency return		Correlation matrix										
Country	Mean	Stdev	Mean	Stdev	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT	Total
BL	0.595	2.963	0.565	3.001	0.107	2.859	1	0.972	0.958	0.788	0.975	0.869	0.919	0.861	0.883	0.951	0.955
FR	0.527	2.930	0.518	3.009	0.112	2.833	0.978	1	0.976	0.810	0.980	0.860	0.903	0.830	0.880	0.948	0.953
GE	0.606	3.032	0.515	2.830	0.109	2.862	0.950	0.964	1	0.807	0.972	0.842	0.899	0.877	0.929	0.964	0.972
IT	0.594	3.315	0.614	3.410	-0.032	2.960	0.831	0.849	0.817	1	0.769	0.713	0.799	0.744	0.748	0.815	0.859
NE	0.539	3.002	0.536	2.974	0.108	2.857	0.968	0.982	0.950	0.790	1	0.860	0.906	0.825	0.881	0.940	0.949
SP	0.737	3.540	0.784	3.680	-0.044	2.990	0.890	0.894	0.863	0.739	0.882	1	0.807	0.737	0.770	0.829	0.849
SW	0.644	3.047	0.600	3.116	-0.357	3.235	0.955	0.943	0.937	0.835	0.928	0.851	1	0.817	0.828	0.900	0.921
UK	0.807	3.326	0.737	3.202	0.045	2.650	0.829	0.805	0.808	0.701	0.771	0.754	0.807	1	0.945	0.931	0.926
SN	0.686	2.835	0.698	2.896	--	--	0.954	0.947	0.938	0.806	0.931	0.857	0.928	0.882	1	0.942	0.950
OT	0.639	2.870	0.577	2.884	--	--	0.956	0.949	0.939	0.818	0.925	0.865	0.931	0.895	0.970	1	0.977
Total	0.657	2.919	0.646	2.872			0.975	0.970	0.963	0.828	0.952	0.886	0.950	0.910	0.979	0.986	1

B. By industry sector

	EW return		VW return		Correlation matrix							
Industry	Mean	Stdev	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT	Total
FF	0.676	3.017	0.629	2.985	1	0.948	0.961	0.959	0.981	0.967	0.963	0.987
GI	0.689	2.906	0.725	2.850	0.960	1	0.933	0.898	0.922	0.933	0.928	0.976
CO	0.644	2.889	0.624	2.935	0.953	0.966	1	0.945	0.972	0.952	0.963	0.964
CT	0.640	2.958	0.618	3.029	0.950	0.957	0.968	1	0.965	0.968	0.935	0.953
BE	0.609	2.969	0.607	3.015	0.968	0.971	0.979	0.977	1	0.966	0.971	0.969
IN	0.618	2.928	0.563	2.947	0.960	0.971	0.971	0.976	0.974	1	0.946	0.971
UT	0.651	3.020	0.659	3.119	0.943	0.952	0.973	0.958	0.972	0.957	1	0.960
Total	0.657	2.919	0.646	2.872	0.988	0.987	0.978	0.974	0.987	0.983	0.965	1

5.2. Decomposition into country and industry effects

The excess return of country indexes are decomposed into pure country effects and a (weighted) average sum of seven industry effects and similarly for excess industry indexes returns. Note that with excess return is meant the return over the total market. Table B1 in Appendix B gives the performance statistics, similar to Table 4.3, for the actual country and industry indexes after decomposition (which are very similar). Table 4.4 presents the results of the decomposition into pure (country/industry) effects and the sum of these effects in the country and industry indexes for the entire sample period of May 1990 to March 2008. The variance as well as the variance ratio in excess of the market of these effects is reported.

The most important result from the decomposition is that the variance of pure country effects outweighs that of the pure industry effects, on average by a factor of 3.8 (=1.29/0.34) for the equal-weighted indexes and by a factor of 3.2 (=1.26/0.39) for the value-weighted indexes. Disregarding the supranationals and the other countries from the sample, which both have comparatively small pure country effects for understandable reasons, would have the effect that this result is even closer to the factor of four Heston and Rouwenhorst (1994) find for European stocks (but for the 1978-1992 period).

The reasons for the stronger average country effects become apparent from the comparison with the pure industry effects and sum of country effects among the industries. First, the variances of pure industry effects (in Panel B) are all rather similar with only one relative outlier which is the utilities sector (0.67). But the variance of the pure industry effect of the utilities sector is higher than that of only four from the ten pure country effects (in Panel A). Variances of pure country effects differ more substantially than variances of pure industry effects. Country effects for Italy, Spain and the United Kingdom are at least nearly four times higher than that of the lowest among the real single countries (France), and at least more than seven times higher than for the non-EU countries. Note that the smallest variance of the pure country effects, 0.20 for the supranationals, is very similar to that of pure industry effects of the government institutions sector (0.18) and that the latter also happens to be smallest variance among the pure industry effects. Secondly, the variation in the excess country indexes returns is mostly due to pure country effects while this is not the case for the excess industry indexes. The sum of ten country effects explains nearly as much (in the case of the value-weighted indexes) and nearly six times as much (in the case of the equal-weighted indexes) as the pure industry effects on average of excess industry returns.

Differences in results for the equal-weighted and the value-weighted indexes are not substantial, with the exception of the sum of country effects in the excess industry indexes returns. Results of the calculations based on the value-weighted indexes are the most representative of the two as it is most in line with market practice. Fixed income portfolio managers invariably take issue size into account with their eurobond purchases. Henceforth, I only discuss the results of the value-weighted portfolios and show the

Table 4.4

Decomposition of excess eurobond index returns (May 1990 – March 2008)

The table gives the variance of the components of the equal-weighted (EW) and the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio of the index in excess of the market.

A. Country Indexes

	EW indexes				VW indexes			
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.55	0.628	0.16	0.183	0.62	0.658	0.11	0.118
FR	0.51	0.655	0.13	0.162	0.54	0.629	0.11	0.132
GE	0.67	0.594	0.17	0.152	0.63	0.659	0.08	0.086
IT	3.71	1.142	0.14	0.042	3.00	1.133	0.07	0.028
NE	0.84	0.671	0.21	0.170	1.07	0.638	0.26	0.157
SP	2.90	1.052	0.17	0.061	2.83	1.011	0.07	0.026
SW	1.16	1.374	0.15	0.170	0.86	1.203	0.06	0.087
UK	1.93	1.161	0.15	0.089	2.54	1.070	0.15	0.061
SN	0.42	1.191	0.29	0.810	0.20	0.600	0.18	0.527
OT	0.22	0.798	0.11	0.407	0.35	1.059	0.08	0.248
Average	1.29	0.927	0.17	0.225	1.26	0.866	0.12	0.147

B. Industry Indexes

	EW indexes				VW indexes			
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.21	0.108	1.60	0.824	0.37	0.400	0.31	0.337
GI	0.29	0.104	2.09	0.760	0.18	0.813	0.14	0.636
CO	0.33	0.193	1.79	1.041	0.42	1.062	0.37	0.946
CT	0.30	0.154	1.66	0.861	0.34	0.607	0.25	0.446
BE	0.30	0.131	2.38	1.029	0.34	1.016	0.42	1.255
IN	0.27	0.173	1.74	1.106	0.33	1.005	0.21	0.641
UT	0.67	0.380	2.29	1.302	0.76	0.743	0.59	0.578
Average	0.34	0.177	1.94	0.989	0.39	0.807	0.33	0.691

the equal-weight results in *Appendix B* for completeness.

Table 4.5 presents the summary statistics for the estimated country indexes returns corrected for their industry composition and the industry indexes returns corrected for their country composition. The values in Table 4.5 can be directly compared with the summary performance statistics on the outright returns in Table 4.3. Significant differences are an indication that industry compositions are important for country returns and vice versa. This comparison shows that average value-weighted returns increase after

Table 4.5
Performance statistics for estimated country and industry indexes

Panel A summarizes the mean and the standard deviation of the monthly value-weighted (VW) estimated country returns corrected for industry compositions and their correlations. Panel B the same for the estimated industry returns corrected for country compositions. The summary statistics for the equal-weighted returns are in Table B4.5 of Appendix B.

A. Country indexes after decomposition, adjusted for their industry composition

	VW return		Correlations									
	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT
BL	0.592	3.025	1	0.977	0.951	0.809	0.963	0.874	0.935	0.821	0.950	0.937
FR	0.535	2.993		1	0.969	0.825	0.979	0.881	0.927	0.811	0.951	0.946
GE	0.604	3.048			1	0.794	0.946	0.848	0.917	0.810	0.937	0.945
IT	0.593	3.299				1	0.751	0.755	0.846	0.683	0.850	0.857
NE	0.555	3.091					1	0.866	0.900	0.796	0.920	0.916
SP	0.728	3.518						1	0.855	0.740	0.879	0.870
SW	0.643	3.050							1	0.793	0.944	0.949
UK	0.817	3.400								1	0.868	0.826
SN	0.645	2.818									1	0.972
OT	0.668	2.960										1

B. Industry indexes after decomposition, adjusted for their country composition

	VW return		Correlations						
	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT
FF	0.648	2.993	1	0.983	0.947	0.953	0.961	0.953	0.929
GI	0.701	2.903		1	0.953	0.958	0.960	0.960	0.933
CO	0.612	2.833			1	0.974	0.985	0.980	0.971
CT	0.650	2.884				1	0.978	0.979	0.962
BE	0.576	2.831					1	0.981	0.974
IN	0.625	2.883						1	0.968
UT	0.601	2.972							1

decomposition and when adjusted for industry composition for Germany, the United Kingdom, Sweden and the non-EU countries, which all have high concentrations in the below-average performing consumer sector. The United Kingdom and non-EU countries are also heavy on basic material and energy companies, which is the worst performing sector. Average returns decline too for Spain, which has an above-average stake in the second best performing sector of communications and technology and a much smaller basic material and energy sector and industrials sector which also performs below-average. Average returns corrected for industry composition decline for the supranational institutions, which are exclusively in the best performing sector of government institutions. For these countries, the industry composition matters to their performance. France, BENELUX and Italy are areas where industry composition matters much less. For these countries their performance can be attributed only to the country-specific component of their index return. This result is especially remarkable for Italy given that its industry composition is so heavily dominated by government institutions which constitute the best-performing sector.

The differences between values reported in Table 4.5 and those in Table 4.3 are smaller for the industry sectors than for the countries. Industry sector performances decline following decomposition and adjustment for geographic composition for all but the consumer and technology, industrials and government sectors. The stronger performance of the government sector is remarkable because it is already the best performing sector. Industry sectors where the geographic compositions matters the least to their return performance are consumer and technology and industrials, despite higher concentrations of these industries in the United Kingdom, the best-performing country. The performance of these sectors is due almost completely to their industry effect.

The correlation structure of index returns provides another way to establish whether industry composition matters for country returns and vice versa. If industry composition matters for country index returns, then correcting for industry compositions should result in a rise in country return correlations, and the same for industry sector correlations. Rather than gauging the difference in the correlation matrixes of Tables 4.3 and 4.5, which is a painstaking task, the so called Jennrich test is utilized to formally establish whether two correlation matrixes are from the same population.[1] *Appendix C* contains a detailed description of the Jennrich test.

The Jennrich test statistics in Table 4.6 are reported for the comparison of the correlation structure of indexes before and after decomposition. For both country and industry indexes the outcome of the test statistic exceeds the critical value and the hypothesis of stability is rejected. These results show that the correlation matrixes for the country and the industry indexes from before and after decomposition and adjustment for industry and country composition are statistically different. This implies that the decomposition produces country and industry indexes that may have different portfolio implications than indexes based on a straightforward allocation of eurobonds. It also suggests that on the whole industry compositions matter for country returns and country compositions matter for industry returns.

Table 4.6

Jennrich test of stability of correlation matrixes before and after decomposition

The table shows the results of the Jennrich test statistic and its corresponding critical value and p-value computed on the correlations of eurobond value-weighted (VW) returns from the country and industry indexes before and after decomposition over the full sample period. The results of the equal-weighted correlation matrixes are in Table B4.6 of Appendix B.

	Country correlation matrixes	Industry correlation matrixes
Jennrich χ^2 test statistic	309.9043	155.0512
Degrees of freedom	45	21
Critical value	61.6562	32.6706
p-value	0	0

[1] From Jennrich (1970). See Adjaoute et al. (2000) for an example of a practical application of the Jennrich test to comovements of stock returns.

In sum, the decomposition of eurobond returns into country and industry effects over the whole sample period of May 1990 to March 2008 yields three main results. First, the decomposition of eurobond returns makes a difference on country and industry indexes because their correlations are statistically not the same. Secondly, the decomposition shows that country effects explain more of the variation in returns than industry effects. The ratio of their importance is nearly the same as Heston and Rouwenhorst (1994) initially find for equity returns, albeit for a sample period that only partially overlaps. Thirdly, the industry composition almost always matters for country index returns and vice versa. The most notable exceptions are Italy and the consumer and technology and industrials sectors.

5.3. The common factor in eurobond returns

While correlations are evidently different before and after decomposition, I observe that they are very high in general. A possible explanation is that eurobond returns have a high common factor. In order to investigate this, Table 4.5 is recreated by correcting the country and industry indexes for the common factor in Table 4.7. Mean returns and volatilities in country indexes can now only be attributed to the pure country effects and the same for industry indexes. The result is a dramatic alteration in the correlation structure of returns on both the country and the industry indexes when the common factor is removed. Correlation coefficients plummet and in several cases even turn negative.

Figure 4.1 depicts the common factor over the full sample period and Table 4.8 compares the mean and standard deviation of the common factor with that of the other two types of (pure) coefficients for the entire sample period, the periods before and after EMU. The variance of the common factor for the full sample period (not listed in Table 4.8) is 8.3, which compares to a variance of the pure country effects of 1.3 and of the pure industry effects of 0.4 (in Table 4.4). This suggests that the common factor in eurobond returns is indeed high, especially for the first forty months of my sample period. This finding merits a further investigation of the common factor in eurobond returns and its driving forces.

A-priori, I suspect that the common factor is concurrent with dynamics that distinctly influence the outcome of bond investment decisions. These dynamics can broadly be described as the currency conversion to the US Dollar and changing expectations of the term structure of interest rates. Because the local currency eurobond returns are immediately converted to USD, the common factor could well represent this pure currency conversion effect. Otherwise, when underlying factors cause changes in term structure of interest rates which are common to all eurobond markets under consideration or affect these markets more or less equally, the common factor could represent these changes dynamically. In portfolio diversification studies this is often referred to as the non-diversifiable international systemic risk factor.

Table 4.7
Performance statistics ignoring the common factor

Panel A summarizes the mean and the standard deviation of the monthly value-weighted (VW) estimated country returns corrected for industry compositions and the common factor, and their correlations. Panel B the same for the estimated industry returns corrected for country compositions and the common factor. The summary statistics for the equal-weighted returns are in Table B4.7 of Appendix B.

A. Country indexes adjusted for their industry composition and the common factor

	VW return		Correlations									
	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT
BL	-0.068	0.785	1	0.643	0.279	-0.099	0.609	0.195	0.191	-0.266	-0.118	-0.194
FR	-0.125	0.733		1	0.510	-0.009	0.797	0.233	0.052	-0.400	-0.176	-0.088
GE	-0.056	0.797			1	-0.207	0.417	-0.007	-0.026	-0.345	-0.413	-0.028
IT	-0.067	1.731				1	-0.297	0.015	0.220	-0.287	0.114	0.218
NE	-0.105	1.033					1	0.229	0.024	-0.235	*0.214*	-0.116
SP	0.068	1.682						1	0.118	-0.158	0.092	0.075
SW	-0.017	0.928							1	-0.342	0.057	0.260
UK	0.157	1.595								1	-0.085	-0.427
SN	-0.015	0.449									1	0.099
OT	0.008	0.588										1

B. Industry indexes adjusted for their country composition and the common factor

	VW return		Correlations						
	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT
FF	-0.012	0.608	1	0.483	-0.164	0.166	0.035	*0.170*	-0.126
GI	0.041	0.421		1	-0.346	-0.388	-0.287	-0.331	-0.304
CO	-0.048	0.647			1	0.427	0.678	0.570	0.592
CT	-0.010	0.580				1	0.469	0.472	0.428
BE	-0.084	0.582					1	0.547	0.631
IN	-0.035	0.579						1	0.533
UT	-0.059	0.871							1

Figure 4.1
Common factor in eurobonds over the sample period

The figure depicts the common value, or the alpha, from the decomposed indexes. The x-axis expresses the number of months into the sample period; 0 starts in May 1990 and 214 ends in March 2008.

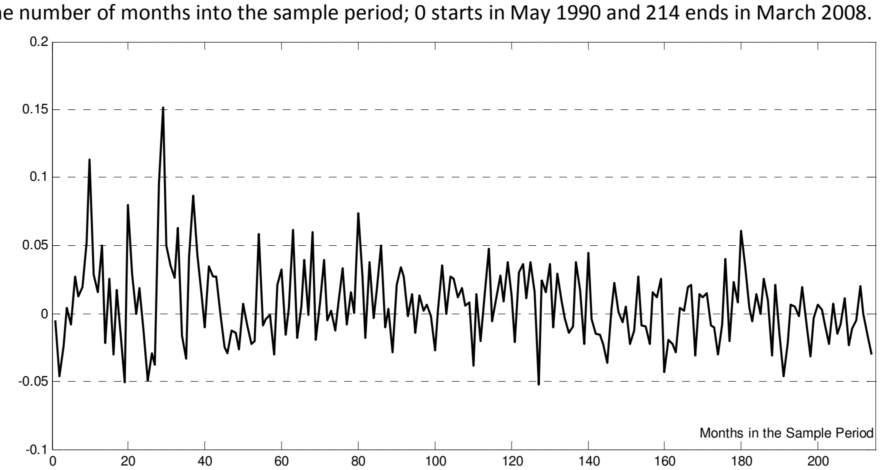


Table 4.8
Common factor in relation to pure country effects and pure industry effects

The table summarizes the mean, standard deviation and variance of the common factor in both value-weighted (VW) country and industry indexes and for the pure country effects from the country indexes and the pure industry effects from the industry indexes. Table B4.8 in Appendix B shows the results for the equal-weighted (EW) indexes.

	Mean			Standard deviation		
	Full period	Pre-EMU	Post-EMU	Full period	Pre-EMU	Post-EMU
Common factor	0.660	1.148	0.207	2.879	3.390	2.228
Average of pure country effects	-0.022	-0.032	-0.013	1.032	1.039	0.907
Average of pure industry effects	-0.030	-0.096	0.032	0.612	0.760	0.378

Two origins cause expectations of the term structure of interest rates to change: the international economic outlook and the prevailing risk preference of investors. Table 4.9 lists the set of pre-selected variables that are deemed to represent each cause adequately, together with a description of the time series used, their frequency and source. The goal is to identify the combination of variables that best explain the common factor in eurobonds. For this purpose, each explanatory variable is tried in a single-variable OLS regression with a constant term in the first instance to determine their individual explanatory power.

The common factor in eurobonds is denoted as CFE_t and is a monthly series from May 1990 to March 2008. Most variables are available on a monthly basis and for the full sample period. Exceptions are GDP_t and EEC_t,which are quarterly series, and GAP_t, $DEBT_t$ and DEF_t which are annually. In those cases, a monthly series is derived through interpolation. The currency adjustment and economic outlook variables are generally available for the eight distinct local markets (or countries) in my data set. They are weighted with the same market value weights with which the common factor is obtained to derive one series for these variables that is representative for the whole market. The M3 and M1 series used for the MON_t variable are only available for the Euro area as a whole, Sweden and the UK in case of M3 and only the Euro area in case of M1 so the weights for M3 are adjusted accordingly and M1 is taken outright. The EEC_t, BCI_t and risk preference variables are one series already so no weights need to be applied.

Table 4.10 lists the results of the single-variable OLS regressions with a constant term obtained with series for the explanatory variable that provide the best overall fit. I omit BCI_t in these series since this variable is defined as a dummy. It can immediately be seen from Table 4.10 that the common factor in eurobond returns is in large part explained by the direct conversion of eurobond returns from national currency to USD. The beta-coefficient of the OLS regression with CUR_t as the only explanatory variable for CFE_t is not significantly different from one at the 95% confidence level and the r-squared is high (0.87). The positive sign of the beta-coefficient indicates that a value-weighted national currency depreciation over

Table 4.9
Overview of explanatory variables used for common factor analysis

Variable	Description	Frequency	Source
For currency conversion			
CUR_t :	Percentage move of national currency to the USD	monthly	Datastream
For international economic outlook			
GDP_t :	Gross Domestic Product at constant prices, seasonally adjusted (market prices for Spain and the UK), chained 2007 (base year). Germany starts Q2-1991 and Sweden starts Q2-1993.	quarterly	Datastream
IIP_t :	Indices of Industrial Production Original series; normalized; ratio of original to trend; trend; original, seasonally adjusted; 12 month rate of change of the reference series	monthly	OECD
CLI_t :	Composite Leading Indicator Normalised; amplitude adjusted; trend restored; 12 month rate of change of trend restored	monthly	OECD
GAP_t :	Output gap, calculated as actual GDP less potential GDP as a percent of potential GDP.	annually	IMF
INF_t :	Index of Consumer Prices, neither seasonally nor working day adjusted. Consumer Prices – all items for Germany, UK, Belgium, Spain. HIPC for others.	monthly	OECD
UMP_t :	Rate of Employment. The numbers of unemployed persons as a percentage of the labour force, seasonally adjusted. Harmonised unemployment rate for all.	monthly	OECD
MON_t :	Monetary Aggregate. - M3: only available for Sweden, UK and Euro-area - M1: only available Euro-area	monthly	OECD
$DEBT_t$:	Maastricht definition of general government gross public debt, as a percentage of GDP	annually	CESifo DICE (EU)
DEF_t :	Cyclically adjusted net lending (+) or net borrowing (-) of the general government, as a percentage of potential GDP	annually	CESifo DICE (OECD)
EEC_t :	Long time-series of the Climate Indicator for the Euro Area (R1)	quarterly	IFO
BCI_t :	Business Cycle indicator for Euro area defined as a dummy variable (=1 for an upturn and =0 for a down turn in the cycle). Based on GDP before 1999 and "Eurocoin" series thereafter.	monthly	CEPR
For investor risk preference			
$STIR_t$:	Short-term Interest Rates - US Federal Funds target rate - US Federal Funds effective rate - German/Euro repo rate (blended series: German 28-day repo until 10/1/1992, German 14-day repo until 12/1/1998, Euro short term repo for remainder)	monthly	Datastream
LTY_t :	Long-term Bond Yield - US benchmark 10-year DS government index – interest yield - German benchmark 10-year DS government index – interest yield	monthly	Datastream
YSP_t :	Yield Curve Spread - Difference between US benchmark 2- year and 10-year DS government index – interest yields - Difference between German benchmark 2- year and 10-year DS government index – interest yields	monthly	Datastream
$RISK_t$:	Risk in global financial markets - CBOE spx volatility VIX (new) – price index - DJ US total stock market – price index - S&P 500 Composite – price index - EURO STOXX 50 – price index - Gold Bullion LBM U$/Troy Ounce	monthly	Datastream

the month vis-à-vis the USD contributes positively to USD-denominated returns. This is because the decision to convert local currency bond holdings into USD is taken at the beginning of the month by the portfolio manager. Compared with the currency move, the other variables have less explanatory power for the common factor in eurobond returns. The beta-coefficients of the economic variables all have the right sign with the exception of INF_t and $DEBT_t$. Inflation and debt-to-GDP on all variants have a remarkably weak relation with the common factor. This may be because eurobond markets are forward looking and not so much interested in realised, i.e. ex post, inflation and debt levels as indicators that risks are building or subsiding.

Ex ante indicators for economic growth, such IIP_t, EEC_t and UMP_t , perform better and are statistically significantly different from zero (at the 95% confidence level). GDP_t and GAP_t are weaker in their explanation for the common factor than IIP_t and CLI_t. As regards the investor risk-preference variables, the beta-coefficients have the expected sign for $STIR_t$, LTY_t, and YSP_t. Best explanatory power is not with the steepness of the yield curve, as one would perhaps expect a priori, but with the rate of change in the level of long-term US Treasury yields. The rate of change in the US Dow Jones stock index is the best among the risk variables. The sign of its beta-coefficient does not necessarily have to be negative if the substitution effect between bonds and stocks dominates.

In the second instance, the variables identified with the largest individual explanatory power on the common factor are combined into multi-variable regressions. To determine which explanatory can safely be added into the model without causing a problem of multicollinearity, direct regressions with a constant term of one explanatory variable on another are performed. Table 4.11 lists the r-squared of these regressions. Fortunately none of the explanatory variables are much correlated with CUR_t, the variable with the highest explanatory power for CFE_t. None of the correlations are alarmingly high. The highest values for the r-squared are among the group of actual and potential economic growth indicators (GDP_t, CLI_t and IIP_t), which is not surprising. It is preferable to include just one of these in the multi-variable model. It is also preferable not to include both EEC_t and CLI_t or both DEF_t and UMP_t in the same regression, which seem somewhat interchangeable.

Table 4.12 shows the results of the multi-variable regressions to explain the common factor in eurobond returns, CFE_t. This table only shows the results for the tree of explanatory variables that provide the overall best fit. I refer to Table D1 in *Appendix D* for other tried models, which provide a lower quality fit but feature in the discussion below.

In combination with the currency move, IIP_t is selected from among the four economic growth variables, as it has the highest explanatory power. The estimated coefficient of IIP_t drops from -0.67 as a single-variable to –0.27 in a multi-variable regression with CUR_t but remains significantly different from zero while CUR_t moves closer to one. Adding the public sector deficit variable improves the overall fit of

Table 4.10

Single-variable regressions to explain common factor in eurobonds

The table shows the results of single-variable OLS regressions of the type $CFE_t = \alpha_t + \beta_t VAR_t + \varepsilon_t$ where VAR_t is filled in with different explanatory variables. The table only shows the results for those explanatory variables for each that provide the overall best fit.

VAR_t	Variant with best fit		Estimated coefficients (95% confidence intervals)			Standard error / p-value	R^2
CUR_t	*m/m*	α:	(*0.0055*)	0.0069	(*0.0083*)	0.00010489	0.8741
		β:	(*0.9718*)	1.0245	(*1.0771*)	0	
GDP_t	*percentage change per month (q/q)*	α:	(0.0028)	0.0097	(0.0166)	0000.82846	0.0053
		β:	(-4.8360)	-1.6895	(1.4571)	0.2911	
IIP_t	Original series unadjusted: *m/av(q)*	α:	(*0.0049*)	0.0090	(*0.0131*)	0.00079356	0.0472
		β:	(*-1.0803*)	-0.6716	(*-0.2629*)	0.0014	
CLI_t	Amplitude adjusted: *m/av(q)*	α:	(*0.0028*)	0.0066	(*0.0105*)	0.00082093	0.0143
		β:	(*-1.7455*)	-0.8217	(*0.1021*)	0.0810	
GAP_t	*percentage for the whole year, repeated each month of that year*	α:	(0.0026)	0.0065	(0.0104)	0.00083026	0.0031
		β:	(-0.5266)	-0.1535	(0.2195)	0.4182	
INF_t	*q/q*	α:	(*-0.0014*)	0.0050	(*0.0114*)	0.00083134	0.0018
		β:	(*-0.5544*)	0.2535	(*1.0613*)	0.5369	
UMP_t	*q/q*	α:	(*0.0028*)	0.0067	(*0.0105*)	0.00081250	0.0244
		β:	(*0.0306*)	0.2119	(*0.3932*)	0.0222	
MON_t	M3 *m/av(q)*	α:	(*0.0040*)	0.0121	(*0.0203*)	0.00082392	0.0107
		β:	(*-0.7304*)	-0.3173	(*0.0957*)	0.1314	
$DEBT_t$	*percentage change per month (y/y)*	α:	(*0.0020*)	0.0059	(*0.0099*)	0.0008871	0.0170
		β:	(*-0.0304*)	0.9953	(*2.0209*)	0.0571	
DEF_t	*percentage for the whole year, repeated each month of that year*	α:	(*-0.0045*)	0.0019	(*0.0083*)	0.00082033	0.0150
		β:	(*-0.3036*)	-0.1448	(*0.0140*)	0.0736	
EEC_t	*percentage change per month (q/q)*	α:	(0.0027)	0.0065	(0.0103)	0.00079452	0.0460
		β:	(-0.2922)	-0.1808	(-0.0693)	0.0016	
$STIR_t$	Fed funds target rate: *q/q*	α:	(*0.0027*)	0.0065	(*0.0104*)	0.00082305	0.0117
		β:	(*-0.0510*)	-0.0227	(*0.0055*)	0.1139	
LTY_t	10-year US Treasury yield: *q/q*	α:	(*0.0021*)	0.0059	(*0.0098*)	0.00080429	0.0343
		β:	(*-0.1317*)	-0.0766	(*-0.0216*)	0.0066	
YSP_t	2-10 year German Bund spread: *q/q*	α:	(*0.0024*)	0.0063	(*0.0102*)	0.00082519	0.0092
		β:	(*-0.0012*)	-0.0005	(*0.0002*)	0.1626	
$RISK_t$	DJ US Total Stocks: *m/m*	α:	(*0.0020*)	0.0059	(*0.0098*)	0.00081923	0.0163
		β:	(*-0.0048*)	0.0946	(*0.1940*)	0.0619	

m/m is from one month-end to the next; q/q is from one month-end to the same month-end in the previous quarter; m/av(q) is from one month-end to the average of the previous quarter.

Table 4.11
Multicollinearity between explanatory variables for the common factor in eurobonds

The table lists the r-squared from direct regressions with a constant term of variables listed down the column individually on the variable along the row. The combination of variables with the highest r-squared is marked in bold.

	CUR	*GDP*	*IIP*	*CLI*	*UMP*	*MON*	*DEF*	*EEC*	*STIR*	*LTY*
GDP	0.00099									
IIP	0.0199	**0.4030**								
CLI	0.0041	**0.2950**	**0.3186**							
UMP	0.0072	0.2169	0.1258	0.0073						
MON	0.0093	0.0130	0.00023	0.0312	0.0106					
DEF	0.00049	0.1162	0.0385	0.0048	**0.3859**	0.0202				
EEC	0.0205	0.1815	0.1353	**0.3741**	0.00088	0.0278	0.00042			
STIR	0.0051	0.0792	0.1252	0.0804	0.0974	0.00008	0.0085	0.1023		
LTY	0.0159	0.0529	0.0710	0.1761	0.0150	0.0092	0.0062	0.1983	0.0851	
RISK	0.0265	0.0038	0.00065	0.0429	0.00028	0.0153	0.0059	0.00073	0.00042	0.00005

the model with an estimated coefficient for DEF_t that has the right sign and is statistically different from zero while the explanatory power of CUR_t and IIP_t remain as before. Trials reveal that UMP_t also improves the model with a beta-coefficient of the correct sign and statistically different from zero. However, compared to DEF_t, UMP_t takes away more from the explanatory power of IIP_t (since IIP_t and UMP_t are more closely related variables than IIP_t and DEF_t) and has less explanatory power. Hence the inclusion of DEF_t over UMP_t in the model in combination with IIP_t is preferred. The variable for the long-term bond yield, LTY_t, can be added to the model with its beta-coefficient showing the right sign and being statistically significantly different from zero, but its explanatory power is low. No other variable is capable of further enhancing the model.

Table 4.12
Multi-variable regressions to explain common factor in eurobonds

The table shows the results of OLS regressions of the type $CFE_t = \alpha_t + \beta_t\, VAR^1_t + \gamma_t\, VAR^2_t + \delta_t\, VAR^3_t + \lambda_t\, VAR^4_t + \varepsilon_t$. The table only shows the results for the multi-variable model that provides the overall best fit.

VAR^1_t	VAR^2_t	VAR^3_t	VAR^4_t		Estimated coefficients (95% confidence intervals)			Standard error	p-value	F-statistic / R^2
CUR_t				α:	(0.0064)	0.0079	(0.0093)			
	IIP_t			β:	(0.9593)	1.0110	(1.0627)	0.000099172	0	784.677
				γ:	(-0.4151)	-0.2692	(-0.1232)			0.8815
CUR_t				α:	(0.0020)	0.0043	(0.0066)			
	IIP_t			β:	(0.9614)	1.0116	(1.0617)			560.7387
		DEF_t		γ:	(-0.3595)	-0.2152	(-0.0709)	0.000093309	0	0.8890
				δ:	(-0.1592)	-0.1046	(-0.0500)			
CUR_t				α:	(0.0017)	0.0040	(0.0064)			
	IIP_t			β:	(0.9569)	1.0069	(1.0569)			427.3894
		DEF_t		γ:	(-0.3268)	-0.1790	(-0.0312)	0.000092028	0	0.8911
			LTY_t	δ:	(-0.1573)	-0.1030	(-0.0488)			
				λ:	(-0.0389)	-0.0195	(-0.0001)			

Thus, from among the pre-selected variables, the best model to explain the common factor in eurobond returns over the full sample period is the following (standard errors of the estimated coefficients in brackets underneath):

$$\underset{}{CFE_t} = \underset{(0.0012)}{0.004} + \underset{(0.0254)}{1.0069} * CUR_t - \underset{(0.0750)}{0.1790} * IIP_t - \underset{(0.0275)}{0.1030} * DEF_t - \underset{(0.0098)}{0.0195} * LTY_t + e_t$$

In sum, the common factor in eurobond returns is high, especially at the start of the sample period (May 1990) to the first half of 1993. I find that the common factor is largely explained by the immediate conversion of returns into USD and otherwise by changes in the economic outlook as indicated by industrial production and deficits. The change in the long-term US Treasury yield, as a measure of adverse risk preference of bond investors, also has some bearing on the common factor, albeit small.

5.4. Competitive currency moves and country effects

Beyond the immediate currency conversion effect, which is evidently captured by the common factor in the standard decomposition model, do local currency moves to the US Dollar have any further role to play in the explanation of country effects? This would be the case if through a more than average devaluation of a national currency to the US Dollar compared to that of the market as a whole, business entities presiding in that country benefit from a competitive advantage that then transpires into better returns on their eurobonds. In order to determine this, the currency component of each country is calculated as the change of its local currency to the US Dollar over and above that of the weighted-average change of all local currencies that make up the whole market (see Eq. (7), in Section 4.1). The supranationals and non-EU entities are omitted from the analysis as no one national currency can be assigned to them. The currency component thus established for each real country is then regressed on the pure country effects of that country from its country return index after decomposition. If the slope of this regression is one (or minus one), then the currency component and the country effect are fully correlated.

The scatter plots of the currency component and country effects are displayed in Figure 4.2 for all countries. An upward sloping relation between the currency component and the country effect in their eurobond returns is clearly visible for all. The strength of this relation is formally established through OLS regressions of the country effects on the currency component, the results of which are given in Table 4.13.

Without exception, the estimated coefficients for the constant are very close to zero and, more importantly, are positive for the slope which is intuitively correct. The latter means that when a country's exchange rate depreciates more to the US Dollar than the weighted-average exchange rates of the whole

Figure 4.2

Scatter plot of the value-weighted currency components vs. pure country effects

The graphs show, for each country, the scatter plot of the currency effect on the x-axis and the country effects on the y-axis for the entire sample period. Both need to be multiplied by one hundred to be able to interpret it as percent per month. Because both axis are forced within set limits, it is possible that more outliers exist that are not visible.

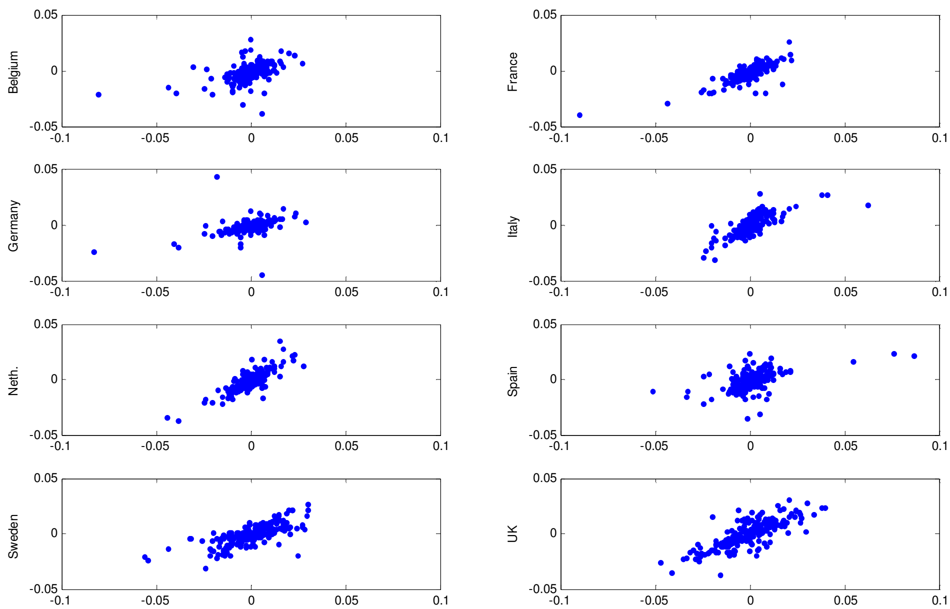


Table 4.13

Country effects and excess exchange rate returns

The table summarizes the statistics of the regressions of pure country effects from the value-weighted (VW) country indexes on the currency component. Estimated coefficients are given for the constant and the slope with 95% confidence intervals on either side in brackets. Statistics for the equal-weighted (EW) country indexes are in Table B4.13 in Appendix B.

	Estimated constant	Estimated slope	p-value	R^2
Belgium	-0.0004 *(-0.0013) (0.0005)*	0.3754 *(0.2847) (0.4662)*	0.00000	0.2389
France	-0.0008 *(-0.0014) (-0.0002)*	0.5792 *(0.5191) (0.6394)*	0.00000	0.6294
Germany	-0.0003 *(-0.0013) (0.0007)*	0.3348 *(0.2401) (0.4296)*	0.00000	0.1863
Italy	-0.0010 *(-0.0032) (0.0013)*	0.4924 *(0.2471) (0.7377)*	0.00010	0.0688
Netherlands	-0.0004 *(-0.0012) (0.0004)*	0.8380 *(0.7634) (0.9126)*	0.00000	0.6983
Spain	0.0004 *(-0.0018) (0.0026)*	0.3707 *(0.1891) (0.5523)*	0.00008	0.0710
Sweden	-0.0005 *(-0.0013) (0.0004)*	0.4206 *(0.3675) (0.4736)*	0.00000	0.5352
UK	0.0017 *(0.0001) (0.0032)*	0.7381 *(0.6361) (0.8400)*	0.00000	0.4900

market combined, resulting in a positive currency component, this has a positive influence on its country effect. In other words, businesses based in a country whose currency depreciates more benefit and eurobond holders are rewarded in the form of better returns on their investment. The slope coefficient is the greatest for the Netherlands and the UK, but even in the lowest case (Germany) the slope's steepness is still remarkable. All slope coefficients are statistically different from zero at the 5% confidence level, though none are statistically different from one either at this confidence level. The fit of the regressions is generally good, as can be seen from the 95% confidence intervals around the estimated coefficients and the very low p-values. The model fit is very good in the case of the Netherlands and France, good in the case of Sweden and the UK, reasonably good for Belgium and Germany but not so good for Italy and Spain.

In sum, currency effects, beyond the mere conversion effect of eurobond portfolio holdings, do play a significant role in explaining the prominence of country effects from the decomposition of eurobond returns in Europe. Though no one-for-one relation between the currency component and the country effectcan be established, it is statistically different from zero with the expected sign showing in all countries. The relation is stronger in case of some countries (e.g. the Netherlands) than others (e.g. Italy).

5.5. Searching for an EMU effect

So far I have subjected eurobond returns over the entire sample period of May 1990 to March 2008 to a decomposition into country and industry effects and have come to two major conclusions. One, that country effects outweigh industry effects for eurobond returns from a predominantly European market; and two, that currency effects play a significant role in eurobond returns, in the common factor and in country effects. Since it is established in Chapter 3 that EMU brings about a remarkable and irreversible change to the constitution of European bond markets, this section investigates how these conclusions hold up if the sample period is partitioned at exactly the time of the introduction of the Euro. Will country effects still dominate in eurobonds returns as much post-EMU? Are the currency effects for the Euro-bloc as significant as for the national currencies before they enter into EMU?

To answer these questions, two time vectors of almost equal length are created: May 1990 to December 1998 (103 months) and January 1999 to March 2008 (111 months). It first ought to be established that there is indeed a statistically significant difference in the correlation and covariance structure of the decomposed country and industry index returns from the pre-EMU to the post-EMU period. So again the Jennrich test is performed to test this formally. Table 4.14 describes the result of the Jennrich tests of statistical equality of the correlation and covariance structure of country and industry (decomposed) index returns in both subperiods. The values of the correlation and covariance matrixes itself are not published but can be provided upon request.

Table 4.14
Jennrich tests of stability of correlation and covariance return matrixes from two subperiods around EMU: 5/1990 – 12/1998 and 1/1999 – 3/2008

The table summarizes the results for the Jennrich χ^2 test statistic from the value-weighted (VW) correlations and covariations of the country and industry indexes returns resulting from decomposition and obtained over each subperiod. The results for the equal-weighted (EW) indexes are in Table B4.14 in Appendix B.

	Country indexes		Industry indexes	
	correlation matrixes	covariance matrixes	correlation matrixes	covariance matrixes
Jennrich χ^2 test statistic	364.48	580.19	157.41	367.01
Degrees of freedom	45	55	21	28
Critical value (95% conf.)	61.66	73.31	32.67	41.34
p-value	0	0	0	0

The test of stability is rejected in all four cases, indicating that the correlations and covariances of country and industry returns after decomposition are statistically different from the first subperiod to the next. In other words, both the correlation and covariance structure of country and industry returns are different before and after EMU. Having established this, the decomposition of eurobond returns into country and industry effects in both periods is performed next.

Table 4.15 presents the variances and ratios in excess of the market of the pure country and industry effects and the sum of the country and industry effects in the decomposed indexes for the pre-EMU and the post-EMU periods. They can be directly compared with those in Table 4.4 in Section 5.2, which are for the whole sample period. There are two main results observable from Table 4.15. On the one hand, the average variance of country effects remains similar and even slightly increases pre to post-EMU. On the other hand, the average variance of industry effects, which is already lower than that of the country effects before EMU, falls away significantly after EMU. The two main results combined lead to a noticeable relative change in importance between country and industry effects pre to post-EMU. While country effects dominate industry effects before EMU, by a factor of nearly two (=1.24/0.63), they do so even more after EMU, by a factor of precisely eight (=1.28/0.16).

Though the importance of country factors in eurobond returns remains as before, this general observation hides a more diverse picture. On the one hand, the core-EMU countries' indexes have the variance of their pure country effects very much reduced, from 1.18 to a mere 0.26, which is low. This indicates that eurobond exposures to Germany, France and BENELUX countries are almost perfect substitutes under EMU, at least up until March 2008. On the other hand, the peripheral-EMU members' country indexes have the variance of their pure country effects very much increased, from an already higher base of 1.00 to 4.67 on average between them.

Table 4.15
Decomposition of excess index returns, pre and post-EMU

The table gives the variance of the components of the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market for May 1990-Dec 2000 and Jan 1999 – Mar 2008. The ratio is the variance ratio to the index in excess of the market. The results for the equal-weighted (EW) indexes are in Table B4.15 in Appendix B.

A. Country Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.94	0.590	0.16	0.010	0.32	0.976	0.06	0.200
FR	0.83	0.560	0.19	0.130	0.24	1.055	0.04	0.156
GE	1.20	0.653	0.14	0.077	0.11	0.743	0.03	0.201
IT	0.95	1.397	0.10	0.155	4.85	1.094	0.05	0.010
NE	1.78	0.590	0.52	0.172	0.40	0.974	0.02	0.058
SP	1.05	0.982	0.11	0.101	4.49	1.018	0.04	0.009
SW	0.49	1.289	0.10	0.254	1.20	1.171	0.03	0.029
UK	4.19	1.119	0.26	0.070	1.02	0.908	0.03	0.029
SN	0.27	1.946	0.11	0.752	0.13	0.262	0.24	0.475
OT	0.65	1.053	0.14	0.224	0.07	1.114	0.03	0.435
Average	1.24	1.018	0.18	0.203	1.28	0.932	0.06	0.160

B. Industry Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.74	0.398	0.60	0.321	0.02	0.415	0.05	0.838
GI	0.11	1.145	0.21	2.315	0.24	0.725	0.07	0.209
CO	0.78	1.237	0.62	0.984	0.08	0.438	0.14	0.819
CT	0.39	0.542	0.45	0.627	0.28	0.725	0.06	0.144
BE	0.63	1.073	0.83	1.409	0.06	0.592	0.04	0.377
IN	0.53	1.062	0.41	0.818	0.15	0.877	0.03	0.203
UT	1.21	0.724	1.13	0.675	0.32	0.766	0.10	0.233
Average	0.63	0.883	0.61	1.021	0.16	0.648	0.07	0.403

The result of the continuing importance of country effects in European eurobond returns, and above all of their divergence within the Euro zone between the core and the periphery is striking. It grinds against the a priori expectation of diminishing country effects following EMU.

Moreover, these results show that from the perspective of eurobond investors that insofar there has been financial and economic convergence, it is only within the set of core member countries. There is national-economic divergence between the core and the periphery under EMU. This result is the opposite of one of the main prior objectives and expectations of EMU, not in the least of the founders of the economic and monetary union. They considered economic convergence as both a precondition for and a consequence of monetary integration and unification.[2] It also contradicts the convergence expectation implicit in “One Market, One Money” a report commissioned by the European Commission in 1990 into the economic benefits and costs of EMU. This convergence expectation is based on the macroeconomic stability effects EMU is anticipated to have by the various economists contributing to the report on prices, output and other variables and from the monetary and fiscal policy discipline EMU is expected to encourage. In so far as can be discerned from the prevailing importance of country effects and disparages within the Euro bloc post-1999, the reality of EMU has turned out differently.

There is no real pattern for the EMU-outs, for the variance of the pure country effects, for Sweden goes up and for the UK goes down significantly after EMU. The sample partitioning now reveals that the high variance of the UK’s pure country effect can be attributed to eurobond price behaviour in the years before EMU.

As regards the industry indexes, it can be seen that the variance of pure industry effects are, with the exception of the government institutions sector, significantly higher pre-EMU than post-EMU. Sectors that previously had an above-average variance of their pure industry effects, such as communication and technology and utilities, still do in the second period. For other previously above-average industry effect variances this is clearly not the case. Particularly the drop in the variance of the pure industry effects for the financial and funds, consumer sector and basic materials and energy is remarkable.

The result of fading industry effects in eurobond returns post-EMU also stands out. This is in contradiction with the ex ante prediction from prevailing economic theory on the subject at the time. While the scenario that monetary integration leads to industry dispersion is favoured on balance in “One Market, One Money”, this view is not that of the mainstream of international trade theories that rather tends to follow the Krugman school and predict one corollary: industry specialisation. These economists predict a concentration of industries driven precisely by local scale economies and partially reduced spatial transaction costs under EMU (see Krugman 1989, 1991, 1993; and Krugman and Venables, 1990). However, the diminishing importance of industry effects that results from eurobond returns strongly suggests that rather than countries specializing in certain industries under EMU, intra-industry dispersion is what seems to have taken place across the single currency region.

Given that the currency component effect, i.e. the effect from a larger than market average local currency move to the US Dollar on eurobond returns via companies’ relative competitiveness, is significant

[2] The Delors Report of 1989 puts as much emphasis on the economic integration as on the monetary unification of European countries in the process leading up to and ultimately achieved through EMU. While the Delors Committee takes the view that “the completion of the single market [through the establishment of EMU, MPB] will link national economies much closer together and significantly *increase the degree of economic integration*” (article 10), it also calls for a need of greater economic policy coordination in the meantime. The Maastricht Treaty of 1992 states that “the Community shall have as its task, by establishing a common market and an economic and monetary union and by implementing the common policies […], to promote throughout the Community […] a high degree of convergence of economic performance” (article 2).

in explaining the pure country effects over the entire sample period, and the above finding of the prevailing dominance of country effects in eurobond returns after EMU, the importance of currency components in the explanation of the country effects is again analyzed both before and after EMU. Does the entry of the national currency of a number of countries in our sample to the Euro make any difference to the earlier detected importance of the currency components on country effects?

Table 4.16 summarizes the results of regressions of the pure country effects on the currency components for each period around the introduction of the Euro. The scatter plots of currency components and country effects for each subperiod are in Figure B1 in *Appendix B*. The results in Table 4.16 can be directly compared with those in Table 4.13 in Section 5.4, which are for the whole sample period. From Table 4.16 it can be seen that the model fit is quite good in both periods. Estimated coefficients for the constant factor are all close to zero and all estimated slope coefficient, with the exception of Italy post-EMU, positive and significantly different from zero. There are, however, some important differences discernible among the various countries in the transition from the pre-EMU to the post-EMU era. Again, the divide between core, peripheral, and non-EMU countries is helpful in detecting certain patterns.

For all core-EMU countries the slope coefficient and the r-squared of the regression increase significantly from the pre to the post-EMU period. For the Netherlands, the slope is no longer statistically significantly different from one under EMU, which indicates that its pure country effect is fully correlated with its currency effect. For the other core-EMU members, their currency effects explain an even greater amount of their pure country effects of which it is also known to have a lower variance post-EMU. Of the peripheral-EMU member states, for whom it is known that the variance of their pure country effects increases after EMU, the correlation for Spain's country effect and currency effect is also statistically equal to one, but the model fit is not all that great. For Italy, any relationship that is there between its pure country effect and currency component prior to the Euro, breaks down under EMU. Italy post-EMU is the only case where there is virtually no relation between its currency and its country effect. In other words, only for Italy among all EMU members, its currency now tied to the Euro-bloc does not play a role in explaining the prominence of its country effects.

For the non-EMU members, the correlation between their currency and country effects of each converges post-EMU. Whereas for Sweden the currency effect explained only a quarter of its country effect prior to EMU, it rises to nearly 80% after EMU. For the UK, the strength of the currency effect in the country effect drops, but is still 66% under EMU. The model fit for both EMU-outsiders improves significantly post-EMU, possibly reflecting greater alignment of their currencies with the Euro vis-a-vis the US Dollar.

Table 4.16

Country effects and excess exchange rate returns, pre and post-EMU

The table summarizes the statistics of the regressions of pure country effects from the value-weighted (VW) country indexes on the currency component of the respective country for two subperiods, May 1990 – Dec 1998 and Jan 1999 – Mar 2008. Estimated coefficients are given for the constant and the slope with 95% confidence intervals on either side of the coefficients in brackets underneath The regression statistics for the equal-weighted (EW) country indexes for both subperiods are in Table B4.16 in Appendix B.

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Estimated constant	Estimated slope	p-value	R^2	Estimated constant	Estimated slope	p-value	R^2
Belgium	-0.0007	0.3155			-0.0002	0.6701		
	(-0.0024) (0.0011)	*(0.1876) (0.4435)*	0.00000	0.1915	*(-0.0010) (0.0006)*	*(0.5361) (0.8041)*	0.00000	0.4741
France	-0.0016	0.5670			-0.0000	0.6066		
	(-0.0026) (-0.0005)	*(0.4881) (0.6458)*	0.00000	0.6682	*(-0.0007) (0.0006)*	*(0.4940) (0.7192)*	0.00000	0.5113
Germany	-0.0007	0.3158			0.0000	0.4180		
	(-0.0024) (0.0013)	*(0.1685) (0.4631)*	0.00047	0.1518	*(-0.0004) (0.0005)*	*(0.3460) (0.4899)*	0.00000	0.5485
Italy	0.0003	0.6358			-0.0025	-0.1335		
	(-0.0009) (0.0016)	*(0.5324) (0.7392)*	0.00000	0.5955	*(-0.0066) (0.0017)*	*(-0.8575) (0.5904)*	0.7154	0.0012
Neth.	-0.0008	0.8138			-0.0000	0.9479		
	(-0.0023) (0.0007)	*(0.7055) (0.9220)*	0.00000	0.6878	*(-0.0006) (0.0006)*	*(0.8434) (1.0524)*	0.00000	0.7478
Spain	-0.0006	0.2878			0.0016	1.0468		
	(-0.0024) (0.0012)	*(0.1778) (0.3978)*	0.00000	0.2106	*(-0.0023) (0.0054)*	*(0.3790) (1.7145)*	0.0024	0.0814
Sweden	-0.0001	0.2558			-0.0005	0.7868		
	(-0.0011) (0.0009)	*(0.2048) (0.3067)*	0.00000	0.4956	*(-0.0014) (0.0005)*	*(0.7123) (0.8613)*	0.0024	0.8007
UK	0.0035	0.8091			0.0001	0.6614		
	(0.0005) (0.0066)	*(0.6234) (0.9949)*	0.00000	0.4251	*(-0.0007) (0.0010)*	*(0.5999) (0.7229)*	0.0024	0.8064

In sum, these are exceptional and important results from partitioning the full sample period at the start of 1999, the date of the introduction of the Euro. The correlation and covariance structure of decomposed country and industry index returns are statistically different, justifying the separate analysis and comparison of each subperiod. The variance of all industry effects significantly reduces in the post-EMU period, while the variance of country effects remains on average as big in explaining eurobond returns. The difference in the evolution of the importance of country effects between core-EMU countries and peripheral-EMU countries is striking though. Results indicate that core-members are virtually complete substitutes with respect to their country effects following EMU, which is what one would expect, but have strongly diverged with southerly EMU countries in this respect whose country effects rise significantly. The divergence within the monetary union is contrary to ex ante expectations. Post-EMU, the currency component is an even stronger factor in the explanation of the country effects of core-EMU countries, but this relation breaks down for the peripheral-EMU countries and especially for Italy. The competitive effects of the behaviour of the Euro, to which their currency is now tied, vis-à-vis the USD for these latter countries does not play a role in explaining the greater prominence of their country effects in eurobond returns. The much reduced importance of industry effects in eurobond returns post-EMU is also remarkable. It implies that intra-industry dispersion is taking place rather than industry specialisation of countries. This is again contrary to ex ante predictions of EMU, from the Krugman school of economists that dominated this debate at the time.

6. Empirical results from the extended model

In this section, the basic decomposition model is extended with the inclusion of liquidity and maturity effects. For this purpose, each eurobond is assigned to one of four liquidity brackets (< $500 mn, $500 mn - $1 bn, $1bn - $3bn, > $3 bn) and one of four maturity brackets (< 3 yrs, 3 -5 yrs, 5-10 yrs, >10 yrs). Note that while the liquidity of a eurobond is based on its issue size and remains in the same liquidity bracket throughout its life, the maturity is in fact the life-to-maturity of the eurobond and varies over the sample period. Country and industry classifications remain as before.

6.1. Summary statistics

Table 4.17 gives the distribution of the sample of 6,440 eurobonds by liquidity and maturity and is complementary to Table 4.2 in Section 5.1. From Table 4.17 it can be seen that the liquidity composition of the sample is heavily skewed towards eurobonds with issue sizes less than $500 million (71% of the total number). However, because smaller eurobonds not only weigh less but also tend to have fewer price

Table 4.17
Liquidity and maturity composition

Panels A and B give for each liquidity and maturity bracket the number of eurobonds included in the total sample and that number as a percentage of the total number of eurobonds. Panel C gives for each country by liquidity and industry by liquidity the number of eurobonds included in the total sample. Panel D gives the average weight of the (live) eurobonds in the country-by-liquidity cross-sector in the total value-weighted market over the whole sample. Panels E and F the same for country by maturity and industry by maturity.

A. By liquidity (number and percent of total)				B. By maturity (number and percent of total)			
≤ $500 mn:	L1	4,561	70.9%	≤ 3 years:	M1	2,573	40.0%
$500 mn - ≤ $1 bn:	L2	1,157	18.0%	3 years - ≤ 5 years:	M2	1,830	28.4%
$1 bn - ≤ $3 bn:	L3	600	9.3%	5 years - ≤ 10 years:	M3	1,243	19.3%
> $3 bn:	L4	113	1.8%	> 10 years:	M4	794	12.3%
Total		6,440		Total		6,440	

C. Number of eurobonds by liquidity and country, and liquidity and industry

	Liquidity by country										Liquidity by industry						
	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT	FF	GI	CO	CT	BE	IN	UT
L1	161	428	1055	75	582	28	342	627	343	920	2737	905	328	124	120	153	194
L2	23	208	129	56	76	41	39	206	45	334	589	112	131	93	58	77	97
L3	8	78	110	38	57	22	33	64	29	161	327	70	56	56	30	28	33
L4	0	3	17	32	4	3	31	3	15	5	56	52	2	2	0	0	1

D. Average weights of eurobonds by liquidity and country, and liquidity and industry

	Liquidity by country										Liquidity by industry						
	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT	FF	GI	CO	CT	BE	IN	UT
L1	0.3	3.1	4.4	0.5	3.9	0.2	1.0	8.7	4.4	7.2	17.1	8.6	2.9	1.2	1.1	0.1	1.2
L2	0.3	3.6	2.5	0.9	1.8	0.6	0.4	4.3	2.2	4.0	8.9	4.8	1.7	1.2	0.1	0.1	1.2
L3	0.4	2.4	5.2	1.2	1.4	0.7	1.7	1.7	3.1	2.5	8.3	7.6	0.7	1.6	0.0	0.1	0.8
L4	0	1.2	1.8	12.9	0.1	1.2	3.8	0.2	3.3	0.2	5.2	19.1	0.0	0.3	0	0	0.1

E. Number of eurobonds by maturity and country, and maturity and industry

	Maturity by country										Maturity by industry						
	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT	FF	GI	CO	CT	BE	IN	UT
M1	135	293	725	71	267	15	247	167	194	459	1630	528	160	36	52	56	57
M2	29	169	333	41	297	24	128	235	157	417	1030	396	141	74	56	63	70
M3	21	176	187	55	127	42	58	185	43	349	636	93	149	122	73	88	82
M4	7	82	68	36	29	13	12	313	38	196	420	69	67	44	27	51	116

F. Average weights of eurobonds by maturity and country, and maturity and industry

	Maturity by country										Maturity by industry						
	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT	FF	GI	CO	CT	BE	IN	UT
M1	0.3	2.1	3.5	9.1	1.1	0.9	2.9	1.5	2.1	3.0	8.9	15.3	0.7	0.2	0.3	0.6	0.5
M2	3.7	4.5	5.3	5.0	4.0	1.0	3.7	5.6	6.6	5.9	16.4	18.5	2.1	1.6	0.7	1.1	1.6
M3	3.0	2.3	3.0	0.7	1.6	0.8	0.3	2.9	2.1	3.3	7.8	3.4	1.7	1.7	0.8	0.7	1.1
M4	0.1	1.3	2.3	0.1	0.5	0.1	0.1	4.9	2.1	1.9	6.6	2.9	0.8	0.6	0.4	1.1	1.7

observations, this is largely evened out in the value-weighted calculations. The average total weight of the four liquidity brackets in the value-weighted indexes are 34%, 21%, 20% and 25% respectively.

Life-to-maturity is more evenly distributed by number of eurobonds than liquidity. Still, eurobonds of less than five years account for more than two-thirds of the total sample. The majority of short-term eurobonds originate from the financial sector. This is not surprising as banks and financial institutions have a disproportionate need for such funding by the nature of their business. Because eurobonds with a remaining life of less than three years from the financial sector also are for the majority the smallest size issues, the average weight shifts between maturity brackets, such that the 3- to 5-year sector is now most dominant (42% average weight in total).

With the exception of the largest liquidity category in Italy, liquidity and maturity tend to be much more evenly spread over the countries than over the industry sectors.

6.2. Decomposition with liquidity and maturity effects

Next, the decomposition or eurobond returns over the entire sample is performed with these additional factors of liquidity and maturity included alongside country and industry. Excess country and industry return indexes are decomposed into four components: pure country or industry effects, sum of industry or country effects, sum of liquidity effects and the sum of maturity effects. It is theoretically feasible to create liquidity and maturity returns indexes and to decompose these in similar fashion. However, practice learns that bond portfolio investors hardly base their primary asset allocation decisions on liquidity or maturity alone and tend to use them only as secondary considerations. Hence, liquidity and maturity effects are merely incorporated as second order effects in country and industry indexes.

Table 4.18 gives the decomposition of the excess country and industry indexes into the four components and shows the variance and ratio of these components by country and by industry. Table 4.18 is complementary to Table 4.4 and results can be directly compared. The main conclusion is that the dominance of pure country effects in eurobond returns with the inclusion of liquidity and maturity effects remains. The pure country effects are naturally somewhat diminished with the inclusion of these additional effects, largely so in Italy and the UK. Their country portfolios are both skewed towards the largest liquidity segment and the longest maturity bonds respectively, which each have inherently larger variances. The sum of industry effects in the country indexes is virtually unchanged from before, but the sum of liquidity and of maturity effects are on average similar in size to the sum of industry effects. With respect to the industry indexes, the size and pattern of pure industry effects is broadly as before. Now, the sum of country effects in the industry indexes is much reduced, but still nearly three times as large as the sum of liquidity and of maturity effects each.

Table 4.18

Decomposition of excess index returns with liquidity and maturity effects (May 1990 – Mar 2008)

The table gives the variance of the four components of the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio to the index in excess of the market. The results for the equal-weighted (EW) indexes are in Table B4.18 in Appendix B.

A. Country indexes

	Pure country effects		Sum of industry effects		Sum of liquidity effects		Sum of maturity effects	
	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.30	0.313	0.10	0.106	0.13	0.135	0.14	0.146
FR	0.40	0.559	0.11	0.161	0.06	0.087	0.10	0.140
GE	0.51	0.742	0.08	0.119	0.08	0.115	0.12	0.179
IT	2.45	0.740	0.08	0.023	0.28	0.084	0.19	0.058
NE	0.89	0.700	0.30	0.240	0.11	0.088	0.12	0.094
SP	2.85	0.993	0.07	0.025	0.11	0.039	0.17	0.060
SW	0.94	0.974	0.07	0.071	0.11	0.117	0.13	0.130
UK	2.35	0.918	0.16	0.064	0.06	0.023	0.14	0.054
SN	0.28	0.369	0.15	0.200	0.07	0.088	0.10	0.130
OT	0.29	0.575	0.09	0.185	0.06	0.125	0.10	0.191
Average	1.13	0.688	0.12	0.119	0.11	0.090	0.13	0.118

B. Industry indexes

	Pure industry effects		Sum of country effects		Sum of liquidity effects		Sum of maturity effects	
	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.41	0.610	0.21	0.318	0.07	0.106	0.09	0.138
GI	0.15	0.369	0.10	0.241	0.10	0.255	0.10	0.249
CO	0.39	0.408	0.32	0.340	0.13	0.137	0.07	0.077
CT	0.40	0.502	0.16	0.196	0.07	0.082	0.06	0.075
BE	0.52	0.701	0.37	0.504	0.14	0.192	0.09	0.118
IN	0.30	0.570	0.14	0.256	0.11	0.213	0.20	0.372
UT	0.79	0.552	0.58	0.406	0.06	0.045	0.15	0.107
Average	0.42	0.530	0.27	0.323	0.10	0.147	0.11	0.162

Table 4.19

Variance of pure liquidity and maturity effects

The table gives the variance of the pure liquidity effects of the value-weighted (VW) excess liquidity index returns over the total market, in Panel A, and the variance of the pure maturity effects of the excess maturity index returns over the total market, in Panel B. The results for the equal-weighted (EW) indexes are in Table B4.19 in Appendix B.

A. Pure liquidity effects		B. Pure maturity effects	
L1	0.16	M1	0.43
L2	0.31	M2	0.19
L3	0.28	M3	0.36
L4	0.46	M4	1.95
Average	0.30	Average	0.73

The overall result is that country effects remain dominant in eurobond returns over the full sample period. While liquidity and maturity structure of the portfolio matter for the explanation of returns of the country and industry indexes and their effect takes away from the importance of country effects, it is overall not that huge.

As discussed, it is somewhat theoretical to compose liquidity and maturity indexes. This theoretical exercise is useful only to show the variance of pure liquidity and pure maturity effects that result from these indexes' returns for purposes of comparison. The determination of the pure effects of the four factors now incorporated into the extended decomposition model provides insight into their ranking of importance in explaining eurobond returns. Table 4.19 gives the variance of the pure liquidity effects resulting from the excess liquidity returns indexes and the variance of the pure maturity effects resulting from the excess maturity returns indexes. These can be compared with the variance of pure country effects and pure industry effects shown in Table 4.18. By and large, variances increases with liquidity and are J- shaped with respect to remaining maturity. So a eurobond portfolio tilted towards largest size issues and the extreme ends of the maturity spectrum with a strong emphasis on long maturities will have greater variance in its returns and more opportunities for risk reduction. The ranking of the strength of the various pure effects in terms of their average variance is country first, maturity second, industry third and liquidity fourth. This is similar to results from Varotto (2003) for a sample of eurobond returns from the pre-EMU years of 1993-1998. Varroto finds that country diversification is best for reducing portfolio credit risk, followed in turn by the diversification of maturity, rating, and only then by industry diversification (the effect of seniority is very small).

In sum, results from the decomposition model extended with liquidity and maturity factors are that the addition of these effects does little to mitigate the importance of country effects in eurobond returns. They do alter the position of industry effects in that maturity effects on average rank ahead in terms of importance. This is purely because eurobonds with a remaining life of more than 10-years have large variation in their returns. While the liquidity of eurobonds makes some difference on returns, their effect is not as big on average as industry sector. These results, which are over the whole sample period of 1990-2008, are in line with what Varotto (2003) finds for eurobond returns from 1993-1998.

6.3. EMU and the ranking of factors

The results from the extended model in the previous section are for the full sample period. It is worth analysing how they turn out in the roughly ten years before and after the creation of the Euro eurobond market to which so many of the eurobonds in the sample belong. Is there a change in the ranking order of importance of factors in explaining eurobond returns between the pre-EMU and the post-EMU eras?

As in Section 5.5, the sample period is partitioned in two: May 1990 to December 1998 and January 1999 to March 2008. The decomposition according to the extended model is separately performed over each subperiod. Results for the variances of the four effects in each period around EMU for the excess country and industry indexes are shown in Table 4.20 and can be compared with Table 4.18. Judging from the average variance of all effects, it can be seen that one of the main conclusions from the previous analysis remains valid; country effects are the dominant factor in explaining eurobond returns, both before and after EMU. The average variance of pure country effects remains roughly the same (1.14 versus 1.11). All other effects – pure and sum of industry effects, liquidity and maturity effects – decline significantly from the first period to the next.

The performance of the extended decomposition over the two subperiods reveals further interesting details. For example, that the Italian country index return pre-EMU contains a high liquidity effect. The country index return for Spain has a high maturity effect and for the Netherlands and the UK has a high industry effect in the same period. Post-EMU, the maturity effect in the Italian country index actually increases and is an outlier amongst otherwise declining maturity effects in country and industry indexes.

To determine the ranking of effects in eurobond returns pre and post-EMU, the variance of pure liquidity and maturity effects is computed for each subperiod. Table 4.21 lists the results of the variance for each liquidity and maturity bracket as well as their overall average. The comparison of the average variance with that of the pure country and industry effects for each period, listed in Table 4.20, shows that the overall ranking of effects – country first, maturity second, industry third and liquidity fourth - remains intact with the only difference that industry and liquidity effects are similar in importance on average post-EMU.

Tables 4.20 and 4.21 tell an interesting tale and that is of the ripening of European eurobond markets. This is concluded from the fact that maturity and especially liquidity characteristics play a much less significant role in the return variance post-EMU. The reduced maturity effect, which remains most pronounced for longer dated eurobonds, could off course be the result of structurally lower and flatter yield curves under EMU, but is more likely the result of higher frequency of issuance at these maturities. The reduced liquidity effect, which is the most significant of the two, can be attributed to the much larger issuance of eurobonds under the Euro, both in number and in size. Both features of the European bond market are discussed in Chapter 3.

In sum, the decomposition of the extended model with the four factors of country, industry, liquidity and maturity over the periods before and after EMU yields three important results. First, the variance of country effects remain the most important and equally important in explaining eurobond returns throughout. Secondly, not only do industry effects diminish greatly in significance from the

Table 4.20

Decomposition of excess index returns (pre and post-EMU)

The table gives the variance of the four components of the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio to the index in excess of the market. The results for the equal-weighted (EW) indexes are in Table B4.20 in Appendix B.

A. Country indexes

	May 1990 – Dec 1998								Jan 1999 – Mar 2008							
Effects:	Pure country		Sum of industry		Sum of liquidity		Sum of maturity		Pure country		Sum of industry		Sum of liquidity		Sum of maturity	
	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio
BL	0.42	0.261	0.15	0.093	0.20	0.125	0.24	0.149	0.18	0.565	0.07	0.226	0.07	0.210	0.19	0.599
FR	0.64	0.541	0.21	0.176	0.07	0.062	0.15	0.131	0.17	0.613	0.04	0.151	0.09	0.339	0.05	0.181
GE	1.02	0.829	0.15	0.118	0.12	0.099	0.21	0.167	0.04	0.227	0.05	0.289	0.08	0.413	0.08	0.413
IT	0.53	0.549	0.11	0.117	0.53	0.546	0.22	0.224	4.21	0.784	0.12	0.023	0.10	0.020	0.37	0.070
NE	1.56	0.675	0.61	0.264	0.20	0.086	0.22	0.095	0.26	0.844	0.02	0.053	0.04	0.131	0.06	0.207
SP	1.24	1.125	0.12	0.107	0.20	0.179	0.30	0.274	4.35	0.959	0.14	0.032	0.08	0.017	0.14	0.030
SW	0.83	0.878	0.11	0.117	0.13	0.117	0.20	0.207	1.05	1.057	0.09	0.087	0.04	0.041	0.12	0.122
UK	4.15	1.032	0.31	0.076	0.09	0.137	0.21	0.051	0.70	0.577	0.02	0.015	0.05	0.041	0.05	0.038
SN	0.46	0.785	0.12	0.195	0.08	0.022	0.13	0.217	0.10	0.113	0.18	0.201	0.03	0.029	0.04	0.050
OT	0.53	0.608	0.16	0.187	0.09	0.130	0.16	0.189	0.07	0.409	0.05	0.295	0.05	0.327	0.05	0.331
Average	1.14	0.728	0.20	0.145	0.17	0.149	0.20	0.170	1.11	0.615	0.08	0.137	0.06	0.157	0.12	0.204

B. Industry indexes

	May 1990 – Dec 1998								Jan 1999 – Mar 2008							
Effects:	Pure industry		Sum of country		Sum of liquidity		Sum of maturity		Pure industry		Sum of country		Sum of liquidity		Sum of maturity	
	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio
FF	0.83	0.659	0.41	0.325	0.11	0.090	0.15	0.117	0.02	0.160	0.07	0.515	0.04	0.308	0.05	0.370
GI	0.12	0.460	0.14	0.567	0.18	0.704	0.16	0.648	0.18	0.324	0.15	0.264	0.05	0.093	0.10	0.179
CO	0.73	0.442	0.57	0.344	0.23	0.141	0.12	0.076	0.07	0.234	0.10	0.309	0.06	0.209	0.04	0.122
CT	0.54	0.441	0.28	0.229	0.10	0.084	0.11	0.088	0.27	0.651	0.13	0.323	0.05	0.121	0.06	0.157
BE	1.01	0.768	0.74	0.563	0.25	0.190	0.13	0.100	0.04	0.212	0.11	0.531	0.07	0.338	0.04	0.188
IN	0.52	0.619	0.26	0.305	0.20	0.235	0.30	0.351	0.10	0.414	0.04	0.180	0.04	0.155	0.12	0.465
UT	1.35	0.574	1.14	0.485	0.10	0.043	0.22	0.095	0.26	0.436	1.10	0.175	0.06	0.098	0.08	0.137
Average	0.73	0.566	0.51	0.403	0.17	0.212	0.17	0.211	0.13	0.347	0.10	0.328	0.05	0.189	0.07	0.231

Table 4.21

Variance of pure liquidity and maturity effects (pre and post-EMU)

The table gives the variance of the pure liquidity effects of the value-weighted (VW) excess liquidity index returns over the total market, in Panel A, and the variance of the pure maturity effects of the excess maturity index returns over the total market , in Panel B. Result for the equal-weighted (EW) indexes are in Table B4.21 of Appendix B.

A. Pure liquidity effects			B. Pure maturity effects		
	5/1990 – 12/1998	1/1999 – 3/2008		5/1990 – 12/1998	1/ 1999 – 3/2008
L1	0.25	0.07	M1	0.33	0.52
L2	0.57	0.05	M2	0.23	0.15
L3	0.43	0.13	M3	0.65	0.09
L4	0.62	0.29	M4	2.96	1.00
Average	0.47	0.14	Average	1.04	0.44

pre-Euro era to the next, so do liquidity and maturity effects. Thirdly, the ranking of importance of effects for eurobond returns – country first, maturity second, industry third and liquidity fourth - remains intact. This much reduced maturity and especially liquidity effects for returns is signifying for the maturing eurobond market under EMU.

7. Conclusions

This chapter empirically studies the factor decomposition in European eurobond markets and the impact of the formation of EMU on the relative importance of effects in their return variation. It does so in the approach first established by Heston and Rouwenhorst (1994) and followed by many for equities but rarely for bonds.

For the purpose of this empirical analysis, I collect a database of 6,440 eurobond prices from Bloomberg and Morgan Stanley. These eurobond price series are denominated in local currencies. Holding period returns for individual corporate eurobonds are calculated for each month from the end-of-month prices with the incorporation of the accrued interest. The local currency holding period returns are subsequently converted into USD using spot exchange rates from Datastream. The resulting 6,440 eurobond USD monthly return series cover the period May 1990 to March 2008, though starting and ending at different times within that period. By virtue of the geographical base and corporate activity of the ultimate guarantor of the issuing entity, obtained from the same source, each eurobond is allocated to one of ten countries (Belgium/Luxembourg, France, Germany, Netherlands, Italy, Spain, Sweden, the UK, supranationals and other) and one of seven industry groups (financials and funds, government institutions, consumer, communications and technology, basic materials and energy, industrials and utilities). This is the base for the standard decomposition analysis, which aims to determine the importance of country and industry effects in returns. The issuer information otherwise contained within the data set allows for the allocation of eurobonds into four liquidity brackets (<$500 mn, 500mn - <$1bn, $1bn - <$3 bn, >$3 bn) and four life-to-maturity brackets (<1 yr, 1 – 3 yrs, 3 – 5 yrs, >5 yrs). This is utilized in the extended decomposition analysis, where liquidity and maturity effects are determined as second order effects in European eurobond returns alongside country and industry effects.

The standard decomposition methodology follows Heston and Rouwenhorst (1994) and starts from cross-sectional regressions of 6,440 individual USD eurobond returns on a set of ten country and seven industry dummy variables for a set time interval. As these dummies are orthogonal in each cross-section, their estimated coefficients represent the return of the country and industry sector they belong to in excess to that of the average market. The contribution of each factor is then computed as the time series' variance of the coefficients estimated in the successive cross-sectional regressions. Excess return country indexes are thus decomposed into pure country effects and the sum of industry effects, and excess return industry indexes into pure industry effects and sum of country effects. In a second instance, excess return country and industry indexes are added to with liquidity and maturity factors for which dummy variables are included. This extended decomposition follows a similar analysis by Varotto (2003) for eurobonds. Standard and extended decompositions are performed as such, first for the whole sample period of May 1990 to March 2008 and secondly for the two subperiods around the start of EMU in January 1999.

The correlation structure of country and industry indexes of outright eurobond returns can be compared with that of the indexes after decomposition and adjusted for industry and geographical composition to determine whether decomposition yields a set of indexes that is significantly different. The Jennrich (1970) test establishes whether the two sets of correlation matrixes are from the same population. Results reject the hypothesis that the correlation structure among country indexes does not change after applying the Heston and Rouwenhorst decomposition for both the equal and value-weighted indexes. The Jennrich test equally shows that decomposed country and industry return indexes have correlation and covariance structures that are statistically significantly different pre to post-EMU. These results formally validate the decomposition of eurobond returns and the split of the sample period at the time of the start of EMU.

The decomposition analysis is a priori expected to confirm four main expectations. First, one can expect to observe diminishing country effects in European eurobond returns as time progresses. Especially following the start of EMU, the financial integration and macroeconomic convergence of participating member states should lead to reduced country effects. This macroeconomic convergence is predicted by the founders of EMU and implicit the "One Market, One Money" ex ante cost-benefit analysis in 1990. Since countries participating in EMU make up the majority of the sample, reduced country effects should be the overall trend. The expectation is of diminishing and not entirely fading country effects, as Euro zone countries' fiscal policies remain at a national level resulting in differences in credit worthiness. Secondly, one can expect industry effects to increase post-EMU if the ex ante predictions from the Krugman school of international trade economists for regional industry specialization in Europe's monetary union that dominate thinking at the time become real. "One Market, One Money" rather predicts that industry dispersion is more compatible with EMU though. Thirdly, while the expectation for the EMU-ins on the direction of their country and industry effects is relatively firm, it is immediately obvious what this expectation should be for the EMU-outs. Two such countries are included in the sample (UK and Sweden) and for them the effects could go both ways. Fourthly, one can expect that with the creation of a larger, deeper, and more liquid bond market under the Euro, the importance of liquidity and maturity effects lessen post-EMU. Reduced maturity effects would be the result of higher frequency of issuance in all segements of the yield curve, especially the longer end. Reduced liquidity effects would result from the much larger issuance of eurobonds under the Euro, both in number and in size.

Results from the decomposition analysis largely contradict these a priori expectations and are therefore noteworthy. First, country effects dominate industry effects over the whole sample period by more than three times (= 1.26/0.39, for the value-weighted indexes) and in both subperiods around EMU. Post-EMU country effects remain on the whole equally important compared to the period before and even rise slightly. More detailed observation of the course of country effects under EMU brings out the striking result of a North-South divide within the Euro zone. The average of country effects of core-EMU countries Germany, France and BENELUX shrinks to nearly one-fifth (from 1.18 to 0.26) under the Euro, while the average of country effects of the peripheral-EMU countries Spain and Italy rises nearly five times (from 1.00 to 4.67) pre to post-EMU. The immediate observation from eurobond returns therefore is of economic divergence between the core and the periphery. These results imply that ex ante convergence predictions of the monetary union that motivated its creation and as predicted in "One Money, One Market" have not been realized. Secondly, the importance of industry effects is significantly reduced, from 0.63 to 0.16, pre to post-EMU. The implication of these observed increased industry effects under EMU is that the ex ante prediction of Krugman economists on industry specialization under EMU is defied by that of industry dispersion predicted in "One Money, One Market". These two results combined lead to the finding that country effects outweigh industry effects pre-EMU by a factor of nearly two (=1.24/0.63) and post-EMU by a factor of precisely eight (=1.28/0.16). The final conclusion from the standard decomposition is that there is indeed no consistency in the pattern of country effects among the EMU-outs. Thirdly, the results from the extended decomposition analysis are that country effects remain dominant throughout and that indeed the importance of liquidity and maturity effects both reduce after EMU. The first verifies that the main conclusions from the standard decomposition are robust and the latter that the depth and maturity of the eurobond markets under the Euro has improved. The ranking of importance of the various effects is country first, maturity second, industry third and liquidity fourth, in line with results from Varotto (2003).

The result of dominating country effects is indeed similar to what Heston and Rouwenhorst find for equity returns (and many others that followed them) and to what Varroto finds for eurobonds returns, at least up until 1998. Beyond this date, which of course coincides with the start of EMU in Europe, the dominance of country effects in equity returns is challenged by the surge of industry effects in Europe in several studies, while to date not sufficiently researched for bonds. My results confirm the dominance of country effects in European eurobond returns pre-EMU. In contrast to this common finding for European equity returns, they also confirm that country effects increase their dominance over industry effects in eurobond returns post-EMU.

In the course of the (standard) decomposition analysis it is found that the common factor in eurobonds is high. Through a multi-variable regression analysis it is established that this is largely caused by the conversion of eurobond returns from national currency to US Dollars. Beyond that, economic outlook factors, such as industrial production and deficit levels and bond market factors, such as the long-term US Treasury yield, have some effect. Further to this mere currency conversion effect, it is found that the currency component, defined as the percentage change of the national currency of each country to the US Dollar over the weighted-average basket of these currencies, can in a number of cases be related to the country effects. The interpretation of this relation is that a more than average depreciation of the national currency results in a competitive business advantage for the company presiding in that country which translates into better eurobond returns. The relation, established through OLS regressions, is shown to be stronger for core-EMU countries than for peripheral-EMU countries and intensifies in the post-EMU phase.

The main conclusion from the empirical analysis performed in this chapter is that for eurobonds country effects matter in their return variation, and contrary to common perception under fund managers, even more under EMU than before. From this one might want to conclude that the willingness on the part of investors to prefer country allocations over industry allocations is established. This is only the case in part, for the decomposition methodology remains bound to the separate identification of factors as main sources of reduction in return variation, i.e. the risk in portfolios. The overall conclusion that is appropriate from the empirical analysis in this chapter is that a diversification across countries within an industry is a more effective tool for risk reduction of portfolios than the other way around, both pre and post-EMU. The empirical study in Chapter 5 extends this analysis and investigates how results from the decomposition analysis translate into the mean-variance performance of country and industry-based bond portfolios.

Appendix A

From Eqs. (3) and (4) in Section 4.1.:

$$r_n = \alpha + \sum_{j=1}^{J} \phi_j I_{nj} + \sum_{k=1}^{K} \psi_k C_{nk} + \varepsilon_n \qquad \text{(A1)}$$

s.t. $\sum_{j=1}^{J} w_j \phi_j = 0$, $\sum_{k=1}^{K} v_k \psi_k = 0$ and $\sum_{j=1}^{J} w_j = \sum_{k=1}^{K} v_k = 1$ (A2)

Rewrite the first two restrictions in (A2) as,

$$0 = \sum_{j=1}^{J} w_j \phi_j = \sum_{j=1}^{J-1} w_j \phi_j + w_J \phi_J \quad \Leftrightarrow \quad \phi_J = - \sum_{j=1}^{J-1} \phi_j \frac{w_j}{w_J} \qquad \text{(A3a)}$$

$$0 = \sum_{k=1}^{K} v_k \psi_k = \sum_{k=1}^{K-1} v_k \psi_k + v_K \psi_K \quad \Leftrightarrow \quad \psi_K = - \sum_{k=1}^{K-1} \psi_k \frac{v_k}{v_K} \qquad \text{(A3b)}$$

and incorporate into the regression equation (A1), using the last country/industry as benchmark,[36]

$$\begin{aligned} r_n &= \alpha + \sum_{j=1}^{J-1} \phi_j I_{nj} - \left(\sum_{j=1}^{J-1} \phi_j \frac{w_j}{w_J}\right) I_{nJ} + \sum_{k=1}^{K-1} \psi_k C_{nk} - \left(\sum_{k=1}^{K-1} \psi_k \frac{v_k}{v_K}\right) C_{nK} + \varepsilon_n \\ &= \alpha + \sum_{j=1}^{J-1} \phi_j \left(I_{nj} - \frac{w_j}{w_J} I_{nJ}\right) + \sum_{k=1}^{K-1} \psi_k \left(C_{nk} - \frac{v_k}{v_K} C_{nK}\right) + \varepsilon_n \\ &= \alpha + \sum_{j=1}^{J-1} \phi_j \, i_{nj} + \sum_{k=1}^{K-1} \psi_k \, c_{nk} + \varepsilon_n \qquad \text{(A4)} \end{aligned}$$

The cross-sectional regressions (A4) are performed over all eurobonds that are present in time period *t*. The systemic part of the return is represented by the fitted values of the returns from the regressions and can be written as:

$$\hat{r}_n = \hat{\alpha} + \sum_{j=1}^{J-1} \hat{\phi}_j i_{nj} + \sum_{k=1}^{K-1} \hat{\psi}_k c_{nk} = \hat{\alpha} + \sum_{j=1}^{J} \hat{\phi}_j I_{nj} + \sum_{k=1}^{K} \hat{\psi}_k C_{nk} ,$$

where I have included the imputed values for ϕ_J and ψ_K from (A3).[37] Note that there is no longer a disturbance term in the above equation because the residuals sum to zero by construction. The estimated coefficients are indicated with hats.

[36] See also Bai and Green (2010) for similar derivations.

[37] Note that in a particular time period *t* it may be that data is not available for *all* countries and industries. In those cases the regression (A4) is adapted by dropping those countries/industries for which no information is given.

Decomposition into country and industry indexes can be constructed in the following way. Let me focus on a country index first. Weigh all systemic returns $\hat{r}_n$ with a weight $p_{n\mathcal{K}}$ that represents the weight a particular bond *n* has in country $\mathcal{K}$ from set *k = 1, … , K* and sum over the eurobonds.[38]

$$R_{\mathcal{K}} \equiv \sum_{n=1}^{N} p_{n\mathcal{K}}\, \hat{r}_n = \hat{\alpha} + \sum_{n=1}^{N} p_{n\mathcal{K}} \sum_{j=1}^{J} \hat{\phi}_j I_{nj} + \sum_{n=1}^{N} p_{n\mathcal{K}} \sum_{k=1}^{K} \hat{\psi}_k C_{nk}$$

$$= \hat{\alpha} + \sum_{n=1}^{N} \sum_{j=1}^{J} \hat{\phi}_j\, p_{n\mathcal{K}}\, I_{nj} + \sum_{n=1}^{N} \sum_{k=1}^{K} \hat{\psi}_k\, p_{n\mathcal{K}}\, C_{nk}$$

$$= \hat{\alpha} + \sum_{j=1}^{J} \hat{\phi}_j \sum_{n=1}^{N} p_{n\mathcal{K}}\, I_{nj} + \hat{\psi}_{\mathcal{K}} \qquad \text{(A5)}$$

The global factor $\hat{\alpha}$ is left unchanged since $\sum_{n=1}^{N} p_{n\mathcal{K}} = 1$. The pure country factor $\hat{\psi}_{\mathcal{K}}$ remains as the terms $p_{n\mathcal{K}} C_{nk}$ will be zero for $k \neq \mathcal{K}$. Note that the terms $\sum_{n=1}^{N} p_{n\mathcal{K}}\, I_{nj}$ can be interpreted as the weight of industry *j* in country $\mathcal{K}$ as the I_{nj} dummies pick out those eurobonds that belong to industry *j*.

For the industry indexes we can do the same. Let $p_{n\mathcal{J}}$ be the weight a particular eurobond has in industry from set *j*= 1, … , J. Sum again over the eurobonds:

$$R_{\mathcal{J}} \equiv \sum_{n=1}^{N} p_{n\mathcal{J}}\, \hat{r}_n = \hat{\alpha} + \sum_{n=1}^{N} p_{n\mathcal{J}} \sum_{j=1}^{J} \hat{\phi}_j I_{nj} + \sum_{n=1}^{N} p_{n\mathcal{J}} \sum_{k=1}^{K} \hat{\psi}_k C_{nk}$$

$$= \hat{\alpha} + \sum_{n=1}^{N} \sum_{j=1}^{J} \hat{\phi}_j\, p_{n\mathcal{J}}\, I_{nj} + \sum_{n=1}^{N} \sum_{k=1}^{K} \hat{\psi}_k\, p_{n\mathcal{J}}\, C_{nk}$$

$$= \hat{\alpha} + \hat{\phi}_{\mathcal{J}} + \sum_{k=1}^{K} \hat{\psi}_k \sum_{n=1}^{N} p_{n\mathcal{J}}\, C_{nk} \qquad \text{(A6)}$$

The global term is unaffected by the weighting as $\sum_{n=1}^{N} p_{n\mathcal{J}} = 1$. The pure industry factor $\hat{\phi}_{\mathcal{J}}$ results from the observation that term $p_{n\mathcal{J}} I_{nj}$ will be zero for all $j \neq \mathcal{J}$. The term $\sum_{n=1}^{N} p_{n\mathcal{J}}\, C_{nk}$ can be interpreted as the weight of country *k* in industry $\mathcal{J}$ as the C_{nk} dummies pick out those bonds that belong to country *k*.

[38] Important to note here is that $p_{n\mathcal{K}} = 0$ for all those bonds that do not belong to country *k*. This also implies

$$\sum_{n=1}^{N} p_{n\mathcal{K}}\, C_{mk} = 1, \quad \mathcal{K} = 1, \dots, K$$

Appendix B

Table B1

Summary performance statistics of Decomposed Indexes

Panel A (B) summarizes the mean and the standard deviation of the equal-weighted (EW) and the value-weighted (VW) monthly returns of the actual country and industry indexes after decomposition. All returns are in US Dollars and expressed in percent per month. In the correlation matrices, the coefficients above the diagonal refer to the value-weighted returns and below the diagonal are between the equal-weighted returns.

A. By country

	EW return		VW return		Correlation matrix									
Country	Mean	Stdev	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT
BL	0.583	3.082	0.613	3.136	1	0.976	0.947	0.808	0.963	0.887	0.930	0.846	0.932	0.929
FR	0.514	2.999	0.526	3.058	0.977	1	0.968	0.826	0.978	0.883	0.923	0.819	0.930	0.938
GE	0.591	3.104	0.607	3.121	0.947	0.965	1	0.798	0.951	0.852	0.919	0.824	0.925	0.945
IT	0.594	3.275	0.609	3.272	0.808	0.832	0.797	1	0.749	0.752	0.846	0.707	0.823	0.858
NE	0.528	3.136	0.533	3.241	0.967	0.980	0.950	0.763	1	0.858	0.893	0.788	0.901	0.911
SP	0.744	3.543	0.744	3.543	0.875	0.884	0.847	0.747	0.868	1	0.855	0.770	0.857	0.871
SW	0.653	3.037	0.652	3.051	0.933	0.929	0.917	0.840	0.907	0.851	1	0.816	0.929	0.951
UK	0.791	3.315	0.799	3.382	0.830	0.810	0.804	0.701	0.782	0.772	0.820	1	0.891	0.831
SN	0.686	2.835	0.686	2.835	0.936	0.938	0.924	0.818	0.916	0.857	0.932	0.898	1	0.958
OT	0.651	3.051	0.659	2.962	0.954	0.959	0.951	0.806	0.951	0.881	0.941	0.900	0.966	1

B. By industry sector

	EW return		VW return		Correlation matrix						
Industry	Mean	Stdev	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT
FF	0.651	3.101	0.654	3.199	1	0.936	0.929	0.943	0.957	0.941	0.885
GI	0.691	2.937	0.713	2.866	0.981	1	0.956	0.940	0.954	0.964	0.931
CO	0.648	2.918	0.643	2.896	0.962	0.966	1	0.962	0.973	0.965	0.958
CT	0.650	2.957	0.618	2.904	0.967	0.959	0.970	1	0.969	0.973	0.931
BE	0.615	2.991	0.612	2.950	0.980	0.968	0.976	0.977	1	0.968	0.942
IN	0.621	2.946	0.615	2.933	0.969	0.973	0.972	0.977	0.973	1	0.935
UT	0.638	3.111	0.633	3.110	0.925	0.940	0.963	0.951	0.952	0.946	1

Table B4.5

Summary statistics for estimated country and industry indexes

Panel A summarizes the mean and the standard deviation of the monthly equal-weighted (EW) estimated country returns corrected for industry compositions and their correlations. Panel B the same for the estimated industry returns corrected for country compositions.

A. Country indexes after decomposition, adjusted for their industry composition

	EW return		Correlations									
	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT
BL	0.589	2.984	1									
FR	0.532	2.953	0.977	1								
GE	0.600	3.005	0.950	0.968	1							
IT	0.590	3.309	0.809	0.824	0.793	1						
NE	0.554	3.042	0.962	0.978	0.944	0.749	1					
SP	0.725	3.504	0.873	0.880	0.846	0.754	0.865	1				
SW	0.639	3.044	0.934	0.927	0.916	0.847	0.898	0.854	1			
UK	0.814	3.364	0.817	0.806	0.806	0.680	0.791	0.737	0.789	1		
SN	0.642	2.810	0.948	0.950	0.935	0.851	0.917	0.878	0.943	0.864	1	
OT	0.665	3.035	0.958	0.964	0.955	0.801	0.954	0.873	0.931	0.897	0.963	1

B. Industry indexes after decomposition, adjusted for their country composition

	EW return		Correlations						
	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT
FF	0.627	2.832	1						
GI	0.686	2.835	0.988	1					
CO	0.597	2.812	0.973	0.951	1				
CT	0.635	2.836	0.973	0.956	0.973	1			
BE	0.561	2.798	0.981	0.959	0.984	0.978	1		
IN	0.610	2.868	0.977	0.959	0.980	0.978	0.981	1	
UT	0.587	2.966	0.956	0.932	0.971	0.962	0.974	0.968	1

Table B4.6

Jennrich test of stability of correlation matrixes before and after decomposition

The table shows the results of the Jennrich test statistic and its corresponding critical value and p-value computed on the correlations of eurobond equal-weighted (EW) returns from the country and industry indexes before and after decomposition over the full sample period.

	Country correlation matrixes	Industry correlation matrixes
Jennrich χ^2 test statistic	128.3636	141.9633
Degrees of freedom	45	21
Critical value	61.6562	32.6706
p-value	0	0

Table B4.7
Performance statistics ignoring the common factor

Panel A summarizes the mean and the standard deviation of the monthly equal-weighted (EW) estimated country returns corrected for industry compositions and the common factor, and their correlations. Panel B the same for the estimated industry returns corrected for country compositions and the common factor.

A. Country indexes adjusted for their industry composition and the common factor

	EW return		Correlations									
	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	SN	OT
BL	-0.068	0.741	1									
FR	-0.125	0.711	0.608	1								
GE	-0.056	0.819	0.262	0.515	1							
IT	-0.067	1.925	0.131	0.239	0.131	1						
NE	-0.103	0.917	0.509	0.726	0.509	*0.162*	1					
SP	0.068	1.703	0.206	0.254	0.206	0.133	0.208	1				
SW	-0.017	1.077	0.321	0.221	0.321	0.414	0.061	0.202	1			
UK	0.158	1.388	-0.656	-0.802	-0.656	-0.280	-0.637	-0.295	-0.445	1		
SN	-0.015	0.649	0.074	0.078	0.074	0.443	*0.172*	0.194	0.406	-0.288	1	
OT	0.008	0.469	0.017	0.122	0.017	-0.078	0.242	0.127	0.108	-0.043	-0.070	1

B. Industry indexes adjusted for their country composition and the common factor

	EW return		Correlations						
	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT
FF	-0.015	0.458	1						
GI	0.044	0.536	0.606	1					
CO	-0.045	0.576	0.222	*0.267*	1				
CT	-0.007	0.546	0.162	*0.201*	0.311	1			
BE	-0.081	0.551	0.435	*0.111*	0.612	0.405	1		
IN	-0.032	0.521	0.217	*0.205*	0.461	0.378	0.470	1	
UT	-0.055	0.818	0.154	*0.231*	0.521	0.341	0.571	0.451	1

Table B4.8
Common factor in relation to pure country effects and pure industry effects

The table summarizes the mean, standard deviation and variance of the common factor in both equal-weighted (EW) country and industry indexes and for the pure country effects from the country indexes and the pure industry effects from the industry indexes.

	Mean			Standard deviation		
	Full period	Pre-EMU	Post-EMU	Full period	Pre-EMU	Post-EMU
Common factor	0.657	1.133	0.214	2.919	3.469	2.221
Average of pure country effects	-0.022	-0.022	-0.021	1.040	1.064	0.927
Average of pure industry effects	-0.027	-0.094	0.034	0.572	0.704	0.377

Table B4.13
Country effects and excess exchange rate returns

The table summarizes the statistics of the regressions of pure country effects from the equal-weighted (EW) country indexes on the currency component. Estimated coefficients are given for the constant and the slope with 95% confidence intervals on either side of the coefficients in brackets.

	Estimated constant	Estimated slope	p-value	R^2
Belgium	-0.0005 *(-0.0014) (0.0004)*	0.4294 *(0.3137) (0.5452)*	0.00000	0.2014
France	-0.0009 *(-0.0015) (-0.0003)*	0.6824 *(0.6007) (0.7677)*	0.00000	0.5518
Germany	-0.0004 *(-0.0014) (0.0007)*	0.3540 *(0.2178) (0.4901)*	0.00000	0.1102
Italy	-0.0012 *(-0.0036) (0.0012)*	0.5787 *(0.4086) (0.7489)*	0.00000	0.1750
Netherlands	-0.0006 *(-0.0013) (0.0001)*	0.9710 *(0.8789) (1.0630)*	0.00000	0.6709
Spain	0.0004 *(-0.0019) (0.0026)*	0.2827 *(0.0994) (0.4660)*	0.00270	0.0418
Sweden	-0.0006 *(-0.0016) (0.0003)*	0.4657 *(0.4116) (0.5198)*	0.00000	0.5758
UK	0.0015 *(0.0001) (0.0028)*	0.6968 *(0.6023) (0.7914)*	0.00000	0.4989

Table B4.14
Jennrich tests of stability of correlation and covariance return matrixes from two subperiods around EMU: 5/1990 – 12/1998 and 1/1999 – 3/2008

The table summarizes the results for the Jennrich χ^2 test statistic from the equal-weighted (EW) correlations and covariations of the country and industry indexes returns resulting from decomposition and obtained over each subperiod.

	Country indexes		Industry indexes	
	correlation matrixes	covariance matrixes	correlation matrixes	covariance matrixes
Jennrich χ^2 test statistic	314.23	569.46	151.49	378.30
Degrees of freedom	45	55	21	28
Critical value (95% conf.)	61.66	73.31	32.67	41.34
p-value	0	0	0	0

Table B4.15
Decomposition of excess index returns, pre and post-EMU

The table gives the variance of the components of the equal-weighted (EW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market for May 1990-Dec 2000 and Jan 1999 – Mar 2008. The ratio is the variance ratio to the index in excess of the market.

A. Country Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.75	0.506	0.30	0.205	0.37	1.178	0.03	0.086
FR	0.71	0.547	0.23	0.176	0.30	1.208	0.03	0.107
GE	1.26	0.572	0.33	0.152	0.13	0.955	0.02	0.156
IT	2.10	1.364	0.25	0.163	5.15	1.074	0.03	0.006
NE	1.28	0.597	0.42	0.197	0.43	1.034	0.02	0.044
SP	1.08	1.231	0.30	0.345	4.61	1.021	0.05	0.010
SW	0.87	1.816	0.25	0.512	1.43	1.205	0.05	0.042
UK	3.06	1.261	0.27	0.112	0.87	0.910	0.03	0.030
SN	0.73	3.049	0.32	1.346	0.13	0.295	0.25	0.556
OT	0.42	0.813	0.21	0.399	0.04	0.690	0.02	0.436
Average	1.23	1.176	0.29	0.361	1.34	0.957	0.05	0.147

B. Industry Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.42	0.216	0.99	0.512	0.02	0.383	0.03	0.735
GI	0.32	0.065	3.44	0.684	0.25	0.997	0.07	0.284
CO	0.60	0.479	1.45	1.150	0.08	0.476	0.11	0.714
CT	0.30	0.163	1.77	0.963	0.30	0.795	0.05	0.131
BE	0.56	0.378	1.75	1.180	0.06	0.715	0.03	0.314
IN	0.39	0.294	1.39	1.038	0.15	0.987	0.01	0.093
UT	1.03	0.536	3.09	1.606	0.31	0.680	0.13	0.291
Average	0.52	0.304	1.98	1.019	0.17	0.719	0.06	0.366

Table B4.16

Country effects and excess exchange rate returns, pre and post-EMU

The table summarizes the statistics of the regressions of pure country effects from the equal-weighted (EW) country indexes on the currency component of the respective country for two subperiods, May 1990 – Dec 1998 and Jan 1999 – Mar 2008. Estimated coefficients are given for the constant and the slope with 95% confidence intervals on either side of the coefficients in brackets underneath.

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Estimated constant	Estimated slope	p-value	R^2	Estimated constant	Estimated slope	p-value	R^2
Belgium	-0.0008	0.2854			-0.0001	0.7358		
	(-0.0025) (0.0008)	*(0.1091) (0.4618)*	0.0018	0.0926	*(-0.0009) (0.0006)*	*(0.6088) (0.8627)*	0.00000	0.5477
France	-0.0019	0.6794			-0.0000	0.6840		
	(-0.0030) (-0.0007)	*(0.5575) (0.8013)*	0.00000	0.5475	*(-0.0007) (0.0007)*	*(0.5742) (0.7937)*	0.00000	0.5834
Germany	-0.0008	0.3061			0.0000	0.4499		
	(-0.0030) (0.0013)	*(0.0710) (0.5412)*	0.0112	0.0620	*(-0.0004) (0.0005)*	*(0.3784) (0.5214)*	0.00000	0.5881
Italy	0.0000	0.5914			-0.0024	0.3822		
	(-0.0018) (0.0018)	*(0.4962) (0.6867)*	0.00000	0.6003	*(-0.0067) (0.0018)*	*(-0.3225) (1.0868)*	0.2848	0.0105
Neth.	-0.0012	0.9810			0.0000	0.9436		
	(-0.0026) (0.0001)	*(0.8360) (1.1261)*	0.00000	0.6405	*(-0.0006) (0.0007)*	*(0.8440) (1.0432)*	0.00000	0.7638
Spain	-0.0005	0.1908			0.0017	0.9907		
	(-0.0025) (0.0015)	*(0.0725) (0.3091)*	0.0018	0.0920	*(-0.0022) (0.0055)*	*(0.3478) (1.6335)*	0.0028	0.0788
Sweden	-0.0003	0.3129			-0.0004	0.7698		
	(-0.0017) (0.0010)	*(0.2481) (0.3776)*	0.00000	0.4763	*(-0.0014) (0.0005)*	*(0.7021) (0.8375)*	0.0024	0.8233
UK	0.0030	0.7349			0.0001	0.6544		
	(0.0003) (0.0056)	*(0.5640) (0.9057)*	0.00000	0.4189	*(-0.0007) (0.0009)*	*(0.5923) (0.7165)*	0.00000	0.8000

Figure B1

Scatter plots of value-weighted currency components vs. pure country effects per subperiod

The graphs show, for each country, the scatter plot of the currency effect on the x-axis and the country effects on the y-axis for the entire sample period. Both need to be multiplied by one hundred to be able to interpret it as percent per month. Because both axis are forced within set limits, it is possible that more outliers exist that are not visible.

May 1990 – Dec 1998 | Jan 1999 – Mar 2008

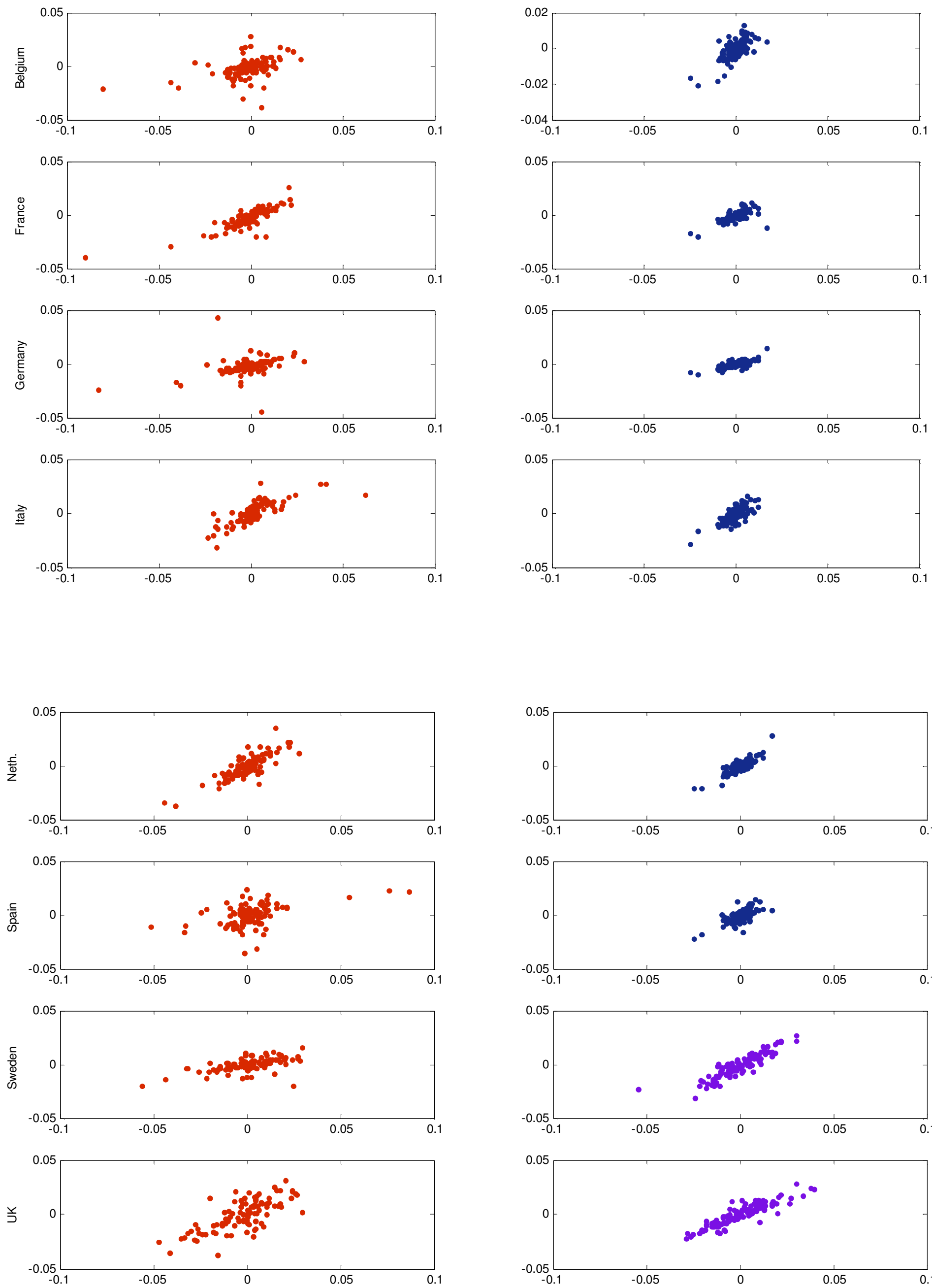


Table B4.18

Decomposition of excess index returns with liquidity and maturity effects (May 1990 – Mar 2008)

The table gives the variance of the four components of the equal-weighted (EW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio to the index in excess of the market.

A. Country indexes

	Pure country effects		Sum of industry effects		Sum of liquidity effects		Sum of maturity effects	
	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.33	0.411	0.13	0.160	0.02	0.022	0.10	0.126
FR	0.49	0.555	0.11	0.130	0.03	0.031	0.12	0.131
GE	0.73	0.612	0.11	0.089	0.03	0.026	0.13	0.110
IT	2.93	0.872	0.12	0.036	0.02	0.006	0.10	0.031
NE	0.74	0.553	0.10	0.075	0.03	0.020	0.13	0.096
SP	2.82	0.977	0.13	0.045	0.02	0.006	0.10	0.035
SW	1.13	1.272	0.12	0.137	0.02	0.023	0.11	0.118
UK	1.75	0.965	0.12	0.065	0.03	0.019	0.13	0.070
SN	0.42	0.897	0.12	0.249	0.04	0.077	0.12	0.248
OT	0.24	0.528	0.11	0.253	0.03	0.073	0.13	0.285
Average	1.16	0.764	0.12	0.124	0.03	0.030	0.12	0.125

B. Industry indexes

	Pure industry effects		Sum of country effects		Sum of liquidity effects		Sum of maturity effects	
	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.24	0.520	0.10	0.221	0.05	0.104	0.16	0.341
GI	0.27	0.944	0.08	0.270	0.05	0.171	0.14	0.474
CO	0.29	0.529	0.04	0.076	0.02	0.043	0.11	0.197
CT	0.34	0.560	0.03	0.056	0.02	0.030	0.11	0.174
BE	0.47	1.045	0.03	0.072	0.02	0.043	0.10	0.230
IN	0.21	0.465	0.03	0.077	0.02	0.045	0.11	0.240
UT	0.74	0.631	0.04	0.034	0.02	0.017	0.11	0.093
Average	0.36	0.671	0.05	0.115	0.03	0.065	0.12	0.250

Table B4.19

Variance of pure liquidity and maturity effects

The table gives the variance of the pure liquidity effects of the equal-weighted (EW) excess liquidity index returns over the total market, in Panel A, and the variance of the pure maturity effects of the excess maturity index returns over the total market, in Panel B.

A. Pure liquidity effects		B. Pure maturity effects	
L1	0.01	M1	0.40
L2	0.16	M2	0.18
L3	0.30	M3	0.34
L4	0.84	M4	1.95
Average	0.33	Average	0.72

Table B4.20

Decomposition of excess index returns (pre and post-EMU)

The table gives the variance of the four components of the equal-weighted (EW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio to the index in excess of the market.

A. Country indexes

	May 1990 – Dec 1998								Jan 1999 – Mar 2008							
Effects:	Pure country		Sum of industry		Sum of liquidity		Sum of maturity		Pure country		Sum of industry		Sum of liquidity		Sum of maturity	
	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio
BL	0.45	0.335	0.24	0.178	0.01	0.012	0.14	0.101	0.22	0.716	0.04	0.122	0.02	0.063	0.05	0.159
FR	0.76	0.517	0.21	0.143	0.04	0.025	0.15	0.104	0.23	0.717	0.03	0.086	0.02	0.060	0.06	0.198
GE	1.46	0.651	0.19	0.086	0.04	0.019	0.17	0.077	0.06	0.260	0.03	0.128	0.02	0.071	0.07	0.292
IT	1.20	0.815	0.23	0.155	0.02	0.015	0.14	0.095	4.51	0.900	0.03	0.007	0.02	0.004	0.05	0.011
NE	1.22	0.511	0.18	0.076	0.04	0.015	0.17	0.072	0.26	0.797	0.03	0.092	0.02	0.043	0.06	0.163
SP	1.13	1.121	0.24	0.242	0.02	0.016	0.14	0.134	4.41	0.946	0.04	0.008	0.02	0.004	0.05	0.011
SW	0.96	1.451	0.23	0.344	0.02	0.033	0.14	0.209	1.29	1.178	0.03	0.029	0.02	0.018	0.05	0.050
UK	3.02	1.221	0.22	0.087	0.05	0.020	0.16	0.065	0.58	0.484	0.02	0.020	0.02	0.016	0.08	0.063
SN	0.76	2.302	0.22	0.654	0.05	0.157	0.15	0.465	0.11	0.187	0.02	0.040	0.02	0.036	0.08	0.127
OT	0.46	0.630	0.21	0.288	0.05	0.067	0.16	0.226	0.04	0.191	0.02	0.122	0.02	0.093	0.07	0.362
Average	1.14	0.955	0.22	0.226	0.03	0.038	0.15	0.155	1.17	0.637	0.03	0.065	0.02	0.041	0.06	0.144

B. Industry indexes

	May 1990 – Dec 1998								Jan 1999 – Mar 2008							
Effects:	Pure industry		Sum of country		Sum of liquidity		Sum of maturity		Pure industry		Sum of country		Sum of liquidity		Sum of maturity	
	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio	Var.	Ratio
FF	0.48	0.640	0.08	0.107	0.08	0.102	0.20	0.269	0.02	0.082	0.10	0.496	0.02	0.090	0.09	0.444
GI	0.35	1.387	0.08	0.298	0.08	0.310	0.18	0.717	0.20	0.608	0.12	0.383	0.02	0.071	0.09	0.290
CO	0.53	0.731	0.05	0.070	0.03	0.041	0.14	0.193	0.07	0.178	0.06	0.141	0.02	0.050	0.06	0.152
CT	0.40	0.574	0.05	0.072	0.18	0.026	0.14	0.202	0.28	0.529	0.02	0.039	0.02	0.036	0.05	0.097
BE	0.91	1.354	0.05	0.073	0.19	0.290	0.14	0.203	0.04	0.177	0.03	0.111	0.02	0.079	0.05	0.213
IN	0.31	0.512	0.05	0.082	0.02	0.034	0.14	0.234	0.11	0.366	0.03	0.101	0.02	0.066	0.05	0.182
UT	1.26	0.744	0.05	0.031	0.02	0.013	0.14	0.085	0.25	0.351	0.03	0.040	0.02	0.026	0.05	0.077
Average	0.73	0.849	0.06	0.105	0.04	0.079	0.16	0.272	0.14	0.327	0.05	0.187	0.02	0.060	0.06	0.208

Table B4.21
Variance of pure liquidity and maturity effects (pre and post-EMU)

The table gives the variance of the pure liquidity effects of the equal-weighted (VW) excess liquidity index returns over the total market, in Panel A, and the variance of the pure maturity effects of the excess maturity index returns over the total market , in Panel B.

A. Pure liquidity effects			B. Pure maturity effects		
	5/1990 – 12/1998	1/1999 – 3/2008		5/1990 – 12/1998	1/ 1999 – 3/2008
L1	0.00	0.02	M1	0.40	0.39
L2	0.27	0.06	M2	0.27	0.10
L3	0.40	0.20	M3	0.59	0.11
L4	1.52	0.21	M4	2.74	1.20
Average	0.55	0.12	Average	1.00	0.45

Appendix C

When a sample period is partitioned into two subsamples, correlation (m_{1c} and m_{2c}) and variance-covariance (m_{1v} and m_{2v}) matrixes can be computed for both periods.

I wish to conduct a test of stability of each type of matrix between both subsamples. The null hypothesis of the tests holds if the two correlation or variance-covariance matrixes are equal. Jennrich (1970) established that this test has a χ^2 distribution with degrees of freedom related to *n*, as follows:

Let T_1 and T_2 be the sample size and *n* the number of assets (and the dimension of the correlation and variance-covariance matrixes). Define:

$\overline{m}_c = (T_1 m_{1c} + T_2 m_{2c})/(T_1+T_2) = (\bar{r}_{ij})$ = 'average' correlation matrix

δ_{ij} = Kronecker delta = identity matrix of the same dimension as $\overline{m}_c$

$S = (\delta_{ij} + \bar{r}_{ij}\ \bar{r}^{ij})$ where the elements $\bar{r}^{ij}$ are from the inverse of the matrix $\bar{r}_{ij}$

$Z = \left[\frac{T_1 T_2}{T_1+T_2}\right]^{1/2} \overline{m}_c^{-1}\ (m_{1c} - m_{2c})$

The Jennrich test statistics for the stability of the correlation matrixes is:

$$\chi^2 = \frac{1}{2}\ trace\ (Z^2) - (diag(Z))'\ S^{-1}\ diag(Z) \qquad \text{with } \frac{n(n-1)}{2} \text{ degrees of freedom}$$

Replacing the correlation matrixes with the corresponding covariance matrixes, the Jennrich test statistic for the stability of the covariance matrixes is:

$$\chi^2 = \frac{1}{2}\ trace\ (Z^2) \qquad \text{with } \frac{n(n+1)}{2} \text{ degrees of freedom}$$

Appendix D

Table D1
Additional multi-variable regressions to explain common factor in eurobonds

The table shows the results of regressions of the type $CFE_t = \alpha_t + \beta_t\, VAR^1_t + \gamma_t\, VAR^2_t + \delta_t\, VAR^3_t + \lambda_t\, VAR^4_t + \eta_t\, VAR^5_t + \varepsilon_t$. Coefficients that are not statistically significantly different from zero at the 95% confidence level are in bold.

VAR^1_t	VAR^2_t	VAR^3_t	VAR^4_t	VAR^5_t		Estimated coefficients *(95% confidence intervals)*			St.error p-value	F-stat. R^2
CUR_t					α:	*(0.0059)*	0.0074	*(0.0088)*		
	IIP_t				β:	*(0.9530)*	1.0042	*(1.0554)*		
		UMP_t			γ:	*(-0.3317)*	-0.1742	*(-0.0167)*	0.000096148	406.839
			LTY_t		δ:	*(0.0048)*	0.0716	*(0.1384)*	0	0.8862
					λ:	*(-0.0398)*	-0.0200	*(-0.0001)*		
CUR_t					α:	*(0.0018)*	0.0044	*(0.0070)*		
	IIP_t				β:	*(0.9563)*	1.0064	*(1.0566)*		
		DEF_t			γ:	*(-0.3189)*	-0.1657	*(-0.0124)*		
			LTY_t		δ:	*(-0.1629)*	-0.1072	*(-0.0515)*	0.000092276	341.082
				BCI_t	λ:	*(-0.0380)*	-0.0182	*(0.0016)*	0	0.8913
					η:	*(-0.0038)*	**-0.0010**	*(0.0019)*		
CUR_t					α:	*(0.0008)*	0.0044	*(0.0080)*		
	IIP_t				β:	*(0.9557)*	1.0062	*(1.0566)*		
		DEF_t			γ:	*(-0.3271)*	-0.1789	*(-0.0308)*		
			LTY_t		δ:	*(-0.1569)*	-0.1019	*(-0.0470)*	0.000092439	340.405
				MON_t	λ:	(-0.0394)	-0.0198	*(-0.0002)*	0	0.8911
					η:	*(-0.1606)*	**-0.0191**	*(0.1224)*		
CUR_t					α:	*(0.0017)*	0.0040	*(0.0064)*		
	IIP_t				β:	*(0.9568)*	1.0069	*(1.0571)*		
		DEF_t			γ:	*(-0.3336)*	-0.1788	*(-0.0239)*		
			LTY_t		δ:	*(-0.1574)*	-0.1030	*(-0.0486)*	0.000092470	340.276
				$STIR_t$	λ:	*(-0.0394)*	-0.0195	*(0.0005)*	0	0.8911
					η:	*(-0.0104)*	**-0.0001**	*(0.0103)*		
CUR_t					α:	*(0.0017)*	0.0041	*(0.0064)*		
	IIP_t				β:	*(0.9580)*	1.0086	*(1.0592)*		
		DEF_t			γ:	*(-0.3266)*	-0.1785	*(-0.0304)*	0.000092366	340.707
			LTY_t		δ:	*(-0.1585)*	0.1040	*(-0.0495)*	0	0.8912
				$RISK_t$	λ:	*(-0.0391)*	-0.0196	*(-0.0001)*		
					η:	*(-0.0421)*	**-0.0083**	*(0.0255)*		

CHAPTER 5
International bond diversification and EMU: Country versus industry portfolios

1. Introduction

This is the second of empirical chapters. Following the factor decomposition analysis in the previous chapter, it uses a complementary methodology to study whether a country or an industry portfolio diversification strategy performs better in European bond markets.

The methodological approach adopted in this chapter is a mean-variance portfolio optimization setting from which the risk-return performance of country and industry-based bond portfolios can be compared. In this setup unconditional mean-variance portfolio optimization results in three efficient frontiers: one for a portfolio based on country indexes alone, one based on industry indexes alone and one constructed from both. By definition the efficient frontier from all available indexes will be the most efficient and the other two investment strategies are nested. Spanning and efficiency tests are applied to determine how these investment strategies compare among each other statistically, building on earlier analytical work from Huberman and Kandel (1987) and De Roon and Nijman (2001) and as has been performed on European equity returns by Moerman (2004, 2008) and Eiling et al. (2006). The mean-variance test of spanning analyzes the effect that the introduction of additional industry (country) assets has on the efficient frontier of a benchmark country (industry) portfolio. The test of efficiency compares the maximum Sharpe ratios of the different portfolios.

Results from this empirical analysis balance the ones from the previous chapter in the aim to determine whether EMU justifies a change in the composition of European bond portfolios and potentially also a shift in diversification strategy from a country-first to an industry-first allocation. While the decomposition analysis of the previous chapter focuses on risk-contributing properties of country and industry factors in returns, the tests performed in this chapter consider whether an investment portfolio strategy based on either has a relatively better mean-variance performance. This allows for qualifications on optimal portfolio construction with respect to the twin objectives of risk and return and not just risk alone.

While the analysis in the previous chapter is from individual eurobond returns, mean-variance tests are performed at the portfolio index level. This allows for the addition of government bond indexes in the analysis of the outright performance evaluation with portfolio indexes from eurobonds. Thus for the first time in the empirical analysis the merit of a portfolio of government bonds allocated on a country basis vis-à-vis a portfolio of eurobonds allocated on an industry basis is analyzed.

In this chapter, mean-variance tests are performed on country and industry portfolios built from three types of content. Portfolio indexes are first constructed through the straightforward direct allocation into country and industry groups. It is shown how from the 6,440 eurobond returns utilized in the previous chapter, 4,587 are selected to form a so-called 'closed' data set. Secondly, portfolio indexes are calculated from the main decomposition model of the previous chapter. This builds on the result that decomposition creates country and industry indexes with different portfolio implications than indexes from their direct allocation. In this chapter, it is tested whether this is also visible in the comparable mean-variance performance of the two sets of indexes. In the third instance, industry portfolio indexes constructed from the set of 4,587 eurobond returns on either basis, direct and decomposed, are compared with a new and separate set of country indexes created from government bond returns. For the latter, I obtain index series from the European Federation of Financial Analysts' Societies (EFFAS) which are published by Bloomberg and available from December 1991. In my model set-up, spanning tests are performed on outright returns but for the efficiency tests returns in excess of the risk-free rate are required. For this purpose, 1-month USD deposit rates are obtained from Datastream.

Mean-variance tests of spanning and efficiency on all three sets of country and industry portfolio indexes are performed for the whole sample period and either period around EMU. This renders results comparable to those in the previous chapter. A priori, one would expect from the analysis in Chapter 3 that the inclusion of eurobonds in European bond portfolios results in a better mean-variance performance. Before EMU, portfolios are likely to have been overweight government bonds Any prospective change to shift from a country to an industry-based diversification of bond portfolios post-EMU, alluded to in Chapter 3, has come under question by results of Chapter 4 of dominating country effects in European bond returns. From this result, one might actually expect that a country-based diversification strategy for bonds ought to be preferred over an industry-based diversification from a mean-variance perspective before and after EMU. As will be seen from the results of the tests of spanning and efficiency performed in various setups and analyzed in detail in this chapter, these a priori expectations are confirmed in part.

The remainder of this chapter is organized as follows. Section 2 sets out the reach of the results obtained from the decomposition analysis in the previous chapter in order to outline how the empirical analysis of this chapter complements it. Section 3 outlines the mean-variance framework and derivation of its two main statistical tests, spanning and efficiency. Section 4 details the construction of country and industry portfolio indexes from the closed set of 4,587 eurobond returns, from their direct allocation and from their decomposition. It also describes the use of the EFFAS government bond indexes for the alternative set of country indexes. Section 5 gives the empirical results of the spanning and efficiency tests performed on the different sets of country and industry indexes. Section 6 concludes.

2. Critique of the standard decomposition model

The decomposition methodology of Heston and Rouwenhorst (1994) has a number of attractive features. Above all, it is capable to clearly and separately attribute the variation in asset returns to the factors incorporated in the model. In the case of my sample of 6,440 eurobond returns from predominantly European countries for May 1990 to March 2008, it is thus established that country effects account for more of the return variance than industry effects (in Chapter 4). The portion that cannot be attributed to either country or industry effects resides with the common factor of which it is determined that this is largely the conversion effect of local currency to common currency returns. This is again a clear-cut result for eurobond returns and a great quality of the decomposition model that it can so unambiguously extract and capture these distinct effects.

It is tempting to conclude from these results that a geographical portfolio allocation yields better results than an industry sector portfolio allocation for eurobonds in Europe. I am careful not to draw such stark conclusions from the decomposition analysis on superior or even preferable bond portfolio allocation strategies for two reasons. One, because the assumptions innate to the decomposition model can prejudice the measure for country and industry effects. Two, because there are limitations with respect to the interpretation of the results from the model calculations. Each of these deserve further elaboration, if only because it points out directions for further research.

The two assumptions inherent to the Heston and Rouwenhorst decomposition model that have drawn the most criticism are of unit and constant factor exposures. First, consider the assumption of unit factor exposure, which is built in because all assets under consideration within a country and within an industry sector have a unit exposure, or beta, to global market shocks. This is in contrast with mainstream asset pricing theory (such as CAPM), which contends that differences in systemic risks across firms are precisely to be explained by their betas, i.e. their exposure to common market shocks. Brooks and Del Negro (2002, 2004) are often quoted in this respect because they demonstrate, as one of the first, that the assumption of unit betas is less well supported by the data. Their latent factor model relaxes the restriction that all stocks with exposure to a given shock have the same exposure to that shock and nests the fixed effects model of Heston and Rouwenhorst. Their results also uncover that many industry betas are negative while almost all country betas are positive, at least for their sample of USD-denominated stock returns from 1985 to 2002 from a broad range of countries. These differences within groups in beta-heterogeneity are thought to be the reason why country factors have historically outweighed industry factors in explaining international return variation. Their research has set up a strand of literature where factor coefficients are left unconstrained (though zero restrictions on the exposures to other countries or industry sectors are maintained, which would otherwise lead to the identification problem familiar from standard exploratory factor analysis). De Moor and Sercu (2006) is a more recent example of this type of studies. Via a two-stage estimation approach, provisionally estimated factor returns determine sensitivities through time series OLS and then the revised factors are extracted from cross-section regressions on these estimated sensitivities. They also verify that this makes a difference.

Secondly, the assumption of constant factor exposures is inherent in Heston and Rouwenhorst's decomposition model because the factors driving country and industry-affiliation in the standard decomposition model have very little to no dynamics. This is in contrast with considerable evidence from current literature of time-varying betas. Consequently, there is another strand of literature motivated by this evidence that attempts to overcome these limitations. Examples are Bekaert, Hodrick and Zhang (2009) who use an arbitrage pricing theory (APT) model where the identity of the important systemic factors may change over time. Likewise in Baele and Inghelbrecht (2009, 2010), a GARCH-framework explicitly allows both factor exposures and asset-specific volatilities to vary over time.

It is entirely plausible that models that overcome the restrictive assumptions of unit and constant betas provide a better fit for asset returns data, as all studies discussed so far claim. That in itself has made a commendable contribution to the research field. Yet, it is doubtful that this direction of research will provide any further insights into my key question of optimal portfolio diversification strategies in European bond markets. For one, both strands of literature, with their various additions and estimated in two or sometimes even three stages, continue to rely on linear factor specifications, which is the main trait of the decomposition model. Secondly, results from these studies have by and large left the overall conclusion of domineering country effects over industry effects in stock return variations intact. If a rise in the primacy of industry versus country effects is detected, then this is not recognized as a lasting trend but rather as a temporary phenomenon (e.g. Bekaert, Hodrick and Zhang, 2009). Thirdly, these studies, and especially the time-varying type, are mostly concerned with the explanation of the empirically observed time variation of stock (and recently also bond) return correlations and covariances, as the most recent study from this group of authors confirms (Baele, Bekaert and Inghelbrecht, 2010). Through the better identification of asset return correlation and covariance structures and varying determinants over time, these studies aim to dynamically identify factors as sources that most contribute to risk diversification in a portfolio setting. By extension of the standard Heston and Rouwenhorst model, which these studies essentially are, therein also lies the limitations of the interpretation of the results that are obtained from it.

2.1. Alternative methodologies

In essence, the Heston and Rouwenhorst decomposition of stock returns model determines the extent to which separate factor-related effects explain their return variation. In so far as the objective of the portfolio manager is to reduce risk from these variation or risk-contributing factors, is a valid conclusion that “diversification across countries within an industry is a much more effective tool for risk reduction than industry diversification within a country” (Heston and Rouwenhorst, 1994, p3). The proper identification of the importance of country and industry (and potentially other) effects in asset return variation is an important achievement in itself, but little more in terms of portfolio design can justifiably be concluded from it. I concur with De Moor and Sercu (2009, p 6) when they state that “the Heston and Rouwenhorst (1994) methodology does not tell us anything about the correlations among sectors or countries, and no conclusion can therefore be made to international risk diversification”. While more recent studies highlighted earlier go much further in explaining asset return comovements, theirs remain bound too to the identification of the main sources of reduction of variation (or volatilities) in portfolio returns. Portfolio allocation is about more than just risk reduction.

It seems altogether that a complementing tool is needed to enable any qualifications of country versus industry portfolio construction. Certainly if any statements wish to be made on the portfolio allocation strategies in terms of the twin objectives of return optimization in relation to the amount of risk a portfolio manager is willing to take, as is often the case in fund management practice. This is offered by a strand of literature that adopts a model-based approach in the outright comparison of the performance of country and industry-based portfolios. Building on the analytical work of Huberman and Kandel (1987) and De Roon and Nijman (2001), Moerman (2004, 2008) and Eiling et al. (2006) evaluate the risk-return characteristics of equity portfolios constructed from a country and industry allocation. Taking an investor’s perspective, the starting point is a Markowitz-style mean-variance optimization problem from which efficient frontiers can be created for country and industry portfolios (and both combined, which by nature is always best). So-called spanning and efficiency tests are devised which are able to establish whether a country or industry portfolio has superior mean-variance properties. Spanning tests show whether the inclusion of extra investment opportunities enlarges the efficient set of portfolios. They are conducted by Moerman (2004, 2008) using the MSCI equity indexes for Euro zone countries (excluding Luxembourg) over the period 1995-2004. He finds that a stock investor is better off diversifying over industries rather than over countries, both for the full sample period and for two subperiods around EMU, but especially post-EMU. Moerman’s result is robust when sectors affected by the IT-bubble are neglected, though the difference in performance between the country and industry diversification becomes less pronounced. Eiling et al. (2006) conduct similar spanning tests for the Euro zone’s equity markets for the period 1990-2003. They also introduce efficiency tests, which test for the difference in maximum Sharpe ratios between cross-country and cross-industry diversified portfolios. Eiling et al. find, however, that country and industry-based portfolios cannot be distinguished in terms of mean-variance performance and Sharpe ratios. Their style analysis, which examines the ability to replicate the variation of industry portfolio returns with country indexes and vice versa, suggests an increasing relative importance of industry effects over country effects. This style analysis is further elaborated upon and comparable results confirmed in a subsequent study of Euro zone equity returns over the 1990 to 2008 period (Eiling et al., 2010). These latter results of the increased importance of industry effects are obtained through a related but different methodology (i.e. style analysis) from spanning and efficiency tests though.

The performance of mean-variance tests of spanning and efficiency provides yet another perspective in addition to the results obtained from the decomposition model in Chapter 4 on optimal portfolio diversification on a country or industry sector basis. For this reason and because this analysis has so far, to the best of my knowledge, not been performed on bonds, do I prefer to go down this route in this second chapter of the empirical analysis.

3. Mean-variance testing of country and industry portfolios

For the mean-variance comparison of bond portfolios, results are utilized of De Roon and Nijman's (2001) survey of mean-variance tests and as empirically tested for stocks by Moerman (2004, 2008) and especially Eiling et al. (2006). For the outline of the model specification, I stay as closely as possible to theirs to allow best comparison of the results for bonds with their results for stocks.

3.1. Spanning and efficiency tests

Starting point of the analysis is an investor with a mean-variance perspective who optimizes her European-wide country and industry portfolios constructed from country and industry subindexes. Consider $\mathcal{K}$ countries and $\mathcal{J}$ industries. The typical Markowitz-style unconditional portfolio optimization problem[1] results in three mean-variance efficient frontiers: one for a portfolio based on country indexes alone, one for a portfolio based on industry indexes alone and one constructed from both country and industry indexes. By definition the efficient frontier for all investment opportunities (countries and industries) is the most efficient. The other two investment strategies - countries alone and industries alone - are nested. The efficient frontiers can be plotted graphically in an average risk-return grid for the entire sample period and various subperiods, and their position compared.

Two types of tests, spanning and efficiency, are performed to determine whether country portfolios that are the aggregate of equal and value-weighted industry subindexes European-wide, or

[1] Where the investor minimizes the amount of portfolio risk as measured by the portfolio variance given a certain demanded realised return and subject to the budget restriction that all weights sum to one (De Roon and Nijman, 2001).

industry portfolios that are the aggregate of equal and value-weighted subindexes of European countries across industries are the most optimal.

The mean variance spanning test analyzes the effect that the introduction of additional industry (country) assets has on the mean-variance frontier of country (industry) portfolios. If the mean-variance frontier of the portfolio consisting of country or industry indexes alone coincides with the frontier of both, then there is spanning.[2] De Roon and Nijman (2001) show that testing for spanning can be done in a regression analysis framework, which is adopted by Eiling et al. (2006). I also use this regression framework for the purpose of testing the efficiency of bond portfolios.

With $\mathcal{K}$ countries (with $k = 1, \ldots, \mathcal{K}$), $\mathcal{J}$ industries (with $j = 1, \ldots, \mathcal{J}$) and T observations (with $t = 1, \ldots, T$), the returns of the portfolios on the two sets of indexes over time can be formulated as:

$$r_t^k = \alpha_k + \beta_k \, r_t^{\mathcal{J}} + \varepsilon_t^k \quad (1)$$

$$r_t^j = \alpha_j + \beta_j \, r_t^{\mathcal{K}} + \varepsilon_t^j \quad (2)$$

Eq. (1) considers whether the addition of industry indexes to a set of country sector indexes improves the investor's portfolio performance from a mean-variance point of view. The Jensen measures are the intercepts in Eqs. (1) and (2). A zero Jensen measure supports mean-variance spanning. Since outright returns are used, constraints have to be imposed also on the beta-coefficients for the spanning tests.[3] The null hypothesis of spanning implies that the intercepts are jointly statistically insignificantly different from zero *and* the sum of beta-coefficients are statistically insignificantly different from one. This hypothesis indicates that the diversification benefits of the portfolio of country indexes cannot be further improved from adding industry indexes to the portfolio. Eq. (2) can be given a similar interpretation with respect to the addition of industry indexes to a portfolio of country indexes.

Regressions performed for all T for all countries $\mathcal{K}$ result in a $\mathcal{K}\times 1$ of vector of estimated intercept coefficients, $\hat{\alpha}_{\mathcal{K}}$, a $\mathcal{K}\times\mathcal{J}$ matrix of estimated beta coefficients, $\hat{\beta}_{\mathcal{K}}$, and a $T\times\mathcal{K}$ matrix of error terms, $e_t^{\mathcal{K}}$; and for all industry sectors $\mathcal{J}$ similarly in a $\mathcal{J}\times 1$ of vector of estimated coefficients of intercepts, $\hat{\alpha}_{\mathcal{J}}$, a $\mathcal{J}\times\mathcal{K}$ matrix of estimated beta coefficients, $\hat{\beta}_{\mathcal{J}}$, and a $T\times\mathcal{J}$ matrix of normally distributed error terms, $e_t^{\mathcal{J}}$. The

[2] If the mean-variance frontier of the portfolio consisting of country or industry indexes alone and the frontier of both have exactly one point in common, then there is intersection. Intersection is thus one special case of spanning, tested for one investor's assumed risk-preference often taken to be directly related to the (gross) risk-free rate, while spanning tests for all investors' risk-preferences, i.e. whether it enhances diversification opportunities in general. Spanning is a more restrictive test than intersection (De Roon and Nijman, 2001).

[3] Eiling et al. (2006) use excess returns (i.e. returns in excess of risk-free returns) throughout and do not need to impose constraints on the beta-coefficients. In the case of excess returns, the spanning test is reduced to a test of whether the intercepts are jointly equal to zero.

restrictions imposed by the null hypothesis of the two spanning tests, corresponding with Eqs. (1) and (2) respectively, are defined as:

$$H_0 : \hat{\alpha}_{\mathcal{K}} = 0 \text{ and } \hat{\beta}_{\mathcal{K}}\, i_{\mathcal{J}} - i_{\mathcal{K}} = 0 \quad (3)$$

$$H_0 : \hat{\alpha}_{\mathcal{J}} = 0 \text{ and } \hat{\beta}_{\mathcal{J}}\, i_{\mathcal{K}} - i_{\mathcal{J}} = 0 \quad (4)$$

where $i_{\mathcal{J}}$ and $i_{\mathcal{K}}$ are $\mathcal{J}$×1 and $\mathcal{K}$×1 unit vectors respectively with all elements equal to one. De Roon and Nijman (2001) proof that the test statistic for the null hypothesis of Eq. (3) has a χ^2 distribution with $2\mathcal{K}$ degrees of freedom and can be derived from a standard Wald test as:

$$\chi^2_{\mathcal{K}} = h'_{span,\mathcal{K}} \left(H_{span,\mathcal{K}}\, \hat{Q}_{\mathcal{K}}\, H'_{span,\mathcal{K}}\right)^{-1} h_{span,\mathcal{K}} \quad (5)$$

If $\hat{b}_{\mathcal{K}} = \text{vec}\left(\left(\hat{\alpha}_{\mathcal{K}} \hat{\beta}_{\mathcal{K}}\right)'\right)$, a $\mathcal{K}(\mathcal{J}+1)$-dimensional vector of regression coefficients, and

$\hat{Q}_{\mathcal{K}} = \text{cov}\,(\hat{b}_{\mathcal{K}})$, the consistent estimate of the asymptotic covariance matrix thereof.

And $h_{span,\mathcal{K}} \equiv H_{span,\mathcal{K}}\, \hat{b}_{\mathcal{K}} - i_{\mathcal{K}} \otimes \begin{pmatrix}0\\1\end{pmatrix}$, a $2\mathcal{K}$×1 matrix, wherein ⊗ is the Kronecker delta and

$H_{span,\mathcal{K}} \equiv I_{\mathcal{K}} \otimes \begin{pmatrix}1 & 0'_{\mathcal{J}}\\ 0 & i^{i}_{\mathcal{J}}\end{pmatrix}$, is a $2\mathcal{K}\times\mathcal{K}(\mathcal{J}+1)$ matrix created from a $\mathcal{K}\times\mathcal{K}$ identity matrix times the Kronecker delta of $\begin{pmatrix}1 & 0'_{\mathcal{J}}\\ 0 & i'_{\mathcal{J}}\end{pmatrix}$ which also contains the (transposed) elements of $0_{\mathcal{J}}$, a $\mathcal{J}$×1 unit vector of zeros.

Likewise, the null hypothesis of Eq. (4) has a χ^2 distribution with $2\mathcal{J}$ degrees of freedom and can be derived from a standard Wald test as:

$$\chi^2_{\mathcal{J}} = h'_{span,\mathcal{J}} \left(H_{span,\mathcal{J}} \hat{Q}_{\mathcal{J}} H'_{span,\mathcal{J}}\right)^{-1} h_{span,\mathcal{J}} \quad (6)$$

If $\hat{b}_{\mathcal{J}} = \text{vec}\left(\left(\hat{\alpha}_{\mathcal{J}} \hat{\beta}_{\mathcal{J}}\right)'\right)$, a $\mathcal{J}(\mathcal{K}+1)$-dimensional vector of regression coefficients, and

$\hat{Q}_{\mathcal{J}} = \text{cov}\,(\hat{b}_{\mathcal{J}})$, the consistent estimate of the asymptotic covariance matrix thereof.

And $h_{span,\mathcal{J}} \equiv H_{span,\mathcal{J}}\, \hat{b}_{\mathcal{K}} - i_{\mathcal{J}} \otimes \begin{pmatrix}0\\1\end{pmatrix}$, a $2\mathcal{J}$×1 matrix, wherein

$H_{span,\mathcal{J}} \equiv I_{\mathcal{J}} \otimes \begin{pmatrix}1 & 0'_{\mathcal{K}}\\ 0 & i^{i}_{\mathcal{K}}\end{pmatrix}$, a $2\mathcal{J}\times\mathcal{J}(\mathcal{K}+1)$ matrix

The interpretation of the rejection of the null hypotheses in the spanning tests is relatively straightforward. In case the null hypothesis is rejected, mean-variance efficient country (industry) indexes do not span the universe of both types of indexes. This implies that all investors in general can improve their mean-variance efficient set by including the other set of indexes.

The spanning tests compare a portfolio of country or industry indexes to a portfolio consisting of both. The characteristics of the country and industry portfolios can be compared outright with the use of the maximum Sharpe ratio. De Roon and Nijman (2001) demonstrate that if the Sharpe ratio of a portfolio is defined as the expected excess portfolio return divided by the standard deviation of the portfolio returns, that by definition for a given expected portfolio return or for a given standard deviation of portfolio returns, the maximum attainable Sharpe ratio is the Sharpe ratio of the mean-variance efficient portfolio. Note that excess returns, i.e. the return over a risk-free rate, are utilized instead of outright returns to test this relation.

The efficiency test introduced by Eiling et al. (2006) uses this notion from de Roon and Nijman to devise a statistical test that determines whether the maximum Sharpe ratio of mean-variance efficient industry-based portfolios (denoted $\theta_{\mathcal{J}}$) equals that of country portfolios (denoted $\theta_{\mathcal{K}}$). Based on Gibbons et al. (1989) and Gerard et al. (2006), Eiling et al. (2006, p 8-9) write the difference in the maximum Sharpe ratios, denoted λ, as:

$$\lambda = \theta_{\mathcal{J}}^2 - \theta_{\mathcal{K}}^2 = \hat{c}_{\mathcal{J}}' \, \hat{c}_{\mathcal{J}} - \hat{c}_{\mathcal{K}}' \, \hat{c}_{\mathcal{K}} \qquad (7)$$

where $\hat{c}_{\mathcal{J}}$ and $\hat{c}_{\mathcal{K}}$ are $\mathcal{J}$×1 and $\mathcal{K}$×1 matrixes of estimated coefficients obtained from the regressions of Eqs. (1) and (2) of excess returns scaled by the covariance matrixes of the error terms from the same regressions, $\Omega_{\mathcal{K}\mathcal{K}}$ and $\Omega_{\mathcal{J}\mathcal{J}}$, in the following way:

$$\Omega_{\mathcal{K}\mathcal{K}}^{-1/2} \, r_t^k = c_k + D_k \, r_t^{\mathcal{J}} + u_t^k \quad \text{, where } \Omega_{\mathcal{K}\mathcal{K}} = \text{cov}\,(\varepsilon_t^k) \qquad (8)$$

$$\Omega_{\mathcal{J}\mathcal{J}}^{-1/2} \, r_t^j = c_j + D_j \, r_t^{\mathcal{K}} + u_t^j \quad \text{, where } \Omega_{\mathcal{J}\mathcal{J}} = \text{cov}\,(\varepsilon_t^j) \qquad (9)$$

The null hypothesis of the efficiency test is that the difference in maximum Sharpe ratios is statistically insignificantly different from zero:

$$H_0 : \lambda = \theta_{\mathcal{J}}^2 - \theta_{\mathcal{K}}^2 = \hat{c}_{\mathcal{J}}' \, \hat{c}_{\mathcal{J}} - \hat{c}_{\mathcal{K}}' \, \hat{c}_{\mathcal{K}} = 0 \qquad (10)$$

The test statistic of the null hypothesis is again χ^2 distributed with 1 degree of freedom and can be derived as a standard Wald test as λ^2. If the null hypothesis, i.e. efficiency, is rejected then the mean-variance efficiency of either the country optimal portfolios or the industry optimal portfolios as measured by their maximum Sharpe ratios is significantly larger than the other.

Eiling et al. (2006) additionally perform both the spanning and efficiency tests with the incorporation of no-short sales assumption, which imposes constraints in the conditional analysis required to guarantee positive aggregate weights in the assets. I do not incorporate short sale restrictions in the analysis, as bonds can be shorted quite easily by professional investors.

3.2. Excluding overlapping components

Whenever country and industry indexes are by construction based on the same universe of subindexes, each country portfolio (e.g. Germany) that is industrially diversified and industry sector portfolio (e.g. consumer) that is geographically diversified contains one common subindex (consumer sector in Germany). Eiling et al. (2006) observe that these common or overlapping components could be a source of covariance between country and industry portfolios. They propose to perform the spanning and efficiency tests on portfolios from which common components have been removed, which allows them to extract pure country and industry effects.

The adjusted equations for the exclusion of common components to replace the base Eqs. (1) and (2) and where the same logic for either test can be followed through, are:

$$r_{x,t}^{k} = \alpha_x + \sum_{y=1}^{\mathcal{J}} \beta_{xy}\, r_{y,t}^{\mathcal{J}\backslash x} + \varepsilon_{x,t}^{k} \qquad (11)$$

$$r_{y,t}^{j} = \alpha_y + \sum_{x=1}^{\mathcal{K}} \beta_{yx}\, r_{x,t}^{\mathcal{K}\backslash y} + \varepsilon_{y,t}^{j} \qquad (12)$$

where $r_{y,t}^{\mathcal{J}\backslash x}$ is the excess return on the $\mathcal{J}$th European-wide geographically diversified industry sector portfolio from which country *x* components have been excluded, and the same for $r_{x,t}^{\mathcal{K}\backslash y}$ for industry *y.*

4. Construction of the portfolios

In principle, the spanning and efficiency tests specified in the previous section can be applied to country and industry portfolios of various content. Eiling et al. (2006) utilize monthly USD returns from a set of stock indexes, which are sectioned into country-industry subindexes. Their data set constitutes a closed set since each stock return belongs to exactly one country index and one industry index. Starting from the data set of 6,440 eurobond returns, described in Chapter 4 Section 3, those belonging to the country group “other” are removed to similarly create a closed sample. Eurobonds from supranational institutions are also removed from the sample because all bonds in this subindex belong per definition to one industry group only. Following this, 4,587 eurobonds returns remain for the period May 1990-March 2008 that can be assigned to the eight remaining countries which are all from Europe (Belgium/Luxembourg, France, Germany, Netherlands, Italy, Spain, Sweden and the UK) and the same seven industry groups (financials and funds, government institutions, consumer, communications and technology, basic materials and energy, industrials and utilities). The summary and performance statistics of this subset of the original data set of eurobonds are in Tables A1 and A2 of *Appendix A*. They remain largely as described in Chapter 4 Section 5.1.

I conduct the mean-variance testing on two types of portfolio index construction methods. The first set is based on straightforwardly constructing indexes from the country and industry classifications of the 4,587 eurobonds in the sample. In this case a German bond issued by a consumer product manufacturer is included in both the German country index as well as the consumer industry index. The second set of country and industry portfolio indexes is based on the standard decomposition, since it is shown in Chapter 4 (Section 5.2) that decomposition produces portfolio indexes that may have different portfolio implications than indexes based on the direct allocation of eurobonds. Both types of indexes are created on an equal and value-weighted basis and with and without overlapping components. They are calculated from outright returns for the purpose of the spanning tests and from excess returns for the purpose of the efficiency tests. Excess return is defined as the return obtained from the investment in the eurobond over the risk-free return. I obtain 1-month USD deposit rates from Datastream to proxy this risk-free return.[4]

4.1. Inclusion of government bonds indexes

While the performance of the spanning and efficiency tests on these two types of subindexes will already render important insights on the diversification gains of country versus industry portfolios, these remain limited to portfolios of eurobonds only. Eurobonds from government institutions are included in the data set, but these are not (pure) government bonds. Government eurobonds are bonds issued by sovereigns in a non-national currency and in international format. Government bonds are bonds issued by sovereigns in their national currency, often through an established debt management agency and pre-announced auction program and initially absorbed and traded by a group of primary dealers. As government bonds tend to be

[4] To calculate the risk-free return, R_t^{RF} I extract from the 1-month deposit rate, which is expressed as an annualized rate and denoted i_t^{DEP}, the interest earned by the end of month *t* assuming compounded interest through the following equation: $R_t^{RF} = (1 + (i_{t-1}^{DEP}/100))^{1/12} - 1$. The excess return for each eurobond is simply the subtraction of the 1-month risk-free return from the monthly USD eurobond return (obtained from Eq.(2) in Chapter 4).

larger in size and thus more liquid than eurobonds, their yield curve is often one of the benchmarks for eurobond price setting and has its own price dynamic. The analysis of bond market practice in Chapter 3 is evidence of bond portfolios consisting predominantly of government bonds and being allocated along country lines as such before EMU. Investor interest in corporate eurobonds surges thereafter. The benefits of diversifying away from government bonds post-EMU into eurobonds can be further proven if the first are also explicitly included in the empirical analysis. For this purpose, indexes for government bonds will be used to create a third set of country indexes.

A number of institutions provide government bond indexes for the European markets from which the holding period returns series can be readily obtained. From the various providers, I choose the European Federation of Financial Analysts' Societies (EFFAS) indexes as published by Bloomberg on three grounds. First, their indexes cover all countries otherwise included in the data set and date back the furthest. Secondly, as the only not-for-profit organization among potential providers, EFFAS are the most independent and transparent source in the marketplace with the finest methodology, least arbitrary rule changes and greatest level of consistency applied to their indexes calculations. Thirdly, the EFFAS methodology for calculating bond indexes is published and has become accepted as the industry-standard shortly after they were launched.[5] I obtain the end-of-month EFFAS local currency all-bond total returns index series for the whole market (i.e. all maturities above one year) from Bloomberg for eight government bond markets: Germany, France, Italy, Spain, Belgium, Netherlands, Sweden and the UK. These series are available from December 1991 to March 2008.

From the EFFAS local currency total return indexes, after conversion to US Dollar, the third set of eight country portfolio indexes are created. EFFAS performs the local currency return calculations on a (changing) set of government bonds weighted by amount outstanding for each country *k* and provides a total return index in local currency at each time t, $TR_{k,\ddot{j},t}$, which is set at a monthly interval. The country index return, $\ddot{R}^{LC}_{k,\ddot{j},t}$, is value-weighted by nature of their calculation and simply obtained from:

$$\ddot{R}^{LC}_{k,\ddot{j},t} = \left(TR_{k,\ddot{j},t}/TR_{k,\ddot{j},t-1}\right) - 1, \quad k = 1, \dots, K \text{ and } \ddot{j} = \text{domestic government} \qquad (13)$$

The local currency returns for government bonds of the respective countries are converted to common currency through a variant of Eq.(2) in Chapter 4:

$$\ddot{R}^{CC}_{k,\ddot{j},t} = (1 + \ddot{R}^{LC}_{k,\ddot{j},t})\,(S_t / S_{t-1}) - 1, \quad k = 1, \dots, K \text{ and } \ddot{j}^{*} = \text{domestic government} \qquad (14)$$

[5] I refer to Brown, P.J. (1994, 2002) for a full description of the EFFAS bond indexes.

Note that I stay with the formula as proposed by Heston and Rouwenhorst using spot exchange rates, rather than the method suggested by Brown (2002, pp 135-137) using forward rates. Excess return indexes are calculated as the difference in return obtained through Eq. (14) over the risk-free return, in similar fashion as before.

Country indexes thus obtained from the EFFAS government indexes are compared for spanning, using outright returns, and efficiency, using excess returns, with the two sets of eurobonds allocated by industry sector (from the straightforward allocation and from the decomposition). While it is theoretically feasible to incorporate government bonds into the industry sector of government institutions calculated from eurobond returns, there are two arguments against this. First, the government bond sector carries such substantial weight in some countries, particularly those with historically large public sectors and small corporate eurobond markets (such as Belgium and Spain), that the new value-weighted industry index returns would be heavily skewed towards governments bonds, while in other countries where it carries considerably less weight (such as the UK), the opposite is the case. The incorporation of the government sector in the industry indexes would result in considerable distortion of the returns. Secondly, while the industry indexes calculated from returns of individual eurobonds complies with the EFFAS guidelines, differences remain with the way in which EFFAS derives the government bond indexes. The reinvestment of a coupon payment received is from the start of the new balancing period in the calculation of the eurobond return indexes instead of immediately in the case of the EFFAS government bond indexes, and for the value weights of eurobonds the amount issued is used instead of the amount outstanding and only the amount issued failing that for the government bonds. Rather than mixing subindexes created from different sources and methodologies, albeit with just slight differences, it is preferable to keep the country indexes from government bonds separate from industry indexes from eurobonds and compare their mean-variance performance outright.

5. Empirical results

This section gives the empirical results for mean-variance testing of country and industry bond portfolios. Spanning tests are performed, which will indicate whether country portfolios can be improved by adding assets from the industry indexes and vice versa. Efficiency tests are performed, which will indicate whether the maximum Sharpe ratio of one set of portfolios compared to the other is statistically better (or worse). Country and industry portfolios created from three types of input are the subject of these tests: both created directly from eurobond (excess) returns (in Section 5.1), both created from eurobond (excess) returns after decomposition (in Section 5.2), and country indexes created from government bond returns and industry indexes created from (decomposed) eurobond (excess) returns (in Section 5.3). For the country and industry portfolios based on eurobond returns alone, before and after decomposition, result from both equal and value-weighted indexes are shown. Because in these portfolios, each eurobond belongs to one country and one industry simultaneously, results are also shown for portfolios excluding overlapping components. Country portfolios consisting exclusively of government bonds are always value-weighted and have no overlapping components with industry indexes created from eurobond returns. Results are for the full sample period and two subperiods around EMU.

In contrast to Eiling et al. (2006) who find that for stocks from the Euro zone for the period 1990-2003, country-based and industry-based portfolios cannot be distinguished in terms of mean-variance efficiency and Sharpe ratios, country and industry bond portfolios can in a number of cases be improved by adding assets from the other portfolio and do not always have (statistically) equal maximum Sharpe ratios. It is also found that there is a noticeable difference in the benefits of country and industry portfolios of bonds before and after EMU. These are noteworthy results, which are discussed below for each type of country and industry portfolios.

5.1. From eurobond returns

First, country and industry portfolios from the sample of 4,587 eurobond returns are constructed directly. Their monthly equal and value-weighted returns and excess returns in USD are calculated for the sample period of May 1990 to March 2008. Returns of country indexes are then regressed on the returns of industry indexes and vice versa and from the various regression estimates, the test statistics of the spanning tests from outright returns and efficiency tests from excess returns are calculated.[6] This is then repeated for the subperiods before and after EMU.

Table 5.1 lists the results, where H_0*: spanning* $\mathcal{K}$ *(*$\mathcal{J}$*)* is the result for the null hypothesis that country (industry) return indexes are spanned by industry (country) indexes and H_0*: efficiency* is the result from the null hypothesis that the maximum Sharpe ratios of the country and industry excess return indexes are the same. When the result exceeds the critical level, indicated in bold in the table, the null hypothesis is rejected and is the country eurobond portfolio statistically distinguishable from the industry eurobond portfolio in terms of mean-variance performance over the respective period. The difference in the values of the maximum Sharpe ratios, λ, is also reported. It is consistently defined as the maximum Sharpe ratio of the industry-based portfolios less that of the country-based portfolios, which are reported directly underneath.

[6] Results from spanning tests for excess returns are very similar to those reported in Tables 5.1 and 5.2 for outright returns and are available upon request.

Table 5.1

Spanning and efficiency of country and industry portfolios of eurobond returns

The table shows the results of the spanning and efficiency tests performed on country and industry indexes created from (excess) eurobond returns for the period indicated. *H_0: spanning $\mathcal{K}$ ($\mathcal{J}$)* is the result for the null hypothesis that country (industry) indexes are spanned by industry (country) indexes. *H_0: efficiency* is the result that the maximum Sharpe ratios are the same. Test results are in bold when it exceeds the critical level (95% confidence interval).

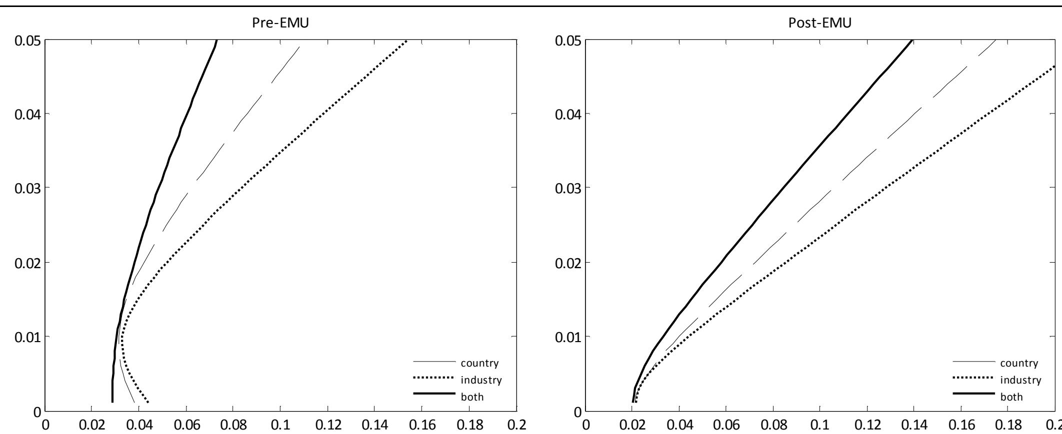
Country and industry indexes from:	*Critical level*	Full period 5/1990 – 3/2008 EW	Full period 5/1990 – 3/2008 VW	Pre-EMU 5/1990 – 12/1998 EW	Pre-EMU 5/1990 – 12/1998 VW	Post-EMU 1/1999 – 3/2008 EW	Post-EMU 1/1999 – 3/2008 VW
I. Eurobond returns							
H_0: spanning $\mathcal{K}$	*(26.3)*	24.9	**27.7**	22.2	**37.2**	8.2	20.8
H_0: spanning $\mathcal{J}$	*(23.7)*	17.7	**26.3**	6.78	**24.2**	5.5	11.5
excl. overlapping components							
H_0: spanning $\mathcal{K}$	*(26.3)*	**27.8**	**51.2**	22.5	**50.0**	10.7	12.8
H_0: spanning $\mathcal{J}$	*(23.7)*	11.3	**26.2**	22.4	**82.7**	16.2	23.0
II. Eurobond excess returns							
H_0: efficiency	*(3.84)*	0.02	0.004	0.19	0.67	0.21	0.05
Difference in MSR (λ)		-0.15	-0.07	-0.43	-0.82	-0.46	-0.23
MSR $\mathcal{J}$		0.00064	0.00096	0.0013	0.0015	0.00021	0.00067
MSR $\mathcal{K}$		0.37	0.26	0.66	0.90	0.68	0.48
excl. overlapping components							
H_0: efficiency	*(3.84)*	0.003	0.004	0.32	0.17	0.010	0.009
Difference in MSR (λ)		-0.06	-0.07	-0.57	-0.42	-0.10	-0.10
MSR $\mathcal{J}$		0.00078	0.00072	0.0024	0.0018	0.00079	0.0012
MSR $\mathcal{K}$		0.24	0.26	0.75	0.65	0.32	0.31

Note: MSR stands for maximum Sharpe Ratio, whereby $\mathcal{J}$ indicates that for the industry indexes and $\mathcal{K}$ that for the country indexes

Figure 5.1

Mean-variance frontiers for country and industry indexes of eurobond returns

The figure shows the mean-variance frontiers for corporate eurobonds for three investment types before and after EMU. The dashed line represents the set of optimal opportunities when only value-weighted industry indexes can be invested in. The dotted line is the mean-variance frontier when only value-weighted country indexes are considered. The solid line considers both types of indexes. The *x*-axis represents the standard deviation of returns and the *y*-axis the mean returns of the respective portfolios. Returns are in USD and per month and need to be multiplied by 100 for percentages.



It can be seen from Table 5.1 that the mean-variance performance of country and industry portfolios can in a number of cases be improved by adding assets from the opposite set. This is predominantly the case for value-weighted country and industry portfolios over the full sample period and pre-EMU. Note that spanning is rejected less often in the case of equal-weighted portfolios. Value-weighting the portfolios leads to a higher concentration in larger size issues from the government insititutions and the communications and technology sectors away from the numerous but smaller sized issues of financial institutions sector (see Table A1 in *Appendix A*). This evidently results in a deteriorating mean-variance performance. While in the pre-EMU period value-weighted country portfolios are not spanned by industry portfolios and vice versa, in the post-EMU period both types of portfolios are. This implies that in Europe before the introduction of EMU neither a pure country diversification nor a pure industry diversification of eurobonds is mean-variance optimal, but that following EMU both of them are more or less equally optimal.

The results from the spanning tests allows for further qualifications. It has already been observed that there is a significant difference in results between equal and value-weighted portfolios. It is when eurobonds are incorporated according to their issue size rather than on a like-for-like basis that country and industry portfolios become mean-variance suboptimal. Also, the mean-variance performance of all portfolios deteriorates significantly when overlapping eurobonds are removed. Both results are a reflection of the loss of diversification opportunity, the former because portfolios are skewed towards larger size issues and the latter because either complete geographical diversification or complete industrial diversification can no longer be achieved.

Figure 5.1 plots the mean-variance frontier for the three value-weighted investment opportunities from the outright eurobond returns pre and post-EMU. It visualizes that for a given amount of risk the difference between the average returns of country and industry portfolios is comparatively larger in the pre-EMU period. This corroborates the test results in Table 5.1, which show that in the pre-EMU period the performance of value-weighted portfolios can be improved by adding either country or industry-based indexes.

The results from the efficiency tests show that country and industry portfolios cannot be distinguished in terms of their maximum Sharpe ratios, neither for the whole sample period nor in either subperiod. The maximum Sharpe ratio is consistently higher for the country portfolios than for the industry portfolios, which is confirmed by negative values for λ. This can also be observed in Figure 5.1, where the mean-efficient frontier of country portfolios lies outside that of industry portfolios. The difference in maximum Sharpe ratio between the two types of portfolios is not statistically different though.

5.2. From decomposed eurobond returns

To create the second set of portfolios, the returns of the 4,587 eurobonds are decomposed into country and industry effects. The motivation to include decomposed country and industry portfolios is not so much because such portfolios are immediately replicable by fund managers. They rather serve as a construct to build on and verify results from the previous chapter. Table A3 in *Appendix A* presents the results of this decomposition for the entire sample period of May 1990 to March 2008 for the closed set of eurobonds. Table A4 in the same appendix shows the decomposition results for the two subperiods around EMU, which are very similar to the ones described for the complete data set in Chapter 4. Here, equal and value-weighted country and industry indexes are created from the decomposition for the full sample period and two subperiods, with and without overlapping constituents. Results for the spanning and efficiency tests on these sets portfolios are shown in Table 5.2, which has the same format as Table 5.1.

Comparing the results in Table 5.1 with Table 5.2, it can be seen that the null hypothesis of spanning is rejected less often for the indexes based on decomposed returns. Generally, country and industry portfolios become more mean-variance efficient after decomposition. In Table 5.2 spanning is rejected mostly for industry indexes rather than country indexes. Over the full sample period, both equal and value-weighted industry indexes are not spanned by the country indexes. This is in line with the results from the decomposition analysis in Chapter 4, where it is established that country effects contribute more to the variation in eurobond returns than industry effects. It is now largely the industry indexes that can be improved in their mean-variance performance with the incorporation of assets from the country indexes rather than the other way around. Note otherwise that the difference between equal and value-weighted portfolios is less than in the case of portfolios from the direct allocation of eurobonds, but that the removal of overlapping components has as much of a deteriorating effect on mean-variance comparable performance of portfolios. Evidently, the loss in diversification from incomplete geographical or industrial spread remains the same after decomposition.

The results from the efficiency tests in Table 5.2 show that the null hypothesis of equal maximum Sharpe ratios between country and industry portfolios cannot be rejected, as was the case with the previous set of portfolios. Figure 5.2, as is true for Figure 5.1, shows that the mean-variance frontier of country indexes allows for more risk and return combinations than the equivalent frontier of industry indexes. This is confirmed by the negative values of the lambda in Table 5.2, which indicate that the maximum Sharpe ratio of country portfolios is always greater than that of industry-based portfolios. The results from Table 5.2 also show that this difference is not statistically different, though.

Table 5.2

Spanning and efficiency of country and industry portfolios of decomposed eurobond returns

The table shows the results of the spanning and efficiency tests performed on country and industry indexes created from decomposed (excess) eurobond returns for the period indicated. *H_0: spanning $\mathcal{K}$ ($\mathcal{J}$)* is the result for the null hypothesis that country (industry) indexes are spanned by industry (country) indexes. *H_0: efficiency* is the result that the maximum Sharpe ratios are the same. Test results are in bold when it exceeds the critical level (95% confidence interval).

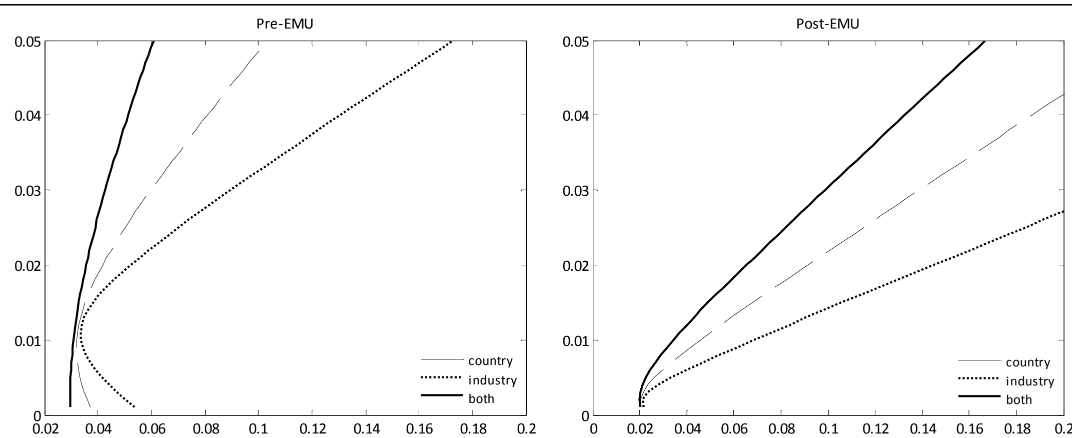
Country and industry indexes from:	*Critical level*	Full period 5/1990 – 3/2008		Pre-EMU 5/1990 – 12/1998		Post-EMU 1/1999 – 3/2008	
		EW	VW	EW	VW	EW	VW
I. Eurobond returns							
H_0: spanning $\mathcal{K}$	*(26.3)*	25.4	25.7	23.3	23.5	10.8	22.6
H_0: spanning $\mathcal{J}$	*(23.7)*	**27.8**	**36.1**	19.7	16.8	4.7	8.0
excl. overlapping components							
H_0: spanning $\mathcal{K}$	*(26.3)*	**31.5**	18.7	22.6	24.3	22.4	25.9
H_0: spanning $\mathcal{J}$	*(23.7)*	18.7	**28.2**	**31.0**	**36.7**	9.9	14.8
II. Eurobond excess returns							
H_0: efficiency	*(3.84)*	0.04	0.01	2.02	1.85	2.02	0.79
Difference in MSR (λ)		-0.20	-0.11	-1.42	-1.36	-1.42	-0.89
MSR $\mathcal{J}$		0.00063	0.00075	0.0013	0.0012	0.00023	0.00045
MSR $\mathcal{K}$		0.45	0.33	1.19	1.17	1.19	0.94
excl. overlapping components							
H_0: efficiency	*(3.84)*	0.002	0.002	0.09	0.06	0.007	0.03
Difference in MSR (λ)		-0.04	-0.05	-0.31	-0.25	-0.08	-0.18
MSR $\mathcal{J}$		0.00071	0.00078	0.0023	0.0019	0.00068	0.00076
MSR $\mathcal{K}$		0.21	0.21	0.55	0.50	0.28	0.42

Note: MSR stands for maximum Sharpe Ratio, whereby $\mathcal{J}$ indicates that for the industry indexes and $\mathcal{K}$ that for the country indexes

Figure 5.2

Mean-variance frontiers for country and industry indexes of decomposed eurobond returns

The figure shows the mean-variance frontiers for corporate eurobonds after decomposition for three investment types before and after EMU. The dashed line represents the set of optimal opportunities when only decomposed value-weighted industry indexes can be invested in. The dotted line is the mean-variance frontier when only decomposed value-weighted country indexes are considered. The solid line considers both types of indexes. The *x*-axis represents the standard deviation of returns and the *y*-axis the mean returns of the respective portfolios. Returns are in USD and per month and need to be multiplied by 100 for percentages.



5.3. Government bonds versus eurobonds

Thirdly, the set of country portfolio indexes consists exclusively of government bonds and industry indexes exclusively of eurobonds. Because the EFFAS total return series for government bonds start in December 1991, the full sample period is shortened by 18 months. Country indexes are always value-weighted, while industry indexes can be both equal and value-weighted. There are no overlapping components. Results of spanning and efficiency tests for these entirely separate country and industry portfolios are shown in Table 5.3 (which has the same format as Tables 5.1 and 5.2).

The results of these tests give an indication, for the first time in the analysis, whether a portfolio strategy based on government bonds alone in Europe and allocated along country lines has been efficient and whether the inclusion of eurobonds enhances the performance of these portfolios, particularly after the monetary union. From the spanning tests it can be seen that both value-weighted country and industry indexes can be improved over the whole sample period and pre-EMU when the industry indexes are created directly from eurobond returns. When industry indexes are created from eurobond returns after

Table 5.3
Spanning and efficiency of country portfolios from government bond (excess) returns and industry portfolios from (decomposed) eurobond (excess) returns

The table shows the results of the spanning and efficiency tests performed on country indexes created from domestic government bond returns and industry indexes created from (decomposed) eurobond (excess) returns for the period indicated. *H_0: spanning $\mathcal{K}$ ($\mathcal{J}$)* is the result for the null hypothesis that country (industry) indexes are spanned by industry (country) indexes. *H_0: efficiency* is the result that the maximum Sharpe ratios are the same. Test results are in bold when it exceeds the critical level (95% confidence interval).

Country and industry indexes from:	*Critical level*	Full period 12/1991 – 3/2008 EW	VW	Pre-EMU 12/1991 – 12/1998 EW	VW	Post-EMU 1/1999 – 3/2008 EW	VW
I.a Government bond and eurobond returns							
H_0: spanning $\mathcal{K}$	*(26.3)*	23.8	**44.5**	21.9	**40.9**	14.2	21.0
H_0: spanning $\mathcal{J}$	*(23.7)*	**24.1**	**36.0**	12.7	**32.6**	13.7	12.9
I.b Government bond and eurobond excess returns							
H_0: efficiency	*(3.84)*	0.37	0.05	0.17	0.07	**14.4**	**46.9**
Difference in MSR (λ)		-0.62	-0.22	-0.41	-0.27	-3.80	-6.85
MSR $\mathcal{J}$		0.00095	0.00067	0.0014	0.0016	0.0008	0.001
MSR $\mathcal{K}$		0.78	0.47	0.64	0.52	1.95	2.62
II.a Government bond and decomposed eurobond returns							
H_0: spanning $\mathcal{K}$	*(26.3)*	**32.4**	**39.0**	**43.6**	**38.6**	**29.6**	**29.8**
H_0: spanning $\mathcal{J}$	*(23.7)*	21.5	**42.0**	13.7	**26.6**	11.8	14.3
II.b Government bond and decomposed eurobond excess returns							
H_0: efficiency	*(3.84)*	0.25	0.36	0.07	0.11	**406.1**	**341.1**
Difference in MSR (λ)		-0.50	-0.60	-0.26	-0.32	-20.2	-18.7
MSR $\mathcal{J}$		0.00099	0.00097	0.00078	0.0011	0.00087	0.00088
MSR $\mathcal{K}$		0.71	0.78	0.51	0.57	4.49	4.30

Note: MSR stands for maximum Sharpe Ratio, whereby $\mathcal{J}$ indicates that for the industry indexes and $\mathcal{K}$ that for the country indexes decomposition, however, country portfolios of government bonds can always be improved with the addition of eurobonds. It therefore seems that a bond allocation strategy based on government bonds alone, presumably the dominant practice in the days before EMU, is uncovered as sub-optimal. In the post-EMU environment, such portfolios can be enhanced by adding assets from decomposed industry indexes.

From the efficiency tests it can be seen that there is now, in contrast to the previous two cases, a very clear result. In the post-EMU environment country portfolios of government bonds and industry portfolios of eurobonds can be distinguished in terms of their maximum Sharpe ratios. It has already been observed with the previous two sets of portfolios that the maximum Sharpe ratio is higher for the country-based portfolios than for the industry-based portfolios. This is true in this third case as well. It can be seen from Table 5.3 that values of the lambda are negative throughout. This leads to an important overall observation; even in cases where industry portfolios are mean-variance optimal and cannot be enhanced with assets from country portfolios, country portfolios seem capable of achieving a higher maximum Sharpe ratio. This efficiency characteristic is only statistically significantly different in the case of country portfolios created from government bonds in the post-EMU environment.

6. Conclusions

This chapter compares the mean-variance performance of country and industry portfolios of European bonds through spanning and efficiency tests. Similar studies, such as Huberman and Kandel (1987), Moerman (2004, 2008) and Eiling et al (2006) have been performed for equities but not for bonds. Not only can results from this analysis again be compared with the outcome for stock returns, they also allow for further qualifications on whether a country or an industry-based allocation strategy performs better in European bond markets overall.

It is described that the empirical application of mean-variance tests is at the portfolio index level. Starting from the complete set of 6,440 USD of individual eurobond returns a closed set is created for the purpose of this analysis. By virtue of excluding eurobonds from supranational institutions and from the category other, 4,587 eurobond returns remain. These belong each to exactly one of eight European countries (Belgium/Luxembourg, France, Germany, Netherlands, Italy, Spain, Sweden and the UK) and the same seven industry groups (financials and funds, government institutions, consumer, communications and technology, basic materials and energy, industrials and utilities) as before. From this ‘closed’ set, country and industry portfolio indexes are created, first from their direct categorization and secondly after decomposition using the standard methodology of Chapter 4. Return indexes in these two cases are calculated on an equal and on a value-weighted basis. They are also calculated following the exclusion of overlapping components, as these could be a source of covariance. In the third case, country portfolios are created from the EFFAS government bond index series and compared with industry portfolios of eurobonds created either way (direct and decomposed). Such country portfolios are by their nature value-weighted and do not have overlapping components with the industry portfolios of eurobonds. While with the previous two sets of portfolios, the full sample period remains May 1990 to March 2008, in this third case it is reduced by 18 months because the EFFAS series have their base date in December 1991.

In all three cases, country and industry portfolios are compared for spanning and efficiency for the full sample period and in each subperiod around the inception of EMU. The methodology of spanning follows that of Huberman and Kandel (1987) and De Roon and Nijman (2001). In a mean-variance optimization framework, the statistical test of spanning is devised to determine whether the return performance of one type of portfolio (e.g. country) can be improved by adding assets from the opposite set (i.e. industry portfolios). Based on this analytical work, the hypothesis for spanning is statistically derived from a standard Wald test with a χ^2 distribution. Rejection of the null hypothesis of spanning implies that the mean-variance efficient country (or industry) indexes do not span the universe of both types of indexes. Hence spanning tests compare a portfolio of country or industry indexes to a portfolio of both. The mean-vairance test of efficiency compares country and industry portfolios directly in their maximum Sharpe ratios. From De Roon and Nijman (2001) and Eiling et al. (2006), the hypothesis of efficiency is similarly derived from a standard Wald test with a χ^2 distribution. Rejection of the null hypothesis for efficiency implies that the maximum Sharpe ratio of country-based and industry-based portfolios can be statistically distinguished. In the set-up followed in this chapter, outright returns of country and industry indexes provide the input for the spanning tests and returns in excess of 1-month USD deposit rates provide the input for the efficiency tests.

Spanning tests find that for the first two sets of country and industry portfolios created from eurobond indexes alone, spanning on the whole is rejected less often in the case of decomposed portfolios. In cases it is rejected, in the pre-EMU and full sample periods, it is mostly found that industry portfolios are not spanned by their country components. Both the decision to incorporate bonds on a value-weighted rather than on an equal-weighted basis and the decision to remove overlapping components leads to a loss of diversification opportunities. Efficiency tests find that country and industry portfolios of eurobonds cannot be distinguished in their maximum Sharpe ratio, though it is consistently found to be higher for country-based portfolios. These first set of conclusions are in line with results from the decomposition analysis in Chapter 4, where it is found that country effects contribute more to the variation of eurobond returns than industry effects.

Following the addition of government bonds in the analysis and their insertion an alternative set of country portfolios leads to yet further results. Spanning tests find that a country diversification of a portfolio of government bonds is largely a suboptimal strategy. In the majority of cases such country portfolios can be improved with the addition of eurobonds. In fact, country portfolios of government bonds can always be improved by the addition of assets from decomposed industry indexes of eurobonds. This is yet further confirmation that following decomposition, industry indexes of eurobonds become more mean-variance optimal. In contrast to the first two sets of portfolios constructed from eurobonds alone, the null hypothesis for efficiency is rejected occasionally in this third case. Post-EMU, portfolios can be distinguished in their maximum Sharpe ratio whereby it is further established that this ratio is higher for country than for industry portfolios. The maximum Sharpe ratio is higher in all other cases too for country portfolios.

These results from mean-variance tests of portfolios of European bonds are noteworthy; particularly if one considers that similar tests performed on European stock returns over comparable time periods have yielded mixed results at best. Formulated in terms of the willingness of investors to diversify on a country or an industry basis in European bond markets, they add two qualifications to those from Chapter 4. First strictly for eurobonds alone, investors are more willing to follow country-based allocation strategies pre-EMU, as these portfolios are more often spanned by industry-based portfolios than vice versa. Post-EMU, both strategies become mean-variance efficient, but country-based portfolios seem to generate better risk-adjusted returns in the long run (though not of statistical significance). Thus the ex-ante expectation based on the observation of dominating country effects in European eurobond returns that country-based portfolios ought to be preferred finds further confirmation through these results. Secondly, investors should be less willing to construct portfolios from government bonds alone despite their statistically superior maximum Sharpe ratios. Such portfolios can invariably be improved for their mean-variance performance with the inclusion of eurobonds. Thus, the ex ante expectation that European bond portfolios that were biased towards government bonds have benefitted from the incorporation of eurobonds is also confirmed with these results. Despite, the validation of a larger credit diversification of European bond portfolios post-EMU, fund manager should in light these results overall consider carefully to discard country-based diversification strategies in favor of industry-based diversification strategies.

Appendix A

Table A1

Country and industry composition of closed data set of eurobonds

Panels A and B give for each country and industry, the number of eurobonds included in the total sample and as a percentage of the total number of eurobonds. Panel C gives for each country by industry the number of eurobonds included in the total sample. Panel D gives the average weight of the (live) eurobonds in the country by industry cross-sector in the total value-weighted market over the whole sample.

A. By country (number and percent of total)				B. By industry (number and percent of total)			
Belgium/Luxembourg:	BL	192	4.19%	Financials & Funds:	FF	2,879	62.76%
France:	FR	720	15.70%	Government Institut:	GI	484	10.55%
Germany:	GE	1,313	28.62%	Consumer:	CO	386	8.42%
Italy:	IT	203	4.43%	Comm. & Technology:	CT	215	4.69%
Netherlands:	NE	720	15.70%	Basic materials &			
Spain:	SP	94	2.05%	Energy:	BE	149	3.25%
Sweden:	SW	445	9.70%	Industrials:	IN	202	4.40%
United Kingdom:	UK	900	19.62%	Utilities:	UT	272	5.93%
Total		4,587		Total		4,587	

C. Number of eurobonds by country and industry

	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	139	13	2	5	15	7	11	192
France	401	58	57	48	31	80	45	720
Germany	912	193	76	32	28	43	29	1,313
Italy	95	47	18	15	3	6	19	203
Netherlands	610	5	19	27	21	18	20	720
Spain	44	14	8	12	4	1	11	94
Sweden	198	134	49	21	13	14	16	445
United Kingdom	480	20	157	55	34	33	121	900
Total	2,879	484	386	215	149	202	272	4,587

D. Average weights in the total value-weighted market

	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	0.48	0.41	0.00	0.14	0.11	0.10	0.19	1.43
France	5.93	2.81	1.00	1.42	0.37	1.48	1.12	14.13
Germany	11.80	3.30	1.11	0.77	0.39	1.37	0.80	19.55
Italy	1.21	17.80	0.36	0.54	0.09	0.17	0.22	20.39
Netherlands	8.51	0.03	0.24	0.29	0.35	0.32	0.30	10.05
Spain	0.53	2.42	0.06	0.21	0.14	0.00	0.32	3.70
Sweden	7.01	2.58	0.08	0.08	0.03	0.01	0.15	9.94
UK	10.87	0.88	3.13	1.72	0.67	0.85	2.69	20.82
Total	46.35	30.25	5.99	5.17	2.15	4.29	5.80	100.00

Percentages may not add up to precisely 100.00 or the number given as the total due to rounding.

Table A2

Summary performance statistics of closed data set of eurobonds

Panel A (B) summarizes the mean and the standard deviation of the equal-weighted (EW) and the value-weighted (VW) monthly returns by country (industry sector). All returns are in US Dollars and expressed in percent per month. The currency return is the proportional change in the exchange rate of the respective country vis-à-vis the US dollar, where a positive number indicates an appreciation. In the correlation matrices, the coefficients above the diagonal refer to the value-weighted returns and below the diagonal are between the equal-weighted returns.

A. By country

	EW return		VW return		Currency return		Correlation matrix								
Country	Mean	Stdev	Mean	Stdev	Mean	Stdev	BL	FR	GE	IT	NE	SP	SW	UK	Total
BL	0.595	2.963	0.565	3.001	0.107	2.859	1	0.972	0.958	0.788	0.975	0.869	0.919	0.861	0.955
FR	0.527	2.930	0.518	3.009	0.112	2.833	0.978	1	0.976	0.810	0.980	0.860	0.903	0.830	0.953
GE	0.606	3.032	0.515	2.830	0.109	2.862	0.950	0.964	1	0.807	0.972	0.842	0.899	0.877	0.972
IT	0.594	3.315	0.614	3.410	-0.032	2.960	0.831	0.849	0.817	1	0.769	0.713	0.799	0.744	0.859
NE	0.539	3.002	0.536	2.974	0.108	2.857	0.968	0.982	0.950	0.790	1	0.860	0.906	0.825	0.949
SP	0.737	3.540	0.784	3.680	-0.044	2.990	0.890	0.894	0.863	0.739	0.882	1	0.807	0.737	0.849
SW	0.644	3.047	0.600	3.116	-0.357	3.235	0.955	0.943	0.937	0.835	0.928	0.851	1	0.817	0.921
UK	0.807	3.326	0.737	3.202	0.045	2.650	0.829	0.805	0.808	0.701	0.771	0.754	0.807	1	0.926
Total	0.667	2.980	0.654	2.901			0.972	0.967	0.961	0.824	0.950	0.887	0.948	0.917	1

B. By industry sector

	EW return		VW return		Correlation matrix							
Industry	Mean	Stdev	Mean	Stdev	FF	GI	CO	CT	BE	IN	UT	Total
FF	0.684	3.069	0.642	3.008	1	0.953	0.950	0.948	0.978	0.967	0.958	0.982
GI	0.663	3.005	0.673	2.935	0.941	1	0.891	0.887	0.907	0.920	0.893	0.982
CO	0.650	2.942	0.634	2.997	0.933	0.935	1	0.928	0.959	0.937	0.956	0.943
CT	0.666	3.041	0.639	3.092	0.930	0.932	0.954	1	0.950	0.964	0.922	0.941
BE	0.644	3.052	0.643	3.108	0.960	0.955	0.966	0.963	1	0.959	0.963	0.955
IN	0.608	2.931	0.557	2.954	0.952	0.960	0.959	0.971	0.974	1	0.934	0.965
UT	0.719	3.108	0.730	3.220	0.924	0.919	0.967	0.944	0.958	0.950	1	0.946
Total	0.667	2.980	0.654	2.901	0.990	0.972	0.962	0.959	0.981	0.980	0.951	1

Table A3

Decomposition of excess index returns from closed data set of eurobonds (May 1990 – March 2008)

The table gives the variance of the components of the equal-weighted (EW) and the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market. The ratio is the variance ratio of the index in excess of the market.

A. Country Indexes

	EW indexes				VW indexes			
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.66	0.966	0.17	0.255	0.62	1.061	0.17	0.283
FR	0.59	0.614	0.17	0.176	0.54	0.586	0.15	0.161
GE	0.79	0.565	0.24	0.175	0.60	0.592	0.11	0.110
IT	4.19	1.186	0.24	0.069	3.06	1.310	0.16	0.070
NE	0.81	0.596	0.31	0.229	1.10	0.584	0.39	0.206
SP	3.25	1.188	0.39	0.144	3.04	1.133	0.22	0.081
SW	1.52	1.709	0.36	0.404	0.97	1.368	0.12	0.165
UK	1.75	1.211	0.22	0.151	2.66	1.121	0.21	0.089
Average	1.69	1.004	0.26	0.200	1.58	0.969	0.19	0.146

B. Industry Indexes

	EW indexes				VW indexes			
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.18	0.853	0.02	0.119	0.41	0.400	0.38	0.376
GI	0.67	1.403	0.51	1.072	0.44	2.540	0.48	2.787
CO	0.48	0.732	0.27	0.415	0.57	0.733	0.77	0.998
CT	0.49	0.649	0.13	0.167	0.54	0.595	0.43	0.470
BE	0.67	1.778	0.30	0.794	0.64	0.989	1.07	1.650
IN	0.30	0.801	0.06	1.170	0.32	0.908	0.23	0.661
UT	0.88	0.935	0.52	0.549	0.92	0.933	1.14	1.157
Average	0.52	1.022	0.26	0.470	0.55	1.014	0.65	1.157

Table A4
Decomposition of excess index returns from closed data set of eurobonds, pre and post-EMU

The table gives the variance of the components of the value-weighted (VW) excess country, in Panel A, and excess industry, in Panel B, index returns over the total market for May 1990-Dec 2000 and Jan 1999-Mar 2008. The ratio is the variance ratio to the index in excess of the market.

A. Country Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	1.01	1.519	0.19	0.292	0.26	0.506	0.14	0.266
FR	0.87	0.522	0.26	0.151	0.21	1.162	0.05	0.284
GE	1.17	0.590	0.20	0.010	0.08	0.653	0.03	0.269
IT	0.92	1.470	0.17	0.279	5.01	1.285	0.15	0.040
NE	0.95	0.545	0.78	0.219	0.31	0.997	0.03	0.085
SP	1.07	0.970	0.18	0.159	4.88	1.175	0.26	0.062
SW	0.57	1.301	0.16	0.368	1.35	1.394	0.08	0.080
UK	4.23	1.228	0.39	0.112	1.21	0.868	0.04	0.031
Average	1.48	1.018	0.29	0.210	1.66	1.005	0.10	0.139

B. Industry Indexes

	May 1990 – Dec 1998				Jan 1999 – Mar 2008			
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.82	0.392	0.79	0.374	0.02	0.917	0.02	0.600
GI	0.17	1.124	0.27	1.767	0.69	3.585	0.68	3.540
CO	1.07	0.899	1.24	1.035	0.10	0.252	0.35	0.896
CT	0.78	0.578	0.77	0.570	0.33	0.646	0.12	0.229
BE	1.25	1.019	2.14	1.742	0.08	0.622	0.09	0.721
IN	0.49	1.057	0.44	0.934	0.15	0.661	0.04	0.188
UT	1.41	1.125	2.24	1.782	0.43	0.591	0.21	0.278
Average	0.86	0.885	1.13	1.172	0.26	1.039	0.21	0.922

CHAPTER 6
Summary and Conclusions

1. Summary of main conclusions

The main conclusions of this study into the impact of EMU on European bond market integration and investor portfolios allocations are summarized through the concepts of *ability and willingness* introduced in Chapter 1. Recall that *ability* refers to prevailing market barriers and results in an analysis of bond market integration. *Willingness* refers to investor behavior in dynamically integrated markets and results in an analysis of portfolio allocations and diversification.

The detailed review of literature on international financial integration in Chapter 2 leads to the main conclusion of largely integrated fixed income markets in Europe on the road to and following the introduction of the Euro. It arrives at this conclusion through an appraisal of the empirical evidence from theories that measure integration. The literary review starts from macroeconomic theories that emerge post-WWII and take flight in the 1970s through to the 1990s in an environment of increasing international capital flows. They are categorized into four strands, each with their own integration measures: interest parity conditions, savings-investment correlations, consumption growth correlations and capital control determinants. An analysis of the produce of these theories and measures results in the following conjectures. Capital controls are still in force in the 1970s in many industrialized countries, but are progressively dismantled in the 1980s. They are abolished in Europe by political agreement within the EEC by 1990. Studies based on deviations from interest parity conditions reflect the course of increasingly integrated financial markets in Europe in parallel with the EEC's determination to create a single market under the Euro.

Interest parity conditions are price-based measures and typically applied to short-term fixed income securities of the money markets. Closed interest parity and its synthetic approximation of covered nominal interest parity (*CIP*) are the narrowest among them. Both are shown to hold by close approximation in the money markets of the industrialized world including Europe already in the 1980s. Ex ante uncovered nominal interest parity (*UIP*), which in addition to *CIP* demands that exchange rate risks do not pose a barrier, generally holds less often. Specifically in Europe, exchange rate volatility within the ERM in the 1980s and the 1990s is identified as the principal obstruction to the advance of financial integration. The broadest interest parity condition is that of real interest parity (*RIP*). In empirical studies *RIP* hardly ever holds, not in Europe or elsewhere.

Measures from the two remaining macroeconomic strands rely on savings-investment correlations (Feldstein-Horioka condition) and consumption growth correlations. They are quantity-based and are shown to be yet more broad measures of integration than *RIP,* which is also their prime weakness. Studies of savings-investment and consumption growth correlations produce either conflicting or weak empirical evidence on financial integration. In the course the theoretical debate in the 1990s they become widely discarded because of questions around the structural parameters they actually measure.

Following the successful changeover of Europe's capital markets to the Euro, the measurement of their integration within the Euro zone takes on new rigor in the 2000s. Capital markets have grown more complex by now and measures are sought for its various instruments – e.g. bank credit, equities, fixed income. The fixed income markets are further segmented into money, government bond and eurobond markets. From among the traditional macroeconomic measures, interest parity conditions have best withstood the test of time. Yet they have found little application beyond the money markets into longer markets. Furthermore, it is shown that with the elimination of intra-market currency risk under the Euro, these price-based conditions resort to the measurement of either closed interest parity, already shown to hold, or real interest parity, widely shown not to hold. This motivates the choice to explore new fields for price-based measures. Among them, the theorem in financial economics that the less price behavior of securities with dissimilar risk characteristics is influenced by their country effects the better markets are integrated. Including such new theorems, the scope implicitly shifts from the measurement of financial integration alone (the old interest parity conditions) to that of financial ánd economic integration. Such an integrated set of measures provides compelling evidence that fixed income markets' integration carries on with accelerated effect under EMU. Some notable differences are observed though between instruments: (unsecured) money markets are deemed more or less fully integrated, government bond markets largely integrated and eurobond markets the least but still fairly well integrated.

The *ability* of investors to make uninhibited asset allocation choices in fixed income markets in Europe is thus shown to have significantly improved pre to post-EMU. The degree of integration of the money markets, already large before the Euro, is with the removal of intra-market currency risk further improved and extends itself to longer markets, government bonds before eurobonds. While the theoretical analysis of Chapter 2, and therefore by extension its conclusions, remain rather general, Chapter 3 provides further color and detail to the impact of EMU on financial integration from the perspective of bond market evidence. The first main conclusion of Chapter 3 is that the establishment of EMU causes a number of significant changes to the constitution of the European bond markets, which altogether lead to the creation of a larger, deeper and more liquid bond market under the Euro, but also one that remains segregated in some ways. The various impacts of EMU are grouped into direct and indirect effects. The direct effects are the immediate technical implications of one currency and one monetary policy. They also include the decision by EMU sovereigns to harmonize conventions, redenominate outstanding bonds and conduct new issuance in Euro. These actions create instant critical mass and further momentum is provided as market participants decide to quote and trade all securities in Euro. An indirect effect of EMU is the elevation of markets to a pan-European level. An important stimulus on the demand-side is the lifting of domestic market protecting and currency matching rules for institutional investors. On the supply-side, there is increased competition among borrowers to position their debt. Another significant indirect effect is that the success of the new Euro bond market encourages other issuers to enter. An array of fixed income securities data show that the whole market quickly becomes more than the sum of its parts. Initially the government bond sector takes the lead but, much sooner than expected, the corporate eurobond sector emerges as the main driver to its expansion. While EMU thus leads to the creation of a large 'domestic' bond market in Euro, which quickly grows in depth and liquidity, the market also remains segregated. This is most visible in the government bond segment where separate yield curves continue to exist. Not directly visible is the continued dispersion of post-trading infrastructure. Important national differences in the regulation and tax treatment of fixed income instruments also continue to exist.

Overall, the *ability* for bond investors to freely allocate funds is significantly enhanced pre to post-EMU. EMU, directly and indirectly, lowers the barriers for investors to seek opportunities across the pan-European bond market. The second main conclusion from Chapter 3 is that EMU causes fund managers to respond to the new *ability* and opportunities with a certain *willingness* to adapt their portfolio allocations and diversification strategies. Indications from market practice, though on the whole circumstanstial, are that government bonds dominate bond holdings pre-EMU with a certain home bias. Financial studies of IMF CPIS survey data find that the international diversification of European bond portfolios improves post-EMU, but that this diversification remains confined to the Euro zone. These studies are not able to detect any credit diversification, but there is some evidence from market practice that this has taken place. Converging yields of government bonds encourage investors to seek better investment opportunities in the corporate eurobond sector. Anecdotal evidence shows that the flurry of new eurobonds are keenly immersed into portfolios henceforth. Thus the *willingness* to diversify geographically within the Euro zone is confirmed by (CPIS) studies on international investment holdings. The *willingness* to diversify along the credit spectrum is established only anecdotally and could be deferred from market evidence.

The conclusions so far also demonstrate that the factors involved with the ability and willingness to make free and optimal portfolio allocations become more numerous as the dissimilarity of instruments increases. Figure 6.1 illustrates this. Moving along the spectrum of fixed income instruments asset substitutability declines. Between money markets and government bonds this decline is due to the lengthening of the term structure; the decline between government bonds and corporate eurobonds is due to greater credit risk variation. In the context of the Euro zone, where capital controls have been abolished and exchange rate risks eliminated, any obstructions to the *ability* to freely allocate funds in the money markets are primarily from cross-border transaction costs and asset-specific risks (including national

Figure 6.1
Factors determining ability and willingness to allocate investments in Euro fixed income markets

		Asset substitutability of fixed income instruments: High → Low		
		<u>Money Markets</u>	<u>Government Bond Markets</u>	<u>Corporate Eurobond Markets</u>
Free and optimal asset allocation	Ability ↓	Transaction costs Asset-specific risks		
			+ Maturity risks + Credit worthiness	
	Willingness			+ Credit familiarity + Liquidity risks

Note: Asset substitutability indicates, from high to low, the extend in which instruments from the respective segment of fixed income markets are comparable in terms of their overall investment-risk characteristics. The ability to freely and optimally allocate investment assets refers to remaining market barriers and the willingness to the behavior of investors. Within the grid, the factors are identified that influence this ability and willingness for each type of fixed income instrument. Transaction costs refer to the differential costs of trading; Asset-specific risks refer to differences in legal, tax and regulatory treatment of assets; Maturity risks arise from the lengthening of the investment horizon; Credit worthiness is the default risk of the issuer; Credit familiarity is the cost associated with overcoming information asymmetries on the credit risk of issuers; Liquidity risks are the costs associated with the timely execution of sizeable transactions. Factors initially indentified are added to by further factors as one moves along and down the spectrums, indicated by the plus sign.

regulation and taxes). While these factors increase in importance for longer-dated bonds with comparable risk characteristics, maturity risk and creditworthiness risk add to the list of factors. With the inclusion of eurobonds, an investors' familiarity of non-national corporations come into play with the *willingness* to invest. Liquidity risks also increase because eurobonds vary more in size and turnover than government bonds.

The shift in focus away from the traditional ground of money markets to that of the bond markets renders the analysis richer, but its results also more complex for interpretation. There is hardly one single methodology in the dual study of financial integration and portfolio allocation that can precisely pinpoint these various factors. I find common ground in the analysis on *ability and willingness* in a further examination of the importance of country and industry, as first order effects, and liquidity and maturity, as second order effects, in the structure of European bond returns. The central idea is that bond investors strive to optimally allocate their portfolios to benefit from diversification opportunities in the more integrated bond markets of Europe. The assumption is that the ex ante benefits for return on investment can be determined ex post through an examination of observed returns. In the analysis, the inception of EMU is adopted as an explicit turning point to study its impact. The observed relative importance of effects is in turn indicative of the level of integration. Due to the nature of the empirical study and the applied methodologies, this results only in more general observations of financial ánd economic integration.

The empirical study in this thesis comprises starts from a decomposition analysis of returns into primarily country and industry effects and extends into a mean-variance performance analysis of bond portfolios allocated on either basis. Table 6.1 summarizes the main results of the entire empirical analysis and serves as the backbone for the discussion below.

Table 6.1
Summary of main results from empirical analysis

Data	Model	Full sample results	Pre to post-EMU results	Interpretation
A. Decomposition analysis of returns (Chapter 4)				
6,440 monthly USD eurobond returns, May 1990-Mar 2008; - assign to 10 country and 7 industry groups	Standard decomposition into a common factor, country and industry effects	Country effects dominate industry effects more than three times (1.26 / 0.39)	Country effects increase slightly while industry effects drop; pre-EMU the ratio of country to industry effects is two (1.24 / 0.63), post-EMU it is eight (1.28 / 0.16). Average country effects of core EMU fall (from 1.18 to 0.26), while that of the periphery rises (1.00 to 4.67).	Industry dispersion Economic divergence within EMU
	(separate) multivariable regression analysis on the common factor	Variance of common factor is high (8.3)	Over the whole sample period the common factor is explained for 87% by the conversion of returns to USD, and otherwise by economic outlook and risk appetite.	Common factor captures currency conversion effect
	(separate) OLS regressions of currency components on pure country effects	Good statistical model fit, especially for core-EMU countries	The model fit improves pre to post-EMU for core-EMU countries but deteriorates for peripheral countries.	Currency competitiveness relates to country effects
- assign to 4 liquidity and 4 maturity groups	Extended decomposition with liquidity and maturity effects	Country effects remain dominant (1.13), followed by maturity (0.73), industry (0.42) and liquidity (0.30)	Country effects decrease slightly (from 1.14 to 1.11) but remain dominant. Ranking of pure effects remains the same. Liquidity effects reduce significantly post-EMU (from 0.47 to 0.14), as do maturity effects (1.04 to 0.44).	Growing depth and maturity of eurobond markets
B. Mean-variance testing of portfolios (Chapter 5)				
4,587 are a closed set; - assign to one of 8 real countries and same 7 industries	Spanning and efficiency tests on country and industry portfolios: first from their direct allocation and secondly from the decomposition	Spanning is rejected for both VW country and industry portfolios. It is rejected less after decomposition, now mostly for industry portfolios Efficiency cannot be rejected	Pre-EMU VW country and industry portfolios resulting from a direct allocation are not spanned but post-EMU they are. Following decomposition, spanning improves in both subperiods and can no longer be rejected. Efficiency cannot be rejected either in both subperiods, but the maximum Sharpe ratio of country portfolios is always higher.	Industry-based portfolios less often optimal. Results improve after decomposition. Post-EMU, all portfolios are optimal but country-based generate better returns long term
EFFAS indexes of government bond returns added, Dec 1991 – March 2008	- replace country portfolios and compared with industry portfolios from eurobonds either way	Spanning is again rejected for both VW portfolios. Efficiency cannot be rejected	Pre-EMU VW country portfolios of government bonds and industry portfolios resulting directly from eurobonds are not spanned but post-EMU they are. Decomposed industry portfolios can improve such country portfolios. Efficiency is rejected post-EMU; country portfolios have higher maximum Sharpe ratios.	Country allocation strategy of government bonds alone largely suboptimal. Inclusion of eurobonds improves performance

Note: Numbers in brackets in Panel A represent the variance in value-weighted excess returns after decomposition. VW in Panel B stands for value-weighted

Chapter 4 commences with the factor decomposition of European bond returns. This analysis starts with eurobonds, though not only from pure corporates but also from (quasi-) sovereigns. 6,440 returns of individual eurobonds from Bloomberg and Morgan Stanley in local currency are converted to USD through exchange rates from Datastream. They cover the period from May 1990 to March 2008. They are separated into country and industry effects in a standard decomposition and into additional effects of liquidity and life-to-maturity in an extended decomposition. The methodology for the standard decomposition follows Heston and Rouwenhorst (1994). It consists of cross-sectional regressions of the individual, in US Dollar converted eurobond returns on a set of country and industry dummy variables. Estimated coefficients of these dummies represent the return of the country and industry sector they belong to in excess of the average market. The contribution of each factor is subsequently derived from the time series' variance of the estimated coefficients. Return indexes are thus decomposed into pure country effects and the sum of industry effects for ten countries (Belgium/Luxembourg, France, Germany, Netherlands, Italy, Spain, Sweden, UK, supranationals and other) and vice versa into pure industry effects and sum of country effects for seven industry groups (financials and funds, government institutions, consumer, communications and technology, basic materials and energy, industrials and utilities). Liquidity and maturity factors are added to decompose excess return country and industry indexes. Each are divided over four brackets for which dummy variables are included. This extended decomposition follows a similar analysis by Varotto (2003) for eurobonds. Standard and extended decompositions are performed on my set of 6,440 eurobond returns, first for the whole sample period and secondly for the two subperiods before and after the start of EMU in January 1999. Formal tests (i.e. the Jennrich test) demonstrate that the return structure of country and industry indexes resulting from their direct allocation is statistically significantly different from the indexes after decomposition. Equally, decomposed returns are shown to have correlation and covariance structures that are statistically significantly different pre to post-EMU.

According to integration theory, one would expect to observe diminishing country effects versus industry effects over time in European eurobond returns and especially following EMU. Reduced country effects would be in response to progressing financial and economic integration of states participating in the monetary union which make up the majority of the sample. As Euro zone countries' fiscal policies remain at a national level, the expectation is of diminishing rather than disappearing country effects. One can also expect industry effects to increase post-EMU, if the ex ante predictions from the Krugman school of international trade economists for regional industry specialization in the monetary union become real. It is not obvious what the expectation of country and industry effects should be for the EMU-outsiders. Two such countries are included in the sample (UK and Sweden) and for them the effects could go both ways. The importance of liquidity and maturity effects would lessen as the Euro eurobond market becomes larger, deeper and more liquid.

Results from the decomposition analysis are noteworthy because they largely contradict these a priori expectations. The *first main conclusion* is that country effects dominate industry effects over the whole period from May 1990 to March 2008 by more than three times. When the sample period is split around the introduction of EMU, the *second main conclusion* is that country effects remain on the whole equally important post-EMU compared to the period before and even rise slightly. This shatters the expectation of diminishing country effects under EMU. The *third main conclusion* is that the strength of industry effects decreases significantly. This shatters the prediction of increased industry effects under EMU. The combination of the latter two results is that country effects outweigh industry effects pre-EMU by a factor of nearly two, and post-EMU by a factor of precisely eight. The *fourth main conclusion* is that of a North-South divide within the Euro zone in the results of the direction of country effects. The average of country effects of the core-EMU countries Germany, France and BENELUX shrinks to nearly one-fifth under the Euro, while the average of country effects of the more peripheral-EMU countries Spain and Italy rises nearly five times pre to post-EMU. The immediate observation from eurobond returns, therefore, is of economic divergence between the core and the periphery. The *final conclusion* from the standard decomposition is that there is, as expected, no consistency in the pattern of country effects among the EMU-outs. The main conclusion from the extended decomposition analysis is that liquidity and maturity effects both diminish after EMU. This is the only case where a priori expectations are confirmed and the growing depth and maturity of the eurobond markets under the Euro is verified. Results from the extended decomposition also confirm that country effects remain dominant throughout. This implies that the main conclusions from the standard decomposition are robust.

Finally, in the course of the decomposition analysis it is found that the common factor in European eurobond returns is high. A separate regression analysis concludes that the conversion of local currency casu quo Euro returns into US Dollar is predominantly responsible for this high common factor. In addition, it is found that the currency component, defined as the percentage change of the local currency of each country to the USD over the weighted-average basket of these currencies, can in a number of cases be related to the country effects. The interpretation of this relation is that a more than average depreciation of the national currency implies a competitive business advantage for the local companies and better returns on their eurobonds. The relation between currency components and country effects is stronger for core-EMU countries than for peripheral EMU countries and intensifies post-EMU.

The empirical analysis in Chapter 5 extends the previous analysis by comparing the mean-variance performance of bond portfolios diversified on either a country or an industry sector basis. Country and industry portfolios are created first from their direct allocation and secondly after decomposition from a closed set of 4,587 eurobond returns that belong to exactly one of the same seven industry groups and one of eight remaining European countries. The decomposed country and industry portfolios use the results from the previous chapter. Whereas in the previous analysis, government bonds could not be included as their volume would have distorted results, the analysis in this chapter is performed at a portfolio index level which allows for their inclusion. Hence, in the third instance, country portfolios created from the EFFAS government bond return series are compared with industry portfolios of eurobonds created either way (direct and decomposed). In all three cases, country and industry portfolios are compared for spanning and efficiency. Spanning tests determine whether the return performance of one type of portfolio (e.g. country) can be improved by adding assets from the opposite set (i.e. industry portfolios). Efficiency tests determine whether the maximum Sharpe ratio of country-based and industry-based portfolios can be distinguished.

The mean-variance tests of spanning and efficiency are performed for the complete sample period and again for each subperiod before and after the start of EMU. The *first main conclusions* are that spanning of eurobond indexes is rejected less often in the case of decomposed portfolios. In cases it is rejected, in the pre-EMU and full sample periods, it is most often that industry portfolios are not spanned by their country components. Efficiency tests find that country and industry portfolios of eurobonds cannot be distinguished in their maximum Sharpe ratio, though it is consistently found to be higher for country-based portfolios. These conclusions confirm results from the decomposition analysis in Chapter 4, where it is found that country effects contribute more to the variation of eurobond returns than industry effects. The *second main conclusion* arises from the inclusion of government bonds in the analysis. Spanning tests find that a country diversification of a portfolio of government bonds is largely a suboptimal strategy and can in the majority of cases be improved with the addition of corporate eurobonds. Efficiency tests find that post-EMU country-based portfolios of government bonds can be distinguished from industry-based portfolios of eurobonds. The maximum Sharpe ratio is statistically significantly higher for country than for industry portfolios in these cases. It is higher in all other cases too for country portfolios, which seems to indicate that country-based portfolios are capable of generating higher risk-adjusted returns in the long run than industry-based portfolios.

1.1. Implications for fund managers

The main conclusions from the empirical analysis of both Chapters 4 and 5 have practical implications. The decomposition analysis in Chapter 4 separates and identifies factors as sources of reduction in return variation in portfolios, in this case of corporate eurobonds. This concerns the risk properties of portfolios. The appropriate practical implication that can be derived from the result that country effects dominate industry effects is that a diversification across countries within an industry is a more effective tool for risk reduction of eurobond portfolios than the other way around. Hence, for bond fund managers who consider only the riskiness of their portfolios, the implication is that a country allocation remains the most optimal means of diversification even under EMU.

The mean-variance tests conducted in Chapter 5 compare country-based and industry-based portfolios on both risk and reward performance characteristics, in this case of corporate eurobonds and government bonds. This analysis allows for qualifications on whether a country or an industry based allocation strategy performs better in European bond markets overall, from a perspective of risk and reward and not just risk alone. From the results of the various mean-variance tests, the practical implications are several. First, for portfolios of corporate eurobonds, fund managers who consider both risk and the reward properties are indifferent between a country and an industry diversification in the post-EMU environment. Each type of diversification results in a mean-variance performance that cannot be statistically distinguished. Even so, the choice between a country and an industry-based portfolio of corporate eurobonds needs to be made with the added consideration that it is likely over the longer term that country-based portfolios are rewarded with better risk-adjusted returns. This is because mean-variance tests also demonstrate that the maximum Sharpe ratios tend to be higher overall for country-based portfolios than for industry-based portfolios. Though portfolios are shown to have a better mean-variance performance following decomposition, this is hardly an option for fund managers in real practice. Secondly, for bond fund managers who have stuck with a portfolio of government bonds, the practical implication is that this diversification strategy is distinctly suboptimal. In many cases, portfolios of government bonds can be improved with the addition of eurobonds. This was already true in the years prior to EMU, but even more so thereafter. In all this, the currency hedging decision remains of significant importance as well.

2. Contemplation of results

The observations in this thesis are made through the prism of the European bond markets. Furthermore, specific methods are used to extract results from their return structure that lead to these observations. All the same, they have a bearing on judgments of the accomplishments of EMU. They also offer a perspective on the trace of the recent financial crisis in Europe.

The European Commission's report "One market, one money" (1990) is a foresight on EMU's benefits and costs. It contains an implicit economic convergence expectation for those countries that will form a monetary union in Europe. Results from the analysis in this thesis show that this most fundamental expectation of EMU has not borne out. Instead, national-economic divergence between the core and the periphery is observed. The analysis in "One market, one money" is useful to identify where the discrepancies between expectation and reality could be. The report builds its economic convergence expectation on the two pillars of microeconomic efficiencies and macroeconomic stability effects of EMU. It can hardly be disputed that EMU has brought microeconomic efficiencies through the elimination of foreign exchange rate uncertainty, a reduction in transaction costs and a strengthening of the internal market. It is also plausible that these efficiencies have contributed to economic growth. Greater price stability (inflation), reduced variability of output and employment, monetary stability and fiscal policy discipline and coordination are all expected to contribute to macroeconomic stability. While EMU has fulfilled its expectations in the monetary sphere, it has not done so to the same extent in the fiscal sphere. Positive growth that appeared similar within the monetary union for most part of this decade masked diverging underlying trends, in competitiveness and fiscal policy, between core and peripheral countries.

"One market, one money" defies the ex ante prediction of country industry concentration by the Krugman school of international trade economists and has proven right in this respect. Industry-dispersion rather than concentration is indeed the other main observation that shines through in the empirical results of this thesis. The differences between the European Commission's view and the Krugman view on the expected course of industrial trade patterns under EMU can best be explained with the use of Figure 6.2, which is from De Grauwe (2008). The European Commission's view is that differential shocks occur less frequently under EMU, partially because of greater economic integration and partially because the industrial structure in Europe is that of intra-industry trade. The removal of barriers under EMU reinforces the positive relation between trade integration and symmetry between countries in the union, illustrated by the upward sloping line TT' in Figure 6.2a. It bears an optimistic view on the EMU, for its dynamics sets it on a path to quickly cross the OCA (optimum currency area) line representing minimal combinations of symmetry and trade integration for EMU to break-even on costs and benefits. The Krugman (1989, 1991) view emphasizes centripetal forces resulting from economies of scale, externalities and transportation costs. In this view, trade integration that occurs as a result of economies of scale can lead to regional concentration of industrial activities. Lowering of barriers initially reinforces greater profits from a concentration of production than from a positioning closer to final markets. In Figure 6.2b, the relation between trade integration and symmetry of countries (TT') is now downward sloping. This illustrates

Figure 6.2
Two opposing views on the course of integration under EMU

A. The European Commission view B. The Krugman view

Note: The European Commission view is as expressed in "One market, one money" (1990). "Symmetry" is the correlation of output and employment between groups of countries about to form EMU, and "Trade Integration" is the trade between these countries. "OCA" is the optimum currency area line representing minimal combinations of symmetry and trade integration that make EMU break-even. "EMU" is meant to represent the countries that are about to form a monetary union in Europe. Based on De Grauwe (2008).

the theory that when integration increases, countries becomes more specialized and are more susceptible to economic shocks. This is a more pessimistic view on EMU, for it takes longer to get past the OCA line. The difference in assumption between these two views is primarily with respect to the dynamic development of countries' industrial structure under EMU. The European Commission relies on greater intra-industry trade, i.e. product differentiation. In this scenario, industry sectors in less developed regions follow the pattern of more advanced countries. The Krugman view relies on greater inter-industry trade, i.e. product concentration. In this scenario, less developed regions specialize only in the sectors where they already have a comparative advantage. While the Krugman school dominated economic thinking on regional effects at the time, empirical results from this study confirm that the European Commission's view, particularly as regards the industrial structure in Europe, has probably been closer to the truth.

Of my two empirical results that contradict ex ante expectations of EMU – national-economic divergence and industry dispersion – the first is the most striking, particularly also when considered against the front of decidedly converging bond yields of EMU sovereigns. How are converging EMU government bond yields compatible with the disparaging country effects found in European bond returns especially between core and periphery? It is not inconceivable that a kind of investor herd behavior set into the government bond markets in Europe. The convergence narrative started to build in the run-up to EMU and gathered an ever larger crowd of investors after its launch, driving EMU's sovereign yields together in turn confirming this belief. The narrative is reinforced by reports of the credit agencies. Good prospects for world economic growth, not spoilt by inflation expectations and fired by loose monetary policy in the major economic blocs, provide the backdrop to declining bond yields in the new millennium. In Europe, the emergence of a large domestic bond market invites a strong interest from investors all over, which is channeled into the more liquid sovereign debt market. These were factors that contributed to an overshooting of government bond prices.

The highly visible convergence of government bond yields has for many years created an illusion of economic convergence within EMU. But in retrospect, there was only pseudo-convergence. An important result from my analysis is that beyond the façade of the Euro zone's sovereign bond market investors held a more nuanced view on the total bond market. The return structure of corporate eurobonds is more closely related to real economic activity and subject to greater risks of default than government bond yields. Through the deployed methods, corporate eurobond returns signal a larger disparity in country effects than what can be superficially deferred from government bonds yields. The convergence story based on an overreliance on fiscal policy discipline and coordination under EMU, has given a false sense of security to its government bonds. It has driven a wedge in the pricing of country risks between this segment and that of corporate eurobonds.

This wedge disappeared by the financial crisis that started in subprime credit first, catched the corporate bond markets later on and now, with increased force, seized government bonds. By now, the crisis has worked itself through the system and established widely different effects on countries within EMU. The government bond yields in the periphery have been driven wide away from the core. The pseudo-convergence in the government bond markets has been one of the cradles for this dire circumstance. The ability to issue debt in abundance and at very favorable terms for a near decade under EMU has fuelled credit driven growth and asset bubbles that were at the origin of the crisis. The inability of the government bond market to enforce better market discipline on sovereigns with diverging debt and deficit levels and declining competitiveness within the monetary union left this process unchecked for too long. This is evident too from the initial reaction in EMU sovereign bond yields. When the financial crisis erupted in June 2007 the yield spread divergence remained small and was originally caused by a flight-to-liquidity, more than by a flight-to-credit quality. But beyond this façade, the signs of disparaging fortunes between EMU countries even at the onset of the crisis were already visible in the price behavior within the wider set of bond markets. Separate scrutiny of the July 2007 – March 2008 timeframe in my data set of eurobond returns reveals that the average of country effects in their variation in this nine month period is 1.5 times greater than in the previous nine months. While country effects of core-EMU members such as Germany and the Netherlands remain as before or decline, those in periphery such as Italy and those with a heavy concentration in the financial services industry such as the UK show a significant rise. Industry effects also rise on average, but this is driven by the financial services sector and the government sector, as can be expected from the nature of the crisis. As the subprime financial crisis increasingly turned into a sovereign debt crisis beyond March 2008, an extended empirical study with more recent data would presumably reveal rising and diverging country effects in Europe.

The recent financial crisis will and should inspire an abundance of research under the common denominators of financial stability and financial contagion. The bedrock for this research is a thorough understanding of the financial integration of markets and the various ways in which they act either as a shock-absorber, a straightforward transmission channel or as a shock-amplifier. The bond markets have taken centre stage in this scene.

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Nederlandse samenvatting (Summary in Dutch)

Dit proefschrift is een onderzoek naar het gedrag van investeerders aangaande optimale beleggingsportefeuilles en diversificatie mogelijkheden in Europese obligatiemarkten, in de context van steeds verdergaande integratie van die markten ten gevolge van de monetaire eenwording.

De twee onderwerpen van financiële marktintegratie en portefeuille diversificatie die in dit proefschrift worden behandeld zijn sterk met elkaar verbonden. Immers, goed geïntegreerde financiële markten zijn een voorwaarde voor het optimaal kunnen aanwenden van investeringsgelden. Omgekeerd is de mogelijkheid en de bereidheid van investeerders om een optimale diversificatie aan te brengen in portefeuilles ook indicatief voor de mate waarin markten werkelijk zijn samengesmolten. Toch worden beide onderwerpen in de academische literatuur vanuit twee aparte velden benaderd. Financiële integratie is lang onderwerp van debat geweest in de macro-economie, terwijl optimale portefeuillebelegging en diversificatie vooral in de financiële economie is bediscussieerd. Ieder veld legt zijn eigen invalshoek en methoden aan de dag. Slechts recent zijn er een aantal studies opgekomen die beide velden overbruggen in een tweeledig onderzoek naar marktintegratie en portefeuille allocatie. Dit met interessante en belovende bevindingen. Dit onderzoek is gepositioneerd op dit raakvlak.

De probleemstelling is als volgt: Op welke wijze hebben beleggingsportefeuilles zich qua samenstelling en qua diversificatie mogelijkheden bewogen in de Europese obligatiemarkten in de loop van de overgang naar de Euro, en wat is hieruit af te leiden over de integratie van deze markten? Het onderzoek is in drie fasen opgesteld. De eerste fase heeft als doel een theoretisch-empirisch overzicht te geven van de mate waarin de internationale financiële integratie al is geschied. De tweede fase beschouwt vanuit de praktijk wat de belangrijke ontwikkelingen in de Europese obligatiemarkten zijn geweest en in welke zin deze het gedrag van beleggers heeft beïnvloedt. Samen duiden deze twee analysen de mate aan waarin investeerders vrijelijk hun portefeuilles kunnen inrichten en optimale investeringskeuzes kunnen maken. Hierop volgt in de derde fase een empirisch onderzoek naar de mate waarin investeerders hiervan gebruik hebben gemaakt om met een optimale diversificatie van portefeuilles te profiteren van de veranderende investeringsmogelijkheden in Europese obligatiemarkten. De methodologie die voor dit empirisch onderzoek is gekozen veronderstelt dat ex ante gedrag van investeerders wordt geleid door verwachte opbrengst en dat dit ex post is af te leiden uit gerealiseerde opbrengst. Vanuit deze gedachte worden investeringsrendementen van een breed scala van Europese obligaties onderworpen aan een factor analyse. Door middel van deze analyse wordt bepaald welke effecten de grootste invloed uitoefenen op de variantie alszijde het risico in rendementen. Primair worden landen- en industie-effecten beschouwd en secundair worden liquiditeit- en looptijdeffecten beschouwd. Deze effecten zeggen ook allen impliciet iets over de onderliggende integratie van obligatiemarkten. Vervolgens worden investeringsportefeuilles van Europese obligaties samengesteld op basis van een indeling naar land en naar industrie. Deze landen- en industrieportefeuilles worden met elkaar vergeleken op hun mogelijkheid een meer optimaal voor risico gecorrigeerde rendement te behalen.

De drieledige opstelling van het onderzoek is terug te vinden in de hoofdstukindeling. Hoofdstuk 2 bevat een overzicht van de macro-economische literatuur over internationale financiële integratie. Dit literatuuroverzicht concentreert zich op theorieën die methoden hebben voortgebracht voor het kunnen kwantificeren ervan. Vier stomingen worden als zodanig besproken: rentepariteit condities, correlaties tussen nationale besparingen en investeringen, correlaties in de consumptiegroei van landen, en kapitaal controles. Het overzicht neemt in eerste instantie een theoretisch karakter aan, maar richt zich geleidelijk op de empirische bewijsvoering van de integratie van obligatiemarkten in Europa. De conclusies zijn dat kapitaal controles al door overeenstemming binnen de EEG rond 1990 zijn afgeschaft. Van de overige drie stromingen blijkt uit het overzicht dat de rentepariteit condities nog de meest eenduidige resultaten hebben opgeleverd. Uit deze condities blijkt dat rentepariteit in de meest enge zin in de loop van de jaren negentig al een feit is. Dit is vooral het geval voor korte termijn geldmarkten in Europa. Rentepariteit in bredere zin, en daarmee verdergaande integratie van financiële markten, wordt in deze periode nog geblokkeerd door valutarisico. Alleen al door de opheffing hiervan heeft EMU een sterk positieve invloed op de integratie van markten. Als de Euro eenmaal is ingevoerd, op 1 januari 1999, verrichten financiële markten in Europa snel de overstap van hun nationale munteenheid naar de nieuw geïntroduceerde Europese munt. Hiermee krijgt ook de bepaling van de integratie van financiële markten die deel uitmaken van de Euro nieuw elan. Financiële markten zijn complexer geworden in de tussentijd, en nieuwe relevante methoden voor het meten van integratie worden onderzocht voor verschillende deelmarkten: voor bank krediet, aandelen en vastrentende instrumenten. Vastrentende markten worden verder opgedeeld in korte termijn geldmarkten en lange termijn overheidsobligatie- en bedrijfsobligatiemarkten. De zoektocht naar relevante methoden voor het meten van integratie voor de nieuwe constellatie van financiële markten die de Euro teweeg heeft gebracht, belandt vanuit de traditionele macro-economie in de financiële economie. Vanuit hier verrijst de theorie dat geobserveerde prijzen in markten voor obligaties met een verschillend risicoprofiel minder worden beïnvloed door hun landeneffect naarmate die markten beter geïntegreerd zijn. Niet alleen duidt de gehele set van maatstaven die deze mede omvat op grotendeels geïntegreerde vastrentende markten in Europa vooral volgende op de totstandkoming van EMU, maar duidt deze nieuwe methode tevens op een constructieve onderzoeksaanpak van mijn probleemstelling.

Hoofdstuk 3 bevat naast de meer theoretische analyse in het voorgaande hoofdstuk, een praktische analyze van de integratie van obligatiemarkten in Europa. Dit hoofdstuk berust op statistieken van de uitgifte en verhandeling van obligaties, empirische resultaten vanuit de academische literatuur over portefeuille samenstellingen en anekdotische aanduidingen over beleggergedrag, om belangrijke ontwikkelingen in kaart te brengen. De conclusies van deze datarijke analyse zijn allereerst dat EMU een aantal verschuivingen teweeg brengt die samengenomen leiden tot het ontstaan van een grote, diepe en liquide Europese obligatiemarkt. De verschillende invloeden van EMU worden onderverdeeld in directe en indirecte invloeden. De directe invloed van EMU is niet alleen de onmiddellijke overgang naar één monetair beleid en één munt, maar ook de harmonisatie van conventies van obligaties, de omzetting van uitstaande obligaties naar Euro en de beslissing om nieuwe obligaties uit te geven in Euro door deelnemende lidstaten. Deze acties verschaffen het benodigde momentum aan de Euro obligatiemarkt. De indirecte invloed van EMU is dat obligatiemarkten verheven worden van nationaal naar Europees niveau, voor zowel investeerders als emiteerders. Met behulp van statistieken van nieuwe uitgiften wordt aangetoond dat de Euro markt een ware vlucht neemt. De markt is in de eerste jaren onder EMU al gauw meer dan de som van haar verschillende (voormalige) deelmarkten. Vooral het segment van bedrijfsobligaties groeit aanzienlijk. Terwijl er zo een diepere en meer liquide obligatiemarkt is ontstaan in Europa, blijft de markt ook in bepaalde, niet onbelangrijke opzichten, gescheiden. Ondanks die kanttekening, is de mogelijkheid voor investeerders om meer vrijelijk hun beleggingsportefeuilles te bepalen wel aangetoond, evenals de invloed die EMU daarop heeft gehad. Voor het overige deel, richt dit hoofdstuk zich op aanduidingen in hoeverre obligatieportefeuilles zich daarop hebben aangepast. Die aanduidingen zijn slechts sporadisch en onvolledig. Uit de academische literatuur die voornamelijk gebruik maakt van IMF survey data blijkt een zekere nationale voorkeur in obligatieportefeuilles te heersen in de periode voor EMU. Deze wordt verheven tot de Euro in de periode erna. Hiermee is een bredere geografische spreiding van portefeuilles over het EMU gebied aangeduid. Door een gebrek aan consistente data is er echter weinig bewijsvoering vanuit de academische literatuur wat betreft een veranderende spreiding van het krediet risico in portefeuilles. Op dit vlak zijn er slechts anekdotische aanduidingen uit investeerders surveys die zijn verricht. Eén daarvan duidt erop dat investeerders vlak voor de monetaire eenwording voorstaan een groter deel van hun portefeuille te beleggen in het sterk toenemende aantal en variëteit van bedrijfsobligaties.

Het empirische onderzoek van dit proefschrift is erop gericht om op consistente wijze deze tendensen van obligatiemarkt integratie en daarmee gepaard gaande veranderingen van portefeuille samenstelling en diversificatie mogelijkheden in Europa te analyseren. Hoofdstuk 4 maakt hiermee een aanvang met een factor analyse van Europese obligatierendementen. Deze analyse is op internationale obligaties gericht die vooral door bedrijven maar ook mede door overheidsinstanties in de markt zijn afgezet. Een data set van 6,440 rendementen is bij elkaar gebracht, die gezamelijk een periode van bijna twintig jaar bestrijkt, namelijk van mei 1990 tot en met maart 2008. Deze data is verkregen van Bloomberg en Morgan Stanley en oorspronkelijk aangeduid in nationale valuta. Rendementen worden ieder geconverteerd naar US dollar met wisselkoersen die van Datastream zijn verkregen. De totale set van 6,440

USD rendementen worden toegekend aan tien landen (Belgie/Luxembourg, Frankrijk, Duitsland, Nederland, Italië, Spanje, Zweden, Groot Brittannië, supranationale instituten en overige) en aan zeven industriegroepen (financiele instanties, overheidsinstanties, consumentensector, communicatie en technologie, basis materialen en energie, industriële bedrijven en nutsbedrijven). De standaard decompositie methode van Heston en Rouwenhorst (1994) wordt benut om de variantie in de rendementen primair aan de effecten van deze tien landen en zeven industrieën te bepalen. In een verdere uitbreiding hierop worden liquiditeit- en looptijdeffecten in het model opgenomen. De analyse wordt over de gehele periode verricht. Vervolgens wordt deze periode opgesplitst in twee deelperiodes, één voor en één na de start van EMU om het belang ervan te kunnen waarnemen.

Vanuit de integratie theorie is te verwachten dat landeneffecten afnemen in belangrijkheid, vooral onder EMU. Landeneffecten verdwijnen echter niet in zijn geheel, omdat overheden verantwoordelijk blijven voor het nationale fiscale beleid. Vanuit de redenering van de invloedrijke Krugman school van economen is een zekere industriespecialisatie voorspeld onder EMU, van waaruit te verwachten is dat industrie-effecten juist toenemen in belangrijkheid. Verder is te verwachten dat met de groei van de Europese obligatiemarkt de belangrijkheid van liquiditeit- en looptijdeffecten afneemt. Resultaten uit de decompositie analyse in Hoofdstuk 4 zijn opmerkelijk, omdat ze deze verwachtingen ten dele tegenspreken. Allereerst wordt bevonden over de gehele periode genomen dat landeneffecten veel belangrijker zijn in de bepaling van de variantie van Europese bedrijfsobligaties dan industrie-effecten. In de vergelijking van de periodes voor en na EMU, blijkt juist dat die landeneffecten gelijk blijven terwijl industrie-effecten sterk afnemen. Dit staat haaks op wat er algemeen wordt bevonden voor rendementen van Europese aandelen, waarvoor een aantal studies aantonen dat de belangrijkheid van industrie-effecten toeneemt ten opzichte van landeneffecten na EMU. Voor Europese bedrijfsobligaties is de resultante dat de kracht van landeneffecten dat van industrie-effecten twee keer overheerst voor EMU, en acht keer overheerst na EMU. Een nog opmerkelijker resultaat is dat er een duidelijke Noord-Zuid tegenstelling waar te nemen is in het pad dat de landeneffecten volgen binnen EMU. De landeneffecten van Duitsland, Frankrijk en de BENELUX, de zogenaamde kernlanden van EMU, dalen terwijl die van Italië en Spanje, de zogenaamde periferielanden van EMU, sterk toenemen. Vanuit het perspectief van de Europese obligatiemarkten is er dus sprake geweest van divergentie tussen kern en periferie binnen de monetaire unie. Dit spreekt de gedachte en het doel waarmee EMU in eerste instantie is opgericht geheel tegen. Ook blijkt uit het resultaat van afnemende industrie-effecten dat er geen sprake is geweest van industrie specialisatie binnen de EMU. In tegendeel, industrieën hebben zich meer verspreid in het gebied dat de Euro bestrijkt wat de voorspelling van de Krugman economen tegenspreekt. Het is wel juist gebleken dat de belangrijkheid van liquiditeit- en looptijdeffecten afneemt na EMU. Hiermee is ontwikkeling van de Europese obligatiemarkt tot een grotere en diepere markt deels bewezen.

Een andere bevinding van de decompositie analyse is dat de gemeenschappelijke factor in Europese obligatierendementen groot is. Daarvan wordt bepaald dat deze voornamelijk resulteert uit de omzetting van rendementen naar US dollar. Ook wordt bevonden dat de landeneffecten in een aantal gevallen te relateren is aan de zogeheten competitieve valuta component. Deze laatste component is gedefinieerd als het meerdeel van de nationale valutabeweging ten opzichte van het marktgemiddelde wat een competitief voordeel oplevert voor de bedrijven in het betreffende land, wat zich in betere rendementen vertaalt. De relatie tussen de belangrijkheid van de landeneffecten en deze component is duidelijk aanwezig, vooral in het geval van de kernlanden van EMU, en versterkt onder de Euro.

De empirische analyse in Hoofdstuk 5 bouwt voort op het thema van landen- en industrie-effecten in Europese obligatierendementen. Dat gebeurt in dit hoofdstuk doordat beleggingsportefeuilles ofwel op een landenbasis ofwel op een industriebasis worden ingericht. Deze portefeuilles worden dan met elkaar vergeleken op hun opbrengst. Terwijl de decompositie methode eigenlijk alleen de mate waarin effecten bijdragen in de variantie ofwel het risicogehalte van portefeuilles bepaalt, kijkt de gehanteerde methode in dit hoofdstuk naar de opbrengst ten opzichte van het genomen risico. Volgende op Hubert en Kandel (1987) en De Roon en Nijman (2001) worden er zogeheten spannings- en efficiëntietoetsen opgesteld om een dergelijke vergelijking te kunnen maken. Spanningstoetsen bepalen of de set van landenportefeuilles verbeterd kan worden door toevoeging van delen van de industrieportefeuilles en andersom. Deze toets vergelijkt de ligging van de optimale belegging parabool in een risico-rendement spectrum ten opzichte van elkaar. Efficiëntietoetsen vergelijken direct of het maximum behaalde Sharpe ratio van iedere set statistisch significant van elkaar verschilt. De landen- en industrieportefeuilles worden op drie verschillende wijzes gecreëerd. Te beginnen wordt uit de data set van USD rendementen van bedrijfsobligaties die in het vorige hoofdstuk is benut, een gesloten set van 4,587 rendementen geselecteerd. Het is voor de analyse in dit hoofdstuk namelijk nodig dat ieder rendement toe te kennen is aan één specifiek land en industrie. Voor het eerste type portefeuilles worden deze rendementen direct toegekend aan de acht overgebleven Europese landen en dezelfde zeven industriegroepen. Voor het tweede type portefeuilles worden deze opnieuw gemaakt volgens de standaard decompositie methode in Hoofdstuk 4. Hiermee wordt het bevonden resultaat van het vorige hoofdstuk, namelijk dat portefeuilles een ander rendement structuur hebben na decompositie, verder benut. Ten derde worden overheidsobligaties aan de analyse toegevoegd. De toevoeging van overheidsobligaties is alleen mogelijk in dit stadium omdat de analyse zich nu op het niveau van portefeuilles begeeft. De toevoeging van (individuele) overheidsobligaties zou door hun omvang de uitkomst van de decompositie analyse te zeer hebben beïnvloed. De toevoeging van overheidsobligaties is echter van belang omdat eerder is ondervonden dat beleggingsportefeuilles vooral in dit segment geïnvesteerd waren voor EMU. Voor de portefeuillerendementen van overheidsobligaties worden de indexen van EFFAS gebruikt. Deze zijn beschikbaar vanaf december 1991.

Spannings- en efficiëntietoetsen worden verricht op de drie types van landen- en industrieportefeuilles, eerst voor de gehele periode en vervolgens weer voor de twee deelperiodes rondom het begin van EMU. Resultaten zijn opmerkelijk omdat in een aantal gevallen landen- en industrieportefeuilles van Europese obligaties van elkaar zijn te onderscheiden. De eerste set van conclusies betreft alleen bedrijfsobligaties. Hier blijkt dat spanning minder vaak wordt verworpen in het geval portefeuilles voortkomen uit de decompositie dan uit hun directe allocatie. In de gevallen dat spanning wordt verworpen komt het vaker voor dat industrieportefeuilles verbeterd kunnen worden met delen van de landenportefeuilles dan andersom. De efficiëntietoetsen vinden dat beide portefeuilles niet zijn te onderscheiden in hun maximale Sharpe ratio, maar wel dat deze consistent hoger is voor de landenportefeuilles dan voor de industrieportefeuilles. Deze eerste set van conclusies bevestigd in zekere zin de behaalde resultaten van Hoofdstuk 4, waar werd geobserveerd dat landeneffecten belangrijker zijn dan industrie-effecten voor de rendementen van Europese bedrijfsobligaties. De tweede set van conclusies komt voort uit de toevoeging van overheidsobligaties in de analyse. Deze worden nu ingezet als landenportefeuilles en vergeleken met industrieportefeuilles die geheel uit bedrijfsobligaties bestaan. De uitkomst van de spanningstoetsen laat zien dat een landenallocatie van overheidsobligaties een suboptimale strategie is geweest. In een groot aantal gevallen kan de voor risico gecorrigeerde opbrengst van een dergelijke portefeuille verbeterd worden door het toevoegen van bedrijfsobligaties. Efficiëntietoetsen vinden echter dat de maximale Sharpe ratio van deze landenportefeuilles statistisch significant hoger is dan voor industrieportefeuilles.

Wat hebben deze resultaten uiteindelijk te betekenen? In praktische zin, voor het nut van fonds beleggers in Europese obligatiemarkten kunnen een aantal opmerkingen worden gemaakt. Fondsen die vooral de risicokenmerken van hun portefeuilles beogen, zijn gebaat bij een landenallocatie. Fondsen die de meest optimale voor risico gecorrigeerde opbrengst beogen zijn gelijk gebaat bij een landen- en een industrieallocatie. Dit echter met de gewaarwording dat landenportefeuilles waarschijnlijk een hogere dergelijke opbrengst leveren op de lange termijn. Fondsen die nog vanuit een tijdperk van voor EMU zijn blijven hangen in overheidsobligaties behoren hun strategie te veranderen door meer bedrijfsobligaties op te nemen. In elke samenstelling van portefeuilles is de beslissing van koersdenominatie belangrijk.

In politiek-economische zin, wat betreft de verdienste van EMU, kunnen tevens opmerkingen worden geplaatst. Door het speciale prisma van de obligatiemarkten bezien is de opgemerkte nationaal-economische divergentie tussen de kern- en periferielanden wel heel opmerkelijk. Deze tweedeling in de monetaire unie wordt in de huidige fase van de recente financiële crisis, die in de subprime markt begon, hoog opgespeeld. Obligatiemarkten spelen hierin duidelijk een centrale rol. Deze recente gebeurtenissen tonen aan dat doorlopend onderzoek naar het functioneren van deze markten van belang is.