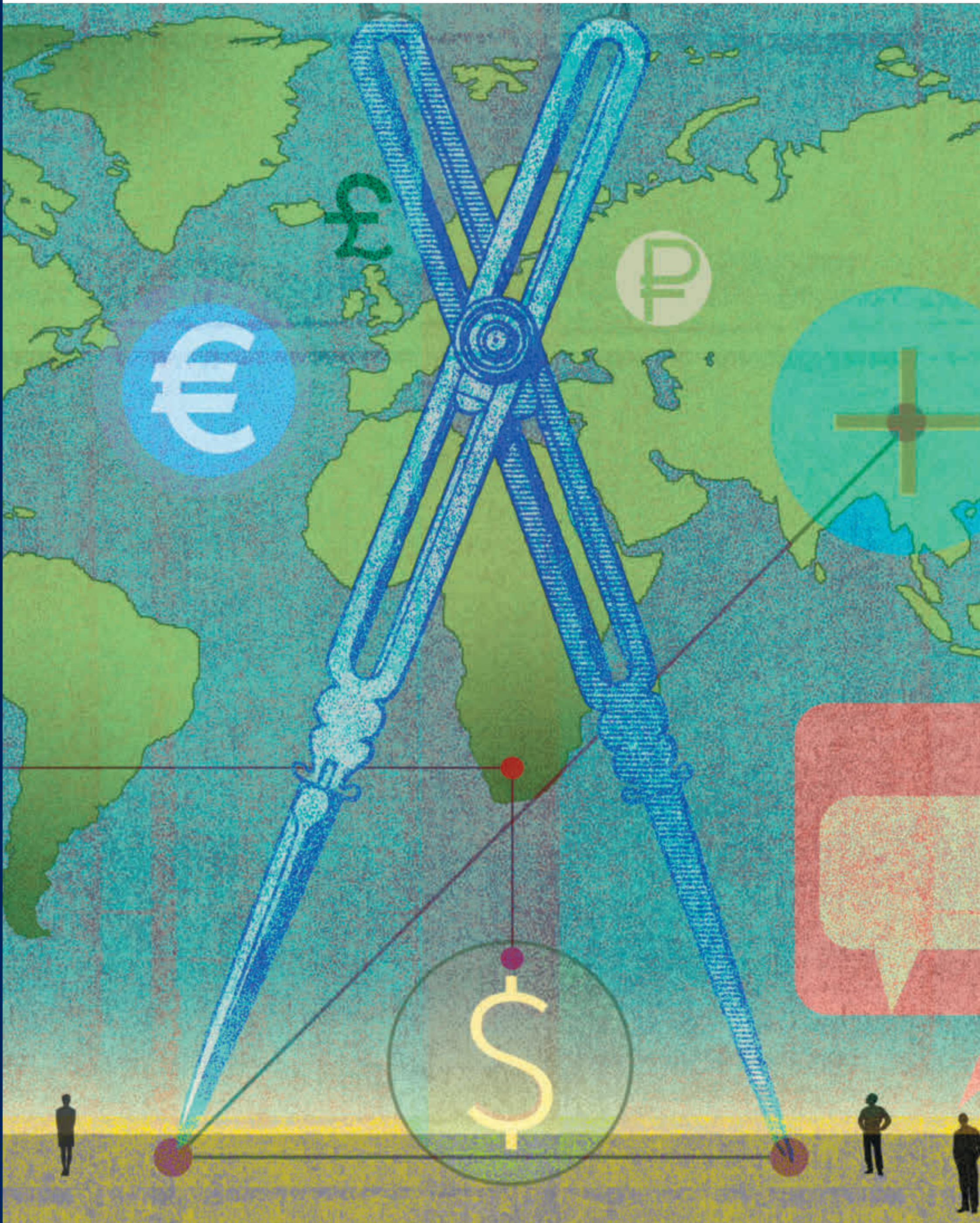
ZHAOWEN QIAN

Time-Varying Integration and Portfolio Choices in the European Capital Markets



Time-Varying Integration and Portfolio Choices

in the European Capital Markets

Time-Varying Integration and Portfolio Choices in the European Capital Markets

Tijdsvarierende integratie en portfolio keuzes op de Europese Kapitaalmarkten

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To my beloved family

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1 Introduction

The country versus industry debate has long been discussed in both academia and industry. The benchmark study is Heston and Rouwenhorst (1994) in which they introduce a factor decomposition model with static and unit country and industry factor exposures in explaining equity returns. A great number of studies (Griffin and Karolyi, 1998; Rouwenhorst, 1999; Cavaglia et al., 2000; Brooks and del Negro, 2004, Baca et al. 2000; Cavaglia et al., 2000; Adjaoute and Danthine, 2003; Flavin, 2004; Ferreira and Gama, 2005; Phylaktis and Xia, 2006 and Carrieri, Errunza and Sarkissian, 2008) have followed since using the same decomposition methodology, or a variant thereof, to analyze the relative importance of the two factors in the stock markets. Studies on the European capital markets, especially in the corporate bond market, are much less prevalent. This is where my PhD dissertation could contribute to the literature and provide new empirical evidence. Two primary reasons could explain why the country versus industry debate attracts continuous attention from the perspective of financial integration and portfolio management, which serve as the main motivations for this PhD dissertation.

First, the country versus industry debate offers us a perspective on international financial integration, which pins down to the European capital markets in this PhD thesis, especially from the corporate bond market and its linkage with the stock market. This line of research is of significant relevance for policymakers like ECB and other central banks who aims for more integrated and unified capital markets in the long run. Enhanced capital market integration is beneficial in Europe which could build the resilience of its capital markets to financial shocks. There are numerous studies that measure to what extent European stock markets are integrated (e.g. Fratzscher, 2002, Adjaoute and Danthine, 2004, Baele, 2005 and Hardouvelis et al., 2006, Jappelli and Pagano, 2008, Bekaert et al., 2013). The general findings are that European stock markets are well integrated. As an important financing and investment tool, corporate bond market and its integration are no less important than its equity peer. According to the 2018 ECB report on financial integration[1], corporate bonds are increasingly utilized by European companies as a source of financing. Moreover, both private and institutional investors in Europe increasingly hold corporate bonds in their investment portfolios. Moreover, the European bond market is currently substantially larger than the European equity market[2]. However, the number of bond studies is vastly smaller than that of stocks partially due to data unavailability, which could attribute to the thinner liquidity in the corporate bond markets. Baele et al. (2004a, b) find that country effects have been low and declining since the start of EMU so they argue that the European corporate bond markets are well integrated. Varotto (2003) and Pieterse-Bloem and Mahieu (2013) directly apply the standard decomposition methodology of Heston and Rouwenhorst (1994) to corporate bond returns. They find that country factors dominate industry factors and other bond-related factors such as credit rating, maturity, and liquidity so there is still significant financial segmentation in the European corporate bond market. The mixed evidence on the relative importance of country and industry factors raise the impression that the corporate bond market offers a distinct and different perspective on financial integration in Europe compared to the stock market. In addition, the Economic and Monetary Union (EMU) with the introduction of the Euro is a ground-breaking step in Europe which provides us a unique setting to study financial integration. The recent financial crisis and the sovereign debt crisis in Europe challenge the EU zone in several ways, which offers a great opportunity to analyze the capital markets during the stress period. In light of that, by hand collecting an unique

[1] https://www.ecb.europa.eu/pub/pdf/fie/ecb.financialintegrationineurope201805.en.pdf

[2] See BIS (2015) and World Federation of Exchanges (2015).

dataset of European corporate bond returns matched with their stock pairs at the individual company level and introducing time-varying country and industry factors in the Heston and Rouwenhorst (1994) decomposition model, this dissertation fills the country and industry literature gap, and offers new perspective on financial integration from the European corporate bond and stock markets during the most recent two decades.

Second, studies on the country and industry debate offer guidance on optimal portfolio construction, which could be quite useful for market practitioners like investors and asset managers, whose goals are to make the best risk-return decisions. Markowitz (1952)'s optimal rule for allocating assets based on the mean and variance of the return is the benchmark study in the portfolio management literature. The classical Markowitz model suffers the drawback of large estimation error, which gave rise to a vast literature of Bayesian approaches to reduce estimation error (Pastor, 2000; Pastor and Stambauch, 2000, Goldfarb and Iyengar, 2003, Garlappi et al., 2007, Kan and Zhou, 2007, Frost and Savarino, 1988, Chopra, 1993, Jagannathan and Ma, 2003, Best and Grauer, 1992, Chan et al., 1999, Ledoit and Wolf, 2008) and poor out-of-sample performance, which leads to studies on dynamic portfolio strategies (Perold and Sharpe, 1988, Dumas and Luciano, 1991, Cesari and Cremonini, 2003, Lui et al., 2003, Liu and Longstaff (2004), Brennan and Xia (2002)). DeMiguel et al. (2009) extensively compare the out-of-sample performance of several sample-based mean-variance models with the naive portfolio and their results show that there are still many miles to go before the gains promised by optimal portfolio choice can actually be realized out of sample. In this PhD thesis, we contribute to the asset management literature by introducing a dynamic portfolio strategy in which corporate bond portfolio weights are the result of an asset pricing model containing time-varying country and industry factors. Our analyses are based on both the index and the individual asset level, the latter of which could be directly replicated by investors. Moreover, by matching the stock-bond sample on the individual company level, further research on multi-asset allocation in the European capital markets using country and industry factors are being put on the agenda, which could yield beneficial results for asset managers and global investors in Europe.

This dissertation studies three research questions in the area of fixed income and portfolio management from the perspective of country versus industry debate in the European capital markets. The first study in Chapter 2 investigates the financial integration in Europe by looking at the time-varying relative importance of country versus industry factors in the European corporate bond market. There are two immediate contributions of the first study, on which the other chapters in this PhD thesis are based. First of all, we construct a unique dataset that is representative of the universe of actively quoted corporate bonds for over two decades. Corporate bond indexes are not readily available which may play a role in the fact that studies on equity returns outnumber those on bond returns. Therefore, I hand collected the daily prices of 8446 European corporate bonds from 1991 to 2013 and construct a unique database of monthly corporate bond returns, which is utilized in all of the empirical studies in this PhD thesis. Secondly, we introduce a straightforward modification of the Heston and Rouwenhorst (1994) decomposition model to allow for bond-specific and time-varying factor exposures. This enables us for the first time to study how the financial integration process evolves among European countries from a corporate bond market perspective. The method we use to make factor exposures time-varying is a multivariate GARCH specification, which has the advantage of not imposing any structure on the time-variation in beta but resulting in a continuous conditional beta. The first study in my PhD thesis finds that although unconditionally the country factor dominates the industry factor, there is substantial time variation and no trend towards full integration. Country factors reduce the relative importance to industry factors after the EMU but regain the power after the recent financial crisis. Breaks in the variation correspond with several important events in the European financial market integration, such as the introduction of the Euro and the sovereign debt crisis. The results in Chapter 2 contribute to the literature of country versus industry factors from the perspective of financial integration in the European corporate bond markets by bringing in time-varying factor analyses.

Chapter 3 builds on the first study but takes a completely different angle. In this chapter, I look into the effects of country versus industry factors in constructing dynamic portfolio strategies in the European corporate bond markets. I propose a strategy for European corporate bonds based on a two-factor pricing model, which capitalizes on the time-varying findings of the relative importance of country versus industry factors in the European corporate bond markets in Chapter 2. I first show that, despite the relative dominance of country factors over industry factors, we cannot rely on a country allocation alone to deliver a mean-variance outperformance. Rolling spanning and efficiency tests that are used to evaluate the performance of the country-only and industry-only portfolios over time show that we need both factors to achieve mean-variance efficiencies. Therefore, I introduce a strategy in which I forecast both country and industry factors as well as bonds exposures to these factors. I compare the performance of the indexes that we are thus able to construct to three benchmark portfolios: (i) the mean-variance portfolio; (ii) the minimal-variance portfolio; and (iii) the naive portfolios on either an equal-weight or a value-weight basis. I find that the strategy based on the forecasted factors outperforms a number of benchmark strategies, whereas the strategy based on the forecasted exposures does not. I also find that there is ample time variation in the performance related to the market conditions that can be exploited. The dynamic strategy performs significantly better than the benchmark when market volatility is low and when the level of market integration is also relatively low. At the individual bond level, we find significant outperformance over the benchmark strategies and the gains promised by optimal portfolio choice can actually be realized out of sample. Since the portfolios from individual bonds can be replicated, our results are relevant for active portfolio management strategies offered by the investment management industry, which in return contribute to the country versus industry debate regarding portfolio construction.

Chapter 4 asks the last research question in this dissertation: Do European corporate bond and the stock markets differ from each other? Diverging from the previous two studies which focus solely on the European corporate bond markets, Chapter 4 directly compares the European corporate bond and the stock markets from the perspective of country versus industry debate. The Merton (1974) model argues that corporate bonds and stocks are related in the sense that equity value is a call option on the companyâs assets while the corporate bond value equals the risk-free bond minus a put option on the firm value. Therefore, in this chapter, corporate bonds and stocks for each company are matched to one-to-one pairs between 1999 and 2013 among the European countries which make a direct comparison between the two markets feasible. We decompose the bond and stock returns respectively using the decomposition model developed in Chapter 2 to allow for bond-specific and time-varying factor exposures. Our results indicate, in general, the differences of the relative importance of the country and industry factors between the stock and corporate bond markets show significant time variation. The difference of the country effects between the two market jumps significantly during the recent financial crisis while the industry differences are less volatile. Country factors, relative to the industry factors become more prominent for bonds compared to their stock pairs after the recent financial crisis, especially for the core countries. At the individual company level, regression analyses show that in general, variables which could signal higher asset volatility (e.g. higher stock volatility, lower capital expenditure, lower working capital) or lower credit risks (e.g. higher interest coverage ratio, better profit margin) would increase the differences between the European corporate bond and stock markets. Such results confirm the findings in Merton (1974) model and several previous studies (Kwan, 1991, Campbell and Taksler, 2003, Cremers et al., 2008 and Demirovic et al., 2017) on the relation between the corporate bond and the stock markets. Our results contribute to the literature on the direct relations between the corporate bond and the stock markets by providing new results from the perspective of country versus industry debate in the European corporate bond markets.

In the paragraph, I will declare the contributions of myself and my co-authors for each chapter. Chapter 1 and 5 are written independently by the author of this thesis. The comments of the promoter and co-promoters have also been incorporated by the author. The majority of Chapter 2, 3 and 4 have been done independently by the author of this thesis. The author developed the proposals, reviewed the literature, conduct the empirical analysis, interpreted the findings and drew the conclusions. The promoter and co-promoters provided lots of valuable suggestions and comments regarding the paper structure, research design and policy contributions. These suggestions have been incorporated in the final version of the chapters by the author, which significantly improved this thesis. The data used in the thesis was partially from the co-promoter, Mary Pieterse-Bloem, which has been further extended to a more recent time period in Chapter 2 and 3 and merged with stock sample in Chapter 4 by the author of the thesis.

2 Time-varying Importance of Country and Industry Factors in European Corporate Bonds.[3]

2.1 Introduction

The process of financial integration in Europe has experienced a number of major events over the past decades. On the one hand, the Economic and Monetary Union (EMU) with the introduction of the Euro is a ground-breaking step towards more financial integration. On the other hand, the recent global financial crisis and the European sovereign debt crisis have challenged the integration process. The state of financial integration is important for both policy makers and market practitioners in the Eurozone alike. For these reasons, financial integration studies have grown into a distinctive field in the international finance literature. This paper contributes to that field by bringing the perspective from the European corporate bond market. Furthermore, this study is to the best of our knowledge the first to bring such an analysis into the territory of time-varying country and industry exposures as well as the global financial crisis.

There are several ways to measure financial integration. In this paper, we study the financial integration process in Europe by looking at the relative importance of country versus industry factors. If the relative importance of country factors decreases (increases), it can be interpreted as market integration (fragmentation). The benchmark study we build on is Heston and Rouwenhorst (1994) who introduce a factor decomposition model, and Baele et al. (2004) who apply the model in the market integration framework. Many studies that follow a similar

[3]This chapter is based on Pieterse-Bloem, M., Qian, Z., Verschoor, W., Zwinkels, R. (2016). We are especially grateful for the helpful comments and suggestions from the anonymous referees. We thank the participants of the European Sovereign Debt Crisis conference, with special thanks to our discussant Evren Örs. We also thank our discussants at the Infiniti Conference, the FMA Europe conference, the EFMA conference, and the Brownbag Seminar in Erasmus University.

approach show by and large that industry factors play an increasingly larger role relative to country factors in the stock market[4]. In Europe, this is especially the case after 2000, which coincides with the introduction of the Euro. Corporate bond market studies, however, have been far less prevalent. Given that the European bond market is substantially larger than the European equity market[5], it is of critical importance to gain more insight on the state of financial integration from this market. The bond studies that do exist lend mixed evidence on the relative importance of country and industry factors[6]. These results raise the impression that the corporate bond market offers a distinct and different perspective on financial integration in Europe compared to the stock market.

Our paper contributes to the field of European financial integration studies by making the perspective from the bond market more detailed and complete. We do so by hand-collecting a comprehensive dataset of the European corporate bonds that spans more than two decades, and by introducing time-varying country and industry exposures. The first specific contribution of this paper is that we introduce a straightforward modification of the Heston and Rouwenhorst (1994) decomposition model to allow for bond-specific and time-varying factor exposures. This enables us for the first time to study how the financial integration process evolves among European countries from a corporate bond market perspective. The method we use to make factor exposures time-varying is a multivariate GARCH specification. A second specific contribution of this paper is that we examine the impacts of several critical events including the start of EMU and the recent financial crisis on the process of financial integration in Europe. Through a rolling-window break point analysis, we let the data identify the events that significantly change the level and the trend of the integration process.

[4]See e.g. Baca et al. 2000; Cavaglia et al., 2000; Adjaoute and Danthine, 2003; Flavin, 2004; Phylaktis and Xia, 2006

[5]See BIS (2015) and World Federation of Exchanges (2015)

[6]See e.g. Varotto (2003), Pieterse-Bloem and Mahieu (2013) and Baele et al. (2004).

We find that the corporate bond markets tell a different story from the stock market on financial market integration in Europe. Unconditionally, country factors dominate industry factors. We observe that the importance of country factors decreases after the launch of EMU, although they still remain dominant relative to industry factors. They become even more important after the global financial crisis despite years of financial integration in the monetary union. Evidently, integration is far from complete in the European corporate bond markets and EMU is not quite the leap forward for integration as it is for stocks. We also find that the relative importance of country and industry factors changes significantly over time. Likelihood ratio tests indicate that our model significantly improves over the static specification for over 95% of the bonds in our sample. This confirms that there is considerable time-variation in the country and industry exposures of European corporate bond returns, as is true for stock returns. Our break point analysis identifies five dates at which the level and the slope of the country and industry factor loadings change significantly. The identified dates coincide with the signing of the Maastricht treaty, anticipation and introduction of the Euro, the global financial crisis and the European debt crisis. Country factor importance is reduced relative to the industry factors after 1999. This indicates that EMU fosters financial integration at first when the industry composition of countries also becomes more specialized. However, after the global financial crisis in 2007, country factors regain their importance in explaining bond returns over industry factors. This indicates that this major shock is a large setback to integration, leading to financial fragmentation in the Eurozone. Integration, therefore, is a dynamic process that does not follow a simple linear path towards full integration.

Additional analyses using classified country groups show that the core, periphery, and non-Euro countries in our sample experience different integration paths. Our results show relatively similar trends for core and peripheral countries across time. However, Germany and the Netherlands show larger impacts from the crisis. This might be due to the sovereign debt fears in EMU igniting a flight to safety to the core countries during the crisis. The non-Euro countries in our sample show different trends than the Euro countries, suggesting that the integration process is indeed affected by the adoption of the Euro. A possible explanation is that in this period the business cycle of these EMU opt-outs diverge considerably from that of the Eurozone. Our results are robust to the exact model specification, excluding the largest country (Germany) and excluding the most influential industry (financial and funds).

The rest of the paper is organized as follows. Section II places the contribution of our paper in the existing literature and develops six main hypotheses. Section III explains how we prepare the data and gives the summary statistics of our final bond sample. In Section IV we outline the main methods that we employ for our study. We discuss our main findings in relation to our hypotheses in Section V. In Section VI we conduct two additional tests, excluding the most dominant country (Germany) and most dominant industry (Financial and Funds) from our sample. The final section concludes the paper.

2.2 Literature and Hypotheses

2.2.1 Background Literature

Our paper relates and contributes to several streams of literature. The first stream of related studies is about financial integration. There are numerous studies that measure to what extent stock markets are integrated in Europe. They differ in quantifying integration by using price measures (e.g. Fratzscher, 2002, Adjaoute and Danthine, 2004, Baele, 2005 and Hardouvelis et al., 2006), quantity measures (Jappelli and Pagano, 2008) or earnings yield (Bekaert et al., 2013). The common finding in these studies is that European stock markets are well integrated. Francesca, Errunza, and Sarkissian (2004) investigate global integration at the industry level by raising the concern of "industry specific price" of country risks. They show that countries are integrated with the world only if most of their industries are integrated. By including both country and industry factors in our model and making betas heterogeneous across bonds, our paper also separate country effects from industry-driven sources of return variation to study the financial integration.

While the question of financial integration is equally important for the fixed income market as for the equity markets, the number of bond studies is vastly smaller than for stocks. This is where our paper adds to the literature and in particular to those studies that approach the integration question from a country versus industry factor analysis. The benchmark study for the relative importance of country and industry factors is Heston and Rouwenhorst (1994). They introduce a factor decomposition model with static and unit factor exposures to study the benefits of international portfolio diversification. Heston and Rouwenhorst (1994) apply their method to European equity markets and find that country factors play a bigger role in explaining stock returns than industry factors. A great number of studies have followed since using the same decomposition methodology, or a variant thereof, to analyze the relative importance of the two factors for stocks. The empirical results of these studies show in general that country effects explain a larger proportion of return variation than industry factors until the turn of the millennium (e.g. Griffin and Karolyi, 1998; Rouwenhorst, 1999; Cavaglia et al., 2000; Brooks and del Negro, 2004). After 2000, industry factors are documented to play an increasingly larger role in explaining equity returns (e.g.: Baca et al. 2000; Cavaglia et al., 2000; Adjaoute and Danthine, 2003; Flavin, 2004; Ferreira and Gama, 2005; Phylaktis and Xia, 2006 and Carrieri, Errunza and Sarkissian, 2008). For Europe, where this result holds quite strongly, the turning point coincides with the introduction of the Euro.

Heston and Rouwenhorst (1994) introduce their decomposition model as a tool to identify whether country or industry diversification is more effective for achieving risk reduction in a portfolio of stocks. This method has been expanded by Baele et al. (2004a,b) to measure financial integration in the corporate bond markets and is still used to this date by the European Central Bank to measure financial integration in the Eurozone[7]. The central idea is that the extent of financial market integration is measured by the degree to which the importance of country factors in returns fade relative to the industry factors. Baele et al. (2004a,b) find that country effects have been low and declining since the start of EMU. This finding may be due to Baele et al. (2004a) two step model, estimating country factors among several other factors after correcting for credit rating risk. Varotto (2003) and Pieterse-Bloem and Mahieu (2013) directly apply the standard decomposition methodology of Heston and Rouwenhorst (1994) to corporate bond returns. Both studies find that country factors dominate industry factors and other bond-related factors such as credit rating, maturity and liquidity.

The sample period of all the mentioned studies do not extend into the global

[7]https://www.ecb.europa.eu/pub/pdf/other/financialintegrationineurope201504.en.pdf

financial crisis and European sovereign debt crisis. The sample of Pieterse-Bloem and Mahieu (2013), being the most recent study, ends before March 2008 and thus only captures the early months of the global financial crisis and none of the Eurozone sovereign debt crisis. As far as we know, there are not many studies, not even for stocks, that address the relative importance of country versus industry factors in the crisis or similar high volatility periods. Brooks and Del Negro (2004) is one of the few examples. They find that after the IT bubble, country factors still play an important role in equity portfolio diversification. This result suggests that at times of crisis and thereafter, the importance of industry factors is set back. This is also confirmed by the recent study of Chou, et al. (2014)[8], which finds that country effects regain importance over industry effects during the global financial crisis period in the equity market. By extending the sample into 2013 in our paper, we are able to study the relative importance of country versus industry factors during the entire crisis period.

We also add to the time-varying factor exposure literature. In equity markets, there are several studies that introduce heterogeneous and time-varying factor loadings. Marsh and Pfleiderer (1997) relax the assumption in Heston and Rouwenhorst (1994) that each stock has the same exposure to country and industry factors. They apply an iteration approach to allow sensitivities to factors to differ across stocks and find a more important role for industry factors than Heston and Rouwenhorst (1994). However, the factor exposures in March and Pfleiderer (1997) are still constant.

Studies like Bekaert and Harvey (1997) and Fratzscher (2002) make factor exposures conditional on certain structural information variables. Baele (2005) models exposures conditional on a latent variable. Baele and Inghelbrecht (2009)

[8]Chou et al. (2014) look for the determinants of country and industry factors in Eurozone stock returns after the recent financial crisis with the inclusion of variables for different types of risks in a regression model. Our paper focuses on the integration measure of the relative importance of country and industry factors, not their determinants.

combine the two approaches and propose a structural regime-switching volatility spillover model, which allows for factor exposures and asset-specific volatilities to vary over structural changes and temporary business and financial fluctuations. They find that the increasing importance of industry effects compared to country effects is a temporary phenomenon. Not accounting for time-varying factor exposure leads to large errors in measuring country and industry risks. Catão and Timmerman (2009) propose a two-step approach to study the relative importance of country versus industry factors. In the first step, they utilize the standard Heston and Rouwenhorst (1994) model to construct country and industry portfolio returns, which are modelled as regime-switching processes in the second step. These studies show that time-varying factor loadings are methodologically preferred to static and unit factor loadings. This suggests that it is of crucial importance to apply time-varying factor loadings in analyzing bond returns as well. Both Varotto (2003) and Pieterse-Bloem and Mahieu (2013) apply unit and fixed factor betas to corporate bond returns, rendering their results contingent on the sample period selection for calculating the factor loadings. Our paper adds to this literature by making factor exposures in corporate bond returns time-varying. The method we use to make betas time-varying is a multivariate GARCH specification (Engle and Kroner, 1995). The main advantage of this method is that it does not impose any pre-defined structures on the factor loadings. The dynamic properties of the factor loadings can be directly observed. Furthermore, the time-variation is continuous rather than discrete. This makes it better suited for our research question than the methods used to calculate time-varying betas in some other studies (e.g.: Bekaert and Harvey, 1997; Fratzscher, 2002; Baele, 2005).

2.2.2 Hypothesis Development

HYPOTHESIS 1: Unconditionally, country factors dominate industry factors in explaining the variance of European corporate bond returns.

The mixed evidence for bonds and equity from the studies on country versus industry factors raises the possibility that the bond perspective on financial integration is different from that of stocks. Whereas stock returns are driven by both expected dividends and the discount factor, changes in bond prices are only driven by the discount factor. This implies that equity market integration has more potential drivers than bond market integration. In addition, corporate bond markets are closely related to sovereign bond markets through the "sovereign ceiling" (Borensztein et. al., 2013) in which the corporate bond spreads are affected by the country risks. Therefore, we expect ex-ante that bond markets are more sensitive to country effects than stock markets. Furthermore, Pieterse-Bloem and Mahieu (2013) find, using a subset of our data, that country factors dominate. When we apply the standard Heston and Rouwenhorst (1994) model to our sample, we expect to see country effects dominate industry effects over the full sample period.

HYPOTHESIS 2: There is significant time-variation in the integration of European corporate bonds.

Country and industry exposures of stock returns have proven to contain significant time-variation and we expect ex ante that the same holds for corporate bond returns. Specifically, studies like Bekaert and Harvey (1997) illustrate the time-variation in country and industry effects for equity, which they state is driven by the "economic and financial market policies followed by its government or other regulatory institutions". In other words, there might be barriers to investments of locals in foreign countries and vice versa, such as capital controls. These barriers hamper investments in both equity and debt markets. In addition, Pieterse-Bloem and Mahieu (2013) illustrate that the start of EMU has a significant change in the relative importance of country factors.

HYPOTHESIS 3: After the start of EMU, European corporate bond markets become more integrated.

Through the time-varying exposures we can see the dynamic properties of the country and industry factors and can compare their relative importance. We expect to see the impact of country factors declining and industry factors rising, hence integration to go up, immediately after EMU. According to optimal currency area theorists[9], a monetary union is expected to foster the convergence of the economies to that of the strongest of member states. According to new trade theorists[10], industry specialization results from the exploitation of economies of scale in production and a preference for diversity by consumers. Our ex-ante expectation that results from these findings is that the relative importance of country factors should decrease and industry factors should rise after EMU.

HYPOTHESIS 4: After the start of the global financial crisis, European corporate bond markets become less integrated.

The global financial crisis and subsequent European debt crisis caused substantial divergence in sovereign CDS spreads across Europe (Augustin, 2014). Through the 'sovereign ceiling' (Borensztein et. al., 2013), this directly affects corporate bond spreads. Whereas differences between country level risk were small before the global financial crisis, they greatly increase after the crisis. We therefore expect that country effects rise in the corporate bond market in Europe after the global financial crisis.

HYPOTHESIS 5: There are several shocks to the financial integration process in Europe which impact both the level and the direction of integration in European corporate bond markets.

There are several major events in our time sample which directly impact the financial integration process in the Eurozone. The start of EMU and the global financial crisis are documented to be events of large magnitude for the European

[9]Starting with Mundell (1961)

[10]Starting with Krugman (1979, 1980)

financial market. Over the whole sample period of January 1991 to January 2013, there are many other events that may have caused a structural shift in the return variation structure. For example, the ERM crisis and signing of the Maastricht Treaty in the early years of the sample period. Following the shock of the sovereign debt crisis, the ECB introduces several measures to stem possible contagion among periphery countries. These events, as well as the actual bail-in of bond holders with certain debt restructurings (of Greece and Cyprus) could have likely affected the European corporate bond returns too. We therefore expect ex-ante that more break points significantly influence the level (direct effect) and trend (anticipation effect) of the relative importance of country versus industry factors.

HYPOTHESIS 6: Core, periphery and non-Euro countries experience different paths of financial integration regarding the corporate bond markets.

Pieterse-Bloem and Mahieu (2013) observe that the country effects of Southern or peripheral countries substantially increase in the latter months of their sample. Furthermore, Augustin (2014) shows that European sovereigns are split in two sets regarding their CDS spreads: core and periphery with sharply increasing and decreasing spreads, respectively. Furthermore, there is a break in the correlation structure between core and periphery around the European sovereign debt crisis induced by the change in perceived credibility of the "no-bailout clause" of the European Union. Based on these observations, we expect ex ante that in the Euro sovereign debt crisis the country effects of peripheral Eurozone countries, rather than those of the core countries, drives the country exposures higher. Furthermore, we expect for the non-Euro countries in our sample that they are less affected by the sovereign debt crisis than the Euro countries due to their lower exposure to troubled countries, either through the "no-bailout clause" or through direct economic linkages.

2.3 Data

Country and industry return indexes are required for the empirical analysis of the importance of those factors in return variation. For equities, these indexes are readily available, but this is not the case for corporate bonds. This may play a role in the fact that studies on equity returns outnumber those on bond returns. In absence of the required European corporate bond indexes, we utilize the bond database used by Pieterse-Bloem and Mahieu (2013) and extend the daily prices of the bonds to January 2013 using Bloomberg. This set of bonds is representative for the actively quoted European corporate bond market[11]. The price series are all collected in their local currency. Since our research is based on one common currency, we also collect end-of-month exchange rates of the local currencies against the US dollar (USD) from Datastream.

We follow Pieterse-Bloem and Mahieu (2013) in the creation of USD country and industry return indexes from the individual corporate bond price series. Holding-period (monthly) returns for individual bonds are calculated for each month from the end-of-month dirty prices, using clean prices and accrued interests. We assume that coupon re-investments take place at the beginning of the following month. These local currency returns are then converted to USD returns using the relevant spot USD exchange rates.

The final data sample includes 8,446 corporate bonds covering the period from January 1991 to January 2013. The data set constitutes a closed set, since each bond belongs to one country and one industry in the sample. In total, we have eight country indexes and seven industry indexes. The countries that are rep-

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[11]Whenever a European corporate bond is issued and when they are quoted a price by one of the banks that is a price source provider, Bloomberg registers the bond with its own ISIN. Bloomberg has practically all the banks that are active in the primary and secondary market as a price source provider. Therefore, Bloomberg captures the universe of actively quoted European corporate bonds. We have made an indiscriminate selection from that universe. We omit bonds that do not provide a price quote for at least two consecutive months from our dataset.

resented in the analysis are Belgium/Luxembourg (BL), France (FR), Germany (GE), the Netherlands (NE), Italy (IT), Spain (SP), Sweden (SW) and the United Kingdom (UK). The industries that are represented are financial and funds (FF), government institutions (GI)[12], consumer goods (CO), communications and technology (CT), basic materials and energy (BE), industries (IN) and utilities (UT). Table 2.1 shows how the bonds distribute over different countries and industries. Panel A of Table 1 shows that Germany constitutes 37.8% in our sample, which is the largest proportion of European corporate bonds among the eight countries. France and the United Kingdom follow with 15.4% and 15.1% of total sample each. For the industries, Panel B shows that the financial and funds sector dominates with 67.0% of corporate bonds in the whole sample. On a value-weighted basis[13], the dominance of Germany and the financial industry is largely reduced. Panel D indicates that the value-weighted share of Germany now consists of only 19.5% among the whole sample. On a value-weighted basis, the United Kingdom and Italy are among the largest issuing countries besides Germany. Among the industries the dominance of the financial industry is likewise reduced. On a value-weighted basis the financial sector still accounts for 43.4% of the sample. These results imply that both Germany and the Financial and Funds industry give out a relatively large number of bonds with relative low notional value.

Table 2.1 indicates that each country has at least one bond in each industry. This indicates that there are good diversification opportunities in our sample and that all countries are industrially diversified. Nevertheless, certain patterns of industry concentration in the European countries are visible from Panels C and D. For example, France is more concentrated in the consumer and industrial

[12]Government Institutions include the bonds from quasi-sovereigns and local authorities. Quasi-sovereigns are entities within the government but are not the same as the sovereign issuer itself. Examples include KFW in Germany, CADES in France, Nederlandse Waterschapsbank in the Netherlands. Local authorities are provinces and municipalities.

[13]We use the bonds' notional value to calculate the value-weighted returns.

Table 2.1: Country and Industry Composition for Bonds

This table shows the country and industry composition for bonds between 1991 and 2013. Panel A and B give for each country and industry the number of bonds included in the total sample and as a percentage of the total number of bonds. Panel C gives for each country by industry the number of bonds included in the total sample. Panel D gives the average weight of the (live) bonds in the country by industry cross-sector in the total value-weighted market over the whole sample. Percentages do not add up to precisely 100 due to rounding.

A. By country (number and percent of total)			
Belgium/Luxembourg	BL	260	3.08%
France	FR	1305	15.45%
Germany	GE	3196	37.84%
Italy	IT	611	7.23%
Netherlands	NE	997	11.80%
Spain	SP	136	1.61%
Sweden	SW	668	7.91%
United Kingdom	UK	1273	15.07%
Total		8446	100%

B. By industry (number and percent of total)			
Financials&Funds	FF	5662	67.04%
Government Institute	GI	784	9.28%
Consumer Goods	CO	691	8.18%
Comm.Technology	CT	313	3.71%
Basic material&Energy	BE	246	2.91%
Industrials	IN	292	3.46%
Utilities	UT	458	5.42%
Total		8446	100%

C. Number of bonds by country and industry

	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	163	13	16	9	24	16	19	260
France	624	95	203	79	90	111	103	1305
Germany	2652	241	137	40	35	58	33	3196
Italy	454	47	22	28	14	6	40	611
Netherlands	641	206	28	42	24	22	34	997
Spain	78	16	5	12	4	7	14	136
Sweden	336	146	70	38	17	37	24	668
United Kingdom	714	20	210	65	38	35	191	1273
Total	5662	784	691	313	246	292	458	8446

D. Average weights of country/industry in the value-weighted European market:

in percentage	FF	GI	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	0.48	0.33	0.03	0.15	0.19	0.09	0.21	1.48
France	6.14	2.18	2.31	1.92	1.03	1.66	2.28	17.52
Germany	12.08	2.8	1.56	0.72	0.44	1.02	0.74	19.36
Italy	2.32	13.76	0.31	0.73	0.29	0.13	0.6	18.05
Netherlands	6.27	3.63	0.26	0.6	0.3	0.3	0.39	11.75
Spain	0.57	1.95	0.03	0.18	0.11	0.12	0.28	3.24
Sweden	6.43	2.04	0.1	0.2	0.03	0.06	0.32	9.18
United Kingdom	9.87	0.61	3.07	1.76	0.54	0.67	2.87	19.39
Total	44.16	27.21	7.67	6.26	2.93	4.05	7.69	100

sectors. Germany, the Netherlands and Sweden have some concentrations in the government sector. The United Kingdom is relatively concentrated in consumers and utilities. All countries have relatively heavy weights in the financial industry. Table 2.2 lists the summary of the monthly percentage mean and standard deviation of European corporate bond returns classified by country (Panel A) and by industry (Panel B). The table shows that although country and industry sector returns are very similar, the variation in average returns and return volatility is larger among the country indexes than the industry indexes. Judging from the value-weighted mean country index returns, countries with above-average returns are the United Kingdom and Spain, while Germany and France are below the average. For the value-weighted industry index mean returns, the highest returns can be found among the utilities whereas the industries sector is the lowest. On a value-weighted basis, the difference between the highest and lowest mean index return among all countries is 0.21%, while the difference is only 0.09% among all industries. The range in the standard deviation of the returns is 0.49% for all countries and 0.18% for all industries. The correlation matrix in Table 2 indicate that different countries are less correlated with each other than different industries are, both on an equal and a value-weighted basis.

Table 2.2: Summary Performance Statistics for Bonds

This table shows the summary performance data of country and industry corporate bond index returns from 1991 to 2013. Panel A (B) summarizes the mean and the standard deviation of the equal-weights (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-a-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 to the equal-weighted returns.

A. By country

Country	EW Return		VW Return		Currency return		Correlation matrix								
	Mean	St.dev	Mean	St.dev	Mean		BL	FR	GE	IT	NE	SP	SW	UK	Total
BL	0.6931	3.3048	0.6765	3.3573	0.0387	3.1389	1	0.9567	0.9621	0.8936	0.9672	0.8536	0.9084	0.8512	0.9517
FR	0.6751	3.1109	0.6685	3.2056	0.033	3.1169	0.965	1	0.9763	0.9049	0.9837	0.8765	0.9211	0.8497	0.9669
GE	0.7101	3.2308	0.6369	3.1361	0.039	3.1395	0.9609	0.9698	1	0.9029	0.9793	0.8579	0.9243	0.8781	0.9757
IT	0.7735	3.2133	0.7871	3.3067	0.145	3.2064	0.9296	0.9428	0.9338	1	0.8914	0.8322	0.867	0.8415	0.9582
NE	0.6508	3.2188	0.6402	3.2268	0.0387	3.1372	0.9685	0.9827	0.9572	0.9156	1	0.872	0.9314	0.8459	0.9654
SP	0.8089	3.4862	0.8499	3.6248	0.1569	3.2277	0.8652	0.8947	0.8719	0.8564	0.8803	1	0.8254	0.7608	0.8718
SW	0.7343	3.2665	0.7142	3.3226	0.1141	3.5417	0.9457	0.9439	0.9493	0.9101	0.9444	0.8473	1	0.8264	0.9429
UK	0.904	3.2909	0.8379	3.2075	0.1189	2.7742	0.7961	0.8065	0.7983	0.7801	0.7868	0.7557	0.7922	1	0.9113
Total	0.7578	3.1274	0.7584	3.1057			0.9641	0.9749	0.9736	0.9383	0.9627	0.8892	0.9505	0.8969	1

B. By industry sector

Industry	EW Return		VW Return		Correlation matrix							
	Mean	St.dev	Mean	St.dev	FF	GI	CO	CT	BE	IN	UT	Total
FF	0.7632	3.2282	0.7331	3.2093	1	0.9665	0.9568	0.9541	0.9686	0.9657	0.9562	0.9861
GI	0.7318	3.2481	0.7402	3.2274	0.9521	1	0.9222	0.9182	0.9173	0.9397	0.92	0.9873
CO	0.7509	3.051	0.7315	3.1366	0.9417	0.9391	1	0.9453	0.9656	0.9529	0.9575	0.9574
CT	0.7664	3.1285	0.7359	3.2123	0.937	0.9433	0.9631	1	0.9546	0.9686	0.9388	0.9548
BE	0.75	3.1429	0.7478	3.1906	0.9571	0.9411	0.9669	0.9616	1	0.9649	0.9574	0.9586
IN	0.7335	3.1247	0.6978	3.1635	0.9571	0.9626	0.9651	0.9723	0.9732	1	0.9476	0.9712
UT	0.7961	3.1893	0.7919	3.3134	0.9161	0.9212	0.9582	0.9555	0.939	0.9422	1	0.9542
Total	0.7578	3.1274	0.7584	3.1057	0.99	0.98	0.97	0.97	0.98	0.98	0.95	1

2.4 Methods

The Heston and Rouwenhorst (1994) model is a straight-forward method to decompose asset returns into country and industry components. It enables us to directly compare the relative importance of country versus industry effect, and draw inference about the process of financial integration. A large number of studies utilizes the method to analyze the country versus industry debate empirically. One shortcoming of this method is that it assumes that the country and industry betas are unit and time-invariant. In that case, the asset exposures to industry risks are equal across countries. In addition, the Heston and Rouwenhorst (1994) model reports the aggregate results of the country and industry effects. Our method extends the Heston and Rouwenhorst (1994) model by making country and industry factor loadings for each bond different and time-varying. There are several methods[14] available in the literature, mainly applied to equity markets. Given that the main goal of our paper is to analyze the continuous evolution of the factor loadings, we prefer not to impose any regime structures on the factor loadings. Therefore, we opt for a multivariate GARCH specification as our basic tool to estimate time-varying betas. The GARCH model is first introduced by Bollerslev (1986). The beta of an OLS regression of x on y is given by $cov(x, y)/var(x)$. The multivariate GARCH approach will give us conditional estimates of both $cov(x, y)$ and $var(x)$. As such, the GARCH based beta estimator has the advantage of not imposing any structure on the time-variation in beta. Furthermore, it results in a continuous conditional beta. Finally, it takes potential conditional heteroscedasticity of the returns into account, which could bias conditional comovement measures

[14] Mergner and Bulla (2008) use a state space model with the Kalman filter approach to model and estimate the time-varying structures of betas. The state equation, however, requires an ex-ante choice of functional form. The Markov switching framework by Hamilton (1989, 1990) can also be used to introduce time-variation in betas. The implicit assumption is that there are switches between different regimes. The data used in the Markov switching model usually results from a process that undergoes abrupt changes, induced, for example, by political or environmental events.

(see Forbes and Rigobon, 2002)[15].

2.4.1 Constructing Country and Industry Factors

We apply a two-step approach. In the first step, we employ the Heston and Rouwenhorst (1994) method to construct the country and industry factors using cross-sectional regressions. For each month from January 1991 to January 2013, the asset returns for the individual bonds that exist in that month are decomposed into a country, industry, and an idiosyncratic component[16] using the following regression equation:

$$r_{n,t} = \alpha + \sum_{j=1}^{J} f_{j,t} I_{nj,t} + \sum_{k=1}^{K} f_{k,t} I_{nk,t} + \varepsilon_{n,t} \tag{1}$$

where $r_{n,t}$ represents the vector of individual bond returns of company n existing in month t. $I_{nj,t}$ is an industry dummy variable which equals one if asset n belongs to industry j at time t and zero otherwise. Likewise, the country dummy $I_{nk,t}$ equals one if asset n belongs to country k in period t and zero otherwise. The coefficients $f_{j,t}$ and $f_{k,t}$ capture the variation in returns that can be assigned to a specific industry and country, respectively.

Equation (2.3) cannot be estimated in its present form because it is unidentified due to perfect collinearity. Intuitively, this is because every bond belongs to both an industry and a country, so that industry and country effects can be measured only relative to a benchmark. To resolve the indeterminacy, we follow

[15] For robustness, we also run all our analyses using rolling window regressions to account for the time-variation in the betas. The results are qualitatively similar and are available upon request from the authors.

[16] There are corporate bond studies (Pieterse Bloem and Mahieu, 2013 and Varotto, 2003) that follow the Heston and Rouwenhorst (1994) decomposition model and take other factors like maturity, liquidity and credit rating into account. The results generally show that country factors still dominate, also after the inclusion of such extra factors. Moreover, our paper does not focus on the determinants of corporate bond returns but rather on on the corporate bond markets perspective on European financial integration for which the relative importance of country versus industry is crucial. We therefore analyse the decomposition of their returns into industry and country factors.

Heston and Rouwenhorst (1994) and impose the restriction that the weighted sum of industry and country effects equal zero at every point in time:

$$\sum_{j=1}^{J} w_{j,t} f_{j,t} = 0 \tag{2}$$

and

$$\sum_{k=1}^{K} w_{k,t} f_{k,t} = 0 \tag{3}$$

where $w_{j,t}$ and $w_{k,t}$ represent the weight of industry j and country k in the total universe of European corporate bonds at time t. In this paper, we focus on market value weights[17]. The value weights are constructed from the USD equivalent of the amounts issued. Imposing such a restriction is equivalent to measuring the size of each industry and country relative to the average size. The country and industry weights sum to unity:

$$\sum_{j=1}^{J} w_{j,t} = 1 \tag{4}$$

and

$$\sum_{k=1}^{K} w_{k,t} = 1 \tag{5}$$

The estimation process decomposes the bond returns into country and industry return indexes. First, $R_{k,t}$ represents the value-weighted index return of country k and can be decomposed as follows:

$$R_{k,t} = \hat{\alpha} + \sum_{j=1}^{J} \hat{f_{j,t}} \sum_{n=1}^{N} w_{nk,t} I_{nj,t} + \hat{f_{k,t}} \tag{6}$$

where $w_{nk,t}$ represents the weight a particular bond n has in country k at time t. In words, the value-weighted index return of country k can be decomposed into three parts: a component which is similar to all countries $\hat{\alpha}$, the average industry effects of the bonds that make up its index and a country-specific component $\hat{f_{k,t}}$. Similarly, the value-weighted index return of industry j can be decomposed as follows:

[17]Equal weights give qualitatively similar results. Results are available on request.

$$R_{j,t} = \hat{\alpha} + \sum_{k=1}^{K} \hat{f_{k,t}} \sum_{n=1}^{N} w_{nj,t} I_{nk,t} + \hat{f_{j,t}} \tag{7}$$

where $w_{nj,t}$ represents the weight a particular bond n has in industry j at time t. The complete derivation of the model is in the appendix.

2.4.2 Creating Time Varying Betas

In the second step, we employ a time-series analysis. More specifically, the time series of the pure factor returns obtained from the cross-sectional regressions in the first step are used to estimate the time-varying factor loadings (unconstrained betas) for each bond. To allow country and industry factor loadings to vary and thus obtain a time-series of betas, we utilize the GARCH-BEKK model. Two different GARCH structures are often used in the literature: BEKK and DCC. The GARCH-BEKK by Engle and Kroner (1995) has the advantage that the positive-definite constraint of the conditional covariance matrix is guaranteed by construction. In this paper, we choose the GARCH-BEKK [18]specification as our basic model to obtain the time-varying country and industry betas[19].

First, we estimate the de-meaned bond returns and the country factors that are obtained in the first step. We then perform the GARCH-BEKK analysis on individual zero-mean bond returns and the country factor. With the conditional covariance and variance of the two, we can calculate the conditional country beta for each bond using the following equation:

$$\beta_{n,t}^{k} = \frac{Cov(r_{n,t}, f_{k,t})}{var(f_{k,t})} \tag{8}$$

Similarly, we obtain the conditional covariance between and variance of individual bond and industry factors by estimating the GARCH-BEKK model on zero-

[18]We apply the bivariate-GARCH model instead of the trivariate-GARCH model because the country factor and the industry factor are orthogonal to each other by construction in our analysis. In addition, bivariate-GARCH has fewer estimated variables than trivariate-GARCH.

[19]For robustness, we also applied the GARCH-DCC model. The results remain qualitatively similar and are available upon request.

mean bond returns and the industry factor. The conditional industry beta can then be calculated as:

$$\beta^{j}_{n,t} = \frac{Cov(r_{n,t}, f_{j,t})}{var(f_{j,t})} \tag{9}$$

2.5 Results

2.5.1 Unconditional Results

The European corporate bond returns in our sample are decomposed into pure country effects and a weighted average sum of seven industries according to the Heston and Rouwenhorst (1994) method in the first step of our analysis. Likewise, we decompose the returns into pure industry effects and a weighted average sum of eight countries. The first column of Table 2.3 shows the decomposition results of the returns for the full sample period from January 1991 to January 2013. The variance of the pure country effects outweighs that of pure industry effects by 2.67 times. Compared to the variance of the pure country effects in the country indexes (Panel A), the variance of the pure industry effects in the industry indexes (Panel B) is more homogeneous. In addition, the weighted sum of eight country effects explains more of the variance in the industry index returns than the sum of the seven industry effects do in the country indexes returns (0.46 versus 0.13). The results in Table 3 indicate that country effects play a bigger role than industry effects over the full sample period from January 1991 to January 2013. This confirms the results of Pieterse-Bloem and Mahieu (2013) for the extended period and supports our Hypothesis 1.

The second and third column of Table 2.3 shows the standard decomposition model for the period before and after the start of global financial crisis in July 2007. It can be directly compared to the first column in Table 2.3. The results show that on average, the ratio of the variance of the pure country and industry effects increases from 2.56 in the pre-crisis period to 3.04 in the post-crisis period. The variance of the pure country effects for France, Netherlands and Spain decreases in the post crisis period while those of Belgium, Germany, Italy and Sweden increase. The variance of pure country effects of the United Kingdom are relatively similar in the two periods. As for the industry indexes, the variance

Table 2.3: Decomposition of Excess Bond Index Returns (Full Period and Sub-periods)

The table gives the variance of the components of the value-weighted (VW) country index returns in panel A and industry index returns in panel B for the full period of January 1991-January 2013 in the first column, pre-crisis period of January 1991-July 2007 in the second column and post-crisis period of August 2007-January 2013 in the third column. The ratio is the variance of that component to the variance of the index returns.

Full Period					January 1991-July 2007				August 2007-January 2013			
A:Country indexes												
	Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects		Pure country effect		Sum of industry effects	
Country	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
BL	0.8444	0.8475	0.1148	0.1153	0.5190	1.0608	0.1029	0.2103	1.8283	0.7208	0.1527	0.0602
FR	0.4359	0.5945	0.1331	0.1816	0.5364	0.5978	0.1400	0.1560	0.1320	0.5571	0.1140	0.4809
GE	0.5250	0.6165	0.0970	0.1139	0.5243	0.5792	0.0946	0.1045	0.5350	0.7619	0.1053	0.1499
IT	0.7434	1.2814	0.1011	0.1743	0.6218	1.2227	0.0825	0.1623	1.1004	1.3933	0.1586	0.2008
NE	0.8315	0.7194	0.2197	0.1901	1.0421	0.7535	0.2563	0.1854	0.2019	0.4260	0.1102	0.2326
SP	2.6464	1.0666	0.0891	0.0359	2.9647	1.0693	0.0826	0.0298	1.7051	1.0503	0.1100	0.0678
SW	0.9030	1.0976	0.0937	0.1139	0.7739	1.2585	0.0699	0.1137	1.3027	0.8908	0.1668	0.1141
UK	2.7489	1.0644	0.1952	0.0756	2.7756	1.1509	0.2109	0.0874	2.6982	0.8652	0.1496	0.0480
Average	1.2098	0.9110	0.1305	0.1251	1.2197	0.9616	0.1300	0.1312	1.1880	0.8332	0.1334	0.1693
B: Industry indexes												
	Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects		Pure industry effect		Sum of country effects	
Industry	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio	Variance	Ratio
FF	0.3076	0.4631	0.2579	0.3883	0.3632	0.4351	0.3371	0.4038	0.1415	0.9144	0.0220	0.1419
GI	0.2803	0.9961	0.2115	0.7518	0.1658	1.7094	0.2405	2.4797	0.6294	0.7452	0.1252	0.1483
CO	0.4801	0.7691	0.6104	0.9778	0.5358	0.7221	0.7882	1.0624	0.3187	1.1499	0.0805	0.2903
CT	0.3743	0.5786	0.2754	0.4256	0.4164	0.5675	0.3515	0.4791	0.2526	0.6487	0.0447	0.1148
BE	0.6256	0.9966	0.8281	1.3193	0.6322	1.1010	1.0745	1.8712	0.6106	0.7638	0.0905	0.1132
IN	0.2703	0.8377	0.1689	0.5182	0.2794	0.9009	0.2077	0.6695	0.2555	0.6803	0.0539	0.1436
UT	0.8345	0.9113	0.8854	0.9670	0.9393	0.9508	1.1577	1.1719	0.5229	0.7395	0.0734	0.1039
Average	0.4536	0.7932	0.4625	0.7640	0.476	0.9124	0.5939	1.1625	0.3902	0.8060	0.0700	0.1509

of the pure industry effects all decrease slightly in the post-crisis period except for the government institution sector. The largest drop in pure industry effects occurs with respect to the financial sector. This is quite an unexpected result given that the financial sector is the source of the crisis and yet the variance of returns of precisely this sector halves. A possible explanation is that in Europe the sovereign sector was the transmission channel for the global financial crisis. As governments in Europe bail out financial institutions, their balance sheet problems are transferred to the sovereign. At the same time, default losses in the financial sector are limited.

2.5.2 Time-varying betas

The decomposition results from Table 3 give us a general picture of the relative importance of the country versus industry factors before and after the financial crisis using static and unit betas. In order to get the relative importance through time, we need to generate the time series of the two factor exposures throughout the whole sample period. To this end we apply the GARCH-BEKK model in the second step of our analysis for the estimation of the time-varying betas. Table 2.4 shows the results of the likelihood ratio tests of our dynamic model versus the static model for country betas in Panel A and for industry betas for Panel B. The average p-value for country betas is 0.0156 and for industry betas is 0.0180, rejecting the static model in favour of our GARCH based dynamic model at 5 percent significance level. In addition, for 95.57 percent of bonds for country betas and 93.88 percent for industry betas, the hypothesis is rejected that the time-varying model does not improve over the static model significantly at 5 percent significance level. Therefore, we argue that our model significantly improves over the standard Heston and Rouwenhorst (1994) decomposition model, supporting Hypothesis 2 that country and industry betas are time-varying. If we further classify the tests into each country and industry, we see that only for Sweden, the hy-

Table 2.4: Likelihood Ratio Tests of the Dynamic versus the Static Model

The table gives the results for the likelihood ratio tests between our dynamic model and the static specification for country betas classifed by each country in Panel A and for industry betas classified by each industry in Panel B. The significant level for testing the hypothesis is 95 percent.

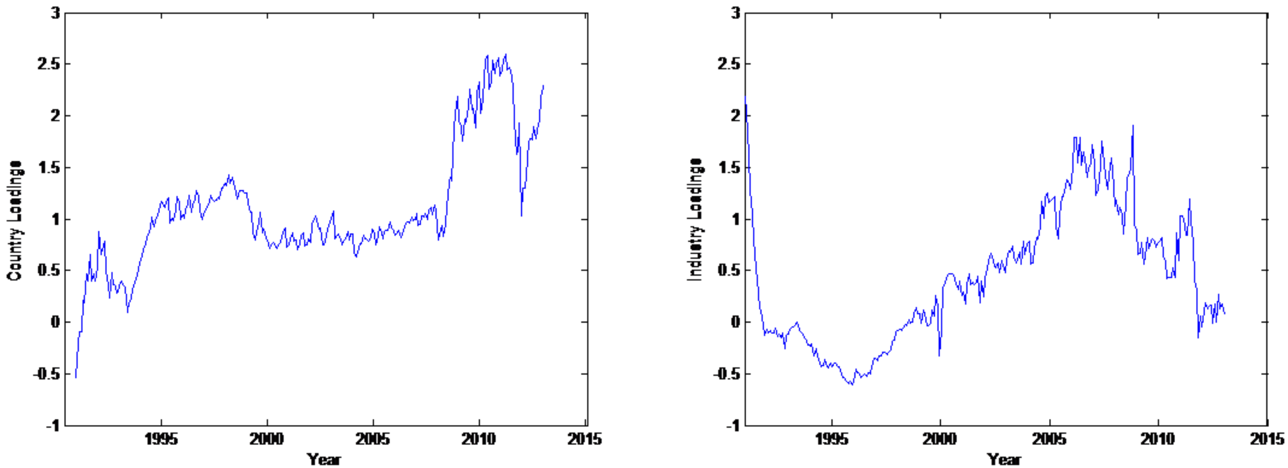
Panel A: for Country Betas		
Country	Avg. P-value	Significant%
BL	0.0190	98.72%
FR	0.0250	91.74%
GE	0.0113	97.21%
IT	0.0059	97.16%
NE	0.0063	97.79%
SP	0.0107	98.25%
SW	0.0680	80.83%
UK	0.0116	97.41%
Total	0.0156	95.57%
Panel B: for Industry Betas		
Industry	Avg. P-value	Significant%
FF	0.0235	91.65%
GI	0.0041	99.17%
CO	0.0118	97.17%
CT	0.0083	97.27%
BE	0.0185	94.40%
IN	0.0048	97.90%
UT	0.0186	94.03%
Total	0.0180	93.88%

pothesis is not rejected at 5 percent significant level. It could signal that country effects of Sweden are more stable than other countries in our sample, which could be explained by the fact that Sweden did not adopt the Euro and is therefore less affected by the two main shocks in our sample period.

The exact movement of the country and industry betas over the sample period can be observed by plotting the factor loadings over time in Figure 1.

Figure 2.1 shows the median value of the time-series country and industry loadings obtained from the GARCH-BEKK model for the period from January 1991 to January 2013 over all bonds. The country betas from the GARCH-BEKK model (in the left graph) decrease around 1999 when the Euro is introduced. How-

Figure 2.1: Time-series Country and Industry Betas



The left graph shows the median value of the country betas for all bonds over the total sample period (January 1991-January 2013). The right graph shows the median value of the industry betas for all bonds over the same period. In both graphs, the x-axis represents the time from 1991 to 2013 and the y-axis represents the median value of country (industry) betas for all bonds. We use value-weighted country and industry indexes in the first step to decompose stock returns into country and industry factors and the GARCH-BEKK model in the second step to obtain the time-varying country and industry betas.

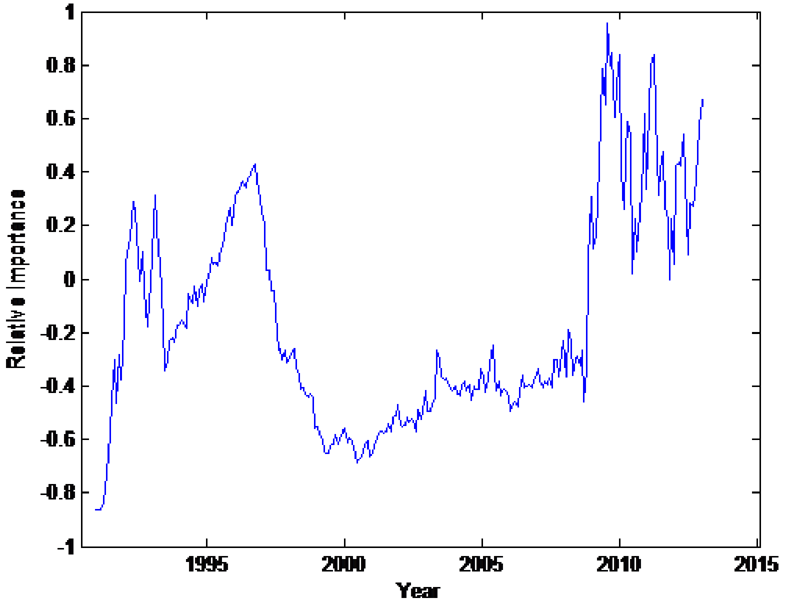


Figure 2.2: The Relative Importance of Country versus Industry Betas

The figure shows the relative importance of the country versus industry factors over the total sample period (January 1991-January 2013). In the graph, the x-axis represents the difference between the absolute value of the country betas and the absolute value of the industry betas divided by the absolute value of the industry betas $((|\beta_c| - |\beta_i|)/|\beta_i|)$. We use value-weighted country and industry indexes in the first step and GARCH-BEKK model in the second step to obtain the time-series country and industry betas.

ever the country betas increase again substantially around 2007 when the financial crisis starts. Figure 2.2 shows the relative importance of country versus industry factors over the whole sample period from January 1991 to January 2013. It shows the difference between the absolute value of the country factor loadings and the absolute value of the industry factor loadings and divides this difference by the absolute value of the industry factor loadings. In the graph, the country factors become less important relative to the industry factors around 1996 and level off afterwards. After 2008, country factors regain their relative importance over industry factors. There are several large swings after 2010. We argue that although the recent crisis starts from the financial industry, it morphs into a sovereign debt crisis in the Eurozone which results in an increased focus on country-specific issues. Therefore, industry effects are set back relative to country effects during the crisis. To sum up, the results of the relative importance of country versus industry factors in Figure 2.2 support both Hypothesis 3 and Hypothesis 4.

Apart from the visual analysis, we would like to establish where the significant break points are located in the sample period. We do not want to predetermine the break points because we do not know ex-ante which events have a significant influence on market integration. Furthermore, it is arbitrary to pinpoint the start of large events such as the global financial crisis to a particular date. Therefore, we run a break point analysis on a rolling-window basis to identify the most significant points. We run the following rolling-window regressions.

$$\beta_t^{'} = \alpha_1 D_1 + \alpha_2 D_2 + \gamma_1 D_1 T_t + \gamma_2 D_2 T_t + \varepsilon_t \tag{10}$$

where $\beta_t^{'}$ are the time-series country factor loadings or the relative importance of the country versus industry factors $(|\beta_c| - |\beta_i|)/\,|\beta_i|)$ from the GARCH-BEKK model. We take a rolling sample of 50 observations and check whether the middle point within the 50 months is a break point by comparing the coefficients before and after the midpoint using an F-test. For example, for the first regression we take period 1 to 50. D_1 equals one if it falls into the period from time 1 to 25 and zero otherwise. D_2 is the opposite of D_1 and equals one if it falls into the period 26 to 50 and zero otherwise. T_t is time. The estimated coefficients α_1 and α_2 allow us to draw inferences on average betas, whereas the estimated coefficients γ_1 and γ_2 measure the time trends in the two periods. We then compare if α_1 and α_2 (γ_1 and γ_2) are significantly different from each other with an F-test.

Figure 2.3 and Figure 2.4 show the rolling F-statistics for the country be-

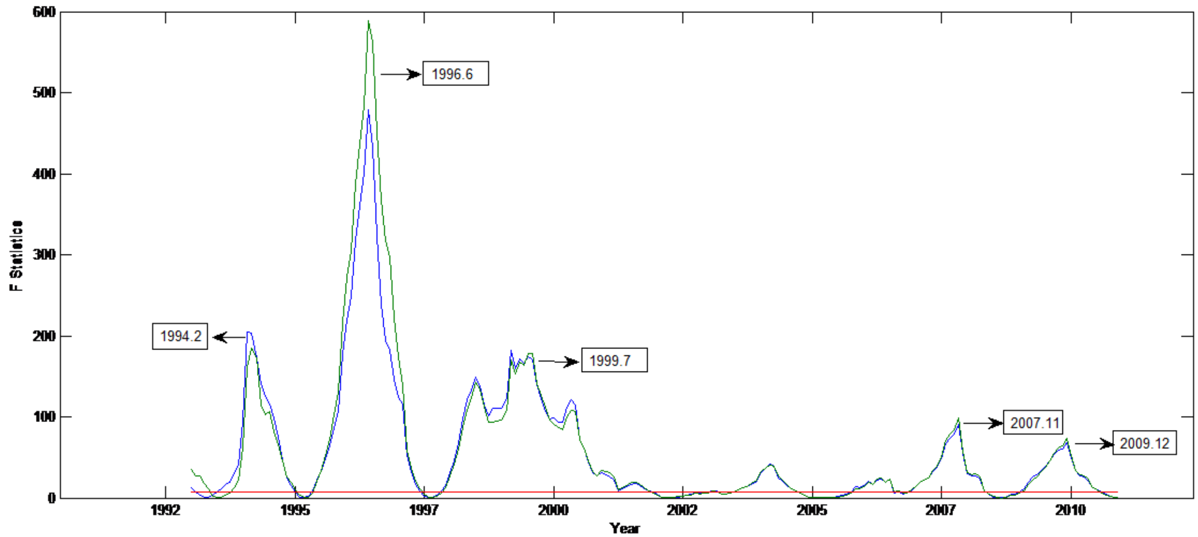


Figure 2.3: Time-series F-statistics for Country Betas

The figure shows the F statistics of comparing the coefficients 10 for country betas using rolling window regression with window period of 50 over the total sample period (January 1991-January 2013). The blue line shows the F statistics of comparing the coefficients α_1 and α_2 and the green line shows the F statistics of comparing the coefficients γ_1 and γ_2. The x-axis represents the year and the y-axis the F statistics. The red line shows the critical value of 7.18 with 99% confidence interval. We use value-weighted country and industry indexes in the first step and GARCH-BEKK in the second step to obtain the time-series country betas.

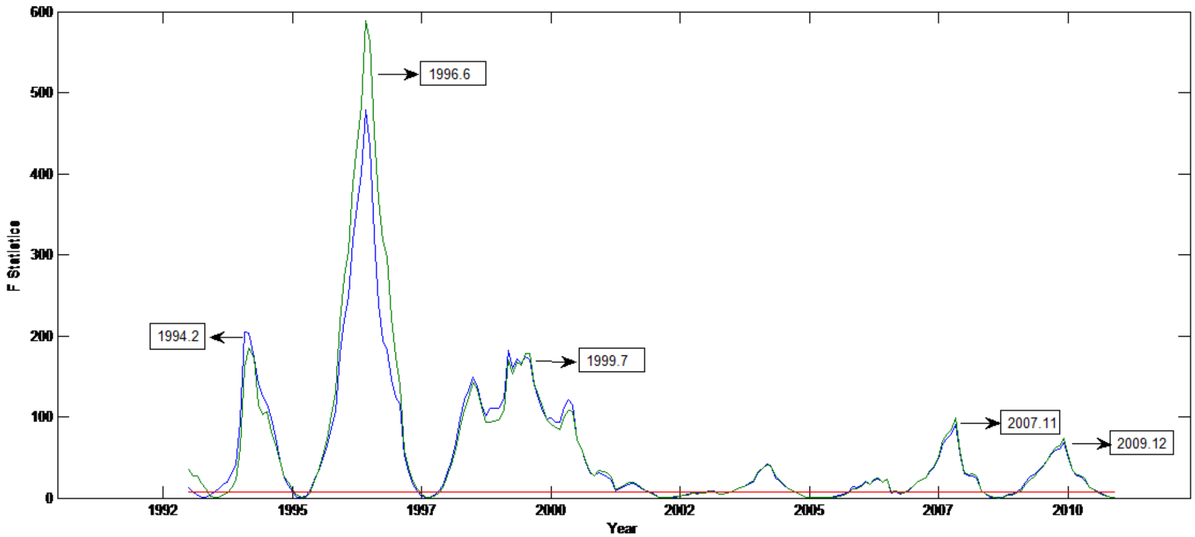


Figure 2.4: Time-series F-statistics for the Relative Importance of Country versus Industry Factors

The figure shows the F statistics of comparing the coefficients in Equation 10 for the relative importance of country versus industry factors $((|\beta_c| - |\beta_i|)/|\beta_i|)$ using rolling window regression with window period of 50 over the total sample period (January 1991-January 2013). The blue line shows the F statistics of comparing the coefficients α_1 and α_2 and the green line shows the F statistics of comparing the coefficients γ_1 and γ_2. The x-axis represents the year and the y-axis the F statistics. The red line shows the critical value of 7.18 with 99% confidence interval. We use value-weighted country and industry indexes in the first step and GARCH-BEKK in the second step to obtain the time-series country betas.

Table 2.5: Five Break Points Identified for The Relative Importance of Country versus Industry Factors

The table gives the results for the break point analysis of the relative importance of country versus industry factors. Specifically, the significant break points detected in the sample period are presented in combination with the events.

The Five Break Points	
Date	Event
February 1994	Signing of the Maastricht Treaty
June 1996	The Anticipation of Euro Adoption
July 1999	Introduction of Euro
November 2007	Global Financial Crisis
December 2009	Sovereign Debt Crisis

tas and the relative importance of country versus industry factors respectively. The blue line represents the F-statistics of comparing the coefficients α_1 and α_2 and the green line stands for the F-statistics of comparing the coefficients γ_1 and γ_2. We add the critical line of 7.18 representing the 99% cut-off value. The most significant dates are marked in the text boxes. The results in Figure 2.3 show that there are six significant break points in our sample which impact the relative country betas and Figure 2.4 indicates there are five for the relative importance of country versus industry factors. Both results support Hypothesis 5 that there are several shocks to the financial integration process in Europe, which impact both the level and the direction of market integration of European corporate bond markets.

Table 2.5 presents the exact months for which the identified break points are at their peak for the relative importance of country versus industry factors. Interestingly, all break points we find in the data clearly coincide with major economic events in our sample period including the start of EMU and the global financial crisis. February 1994 can be matched with the signing of the Maastricht Treaty. In 1992, the Maastricht Treaty is signed which states the completion of EMU as a formal objective. It comes info force on November 1, 1993. In December

1995, the name of the single currency is decided and the transition periods are set. We can match the anticipation of the adoption of the Euro with our second break point of June 1996. In January 1999, the Euro becomes a real currency and a single monetary policy is announced. Therefore, the third break point of July 1999 can be the result of the introduction of the Euro. November 2007 and December 2009 can be linked to the global financial crisis and the sovereign debt crisis respectively.

After obtaining the dates with the most significant F-statistics, we analyze the directions of coefficients before and after these points. For this purpose, we apply the break point analysis to the relative importance of country versus industry factors using the five dates in Figure 2.4. Our main regression equation for the second step in the break point analysis can be described as follows:

$$\begin{aligned} \beta_t^{'} &= \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \alpha_5 D_5 + \alpha_6 D_6 + \\ &\quad \gamma_1 D_1 T_t + \gamma_2 D_2 T_t + \gamma_3 D_3 T_t + \gamma_4 D_4 T_t + \gamma_5 D_5 T_t + \gamma_6 D_6 T_t + \varepsilon_t \end{aligned} \tag{11}$$

where D represent the dummy variables among which D_1 equals 1 if it is from January 1991 to February 1994 and zero otherwise, D_2 equals 1 if it is March 1994 to June 1996 and zero otherwise, D_3 equals 1 if it is from July 1996 to July 1999 and zero otherwise, D_4 equals 1 if it is from August 1999 to November 2007 and zero otherwise, D_5 equals 1 if it is from December 2007 to December 2009 and zero otherwise, D_6 equals 1 if it is from January 2010 to January 2013 and zero otherwise. Table 2.6 reports the break point analysis of the relative importance of country versus industry factors using the five break points identified in Figure 2.4. We see that the five events in our sample significantly change the relative importance on the absolute level at 95% confidence level. On the slope level, except February 1994, all break points significantly impact the relative importance at the 95% confidence level.

Table 2.6: Break Point Analysis for the Relative Importance of Country versus Industry Factors

The table gives the results for the break point analysis for the relative importance of country verus industry factors. D1 equals 1 if it is from 1991.1 to 1994.2 and zero otherwise, D2 equals 1 if it is 1994.3 to 1996.6 and zero otherwise, D3 equals 1 if it is from 1996.7 to 1999.7 and zero otherwise, D4 equals 1 if it is from 1999.8 to 2007.11 and zero otherwise, D5 equals 1 if it is from 2007.12 to 2009.12 and zero otherwise, D6 equals 1 if it is from 2010.01 to 2013.1. T represents time. Panel A shows the estimated coefficients and their t-statistics and p-values of the regression. Panel B indicates the comparisons between the coefficients for the time dummies. The regression uses robust standard errors clustered by time.

Panel A: Country betas				Panel B: Period Comparison		
	Coef.	t	P>t		F	Prob>F
D1	-0.55	-5.68	0.00	D1 vs D2	14.66	0.00
D2	-0.97	-19.09	0.00	D2 vs D3	572.97	0.00
D3	2.40	18.26	0.00	D3 vs D4	617.81	0.00
D4	-0.93	-34.84	0.00	D4 vs D5	106.60	0.00
D5	-12.86	-11.13	0.00	D5 vs D6	90.30	0.00
D6	0.09	0.13	0.90			
D1*T	0.02	4.16	0.02	D1*T vs D2*T	0.47	0.50
D2*T	0.02	21.94	0.00	D2*T vs D3*T	876.17	0.00
D3*T	-0.03	-21.13	0.00	D3*T vs D4*T	531.27	0.00
D4*T	-0.00	17.49	0.00	D4*T vs D5*T	116.30	0.00
D5*T	0.06	11.36	0.00	D5*T vs D6*T	95.21	0.00
D6*T	0.00	0.41	0.68			

When looking at the coefficient estimates, we observe a general decrease of α and an increase of β over the sample, suggesting increasing integration. Two break points are an exception to this rule: D_3 and D_6. In the run-up to the introduction of the Euro, there is quite a bit of uncertainty surrounding the exact terms, and which set of countries will join the Euro. Therefore, after the jump in integration after the signing of the Maastricht Treaty ($\alpha_2 < \alpha_1$), the subsequent period is characterized by increased uncertainty resulting in fragmentation ($\alpha_3 > \alpha_2$). D_6 coincides with the European sovereign debt crisis. Clearly, the sovereign debt crisis lays the fundamental differences bare between countries in the Eurozone. These become especially relevant as doubts are raised about the no-bailout clause of EMU. As a result, country factors become more important in corporate bond returns.

2.5.3 Cross-sectional results

Figure 2.1 and 2.2 show the median value of the country and industry betas for all bonds in our sample. However, there are large economic and financial differences among the countries in EMU. Therefore, we divide the countries into four groups. The first group consists of Germany and Netherlands. The second group is France and Belgium (Luxembourg). These two groups are considered core countries in the monetary union. The third group includes Spain and Italy as the periphery countries, and the fourth group is Sweden and the United Kingdom which are the non-Euro countries in our sample. We expect to see that the core countries and peripheral countries have different time series patterns of country and industry betas. We expect in particular that the country factors of the peripheral countries rise during the financial crisis as they are most effected by the Euro sovereign debt crisis. By looking at the countries like the United Kingdom and Sweden, we can infer whether the adoption of the Euro has affected the integration process. Figure 2.5 shows the median value of the country betas for the four groups. The dark blue line represents Germany and the Netherlands, the green line France and Belgium, the red line Spain and Italy and the light blue line Sweden and the United Kingdom. The results show that Germany and the Netherlands have similar patterns for country betas as France and Belgium. The country betas of these two groups decrease around 1998 and increase significantly after the crisis. However, Germany and the Netherlands show bigger jumps upwards during the crisis. Country betas of the peripheral countries increase in 2000 and remain stable afterwards. They become quite volatile after the crisis. For Sweden and the United Kingdom, countries betas are quite stable before 2005. They increase after 2005 but decrease significantly after the crisis. Figure 2.6 shows the relative importance of the country factor versus the industry factors for the four groups.

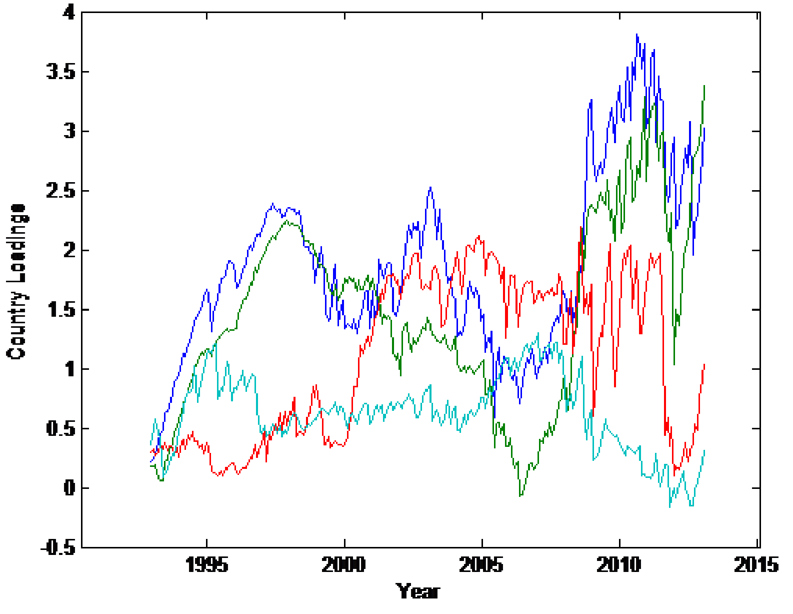


Figure 2.5: Time-series Country Betas for the Four Groups of Countries

The figure shows the median value of the country betas for the four goups of countries over the period from January 1993 to January 2013. The dark blue line stands for Germany and the Netherlands, the green line for France and Belgium, red line for Italy and Spain, and light blue line for Sweden and the United Kingdom. We use value-weighted country and industry indexes in the first step and GARCH-BEKK model in the second step to obtain the time-series country and industry betas.

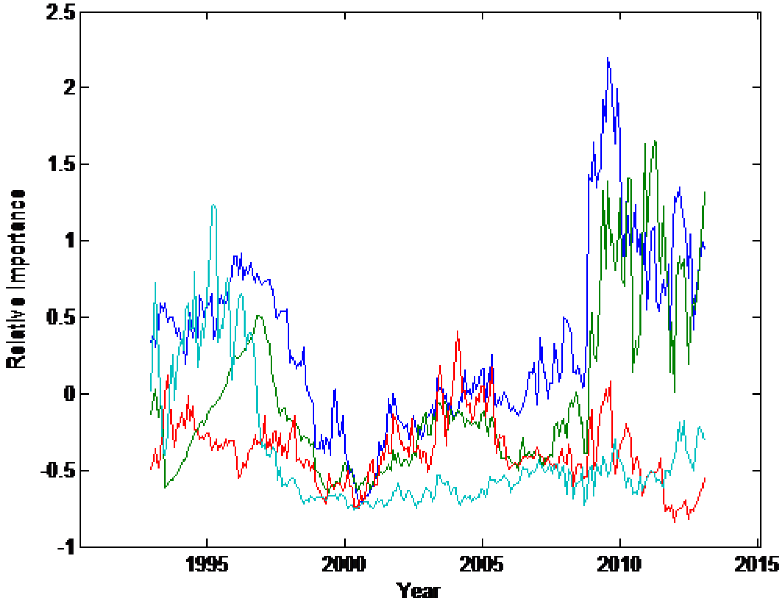


Figure 2.6: Relative Importance of Country versus Industry Factors for the Four Groups of Countries

The figure shows the relative importance of the country versus industry factors over the period from January 1993 to January 2013 for the four groups of countries. The dark blue line stands for Germany and the Netherlands, the green line for France and Belgium, red line for Italy and Spain, and light blue line for Sweden and the United Kingdom. In the graph, the x-axis represents the difference between the absolute value of the country betas and the absolute value of the industry betas divided by the absolute value of the industry betas $((|\beta_c| - |\beta_i|)/\,|\beta_i|)$. We use value-weighted country and industry indexes in the first step and GARCH-BEKK model in the second step to obtain the time-series country and industry betas.

The dark blue line again represents Germany and the Netherlands, the green line France and Belgium, the red line Spain and Italy and the light blue line Sweden and the United Kingdom. The relative importance of country versus industry betas for core countries and peripheral countries show similar patterns across time. They decrease after 1997 and increase after 2000. Before 2005, country betas decrease by a small extent. After the financial crisis, country betas start to regain their power over the industry betas quite dramatically. Around 2009, the relative importance of country versus industry factors decrease significantly with some dramatic ups and downs afterwards. For Sweden and the United Kingdom, the relative importance of country versus industry factors decrease significantly after 1995 and remain stable after 1997. After the crisis, the trend shows some small-scale ups and downs.

To sum up, both the country betas in Figure 2.5 and the relative importance of country versus industry in Figure 2.6 show that patterns for different country groups vary, partially supporting Hypothesis 6. The results show similar trends for core and peripheral countries across time. However, Germany and the Netherlands show larger impacts from the crisis. The fact that the country betas of core countries rise more significantly than those of peripheral countries does not fully support our Hypothesis 6, which states that the country effects of peripheral Eurozone countries, rather than those of the core countries, drive the country betas higher during the recent crisis. This might be due to the sovereign debt fears and accompanying break-up risks of EMU igniting a flight to safety to the core countries during the crisis. In this way, Germany and the Netherlands benefited from flight-to-safety investment flows in the crisis. When investors are looking for a safe haven, it is not so much the industry sector that matters, but the country where the issuer resides. This is consistent with Baele et al. (2013), who find that flights to safety tend to be country specific. Such safe haven flows have the ability to cause variation in credit spreads. Sweden and the United Kingdom, the non-Euro countries in our sample, show different trends than the Euro countries suggesting that the adoption of the Euro indeed affects the integration process. A possible explanation is that in this period the business cycle of these EMU opt-outs diverge considerably from that of the Eurozone. While several studies show that their business cycle has become more synchronized with that of the Eurozone since 1999, differences remain (Holden, 2009). Being higher growth and higher interest rate countries than the Eurozone in 2005 - 2008, it is possible that these macro features cause greater variation in the credit spreads of local corporates, giving rise to higher country factors in the United Kingdom and Sweden in this period.

2.6 Additional Analyses

In this section, we conduct two additional analyses. We exclude Germany and the Financial and Funds industry from our sample to reduce the dominant effects of this country and this industry. We exclude the months from January 1991 to December 1992 due to limited data availability after these exclusions.

2.6.1 Germany

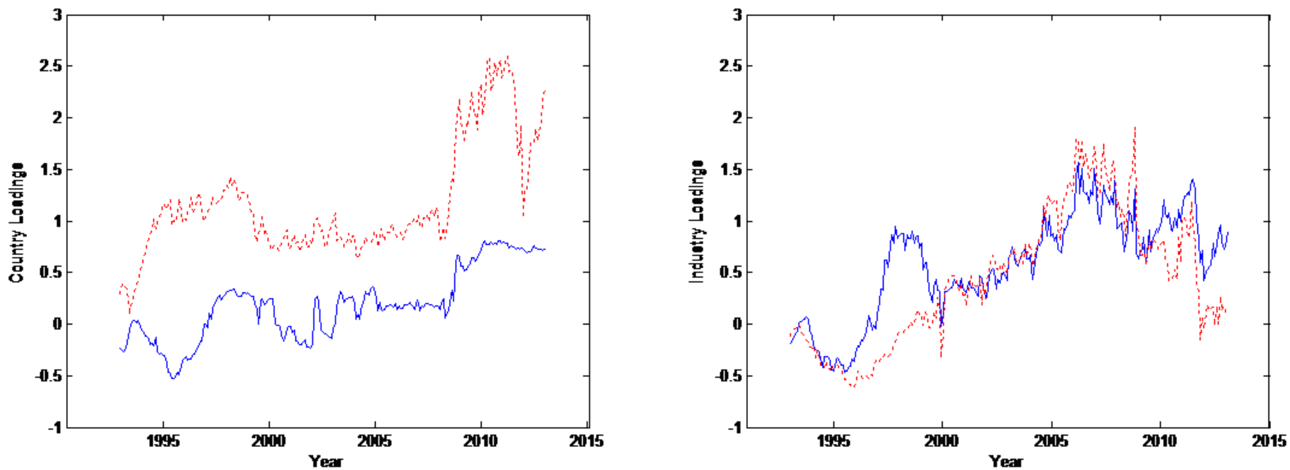
Germany has the largest proportion (37.84%) of the number of bonds in our sample. Omitting Germany from among the countries could reduce the dominant effects of Germany on our analysis. After excluding Germany from our sample, the financial industry still dominates the sample[20]. The left graph in Figure 2.7 shows the median value of the country betas for the bonds excluding Germany from our sample from January 1993 to January 2013 in a blue solid line and the median value of the country betas for all bonds in a dotted red line as a reference to our earlier results. The right graph in Figure 2.7 shows the median value of the industry betas for all bonds in a dotted red line and for those excluding Germany in a solid blue line for the same period of time.

The results excluding Germany are generally similar to those of the whole sample. Country betas decrease after 1998 and increase significantly after the crisis. Although the dynamics are comparable, the level of the country betas after excluding Germany is substantially lower. This implies that the average bond in Germany has a higher exposure to the country factor than the average bond outside of Germany. In other words, the German bond market is relatively less integrated than the rest of the countries in our sample.

Industry betas increase around 2000 and decrease significantly after 2006. After the crisis, industry betas increase for a short while but decline dramatically

[20]The summary statistics are not reported but available upon request.

Figure 2.7: Time-series Country and Industry Betas Excluding Germany



The left figure shows the median value of the country factor loadings from January 1993 to January 2013. The solid blue line stands for bonds from all countries excluding those of Germany. The red dotted line represents all bonds in our sample as a reference. The right figure shows the median value of the industry factors loadings from January 1993 to January 2013. The solid blue line stands for bonds from all countries excluding those of Germany. The red dotted line represents all bonds as a reference. In both graphs, the x-axis represents the time from 1993 to 2013 and the y-axis represents the median value of country (industry) betas. We use value-weighted country and industry indexes in the first step to decompose stock returns into country and industry factors and GARCH BEKK model in the second step to obtain the time-varying country and industry betas.

very soon thereafter. We argue that the dominant position of Germany in our sample does not affect the results substantially.

2.6.2 Financial and Funds

Financial companies dominate in our sample with 43.3 percent on a value-weighted basis[21] and they are also the most heavily impacted by the global financial crisis. Therefore excluding financial and funds from our sample allows to see whether the financial industry significantly influences the relative importance of country versus industry in our analysis. After excluding the Financial and Funds industry, Germany no longer dominates our data sample. France consists of the biggest proportion and is followed by the United Kingdom[22].

The left graph in Figure 2.8 shows in a blue solid line the median value of the country betas after excluding Financial and Funds and in a dotted red line the median value of the country betas for all bonds as a reference from January 1993 to January 2013. The right graph in Figure 8 shows the industry betas excluding (in a blue solid line) and including (in a dotted red line) Financial and Funds for the same period of time. Country betas for bonds excluding Financial and Funds in our sample decrease around 1996 and increase significantly after the crisis. Industry betas are stable with some small but steady increase over time. If we compare the results for all bonds in our sample, the pattern for countries betas are similar with and without Financial and Funds industry. However, excluding Financial and Funds industry significantly affects the industry betas across time. Industry betas show little variance across time after excluding Financial and Funds. We argue that financial industry is the most affected industry during the crisis and absorbs most of the impact.

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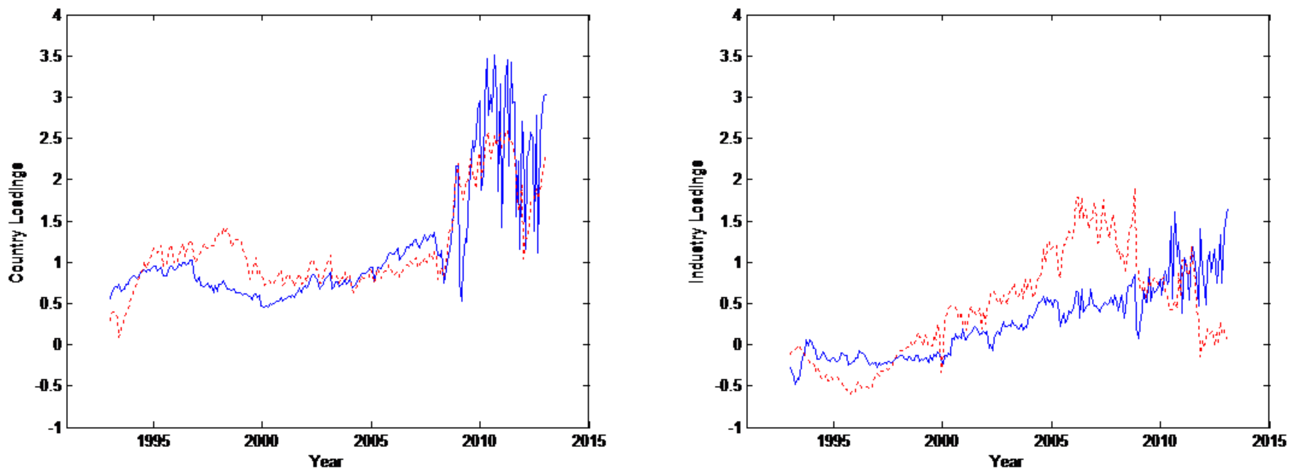
[21]Government Institutions is the second largest sector on the value-weighted basis. For robustness, we also run the analyses excluding both the Financial and Funds and Government Institutions. The results do not change and are available upon request.

[22]The new summary statistics are not reported but available upon request.

Figure 2.8: Time-series Country and Industry Betas Excluding Financial and Funds



The left figure shows the median value of the country factor loadings from January 1993 to January 2013. The solid blue line stands for bonds from all industries excluding those of financial and funds. The red dotted line represents all bonds in our sample as a reference. The right figure shows the median value of the industry factors loadings from January 1993 to January 2013. The solid blue line stands for bonds excluding financial and funds. The red dotted line represents all bonds as a reference. In both graphs, the x-axis represents the time from 1993 to 2013 and the y-axis represents the median value of country (industry) betas. We use value-weighted country and industry indexes in the first step to decompose stock returns into country and industry factors and GARCH BEKK model in the second step to obtain the time-varying country and industry betas.

2.7 Conclusion

Financial integration has made good progress in the European Union, particularly in the Euro area, and has brought substantial benefits. In this paper, we analyze the evolvement of the European financial integration process between January 1991 to January 2013 from the perspective of the corporate bond markets. To our knowledge, our paper is the first to apply time-varying factor loadings to the country and industry factors in corporate bond returns over a relatively long and recent period of time.

We manually collect daily prices of European corporate bonds yielding a unique dataset representative of the entire actively quoted corporate bond universe. Different from previous studies on bond returns that address the country versus industry debate using static factor loadings, we apply the GARCH-BEKK model to obtain bond specific time-varying country and industry loadings. These methods suit our research design, as we can directly observe the time pattern of the relative importance of country versus industry factors throughout the sample period in the European corporate bond market.

The main results of the paper show that there are large time-variations in the relative importance of country versus industry betas. The break point analyses indicate that there are several significant break points which affect the relative importance of factors. Therefore, the trends on integration are highly conditional on market circumstances. More specifically, our results show that country factors reduce the relative importance to industry factors and regains the power after the recent financial crisis. Therefore, we can conclude that integration is a dynamic process that does not follow a simple linear path towards full integration. We also find that significant financial fragmentation still remains in the Euro area, especially in the corporate bond market. Even worse, the recent financial crisis and the sovereign debt crisis threatened the very survival of the Euro project itself. The stability of financial markets and their cross-border integration will largely depend on Europe's success in a sound and resilient economic governance framework.

3 Optimal Portfolio Choice in Corporate Bond Markets.[23]

3.1 Introduction

One of the core questions in asset allocation is how to divide one's wealth into a part in land, a part in merchandise, and a part ready to hand. A substantial amount of research follows Markowitz (1952) on the optimal rule for allocating wealth across risky assets when investors only care about the mean and variance of a portfolio's return. The implementation of this model in a static setting implies that the mean and variance are estimated with moments via their sample analogues. This can lead to extreme weights, fluctuating substantially over time and performing poorly out of sample.

This drawback of the classical Markowitz model gave rise to a vast literature of Bayesian approaches to reduce estimation error. More recent approaches in this strand rely on an asset pricing model establishing a prior (e.g.: Pastor, 2000; Pastor and Stambauch, 2000). Several non-Bayesian approaches also attempt to reduce estimation error by including robust portfolio allocation rules (e.g.: Goldfarb and Iyengar, 2003; Garlappi et al., 2007) or specific portfolio rules that optimally diversify across market and estimation risk (Kan and Zhou, 2007) or that restrict short-selling (e.g.: Frost and Savarino, 1988; Chopra, 1993; Jagannathan and Ma, 2003). Yet other studies introduce methods designed to reduce the error in the estimation of the covariance matrix (e.g.: Best and Grauer, 1992; Chan et al., 1999; Ledoit and Wolf, 2004 and 2008). While the out-of-sample performance as mea-

[23]This chapter is based on Pieterse-Bloem, M., Qian, Z., Verschoor, W., Zwinkels, R. (2018). We gratefully acknowledge helpful comments from participants at the 2018 Australasian Finance and Banking Conference, the 2018 Frontiers of Factor Investing Conference, the 2018 International Risk Management Conference, and the 2018 EFMA Meeting. In an early stage, this paper circulated under the title "Dynamic Portfolio Strategies in the European Corporate Bond Market".

sured by the Sharpe ratios of these extended models are better than the classical Markowitz model, a direct statistical comparison on out-of-sample performance is lacking from those papers.

Attention to the issue of out-of-sample performance also sparked a voluminous literature on dynamic portfolio strategies. This literature contains, among others, the work of Perold and Sharpe (1988), Dumas and Luciano (1991), Cesari and Cremonini (2003), Lui et al. (2003), Liu and Longstaff (2004), Brennan and Xia (2002). Those papers propose dynamic portfolio strategies under specific settings, such as dynamic portfolio strategies with portfolio insurance, with transaction costs, in either bear or bull markets, optimal strategies with event risks, in markets with arbitrage opportunities, and for investors facing inflation. As for more generalized solutions of the Markowitz model, Li and Ng (2000) show how to derive the analytical optimal solution to the mean-variance formulation in multi-period portfolio selection. Brandt and Santa-Clara (2006) propose that the optimal dynamic strategy can be approximated by the static Markowitz solution. However, neither demonstrate out-sample performance compared with a benchmark such as the naive portfolio with a simple equally-weighted allocation.

In light of the literature gap, DeMiguel et al. (2009) serves as the benchmark study to compare the out-of-sample performance of several extended sample-based mean-variance models with the naive portfolio. Using the mean return and variance of the previous period to determine the optimal weights of the next period, they forecast the out-of-sample period returns. Their model extensions include Bayesian approaches to estimation error, moment restrictions, portfolio constraints and optimal combinations of portfolios. They find that their forecasted performances are not consistently better than the naive portfolio. The explanation is two-fold. First, there are still estimation errors in the expected returns and variance-covariance matrix. Secondly, the use of portfolios of stocks instead of individual stocks leads to diversified portfolios with less idiosyncratic risk. The loss from the naive as opposed to the optimal diversification is much smaller when allocating wealth across portfolios. This leads to an overall result whereby the gain from optimal diversification is more than off-set by the size of the estimation error. They therefore derive an analytical expression for the critical length of the estimation window that is needed for the sample-based mean-variance strategy to achieve a higher certainty-equivalent (CEQ) return. They are thus able to establish that all the models need very long estimation windows (3,000 months for a portfolio of 25 assets) before they are able to beat the naive portfolio.

Instead of using rolling window estimates as in DeMiguel et al. (2009), We build our portfolio strategy on an asset pricing model containing country and industry factors and apply it to the European corporate bonds at both the individual security and the index level in this paper. The number of bond studies on portfolio strategies and factor investing are quite limited. However, some factors are documented to be significant in the fixed income markets, which include momentum (Pospisil and Zhang, 2010 or Jostova et al., 2013, and Israel et al., 2018), size (Houweling and van Zundert, 2017, and Chordia et al., 2016) and volatility (Ilmanen et al., 2004 and Frazzini and Pedersen, 2014). In the European fixed income markets, Pieterse-Bloem and Mahieu (2013) decompose the return variation of European corporate bonds and find that, overall, country factors dominate industry factors over a long period of 1991 to 2013. A subsequent study by Pieterse-Bloem et al. (2016), which make the factors dynamic, shows that the country and industry factors in European corporate bonds also inhibit considerable time-variation. Interestingly, the relative dominance of country factors changes considerably. Moreover, despite the relative dominance of country factors over industry factors, the rolling-window spanning and efficiency tests used in this analysis to evaluate the performance of the country-only and industry-only portfolios over time show that we cannot rely on a country allocation alone to deliver a mean-variance outperformance so we need both. This is consistent with the finding in Pieterse-Bloem and Mahieu (2013), who apply the static spanning and efficiency tests with country and industry portfolios for a earlier period of time. Capitalized on the findings of the time-varying importance of country and industry factors in Pieterse-Bloem et al. (2016), we introduce a dynamic portfolio strategy in which time-varying portfolio weights are a function of forecasts of both future factors as well as the future exposure to the country and industry factors. We apply the method to a unique and representative data set of European corporate bonds. To compare the performance of our dynamic strategies, we are able to construct three benchmark portfolios: (i) the mean-variance portfolio; (ii) the minimal-variance portfolio; and (iii) the naive portfolios on either an equal-weight or a value-weight basis. We calculate the out-of-sample performance of all three benchmarks from the sample-based weights which we project forward to the next period. We compare performance on maximum Sharpe ratio and highest certainty-equivalent (CEQ) return.

We find that, at the individual bond level, our dynamic strategy statistically significantly outperformed the naive portfolio. The higher Sharpe ratios of the individual bond strategies are mainly driven by the forecasted factors. Since the dynamic strategy based on individual bonds can be more easily replicated by investors, we also consider the turnover in bonds in the dynamic strategy and the benchmark portfolio. We measure the turnover ratio as the number of bonds traded. Larger number indicates higher turnover ratio. We find that the turnover ratio in the dynamic strategy can be contained and is in some cases even lower than that of the naive portfolio, depending on the specific selection rules for bonds. At the index level, we find that our dynamic strategy is capable of outperforming benchmark portfolios based on a naive allocation, mean-variance and minimum-variance optimization. Specifically, on an index level, the dynamic strategy based on forecasted factors beats all three benchmarks with a higher Sharpe ratio and the naive and mean-variance benchmarks on CEQ return. This outperformance is not statistically significant, but does have ample time variation related to market conditions that can be exploited. The dynamic strategy performs significantly better than the benchmark when market volatility is low and when the level of market integration is also relatively low. Our results are robust to equal or value weighting, and the exact set of countries.

Our result that the dynamic portfolio strategy based on forecasted country and industry factors at the individual bond level can beat the naive portfolio is in sharp contrast to DeMiguel et al. (2009). This may be due to the specific method, or to the specific asset class, as it may suggest that bond portfolios contain higher idiosyncratic volatility than stock portfolios. Either way, our result is noteworthy and a valuable contribution to the literature on dynamic portfolio strategies. We also add to the literature on country versus industry factors, extending previous research to dynamic portfolio allocation strategies. We find that the gains promised by optimal portfolio choice can actually be realized out of sample. Since the portfolios from individual bonds can be replicated, our results are relevant for active portfolio management strategies offered by the investment management industry.

The remainder of this paper is organized as follows. In Section 2 the construction of the corporate bond data is outlined, and summary statistics describing the date are provided. In Section 3 we address the construction of our dynamic portfolios. Section 4 describes our methodology we employ for our study. Our empirical results are provided and discussed in Section 5. In addition, in Section 6 we examine a number of robustness tests. Section 7 concludes the paper.

3.2 Data

We utilized the corporate bond return data collected in Pieterse-Bloem et al. (2016). Detailed explanations of the data collection process and the summary statistic of the final sample can be found in the data section of Pieterse-Bloem et al. (2016).

3.3 Methods

We first apply time-varying spanning and efficiency tests to analyze whether country-only or industry-only portfolios outperform during different periods from January 1991 to January 2013. The outcome of this first test will give us an indication about the potential of time-varying investment strategies in the European corporate bond market. Subsequently, we forecast country and industry factors as well as factor exposures and form dynamic portfolios on two levels: the individual bond level and the index level. Specifically, at the individual bond level, we use forecasted bond returns calculated using both forecasted factor and factor loadings to form portfolios. At the index level we approach the country and industry factors themselves as investable assets, and try to find a dynamic portfolio that could achieve out-sample outperformance relative to the benchmarks.

We build our dynamic portfolio strategy on an asset pricing model consisting of two factors: an industry factor and a country factor. That is, we assume that individual bond returns are driven by the following model:

$$r_{n,t} = \alpha + \beta_k f_{k,t} + \beta_j f_{j,t} + \varepsilon_t \tag{12}$$

in which $f_{k,t}$ and $f_{j,t}$ are the country and industry factor relevant for bond n at time t.

In order to forecast the returns of bond n in this framework, we could forecast the country and industry factors as the first step. Furthermore, from Pieterse-Bloem et al. (2016), we know that the factor exposures β_k and β_j are also time-varying. Therefore, predicting future factor exposures is also relevant if we want to predict bond returns. A higher exposure to one of the factors results, ceteris paribus, in a higher expected return for the bond given the (unconditionally) positive expected factor returns. Once we have forecasts of the factors as well as the factor exposures, we use these information to form the dynamic portfolios, which are then compared with the benchmark portfolios using several performance measures.

3.3.1 Rolling Spanning and Efficiency Tests

We adopt a time-varying mean-variance approach to test whether the country-only or the industry-only portfolios outperform over time. If this were to be the case, a dynamic strategy giving time-varying weights to country and industry factors will never add value. When none of the factors individually stochastically dominate the others, and when the diversification benefit is time-varying, there is room for a dynamic strategy.

Our starting point is an investor who wants to optimize her portfolio in the European corporate bond market constructed from country and industry sub-indexes. We use both spanning and efficiency tests to compare the performance between the industry-only and the country-only portfolios, building on Pieterse-Bloem and Mahieu (2013) but now in a dynamic setting. The spanning tests inform us whether adding extra country (industry) asset has effects on the mean-variance frontier of a benchmark industry (country) portfolio. If the null hypothesis that the mean-variance frontier of the portfolio consisting of country (or industry) indexes alone coincides with the frontier of both together cannot be rejected, we can state that the country (or the industry) portfolio spans the set of both industry and country indexes together. The efficiency test shows the relative performance of the country-only versus the industry-only portfolios by directly comparing their maximum Sharpe ratios.

3.3.2 Forecasting Factors using the ARMA Model

We first construct dynamic portfolios from forecasted country and industry factors using the autoregressive-moving-average (ARMA) model. We obtain the time-series country and industry factors $f_{k,t}$ and $f_{j,t}$ employing the Heston and Rouwenhorst (1994) method using cross-sectional regressions[24]. We then forecast the country and industry factors $f^{'}_{k,t}$ and $f^{'}_{j,t}$ for month 101 to 265 based on an $ARMA(p, q)$ model with p autoregressive terms and q moving-average terms. The model contains the $AR(p)$ and $MA(q)$ models:

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-1} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-1} \tag{13}$$

where X_t and X_{t-1} are the factor returns in time t and $t-1$, c is the constant, $\varepsilon_{t,i}$ is the white noise error terms, and φ_i and θ_i are the parameters to be estimated. We use a rolling window of 100 periods to forecast the country and industry factors for month 101 to month 265. The forecasted factor values are the basis for calculating the weights for the dynamic portfolios. Our results show that the average prediction mean square error (PMSE) is on average 1.13e-4 for country factors and 2.93e-5 for industry factors.

3.3.3 Forecasting Factor Exposures using the GARCH Model

We next construct dynamic portfolios from forecasted country and industry betas using the multivariate GARCH (GARCH-BEKK) model from Pieterse-Bloem et al. (2016). We forecast the one-step ahead conditional covariance and variance of bond returns and country (industry) factor using spanning windows. The first window is month 1 to 100 and the last window is month 1 to 265. We only include the bonds that have data on the last month of the estimation periods. With the conditional covariance and variance forecasted, we obtain the conditional country and industry betas for each bond using the following equations:

$$\beta^k_{n,t+1} = \frac{Cov(r_{n,t}, f_{k,t})}{var(f_{k,t})} \tag{14}$$

[24]More detailed explanations of the Heston and Rouwenhorst (1994) model can be found in the appendix

$$\beta^{j}_{n,t+1} = \frac{Cov(r_{n,t}, f_{j,t})}{var(f_{j,t})} \tag{15}$$

3.3.4 Dynamic Portfolio Construction - individual bond level

We first apply the dynamic portfolio strategies based on the 8446 individual bonds instead of bond indexes. The reason is that the country and industry indexes we use as assets at the index level are not investable indexes; that is, investors would have to create the indexes themselves. This is feasible for large investors, but perhaps not for small investors.

The dynamic strategy is constructed by calculating the expected returns for each bond as the expected multiplied by the expected factors, as shown in Equation (16).

$$r'_{n,t} = \beta^{'}_{kn,t} * f^{'}_{k,t} + \beta^{'}_{jn,t} * f^{'}_{j,t} \tag{16}$$

in which $f^{'}_{k,t}$ and $f^{'}_{j,t}$ are forecasted country and industry factors while $\beta^{'}_{kn,t}$ and $\beta^{'}_{jn,t}$ are forecasted country and industry factors exposures for bond n.

We use three different methods as to forecast the factors and factor exposures. The first is to use the forecasted betas using the GARCH model multiplied by the average of the country/industry factor up until the period in which the forecast is made. The second method is based on the forecasted betas using the GARCH model multiplied by the factors forecasted from the ARMA model. The third method is to multiply the forecasted factors from the ARMA model by the unconditional betas estimated using OLS until the period when the forecast is made. This approach allows us to isolate the added value of the forecasted betas from the added value of the forecasted factors in the strategy's performance. Based on the expected returns using the three methods, we form our dynamic strategy by investing only in bonds with top-percentile expected returns in the previous months.

3.3.5 Dynamic Portfolio Construction - Index level

At the index level, the returns of the dynamic portfolios can be written as follows:

$$R_{D,t} = \sum_{k=1}^{K} w_{k,t} R_{k,t} + \sum_{j=1}^{J} w_{j,t} R_{j,t} \tag{17}$$

where $w_{k,t}$ represents the weight of country k in the dynamic portfolio at time t and $w_{j,t}$ represents the weight of industry j in the dynamic portfolio at time t. $R_{k,t}$ and $R_{j,t}$ are the country index and industry index returns at time t respectively.

We argue that the portfolio weights should be based on the time-varying relative importance of country and industry effects which could be measured by either forecasted factors or forecasted factor loadings in our analyses. Therefore, the dynamic weights $w_{k,t}$ and $w_{j,t}$ are calculated using two methods, by forecasted factors as in Equation 18 and by forecasted betas as in Equation 19.

$$w_{k,t} = (f^{'}_{k,t})^2 / (\sum_{k=1}^{K} (f^{'}_{k,t})^2 + \sum_{j=1}^{J} (f^{'}_{j,t})^2), w_{j,t} = (f^{'}_{j,t})^2) / (\sum_{k=1}^{K} (f^{'}_{k,t})^2 + \sum_{j=1}^{J} (f^{'}_{j,t})^2) \tag{18}$$

$$w_{k,t} = (\beta^{'}_{k,t})^2 / (\sum_{k=1}^{K} ((\beta^{'}_{k,t})^2 + \sum_{j=1}^{J} ((\beta^{'}_{j,t})^2), w_{j,t} = (\beta^{'}_{j,t})^2 / (\sum_{k=1}^{K} ((\beta^{'}_{k,t})^2 + \sum_{j=1}^{J} ((\beta^{'}_{j,t})^2) \tag{19}$$

where $f^{'}_{k,t}$ and $f^{'}_{j,t}$ are the forecasted country and industry factors using the ARMA model, $\beta^{'}_{k,t}$ is the median value of the forecasted country betas for all the bonds in country k at time t and $\beta^{'}_{j,t}$ is the median value of the forecasted industry betas for all the bonds in industry j at time t[25].

3.3.6 Benchmark Strategies

We use three different portfolios as the benchmarks. They are the 1/N naive portfolio, the mean-variance portfolio, and the minimum-variance portfolio.

[25]We also use the value-weighted weights for individual bond betas to calculate the country and industry betas. The results do not change and are available upon request.

The naive portfolio holds a weight $w = 1/N$ in each of the N risky assets. There are two reasons for using the naive rule as a benchmark. First, it is easy to implement because it does not rely either on estimation of the moments of asset returns or on optimization. Secondly, investors continue to use such simple allocation rules for allocating their wealth across asset despite the sophisticated theoretical models developed in the last decades and the advances in methods for estimating the parameters of these models. In our case, the naive portfolios are either with equal-weights or value-weights. The equal-weighted naive strategy is formed by allocating equal weights to eight country and seven industry indexes. Therefore, we have fifteen assets in total. The returns of the equal-weighted naive portfolios are as follows:

$$R_{Ne,t} = (\sum_{k=1}^{K} R_{k,t} + \sum_{j=1}^{J} R_{j,t})/(K+J) \tag{20}$$

The value-weighted naive strategy allocates the assets based on the values of each country and each industry index. The returns of the value-weighted naive portfolios can be written as follows:

$$\begin{gathered} R_{Nv,t} = \sum_{k=1}^{K} w_{k,t} R_{k,t} + \sum_{j=1}^{J} w_{j,t} R_{j,t}, \\ w_{k,t} = \frac{V_{k,t}}{\sum_{k=1}^{K} V_{k,t} + \sum_{j=1}^{J} V_{j,t}}, w_{j,t} = \frac{V_{j,t}}{\sum_{k=1}^{K} V_{k,t} + \sum_{j=1}^{J} V_{j,t}} \end{gathered} \tag{21}$$

where $V_{k,t}$ and $V_{j,t}$ are the balance remaining for the assets.

The second benchmark is the mean-variance portfolio, which maximizes the in-sample Sharpe ratio. In the mean-variance model of Markowitz (1952), the investor optimizes the trade-off between the mean and the variance of portfolio returns. We can think of the optimization problem as follows. At each time t, X_t

is selected to maximize expected utility:

$$\max x_t^T u_t - \frac{\gamma}{2} x_t^T \sum\nolimits_t x_t \tag{22}$$

in which γ can be interpreted as the investor's risk aversion. The solution of the above optimization is $x_t = (1/\gamma) \sum_t^{-1} u$. The vector of relative portfolio weights invested in the N risky assets at time t will then be:

$$w_t = \frac{\sum_t^{-1} u_t}{1_N \sum_t^{-1} u_t} \tag{23}$$

To implement the mean-variance model of Markowitz (1952), we follow the classic "plug-in" method. We use the sample mean and covariance matrix to solve the optimization problem. u_t is the expected return over the risk-free rate. $\sum_t$ is the $N * N$ variance-covariance matrix of returns. We use I_N to indicate the $N * N$ identity matrix. x_t is the vector of portfolio weights invested in the N risky assets, with $1 - 1_N^T x_t$ invested in the risk-free asset. The constraint that the weights sum to 1 is incorporated implicitly by expressing the optimization problem in terms of returns in excess of the risk-free rate.

The third benchmark is the minimum-variance portfolio. We choose the portfolio of risky assets that minimizes the variance of the returns as follows:

$$\min w_t^T \sum\nolimits_t w_t, s.t. 1_N^T w_t = 1 \tag{24}$$

To build the minimum-variance portfolio, we use only the estimate of the covariance matrix of asset returns (the sample covariance matrix) and ignore the estimates of the expected returns.

For both the mean-variance and the minimum-variance portfolios, we forecast the weights in the next period using the same spanning window as in our dynamic strategy. To be more specific, we estimate the weights for month 1 to month

100 and we use these estimated weights as the forecasted weights for month 101. To forecast month 102, we estimate the weights for the period from month 1 to month 101. We continue the process until month 265. The portfolio returns can be written as follows:

$$R_t = \sum_{k=1}^{K} w_{k,t} R_{k,t} + \sum_{j=1}^{J} w_{j,t} R_{J,t} \tag{25}$$

where $w_{k,t}$ and $w_{j,t}$ are the one-month ahead forecasted weights using the spanning window for both the mean-variance and the minimum-variance portfolios.

3.3.7 Performance Evaluation

We use two performance measures to compare between the different portfolio strategies. First, we measure the out-of-sample Sharpe ratios for strategy i, defined as the sample mean of out-of-sample excess returns (over the risk-free rates), μ_i, divided by their sample standard deviation, σ_i:

$$SR_i = \frac{\mu_i}{\sigma_i} \tag{26}$$

To test whether the Sharpe ratios of two strategies are statistically different, we use the method by Ledoit and Wolf (2008). They argue that the test by Jobson and Korkie (1980) is not valid even with the correction made in Memmel (2003) for returns that have tails heavier than the normal distribution or are of a time series nature. They propose the use of robust inference methods to compare between different Sharpe ratios. Specifically, they suggest to construct a studentized time series bootstrap confidence interval for the difference of the Sharpe ratios and to declare the two ratios different if zero is not contained in the obtained interval. This approach has the advantage that one can simply resample from the observed data as opposed to some null-restricted data.

As a second performance measure, the certainty-equivalent (CEQ) return is defined as the risk-free rate that an investor is willing to accept rather than adopting a particular risky portfolio strategy. The CEQ return of strategy i is computed as follows:

$$CEQ_k = \mu_i - \frac{\gamma}{2}\sigma_i^2 \tag{27}$$

We assume γ to be 1 as common practice. To test whether the CEQ returns from two strategies are statistically different, we compute the p-value of the difference, relying on the asymptotic of functional forms of the estimators of means and variance.

3.4 Results

3.4.1 Rolling Spanning and Efficiency Tests

Table 3.1 shows the results of the rolling spanning tests in Panel A and efficiency tests in Panel B for the country and industry indexes (value-weighted). Panel A shows that spanning tests cannot be rejected at the 95% confidence interval. Therefore, country indexes are spanned by industry indexes on average over our sample period, and vice versa. We argue that the diversification benefits of the portfolio of country (industry) indexes cannot be further improved by adding industry (country) indexes to the portfolio. Panel B shows the results of rolling efficiency tests. The null hypothesis of equal maximum Sharpe ratios between country and industry portfolios cannot be rejected either on average at the 95% confidence level. Therefore, the country and industry portfolios cannot be distinguished in terms of their maximum Sharpe ratios. The difference in the values of the Sharpe ratios is consistently defined as that of the industry-based portfolios less that of the country-based portfolios. As we can see from Panel B, the maximum Sharpe ratio is consistently higher for the country portfolios than for the industry portfolios but the difference is not statistically significant. The results confirm the findings in Pieterse-Bloem and Mahieu (2013) from the static spanning and efficiency tests. Table 3.1 shows the results of the rolling spanning tests in Panel A and efficiency tests in Panel B for the country and industry indexes (value-weighted). The results in Table 3.1 only show the average test statistics over the full sample. To see how the results vary over time, we plot the rolling Chi_K and Chi_J values over time in figures 3.1 and 3.2 respectively. Figure 3.1 shows that the country spanning hypothesis is more likely rejected after the global financial crisis. Therefore, there are increasing diversification benefits of adding industry indexes on the country portfolios from the mean-variance perspective.

We further link the average test statistics to market volatility through VIX

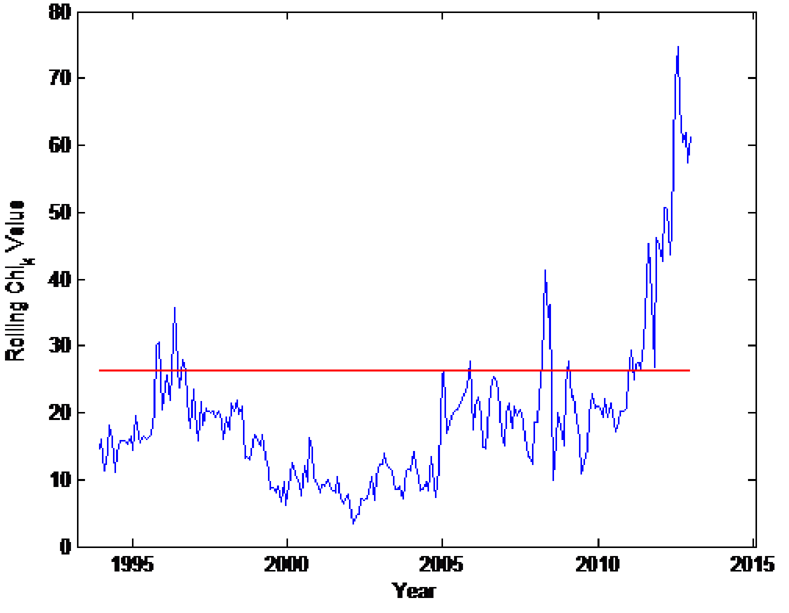


Figure 3.1: Rolling Chi-k Values for the Spanning Tests

The graph shows the rolling Chi-k value (whether country factor is spanned by industry factor). The solid red line is the critical value of 26.296 at 95% confidence level.

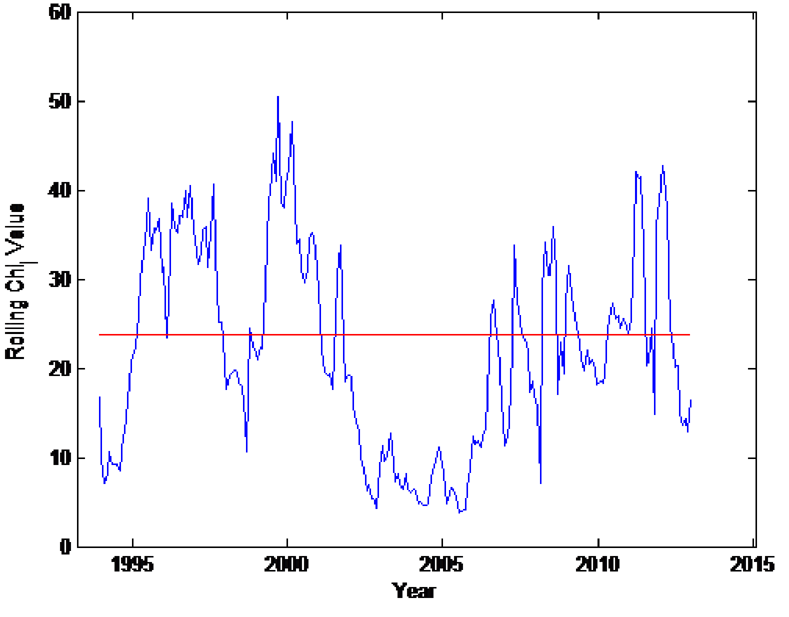


Figure 3.2: Rolling Chi-j Values for the Spanning Tests

The graph shows the rolling Chi-j values (whether industry factor is spanned by country factor). The solid red line is the critical value of 23.685 at 95% confidence level.

Table 3.1: Rolling Spanning and Efficiency Tests of the Country and Industry Indexes

The table shows the results of the rolling spanning and efficiency tests performed on value-weighted country and industry indexes. Panel A shows the results of the rolling spanning tests. H0:spanning K(J) is the results for the null hypothesis that country (industry) indexes are spanned by industry(country) indexes. The median value in Column 3 is obtained from the test statistics between January 1991 to January 2013. Columns 4 and 5 show the correlation coefficient and the p-value between the test statistics and the rolling VIX data. Panel B lists the results for the rolling efficiency tests. H0: Efficiency is the result that the maximum Sharpe ratios of the country and industry portfolios are the same. Columns 4 and 5 show the correlation coefficient and the p-value between the efficiency test statistics and the rolling VIX data. The results of the spanning and efficiency tests can be compared with the critical level at the 95

	(1)	(2)	(3)	(4)
Country and Industry Indexes from:	*Critical Level*	*Median Statistics*	*Correlation*	*P-value*
A. Bond Returns (Spanning Tests)				
H0:spanning K	(26.296)	17.382	0.2576	0.0001
H0:spanning J	(23.685)	21.964	0.2859	0.0000
B. Bond Excess Returns (Efficiency Tests)				
H0:Efficiency	3.842	2.284	0.0050	0.9396
Difference in Sharpe Ratio (Lamda)		-1.22	-0.0405	0.5422

data. Columns 4 and 5 of Table 3.1 show the correlation coefficients and the p-value by linking the VIX with the rolling spanning test statistics in panel A and with efficiency test statistics in Panel B. We see that the correlation between the rolling test statistic of the country indexes (Chi_K) and the VIX is 0.2567. Between that of the industry indexes (Chi_J) and the VIX, the correlation coefficient is 0.2859. Both correlations are positive and highly significant. Therefore, the spanning tests are more likely to be rejected when the market is more volatile, which means that it is more important to include both country and industry indexes during these periods. During high volatility periods, the correlations between the assets tends to increase. Therefore, it is more beneficial to include both country and industry indexes to achieve higher risk reductions. The correlation coefficient between the VIX data and the efficiency test statistics are positive but not significant. The difference in Sharpe ratios of the industry versus the country portfolios

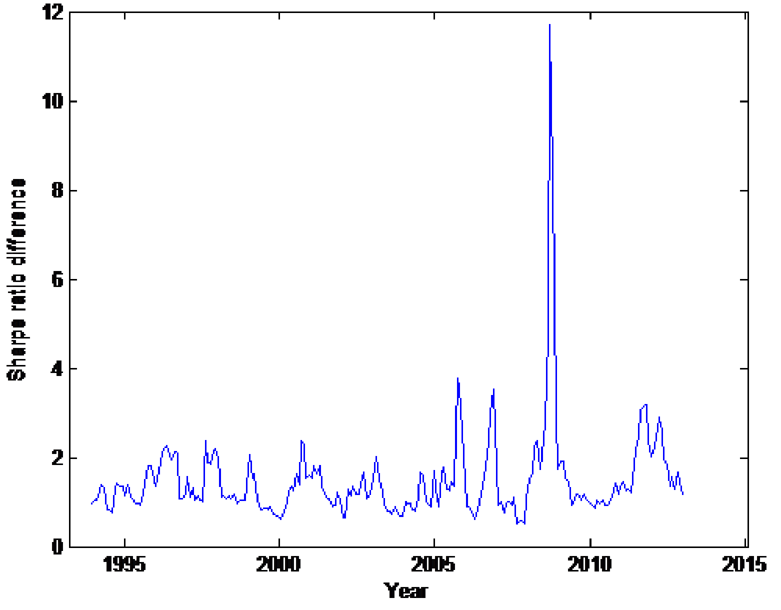


Figure 3.3: Rolling Sharpe Ratio Differences Between the Country-only VS Industry-only Portfolios

The graph shows the Sharpe ratio difference between the country-only portfolio and the industry-only portfolio.

are negatively (-0.0405) correlated with the VIX data but also not significant at 90 percent confidence level (p-value of 0.5422). We conclude that there is an insignificant relationship between the market volatility and the performance difference between the industry-only and country-only portfolios performance, with the industry-only portfolio as the inferior candidate. Figure 3.3 shows the rolling Sharpe-ratio differences between the country-only and industry-only portfolios. It indicates that during the financial crisis, there is a sharp increase in outperformance of the country-only portfolios over the industry-only portfolios.

All in all, we can conclude that the country (industry) indexes do not significantly dominate the industry (country) indexes. Furthermore, there is ample time-variation in the degree to which the two sets of assets perform and co-move. As such, there is scope for a dynamic investment strategy that takes advantage of this time-variation.

3.4.2 Dynamic Portfolio Strategy: Individual Bond Level

Using the expected returns generated using Equation (16), we form our dynamic strategy by investing only in the bonds with top 10, 20, 30, or 40 percent expected returns in the previous month. We also construct strategies using bonds that consistently rank in the top 10% in terms of expected returns in the previous two to six months. As for the benchmark, we can only use the naive portfolio because our data is uneven over time. Therefore, it is not possible to calculate the mean-variance or the minimum-variance portfolios. We report the returns, the standard deviations, and the Sharpe ratios of these dynamic portfolios together with the benchmark portfolio in Table 3.2 (with both forecasted factors and forecasted betas), Table 3.3 (with unconditional beta and forecasted factors), and Table 3.4 (with forecasted betas and unconditional factors).

As for the dynamic portfolio with both forecasted factors and betas, results in Table 3.2 show that the Sharpe ratio is always higher for the dynamic strategy than for the naive portfolio. The Sharpe ratios of the strategies based on the top 10 and top 30 percent expected return deciles are significantly better than that of the naive portfolio. We observe that the performance of the dynamic strategies tends to decrease as lower expected return deciles are added, as can be expected. This decrease originates mainly from the return part of the Sharpe ratio, as the standard deviation remains constant.

Since the top 30 percent decile portfolio has the most significant difference with the benchmark, we also construct portfolios consisting of bonds that are consistently in the top 30% expected return decile over the previous two to six months.

Table 3.2: Performance Measures for Individual Bonds: Factors and Betas

The table shows several portfolio measurements for our dynamic portfolios and the naive strategy constructed using individual bonds. DS1 represents the portfolio invested in the bonds which has the top 10 percent in the previous month. DS2 represents the portfolio invested in the bonds which has the top 20 percent in the previous month. DS3 are for the portfolio with the bonds of the top 30 percent performance in the previous month. DS4 are for the portfolio with the bonds of the top 40 percent performance in the previous month.DS5 represents the portfolio invested in the bonds which has the top 30 percent in the previous two months. DS6 represents the portfolio invested in the bonds which has the top 30 percent in the previous three month. DS7 represents the portfolio invested in the bonds which has the top 30 percent in the previous four months. DS8 represents the portfolio invested in the bonds which has the top 30 percent in the previous five months. DS9 represents the portfolio invested in the bonds which has the top 30 percent in the previous six months. NSE represents the equally-weighted naive portfolio. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Port.	*DS1*	*DS2*	*DS3*	*DS4*	*DS5*	*DS6*	*DS7*	*DS8*	*DS9*	*NSE*
A. Mean returns	0.0053	0.0050	0.0050	0.0048	0.0055	0.0063	0.0059	0.0062	0.0058	0.0042
A. Mean returns	0.0053	0.0050	0.0050	0.0048	0.0055	0.0063	0.0059	0.0062	0.0058	0.0042
B. Standard Deviation	0.0278	0.0278	0.0276	0.0276	0.0282	0.0287	0.0285	0.0293	0.0296	0.0282
C. Sharpe Ratio	0.1135	0.1017	**0.1049***	0.0963	**0.1188***	**0.1451***	0.1348	**0.1411***	0.1261	0.0740
	(0.0972)	(0.1177)	(0.0530)	(0.104)1	(0.0882)	(0.0581)	(0.1115)	(0.0999)	(0.2197)	
D. CEQ Return	0.0049	0.0046	0.0047	0.0044	0.0051	0.0059	0.0055	0.0058	0.0054	0.0038
E. Turnover Ratio	7917	13029	17730	20711	7134	7308	7238	7129	6969	5831

Table 3.3: Performance Measures for Individual Bonds: Forecasted Factors

The table shows several performance measurements for our dynamic strategies (using factors only) and the naive portfolio constructed from individual bonds. DS1 is invested in the bonds which are in the top 10 percent in the previous month. DS2 is invested in the bonds which are in the top 20 percent in the previous month. DS3 is invested in the bonds which are in the top 30 percent performance in the previous month. DS4 is invested in the bonds which are in the top 40 percent performance in the previous month.DS5 is invested in the bonds which are in the top 20 percent performance in the previous two months. DS6 is invested in the bonds which are in the top 20 percent in the previous three month. NSE is the equal-weighted naive portfolio. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Port.	*DS1*	*DS2*	*DS3*	*DS4*	*DS5*	*DS6*	*NSE*
A. Mean returns	0.0063	0.0060	0.0058	0.0053	0.0061	0.0062	0.0042
B. Standard Deviation	0.0272	0.0272	0.0273	0.0271	0.028	0.0283	0.0282
C. Sharpe Ratio	**0.1548****	**0.1413****	0.1331	**0.1183***	0.1429	0.1452	0.0740
	(0.0171)	(0.0405)	(0.0593)	(0.1045)	(0.0933)	(0.1770)	
D. CEQ Returns	0.0060	0.0056	0.0054	0.0050	0.0057	0.0058	0.0038
E. Turnover Ratio	16396	27175	35336	42608	11561	12076	5831

Table 3.4: Performance Measures for Individual Bonds: Forecasted Betas

The table shows several performance measurements for our dynamic strategies (using betas only) and the naive portfolio constructed using individual bonds. DS1 is invested in the bonds which are in the top10 percent in the previous month. DS2 is invested in the bonds which are in the top 20 percent in the previous month. DS3 is invested in the bonds which are in the top 30 percent performance in the previous month. DS4 is invested in the bonds which are in the top 40 percent performance in the previous month.DS5 is invested in the bonds which are in the top 10 percent in the previous two months. DS6 is invested in the bonds which are in the top 10 percent in the previous three month. NSE is the equal-weighted naive portfolio.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Port.	*DS1*	*DS2*	*DS3*	*DS4*	*DS5*	*DS6*	*NSE*
A. Mean returns	0.0045	0.0044	0.0043	0.0044	0.0050	0.0053	0.0042
B. Standard Deviation	0.0279	0.0271	0.0269	0.0269	0.0280	0.0284	0.0282
C. Sharpe Ratio	0.0865	0.0838	0.0813	0.0853	0.1022	0.1126	0.0740
	(0.6774)	(0.6814)	(0.7042)	(0.4375)	(0.3493)	(0.3559)	
D. CEQ Returns	0.0042	0.0040	0.0040	0.0041	0.0046	0.0049	0.0038
E. Turnover Ratio	4587	7284	9902	11256	2234	2253	5831

We find that for bonds with a top 30% performance in the previous 2, 3 and 5 months, the dynamic strategy significantly outperforms the naive portfolio. The strategy that invests in bonds which have been in the top 30 perent over the last five months (DS8 in Table 3.2) nearly doubles the Sharpe ratio of the naive portfolio, but the turnover ratio of bonds for this strategy only increase by 23.8%. Therefore, we argue that our dynamic strategy investing in individual bonds based on their expected returns has the potential to significantly outperform the naive portfolio, even after incorporating the effect on the turnover ratio.

The strategy based on the forecasted factors and unconditional betas, shown in Table 3.3, also outperforms the naive portfolio. In this case, the performance difference also tends to be significant, but the turnover ratio is significantly higher indicating that this is a costly strategy. For the strategy based on forecasted betas only, we find in Table 3.4 that the dynamic strategies consistently outperform the naive portfolio. The performance difference, however, is never significant. The turnover ratio of this dynamic strategy is in some cases lower and in some cases higher than that of the naive portfolio. This confirms our earlier finding that the significant outperformance in Table 3.2 was mainly driven by the forecasted factors. This result is consistent with our earlier findings of the performance of the dynamic strategy at the index level.

3.4.3 Dynamic Portfolio Strategy: Index Level

Table 3.5 shows the performance measures of the dynamic portfolio strategy at the index level, including the mean, standard deviation, Sharpe ratio, and CEQ return. The portfolios include the dynamic portfolios constructed from the forecasted factors alone, forecasted betas alone and both forecasted factors and betas, as well as the benchmark portfolios[26].

[26] As Table 3.5 shows, the value-weighted naive portfolio has a lower sharpe ratio than the equal-weighted naive portfolio. Therefore, we use only the equal-weighted naive portfolio as the benchmark in our analysis hence forth (in Table 6-12).

Table 3.5: Portfolio Measures for the Dynamic Strategies and Benchmark Portfolios

The table shows several performance measurements for all the portfolios constructed in this paper. DS1 indicate the dynamic strategy using weights from the forecasted factors alone. DS2 stands for the strategy using only forecasted betas. DS3 are the strategy using the products from the forecasted betas and forecasted factors. NSE indicates the 1/N equal-weigted naive porfolios. NSV is for the value-weighted naive portfolios. MeanV stands for the portfolios which are mean-variance with the maximum Sharpe ratios. MinV are the portfolios which minimizes the variance. The P-values are the results of comparing our dynamic strategies with the naive portfolios.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Port.	*DS1*	*DS2*	*DS3*	*NSE*	*NSV*	*MeanVS*	*MinV*
A. Mean returns	0.0045	0.0042	0.0039	0.0043	0.0042	0.0044	0.0047
B. Standard Deviation	0.0289	0.0299	0.0296	0.0291	0.0289	0.028	0.0314
C. Sharpe Ratio	0.0827	0.0679	0.0597	0.0749	0.0715	0.0816	0.0822
	(0.4095)	(0.3331)	(0.112)				
D. CEQ Return	0.0041	0.0037	0.0035	0.0039	0.0038	0.004	0.0042

The dynamic strategy based on forecasted factors, DS1, has the highest Sharpe ratio and the highest CEQ return of all portfolios. This result is driven by both a relatively high expected return and a relatively low standard deviation. The Sharpe ratio is not significantly higher, though. The dynamic strategy based on forecasted betas, DS2, does not outperform any of the benchmark portfolios. The combined strategy, both forecasted factors and forecasted betas, in DS3, also does not outperform. From Figures 3.4 and 3.5, we observe that there is substantial time-variation in the performance difference between the strategies. The patterns for the two dynamic strategies and across benchmarks is highly comparable: the dynamic strategies outperform the benchmarks in the first part of the sample, roughly until 2007, but underperform the benchmarks in the second half of the sample. We plot the rolling difference in Sharpe ratios of the dynamic strategy using forecasted factors and forecasted betas and the three benchmark portfolios using a rolling window of 36 months. Figure 3.4 shows the differences in Sharpe ratios between the strategy using forecasted factors and the benchmark portfolios. Figure 3.5 plots the rolling differences between the dynamic strategy using forecasted betas

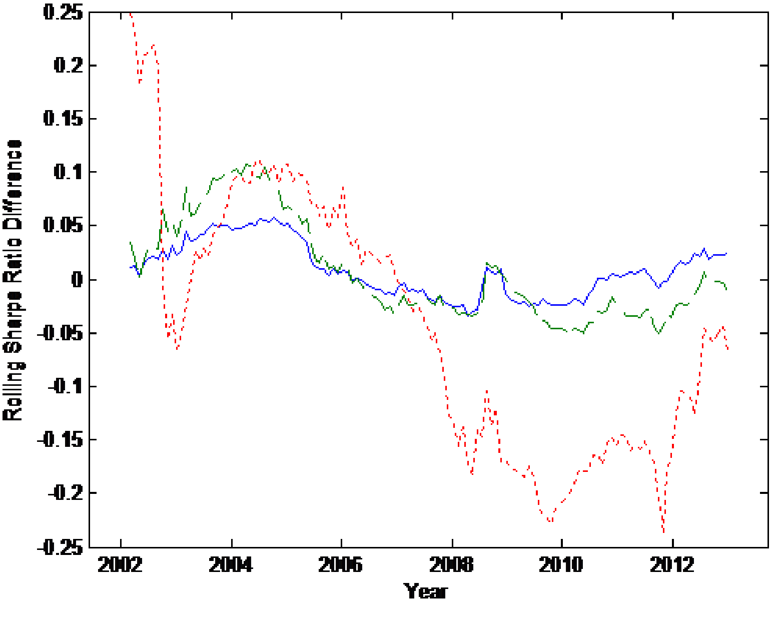


Figure 3.4: Difference in Sharpe Ratios between the Factor-only versus the Benchmark Portfolios

The graph shows the rolling difference in the Sharpe ratios between the dynamic strategy using only the forecasted factors and the three benchmark portfolios. We use 36 months as our rolling window period. The blue solid line is for the difference between dynamic and the naïve, the dashed green line is for the mean-variance and the red dotted is for the minimum-variance portfolio.

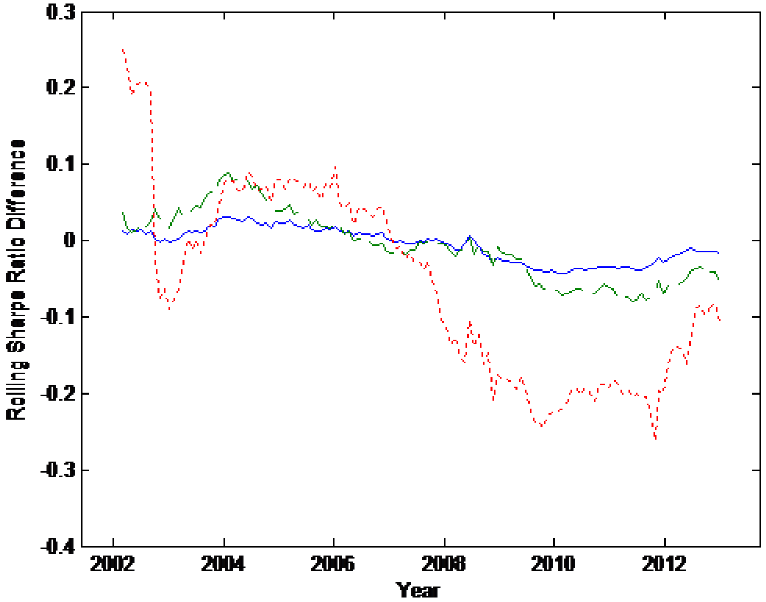


Figure 3.5: Difference in Sharpe Ratios between the Beta-only versus the Benchmark Portfolios

The graph shows the rolling difference in the Sharpe ratios between the dynamic strategy using only the forecasted betas and the three benchmark portfolios. We use 36 months as our rolling window period. The blue solid line is for the difference between dynamic and the naïve, the dashed green line is for the mean-variance and the red dotted is for the minimum-variance portfolio.

and the benchmark portfolios. We investigate whether the time-variation of the Sharpe ratios corresponds with market conditions. If this is the case, it helps to decide when to apply the dynamic strategy. Table 3.6 shows the relation between the performance difference of the dynamic strategy based on forecasted factors and the benchmark portfolios and the lagged VIX and lagged market integration. We measure integration by the relative importance of country versus industry factors for a 36-month rolling period[27]. Likewise, the rolling difference in Sharpe

[27] We calculate the median value of country factor squared minus industry factor squared divided by

Table 3.6: Relation between Relative Performance and Other Variables

The table shows how the relative performance between our dynamic strategies constructed with forecasted factors and the three benchmark portfolios relate to the VIX data, the one-month-lag country versus industry relative importance and the concurrent country versus industry relative importance. SR stands for Sharpe Ratio. Mean-V stands for the mean-variance portfolio. Mini-V stands for the minimum-variance portfolio. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
Relative Porf Perf	*Lag VIX Data*	*Lag ConVSInd Imp*
A. *Dynamic VS Naive SR*	**-0.4480*****	**-0.1739****
	(0.000)	(0.0488)
B. *Dynamic VS Mean-V SR*	**-0.6702*****	**-0.5398*****
	(0.000)	(0.000)
C. *Dynamic VS Mini-V SR*	**-0.7145*****	**-0.5950*****
	(0.000)	(0.000)
D. *Dynamic VS Naive Return*	**-0.5723*****	**-0.2768*****
	(0.000)	(0.002)
E. *Dynamic VS Mean-V Return*	**-0.6273*****	**-0.4166*****
	(0.000)	(0.000)
F. *Dynamic VS Min-V Return*	**-0.8003*****	**-0.5854*****
	(0.000)	(0.000)
H. *Dynamic VS Naive Variance*	**-0.8441*****	**-0.8716*****
	(0.000)	(0.000)
I. *Dynamic VS Mean-V Variance*	**0.5683*****	**0.7357*****
	(0.000)	(0.000)
J. *Dynamic VS Mini-V Variance*	**-0.3823*****	**0.1651***
	(0.000)	(0.062)

ratios between different strategies with a window of 36 months is calculated for month 101 to 265.

Column 2 of Table 3.6 shows how the differences in performance correlate with market volatility measured by the VIX. We find that the dynamic portfolio performs better than the benchmark portfolios when the VIX is low. The relation is significant at a 99% confidence level. This results is driven by both the return and the volatility component. Therefore, we argue that when the market is more

industry factor squared.

volatile, it is less beneficial to conduct our dynamic portfolio strategy. As for the lagged market integration in column 3 of Table 3.6, we find that the dynamic strategy performs better when market integration is relatively low. This result is again driven by both the return and the variance part of the Sharpe ratio.

All in all, we conclude that the performance of the dynamic portfolio strategy at the index level is mainly strong when the strategy is based on forecasted factors. Furthermore, the performance of the strategy is especially strong in periods of low volatility and low market integration.

3.4.4 Robustness Checks

We run a number of robustness tests to determine to what extent our results are sensitive to the set of countries in our sample. As such, we separate our data sample into several country groups. The core countries include Belgium and Luxembourg, France, Germany, and Netherlands; periphery countries include Italy and Spain; and non-Euro countries consist of Sweden and the UK. We form the same dynamic strategies and benchmark portfolios as in the main analysis. Tables 3.7 to 3.8 present the results.

The results generally hold for different country groups with some minor differences. For the set of core countries, in Table 3.7, we find highly comparable results. The strategy based on forecasted factors significantly outperforms the naive portfolio whereas the other configurations do not. For the peripheral countries, in Table 3.8, we also find outperformance for the dynamic strategy, but not significantly so. This is explained by the fact that returns in peripheral countries are more volatile, causing performance differences to be less significant. This finding is also consistent with our earlier finding that the dynamic strategy performs better in tranquil periods.

When splitting up the sample in Euro versus non-Euro countries, in Tables 3.9 and 3.10, we observe substantial outperformance of the dynamic strategies, especially for the non-Euro countries. The differences, though, are not significant. The latter finding implies that the significant outperformance we observed for the full set of countries is partly driven by the combination of Euro and non-Euro countries, which arguably provides for additional diversification benefits.

Table 3.7: Portfolio Measures for the Core Euro Countries during the Euro period

The table shows several performance measurements for the core EU countries after January 1999 when the Euro was introduced. DS1 indicate the dynamic strategy using weights from the forecasted betas alone. DS2 stands for the strategy using only forecasted factors. DS3 is the strategy using the products from the forecasted betas and forecasted factors. NSE indicate the 1/N equal-weighted naive porfolios. MeanV stands for the portfolios which are mean-variance with the maximum Sharpe ratios. MinV are the portfolios which minimizes the variance. The p-values are the results of comparing the dynamic portfolios with the naive portfolios.*, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Port.	*DS1*	*DS2*	*DS3*	*NSE*	*NSE*	*MinV*
A. Mean returns	0.0057	0.0068	0.0061	0.0047	0.0061	0.0110
B. Standard Deviation	0.0361	0.0368	0.0363	0.0267	0.0353	0.043
C. Sharpe Ratio	0.1281	0.1551	**0.1373****	0.1326	0.1406	0.2316
	(0.6033)	(0.0152)	(0.6579)			
D. CEQ Return	0.0051	0.0061	0.0054	0.0043	0.0054	0.0101

Table 3.8: Portfolio Measures for the Periphery Euro Countries during the Euro period

The table shows several performance measurements for the core EU countries after January 1999 when the Euro was introduced. DS1 indicate the dynamic strategy using weights from the forecasted betas alone. DS2 is the strategy using only forecasted factors. DS3 is the portfolio using the products from the forecasted betas and forecasted factors. NSE indicate the 1/N equal-weighted naive porfolio. MeanV stands for the portfolios which are mean-variance with the maximum Sharpe ratios. MinV are the portfolios which minimizes the variance. The p-values are the results of comparing the dynamic portfolios with the naive portfolios.

	(1)	(2)	(3)	(4)	(5)	(6)
Port.	*DS1*	*DS2*	*DS3*	*NSE*	*NSE*	*MinV*
A. Mean returns	0.0062	0.0060	0.0065	0.0036	0.006	0.0111
B. Standard Deviation	0.0358	0.0350	0.0350	0.0209	0.0356	0.0372
C. Sharpe Ratio	0.1431	0.1394	0.1532	0.1190	0.1366	0.2698
	(0.5917)	(0.2069)	(0.6579)			
D. CEQ Return	0.0056	0.0054	0.0058	0.0034	0.0053	0.0104

Table 3.9: Portfolio Measures for the Euro Countries during the Euro period

The table shows several performance measurements for the Euro countries after January 1999 when the Euro was introduced. DS1 indicate the dynamic strategy using weights from the forecasted betas alone. DS2 stands for the strategy using only forecasted factors. DS3 is the strategy using the products from the forecasted betas and forecasted factors. NSE indicate the 1/N equal-weighted naive porfolios. MeanV stands for the portfolios which are mean-variance with the maximum Sharpe ratios. MinV are the portfolios which minimizes the variance. The p-values are the results of comparing the dynamic portfolios with the naive portfolios.

	(1)	(2)	(3)	(4)	(5)	(6)
Port.	*DS1*	*DS2*	*DS3*	*NSE*	*NSE*	*MinV*
A. Mean returns	0.0063	0.0065	0.0061	0.0047	0.0065	0.0084
B. Standard Deviation	0.0348	0.0347	0.0336	0.0357	0.0358	0.0468
C. Sharpe Ratio	0.1483	0.1545	0.1479	0.1452	0.1505	0.1571
	(0.6715)	(0.674)	(0.9289)			
D. CEQ Return	0.0057	0.0059	0.0055	0.0056	0.0058	0.0073

Table 3.10: Portfolio Measures for the Non-Euro Countries during the Euro period

The table shows several performance measurements for the non-Euro countries after January 1999 when the Euro was introduced. DS1 indicate the dynamic strategy using weights from the forecasted betas alone. DS2 is the strategy using only forecasted factors. DS3 is the strategy using the products from the forecasted betas and forecasted factors. NSE indicate the 1/N equal-weighted naive porfolios. MeanV stands for the portfolios which are mean-variance with the maximum Sharpe ratios. MinV are the portfolios which minimizes the variance. The p-values are the results of comparing the dynamic portfolios with the naive portfolios. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Port.	*DS1*	*DS2*	*DS3*	*NSE*	*NSE*	*MinV*
A. Mean returns	0.008	0.0094	0.0092	0.0046	0.0071	0.0070
B. Standard Deviation	0.0331	0.0355	0.0359	0.0196	0.0319	0.0374
C. Sharpe Ratio	**0.2088***	0.2339	0.2267	0.1793	0.1871	0.1585
	(0.0751)	(0.1678)	(0.1877)			
D. CEQ Return	0.0075	0.0088	0.0086	0.0044	0.0066	0.0063

3.5 Conclusions

We propose a dynamic portfolio strategy for European corporate bonds based on a two-factor (country and industry) pricing model. To the best of our knowledge, our paper is the first to apply time-varying factor loadings in dynamic portfolio strategies in European corporate bond markets over a relatively long period of time.

We find that it is important to include both country and industry factors to improve diversification benefits. Since there is ample time variation in the degree in which the two sets of assets perform and co-move, there is scope for a dynamic investment strategy that exploits this time variation to enhance performance. We construct our dynamic strategy first on an individual bond level from forecasted factors, forecasted betas and a combination of both. We find that higher Sharpe ratios compared to the benchmark that are statistically significant. We find that this outperformance is mainly due to the forecasted factors. The bond selection rules can reduce the rise in the turnover ratio of the dynamic strategy from forecasted factors while still generating an outperformance. This is an important result for investors who want to replicate the strategy. We then construct dynamic strategies on an individual bond level. We find that the strategy based on forecasted factors produces better out-of-sample Sharpe ratios and Certainty-equivalent returns than a number of benchmark portfolios though the difference is not statistically significant. The strategy based on forecasted betas or the combination of the forecasted factors and betas cannot produce this outperformance.

Some of our results appear to be sensitive to the level of market uncertainty and market integration. We find that it is especially beneficial to implement the dynamic strategies in periods of low volatility and in periods when country factors gain in strength relative to industry factors. Further investigation of these issues are warranted.

4 Determinants of country and industry factors in Explaining the European corporate bond and stock returns.

4.1 Introduction

Corporate bond and stock markets are two important sources for companies to obtain financing. On one hand, given the fact that companies could issue corporate bonds and stocks at the same time, both of which are claimed on the same company assets, corporate bond and stock returns should be closely related. Merton (1974) develops a structural model, which serves as the benchmark to link the credit risks of a company with its fundamentals through the stock price information. The model is widely used in academia and in practice alike, where market participants use it to derive the fair value of the credit spread on corporate bonds. In the Merton (1974) model, a company's equity value is a call option on the company's assets while the corporate bond value equals the risk-free bond minus a put option on the firm value. Therefore, an increase in the firm's expected earnings leads to an increase in the firm's equity value as well as a decrease in the firm's probability of default which would result in an increase in its bond value. The correlation should be stronger for firms with a greater possibility of default when bonds are more sensitive to the company's earning potential. In addition, asset volatility increases the option value which benefits the equity holders in expenses of the debt holders. To sum up, according to the Merton (1974) model, stock and corporate bond returns are contemporaneously positively correlated due to the earning effects and negatively related due to asset volatility. On the other hand, the stock and corporate bond markets are fundamentally different in several ways. First, whereas stock and bond returns are both driven by the expected cash flows and the discount factor, changes in bond prices are more driven by the discount factor which is linked with the general level of interest rates. This is due to the fact that expected cash flow is more stable for bond valuation than for stocks. This implies that stock returns have partially different drivers than bond returns. Second, in contrast to stocks which are mainly traded through central exchanges, most corporate bonds are traded less frequently over the counter. Therefore, the corporate bond markets are in general less liquid than the stock markets. Third, corporate bond markets are more closely related to sovereign bond markets than the stock markets due to three reasons, which we argue would result in different roles of country and industry factors in the two markets. First, corporate bond yields fluctuate to reflect changes in the price of the bond caused by shifts in market interest rates. Therefore, the sovereign bond yield is the direct benchmark for the corporate bond yield. Second, corporate bond credit ratings are bounded by the sovereign credit ratings through the "sovereign ceiling" (Borensztein et al., 2013). The recent sovereign crisis in Europe starts when several countries in the EU were unable to fulfill their government debt obligations or bail out their banks without the help of third-party financial institutions. Such deteriorate in Sovereign rating has a direct influence on the European corporate bond market. Third, because many institutional investors can hold only investment-grade instruments, rating downgrades may lead to immediate sell-off of the assets which could negatively impact the prices. Nevertheless, the stock returns could also be affected by the sovereign credit risks but in a less direct way. Ferreira and Gama (2005) argue that the stock market could be influenced by the sovereign rating for two reasons. First, sovereign credit downgrades can affect a countryâs ability to borrow in international markets, which would contribute to a credit crunch and negatively impacts the stock market. Second, the sovereign rating can provide information on the future economic prospects of the country which is not usually accessible to the investors.

There are a large body of studies on the relationship between the stock and corporate bond markets. Several papers take the perspective of portfolio strategies and study the relationship between the stock and corporate bond markets through momentum spillover (Gebhardt et.al, 2005 and Haesen et al., 2017). They find that there is momentum spillover from equities to corporate bonds, which suggests that the two markets are interrelated. The study by Goyenko and Ukhov (2009) looks at the liquidity linkage between the stock and the treasury bond market. They find that there is a lead-lag relationship and granger causality (both directions) of the illiquidity between the two markets. Another strand of literature find lead-lag relationships between the equity and the corporate bond returns (Downing, Underwood, and Xing, 2009, Bittlingmayer and Moser, 2014 and Dor and Xu, 2015) which could signal no perfect integration between the two markets. Recent studies including Friewald et al., (2014), Anginer and Yildizhan (2017) and van Zundert and Driessen (2017) analyze the cross-sectional relationship between bond-implied expected equity returns and realized equity returns. The negative relationship between the two indicates relative misplacing of corporate bonds relative to stocks. However, the empirical results are inclusive. There are limited number of studies on the direct relationship between the stock and bond returns at the individual firm level, most of which focus solely on the US capital market. Kwan (1991), Campbell and Taksler (2003), and Cremers et al. (2008) study the unconditional relationship between the bond-stock returns at the company level and find a positive relationship between the two. Bao and Hou (2013) extends the Merton (1974) model and empirically test the hedge ratios at the bond and company level to show the heterogeneity in the corporate bond-equity comovement. More recent studies like Demirovic, Guermat, and Tucker (2017) show that while the average correlation is positive, the conditional correlation between stock and bond returns increases with credit risk and decreases with equity volatility and such relationship does not hold during volatile periods. Given the limited and inconclusive results on the stock-bond relationship on the individual company level, this paper intends to fill the literature gap and provides empirical evidence in light of the Merton (1974) model in the European capital markets utilizing a dynamic setting. More specifically, we look at the one-to-one relationship between the European stock and corporate bond returns at the individual company level from the perspective of country versus industry factors. We employ a time-varying framework by decomposing the asset returns into the time-varying country and industry factors, which enables us to see how the bond-stock relationship varies across the recent two decades including the recent financial crisis and the sovereign debt crisis.

We utilize the European corporate bond database constructed in Pieterse-Bloem et al. (2016) and match the bond sample with stock returns to one-to-one pairs at the company level. We use the method in Pieterse-Bloem et al. (2016) to decompose the bond and the stock returns into the time-varying country and industry factors. We compare the median difference of the country betas, industry betas and relative importance of the country versus industry betas between the corporate bond and the stock markets overtime at the aggregated level. At the individual company level, we collect a set of bond, stock and firm-level characteristics which are then used to explain the difference of the relative importance of country versus industry factors between the stock and the corporate bond markets. We construct the distant to default measure using the Merton model as a proxy for the company's credit risks. Our results show that there are significant time variations in the differences of the country and industry effects between the stock and the corporate bond markets from May 1999 to January 2013. The importance of country effects increases in explaining the bond returns relative to the stock returns after the recent financial crisis and the sovereign debt crisis. Industry effects, on the other hand, show different sign changes during the stressed period. Moreover, there are significant time-varying differences in the relative importance of country versus industry factors between the corporate bonds and stocks at the company level. Regression analyses of the determinants of the differences show that several bond, stock, and company characteristics explain the differences of the country and industry effects between the corporate bond and the stock markets. In general, variables that indicate higher asset volatility (e.g. higher stock volatility, lower capital expenditure, lower working capital) or lower credit risks (e.g. higher interest coverage ratio, better profit margin) would increase the differences between the European corporate bond and stock markets. Such results confirm the findings in Merton (1974) model and several previous studies (Kwan, 1991, Campbell and Taksler, 2003, Cremers et al., 2008 and Demirovic, Guermat, and Tucker, 2017) on the relations between the corporate bond and the stock markets.

Our paper contributes to three strands of literature. First, most previous studies on the country and industry debate focus on either the stock markets or the bond markets but not on both. Our study fills the literature gap by directly comparing the relative importance of country versus industry factors between the European stock and the corporate bond markets both across time and at the individual firm level. Our results emphasize on the distinguishing characteristics of the two markets, which provide new insights on the integration process of the European capital markets and open up new research opportunities of the country and industry factors in the multi-asset portfolio management. Second, more than comparing the differences at the static level, we are able to analyze how the relative importance of country versus industry factors in the stocks and corporate bonds vary over the recent two decades. Our sample includes the recent financial crisis and the sovereign debt crisis. Third, our analysis contributes to the literature on the stock-bond relationship by providing new empirical results from the perspective of country and industry debate in the European capital markets. In our analysis, European corporate bond and stock returns are matched to one-to-one pairs at the individual company level while most of the previous studies focus solely on the US market. Moreover, we regress a set of stock, bond, and company-level characteristics to explain the differences between the two markets. Such results provide new empirical evidence on the Merton (1974) model during stress periods.

The rest of the paper proceeds as follows. Section 4.2 describes how we match the stocks and the corporate bonds for each company and provides summary statistics of the final sample. Section 4.3 documents how we get the time-varying country and industry betas of the bond-stock pair for each individual company and how we construct our regression analysis. Section 4.5 presents the main results of our analysis both at the aggregated and the individual company level. Finally, Section 4.6 concludes the paper.

4.2 Data

The aim of this study is to compare directly the relative importance of country versus industry factors between the corporate bond and the stock markets. Therefore, corporate bond and stock returns matched at the individual company level are of great importance to our analysis. Individual European corporate bond returns are not easily available. We utilize the database constructed in Pieterse-Bloem et al. (2016) [28]. With the corporate bond data in place, we match the stock sample with the bond sample to one-to-one pairs at the individual company level. The stock prices are obtained from the Thomson Reuters Datastream. Three major adjustments are done in the matching process. First, a variety of discrepancies between the bond and stock issuers' names from the two databases are taken care of in order to correctly match the pairs. Second, several bonds are issued by parent companies through unlisted subsidiaries that operate as finance vehicles. To match these bonds with the parent companies' stocks, information about the hierarchical structures of these companies are manually collected to assure accuracy. Third, company events such as mergers, acquisitions, and bankruptcies are evaluated if stocks were delisted or bond guarantors changed following these events. The final sample period in our analyses spans from May 1999 to January 2013. We exclude the data before May 1999 due to the fact that not every country or industry are well represented with stocks in the earlier months. In addition, we also exclude government institutions (GI) in our sample because they do not normally issue stocks. The final data sample includes 3739 corporate bond series matched to 391 stock return series from May 1999 to January 2013. The countries include Belgium/Luxembourg (BL), France (FR), Germany (GE), the Netherlands (NE), Italy (IT), Spain (SP), Sweden (SW) and the United Kingdom (UK). The industries are financial and funds (FF), consumer goods (CO), communications and technology

[28]More detailed explanations of the bond data collection process can be found in Pieterse-Bloem et al. (2016).

Table 4.1: Country and Industry Composition for Bonds

This table shows the country and industry composition for bonds between May 1999 to January 2013. Panel A and B give for each country and industry the number of bonds included in the total sample and as a percentage of the total number of bonds. Panel C gives for each country by industry the number of bonds included in the total sample. Panel D gives the average weight of the (live) bonds in the country by industry cross-sector in the total value-weighted market over the whole sample. Percentages do not add up to precisely 100 due to rounding.

A. By country (number and percent of total)

Belgium/Luxembourg	BL	130	3.48%
France	FR	815	21.80%
Germany	GE	870	23.27%
Italy	IT	393	10.51%
Netherlands	NE	240	6.42%
Spain	SP	92	2.46%
Sweden	SW	315	8.42%
United Kingdom	UK	884	23.64%
Total		3739	100%

B. By industry (number and percent of total)

Financial&Funds	FF	2293	61.33%
Consumer Goods	CO	547	14.63%
Comm.Technology	CT	266	7.11%
Basic material&Energy	BE	144	3.85%
Industrials	IN	189	5.05%
Utilities	UT	300	8.02%
Total		3739	100%

C. Number of bonds by country and industry

	FF	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	91	6	7	7	7	12	130
France	359	188	71	33	77	87	815
Germany	657	110	25	26	24	28	870
Italy	296	19	27	14	3	34	393
Netherlands	165	16	32	16	11	0	240
Spain	55	3	10	4	7	13	92
Sweden	169	59	38	14	35	0	315
United Kingdom	501	146	56	30	25	126	884
Total	2293	547	266	144	189	300	3739

D. Average value-weighted weights of country/industry (in percentage):

	FF	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	0.65	0.06	0.15	0.16	0.02	0.54	1.58
France	4.61	5.30	3.88	0.63	2.20	4.35	20.97
Germany	7.45	3.36	1.55	0.84	0.60	1.78	15.58
Italy	5.14	0.76	1.93	0.76	0.04	1.40	10.03
Netherlands	1.95	0.36	1.36	0.40	0.28	0.00	4.35
Spain	0.93	0.05	0.48	0.31	0.31	0.69	2.77
Sweden	16.36	0.21	0.52	0.03	0.15	0.00	17.27
United Kingdom	12.74	5.26	3.84	0.81	0.94	3.88	27.47
Total	49.83	15.36	13.71	3.94	4.54	12.64	100.00

(CT), basic materials and energy (BE), industries (IN) and utilities (UT).

Table 4.1 shows that except the fact that Netherlands and Sweden do not have any matched bond-stock pairs in the Utility industry, each country has at least one bond-stock pair in each industry between May 1999 to January 2013. This indicates that there are relatively good diversification opportunities in our sample and that almost all countries are industrially diversified. Nevertheless, certain patterns of industry concentration in the European countries are visible from Panels C and D. All countries have relatively heavy weights in the financial industry, especially the UK and Sweden. Consumer Goods (CO) is the second most populated industry following FinancialFunds (FF), in which France and the UK are the top two dominated countries. As for the country decomposition, Sweden, following by the UK and Germany have the highest compositions among all countries. Belgium/Luxembourg and Spain are the bottom two populated countries with the fewest corporate bond issues in our sample. Table 4.2 lists the summary of the monthly percentage mean and standard deviation of European corporate bond returns classified by country (Panel A) and by industry (Panel B) in our sample from May 1999 to January 2013. The table shows that although country and industry sector returns are quite similar, the variation in average returns and return volatility is larger among the country indexes than the industry indexes. On a value-weighted basis, countries with above-average returns are the UK, France, and Spain, while Germany, the Netherlands and Italy are below the average. The Utilities industry has the highest returns whereas the financial and funds sector is the lowest. With respect to the standard deviation, Sweden has the most volatile bond returns while the UK has the lowest volatility. FinancialFunds is the most volatile industry and CO ranks lowest on the bond return standard deviation. The correlation matrix indicates that different countries are less correlated with each other than different industries are, both on an equal and value-weighted basis. Table 4.3 shows that the UK, France, and Germany are the top three countries

Table 4.2: Summary Performance for Bonds

This table shows the summary performance data of country and industry corporate bond index returns from May 1999 to January 2013. Panel A (B) summarizes the mean (in percentile) and the standard deviation of the equal-weights (EW) and the value-weighted (VW) monthly returns by country (industry) sector. In the correlation matrices, the coefficients above the diagonal refer to the value-weighted returns and below the diagonal to the equal-weighted returns.

A. By country

Country	EW Return		VW Return		Correlation matrix								
	Mean	St.dev	Mean	St.dev	BL	FR	GE	IT	NE	SP	SW	UK	Total
BL	0.3060	3.0917	0.2949	3.1286	1	0.9546	0.9674	0.9391	0.9566	0.9240	0.8898	0.8639	0.9537
FR	0.4319	2.9932	0.4417	3.0684	0.9653	1	0.9782	0.9594	0.9694	0.9352	0.8951	0.8985	0.9783
GE	0.3694	3.0130	0.3618	3.0850	0.9767	0.9774	1	0.9490	0.9694	0.9259	0.9205	0.8840	0.9802
IT	0.3843	3.0518	0.3730	3.1039	0.9388	0.9646	0.9482	1	0.8914	0.8322	0.867	0.8415	0.9582
NE	0.3688	2.9104	0.3728	2.9635	0.9694	0.9749	0.9764	0.9415	1	0.9314	0.9121	0.8819	0.9694
SP	0.4149	2.9423	0.4204	3.0469	0.9110	0.9299	0.9078	0.9412	0.9189	1	0.8693	0.8243	0.9284
SW	0.3677	3.2477	0.3940	3.2987	0.9408	0.9169	0.9422	0.8924	0.9337	0.8745	1	0.7892	0.9369
UK	0.5263	2.6631	0.4937	2.7128	0.8010	0.8541	0.8331	0.8085	0.8264	0.7715	0.7528	1	0.9333
Total	0.4330	2.7741	0.4177	2.8821	0.9497	0.9787	0.9754	0.9484	0.9638	0.9094	0.9151	0.9234	1

B. By industry sector

Industry	EW Return		VW Return		Correlation matrix						
	Mean	St.dev	Mean	St.dev	FF	CO	CT	BE	IN	UT	Total
FF	0.3850	2.8814	0.3852	3.0061	1	0.9397	0.9376	0.9701	0.9308	0.9098	0.9859
CO	0.4456	2.7205	0.4007	2.8419	0.9590	1	0.9661	0.9735	0.9829	0.9651	0.9768
CT	0.5030	2.7954	0.4729	2.9292	0.9482	0.9732	1	0.9603	0.9630	0.9591	0.9745
BE	0.3967	2.9547	0.3862	2.9857	0.9826	0.9682	0.9429	1	0.9627	0.9350	0.9847
IN	0.4649	2.9195	0.4323	2.9908	0.9519	0.9799	0.9649	0.9624	1	0.9687	0.9708
UT	0.5123	2.8588	0.4668	2.9566	0.9125	0.9533	0.9645	0.9030	0.9449	1	0.9567
Total	0.4330	2.7741	0.4177	2.8821	0.9896	0.9843	0.9786	0.9796	0.9752	0.9540	1

Table 4.3: Country and Industry Composition for Stocks

This table shows the country and industry composition for stocks between May 1999 to January 2013. Panel A and B give for each country and industry the number of stocks included in the total sample and as a percentage of the total number of bonds. Panel C gives for each country by industry the number of stocks included in the total sample. Panel D gives the average weight of the (live) stocks in the country by industry cross-sector in the total value-weighted market over the whole sample. Percentages do not add up to precisely 100 due to rounding.

A. By country (number and percent of total)

Belgium/Luxembourg	BL	23	5.88%
France	FR	75	19.18%
Germany	GE	65	16.62%
Italy	IT	44	11.25%
Netherlands	NE	17	4.35%
Spain	SP	19	4.86%
Sweden	SW	26	6.65%
United Kingdom	UK	122	31.20%
Total		391	100%

B. By industry (number and percent of total)

Financial&Funds	FF	122	31.20%
Consumer Goods	CO	101	25.83%
Comm.Technology	CT	38	9.72%
Basic material&Energy	BE	39	9.97%
Industrials	IN	52	13.30%
Utilities	UT	39	9.97%
Total		391	100%

C. Number of bonds by country and industry

	FF	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	6	5	3	3	2	4	23
France	14	25	10	8	13	5	75
Germany	20	20	3	7	12	3	65
Italy	23	6	3	2	3	7	44
Netherlands	5	3	3	3	3	0	17
Spain	8	2	1	1	2	5	19
Sweden	10	6	2	3	5	0	26
United Kingdom	36	34	13	12	12	15	122
Total	122	101	36	39	52	39	391

D. Average value-weighted weights of country/industry (in percentage):

	FF	CO	CT	BE	IN	UT	Total
Belgium/Luxembourg	1.28	0.07	0.17	0.17	0.01	0.34	2.04
France	4.83	6.20	3.22	3.95	2.02	2.86	23.08
Germany	3.87	4.25	1.67	1.37	1.44	1.67	14.27
Italy	3.85	0.31	0.61	2.20	0.05	1.13	8.15
Netherlands	1.54	0.46	0.76	1.33	0.91	0.00	5.00
Spain	2.55	0.08	1.42	0.39	0.24	1.07	5.75
Sweden	1.83	0.28	1.39	0.06	0.51	0.00	4.07
United Kingdom	13.08	8.9	7.14	5.17	1.10	2.23	37.62
Total	32.83	20.55	16.38	14.64	6.28	9.30	100.00

who issue the most stocks in our sample. The Netherlands and Spain rank last in stock issuance. As for the industry composition, FinancialFunds has the largest composition, followed by consumer goods and industrials. Panels C and D show the industry stock concentration in the eight European countries. Despite that all countries have relatively large weights in the financial industry, Germany and France are most populated by Consumer Goods. Table 4.4 lists the summary of the monthly percentage mean and standard deviation of European stock returns classified by country (Panel A) and by industry (Panel B) in our sample from May 1999 to January 2013. On a value-weighted basis, countries with above-average returns are Spain and Sweden, while the Netherlands and Italy are below the average. The basic material industry has the highest returns whereas the financial and funds sector is the lowest. The volatility rankings of the stock returns coincide with the bond returns regarding both countries and industries. Just like the bond returns, the country index and the industry index of the stock returns do not differ much. However, country index stock returns show greater variation in average returns and return volatility than the industry indexes.

Table 4.4: Summary Performance for Stocks

This table shows the summary performance of country and industry stock index returns. Panel A (B) summarizes the mean (in percentile) and the standard deviation of the equal-weights (EW) and the value-weighted (VW) monthly stock returns by country (industry) sector. 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 to the equal-weighted returns.

A. By country

Country	EW Return		VW Return		Correlation matrix								
	Mean	St.dev	Mean	St.dev	BL	FR	GE	IT	NE	SP	SW	UK	Total
BL	0.7003	6.9743	0.7414	7.8803	1	0.7901	0.6336	0.7911	0.7497	0.6583	0.7175	0.8077	0.8410
FR	0.8507	7.0308	0.9584	6.5918	0.8567	1	0.8106	0.8532	0.8735	0.8252	0.7885	0.8545	0.9624
GE	0.8542	7.5275	1.3270	7.7767	0.8422	0.9132	1	0.8174	0.8565	0.7412	0.8379	0.8266	0.9355
IT	0.2236	7.4776	0.6125	7.1022	0.8087	0.8552	0.8174	1	0.7663	0.7846	0.7055	0.7955	0.8785
NE	0.2714	7.5150	0.7435	7.0516	0.8035	0.9028	0.8565	0.8091	1	0.7495	0.8043	0.7737	0.8800
SP	1.0637	7.6149	1.0343	7.8296	0.7029	0.7979	0.7412	0.8156	0.7689	1	0.6787	0.7427	0.8430
SW	1.0673	7.8489	1.2716	8.1868	0.7584	0.8629	0.8379	0.7435	0.8388	0.6812	1	0.7610	0.8323
UK	0.7227	5.7388	0.8297	5.2170	0.8378	0.8616	0.8266	0.7850	0.8160	0.6990	0.8020	1	0.9376
Total	0.7136	6.3868	0.9436	5.8658	0.8992	0.9635	0.9355	0.8911	0.9118	0.8180	0.8787	0.9407	1

B. By industry sector

Industry	EW Return		VW Return		Correlation matrix						
	Mean	St.dev	Mean	St.dev	FF	CO	CT	BE	IN	UT	Total
FF	0.4644	8.4096	0.7475	8.3902	1	0.7418	0.5938	0.7038	0.8000	0.7460	0.9384
CO	0.8431	6.0058	1.1148	5.1195	0.8741	1	0.4429	0.7317	0.6727	0.6901	0.8192
CT	0.2511	7.5929	0.5493	7.0514	0.6674	0.6271	1	0.4769	0.6731	0.4628	0.7505
BE	1.2040	6.6975	1.1268	6.1731	0.8164	0.8904	0.5879	1	0.6396	0.7329	0.8192
IN	1.0181	7.2686	1.4562	7.4734	0.8560	0.9023	0.7189	0.8472	1	0.6334	0.8595
UT	0.8815	5.0937	0.8642	5.5267	0.7503	0.7526	0.4732	0.7426	0.6844	1	0.8004
Total	0.7136	6.3868	0.9436	5.8658	0.9638	0.8192	0.7505	0.8192	0.8595	0.8004	1

4.3 Method

The first research question of this analysis is to study how country versus industry factors differ between the stock and the corporate bond markets and whether the differences are time-varying. To analyze the relative importance of country versus industry factors in the two markets, we utilize the method by Pieterse-Bloem et al. (2016), which extends the Heston and Rouwenhorst (1994) model by making factor betas time-varying in decomposing asset returns into country and industry components.[29] The country and industry factor model by Pieterse-Bloem et al. (2016) suits our research agenda since it calculates the time-varying country and industry betas for each asset (both stock and corporate bond), which make a direct comparison between the two markets possible across time. The second research question of this study is to find whether certain stock, bond and firm-level characteristics could explain these differences between the two markets, which in return could empirically test the Merton model in the European stock and corporate bond markets. For this purpose, we collect a set of stock, bond, and firm-level variables and utilize the panel regression analyses. We will explain the methods in detail below.

4.3.1 Constructing Time-varying Country and Industry Betas

In the first step, Heston and Rouwenhorst (1994) method is utilized to construct the country and industry factors using cross-sectional regressions. For each month from January 1991 to January 2013, the returns of the individual asset (stock or bond) that exist in that month are decomposed into a country, industry, and an idiosyncratic component. The detailed model solution for Heston and Rouwenhorst (1994) can be found in the appendix.

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[29] Pieterse-Bloem et al. (2016) use the multivariate GARCH model to estimate the continuous conditional country and industry factor variance and co-variance which betas can be calculated from. Their method has the advantage of not imposing any structure on the betas and taking potential conditional heteroscedasticity of the asset returns into consideration.

In the second step, we employ the method in Pieterse-Bloem et al. (2016) to estimate the time-varying factor loadings (unconstrained betas) for each asset using the GARCH-BEKK model. We apply the GARCH-BEKK method on both stock and bond returns. In this way, we get the country and industry betas $\beta^k_{s,t}$ and $\beta^j_{s,t}$ for each stock and $\beta^k_{b,t}$ and $\beta^j_{b,t}$ for each corporate bond. The median value of the factor differences of the stock-bond pairs can be assessed to see how the difference between the two markets varies across time.

4.4 Regression Analysis on Individual Firm Level

The first research question of the time-variation of country versus industry betas focuses on the median differences between the stock and the corporate bond markets. Such view is only at the aggregated level. In the second step, we would like to see whether certain country, industry and firm-specific characteristics affect the country and industry differences between the two markets at the individual company level.

4.4.1 The Regression Model

We regress the country and industry factors of the bond-stock pair on a set of firm, bond and stock characteristics to see if these characteristics can explain the difference between the two markets. Several hypotheses will be discussed in detail in a subsequent section. The general regression can be written as follows:

$$\begin{aligned} Diff_{i,t} = \alpha_{i,t} + \beta_{i,t} \times CompanylevelVars_{i,t} + \gamma_{i,t} \times StocklevelVars_{i,t} \\ + \Theta_{i,t} \times BondlevelVars_{i,t} + \epsilon_{i,t}, \end{aligned} \quad (28)$$

The regression takes panel form for each individual bond-stock pair at the company level across our time sample. We include time and company fixed effects and use robust white standard errors to correct for heterogeneity. $Diff_{i,t}$ is the dependent variable that measures the differences of between country and industry factors. The details will be discussed in the next section.

4.4.2 Dependent Variable

The focus of the regression analysis is to look at the characteristics which would affect the relative importance of country versus industry factors in the European capital markets. In order to achieve the goal, the dependent variable $Diff_{i,t}$ is measured in three ways. First, the relative importance of country versus industry factors of the stock returns calculated as $({\beta^{k}_{ns,t}}^2 - {\beta^{j}_{ns,t}}^2)/({\beta^{k}_{ns,t}}^2 + {\beta^{j}_{ns,t}}^2)$ for each company n is used to measure the relative factor differences in the stock market. Second, the country versus industry factors of the corporate bond returns calculated as $({\beta^{k}_{nb,t}}^2 - {\beta^{j}_{nb,t}}^2)/({\beta^{k}_{nb,t}}^2 + {\beta^{j}_{nb,t}}^2)|$ is used to measure the country versus industry differences for each company n in the European corporate bond market. Third, the absolute value of the difference of the relative importance of the country versus industry betas for each company is included using equation 29 below, which indicates for the same company, how different its stocks and corporate bonds are integrated in the stock and corporate bond markets respectively.

$$|({\beta^{k}_{nb,t}}^2 - {\beta^{j}_{nb,t}}^2)/({\beta^{k}_{nb,t}}^2 + {\beta^{j}_{nb,t}}^2) - ({\beta^{k}_{ns,t}}^2 - {\beta^{j}_{ns,t}}^2)/({\beta^{k}_{ns,t}}^2 + {\beta^{j}_{ns,t}}^2)| \quad (29)$$

where $\beta^{k}_{nb,t}$ and $\beta^{j}_{nb,t}$ are the time-varying country and industry factor loadings for bonds and $\beta^{k}_{ns,t}$ and $\beta^{j}_{ns,t}$ are the time-varying country and industry factor loadings for stocks.

4.4.3 Explanatory Variables

In this section, we will explain in detail a set of firm, stock and bond-level characteristics included in the regression as our explanatory variables. Several Hypotheses are developed based on the relationship between these characteristics and our dependent variables[30].

[30]Multicollinearity of the explanatory variables are checked and no significant issues are found. The results are available upon request.

Stock Size

In the Merton (1974) model, companies with higher credit risks see closer co-movements between their bond-stock pair due to the earning effects. We argue that bigger firms are more likely to be more diversified with lower credit risks. Therefore, differences between the corporate bond and the stock market are smaller for bigger firms. Company size could be approximated by the stock size which is the market value of total stocks outstanding. We take the log value of the total stock size to minimize the influences of outliers.

Stock Liquidity

Given the fact that the corporate bonds are generally less liquid than the stocks, we argue that stocks with deeper liquidity will differ more from their corporate bond pairs then stocks with thinner liquidity. Stock Liquidity is calculated as the ask-bid spread of the stocks.

Stock Volatility

According to the Merton (1974) model, companies with higher stock volatility have larger discrepancies between the stock and bond returns as volatility increases option values, which will have opposite effects on the stock and corporate bond returns. Monthly stock Volatility is calculated as the log value of the standard deviation of daily stock prices multiplied by the square value of 21.

Price to Book Value

Lakonishok, Shleifer, and Vishny (1994) and Fama and French (1995) show that the price-to-book ratio serves as an indicator for the firm's default probabilities, which is related to the relative strength of company's economic fundamentals. Bao and Hou (2013) use the price-to-book ratio as an indicator of the marketâs assessment of the company's default likelihood and they find that the company with a lower price-to-book value shows closer comovement between its equity and bond returns. Therefore, we argue that growth firms with lower price to book value are more likely to default. Therefore, according to the Merton (1974) model, bonds issued by companies with lower price to book value (growth firm) have higher credit risks, which would behave more like their equity peers. Price-to-book value (P/B) is the ratio of market value over its book value of equity.

Bond Size

According to the Merton (1974) model, corporate bonds with lower credit risks are more likely to behave as risk-free bonds than equities, which would increase the differences between the stocks and the corporate bonds. Therefore, we expect that companies with larger bond issuing amounts are more likely to be larger, better-diversified firms with lower credit risks, which would show larger discrepancies between the stock and the corporate bond returns. The bond size is measured as the log value of the initial outstanding bond amount.

Bond Liquidity

According to the Merton (1974) model, credit risk negatively affects the relationship between the stock and the corporate bond returns. Therefore, we expect that bonds with deeper liquidity would possess less credit risks and move closer with their stock peers. We measure bond liquidity as the difference between the bond ask price and the bid price.

Bond Maturity

According to the extended Merton model developed in Bao and Hou (2013), corporate bonds that mature later are more sensitive to the company value because financially distressed firms may remain solvent only long enough to repay bonds that are due early in its maturity structure, but not those due later. Therefore, we argue that bonds with a longer time to maturity are more sensitive to the earning's effects, which would decrease the difference between the bond and stock returns.

The bond maturity is measured as the time difference between the bond issuing date and each time points in our sample.

Country Groups

We classify the countries into three groups: Core, periphery, and non-EU countries. Core countries include Belgium/Luxembourg (BL), France (FR), and the Netherlands (NE). The periphery countries are Italy (IT) and Spain (SP). The non-EU countries are Sweden (SW) and the United Kingdom (UK). We argue that core, periphery and non-EU countries have experienced different integration process after 1999 and they were also hit by the financial crisis and the sovereign debt crisis in different ways. Bai and Wei (2012) and Augustin et al. (2016) find that the connection between sovereign and corporate credit risk weakens in countries with strong property rights. Therefore, we expect that periphery countries, compared with core countries, will show higher differences between the stock and the corporate bond markets. We include two dummy variables to identify the three country groups in the regression analyses. Country Groups (Non-EU) equals one if the country falls into the non-EU group and 0 otherwise. Country Groups (Periphery) is 1 for periphery countries and 0 for others.

Industry Groups

We expect that firms whose output targets mostly in the domestic market to be more sensitive to the country risk, as the macroeconomic impact of sovereign default may be significantly bigger on them, and furthermore, not having direct foreign currency earnings, they are more vulnerable to capital controls. Industries in our samples include financial and funds (FF), consumer goods (CO), communications and technology (CT), basic materials and energy (BE), industries (IN) and utilities (UT). We treat UT as a non-tradable industry and all the other industries in our sample as tradable goods. We argue the country factor plays a bigger role relative to the industry factor in utilities than other industries for both the corporate bond and the stock market, especially during the recent financial crisis and the sovereign debt crisis. In addition, the sovereign ceiling effect is less prominent in tradable industries, which signals that being in a tradable industry will decrease the differences between the stock and the corporate bond markets.

Capital Expenditure as of Assets

Several papers (McConnell and Muscarella, 1985 and Chung and Charoenwong, 1998) suggest that higher capital investment relative to company assets could suggest better investment opportunities and future earnings prospects. Therefore, according to the Merton (1974) model, we expect that more capital expenditure as of assets will lead to lessen dispersion between the stock and the corporate bond markets due to the earnings' effects. Capital expenditure is the money a company spends to buy, maintain, or improve its fixed assets, such as buildings, vehicles, equipment, or land.

Working Capital as of assets

Aktas , Croci and Petmezas (2015) show that better working capital management leads to better earnings prospects and firm performances. Therefore, we argue that more working capital as of assets would lower the differences between the stock and the corporate bond markets due to the earnings effects in the Merton (1974) model. Working capital indicates the amount of liquid assets that a company has on hand and is calculated as the difference between the current assets and current liabilities.

Interest coverage ratio

The interest coverage ratio is a measurement of a company's ability to handle its outstanding debt. We argue that a higher interest coverage ratio leads to lower company's debt burdens and smaller chances of default. Demirovic, Guermat, and Tucker (2017) show that conditional correlation between stock and bond returns increases with credit risk. Therefore, we assume that a higher interest coverage ratio (lower credit risk) will decrease the relationship between the stock and the corporate bond markets. The interest coverage ratio is calculated as the earnings before interests and taxes divided by the company's interest expenses.

Gross profit margin

Gross margin, alone, indicates how much profit a company makes after paying off its cost of goods sold. The higher the profit margin, the more efficient a company is. We propose that firm with better profitability has less asset volatility which will increase the relationship between the stock and the corporate bond markets according to the Merton (1974) model. The gross profit margin ratio is the ratio of gross margin expressed as a percentage of sales.

Distance to Default Measure

Distance to default measure captures how many standard deviations away a firm is from the default. Higher values imply a lesser likelihood of the firm to default. The measure is derived using the structural default model of Merton (1974) which exploits the interpretation of equity as a call option on the firm's underlying assets. The model was later extended by subsequent papers (Vasicek, 1984 and Crosbie and Bohn, 2003). It is widely utilized as an indicator of credit default risks in academia (e.g., Hillegeist, Keating, Cram, and Lundstedt, 2004), Vassalou and Xing, 2004, Campbell, Hilscher, and Szilagyi, 2008, Bharath and Shumway, 2008 and Bao and Hou, 2013)) and credit rating industries (like KMV). We measure the distance to default as follows:

$$DTD_t = \frac{ln(V_A/D) + (r - 0.5 * (\sigma_A/100)^2)}{\sigma_A/100} \tag{30}$$

where V_A means the company's stock value plus the debt value. D is the value of the company' debt. We use short term debt plus half of the long term debt value as our debt amount. σ_A is the monthly stock volatility which is calculated as the standard deviation of the daily stock prices within each month multiply by the square root of 21. According to the Merton model, higher distance to default indicates lessen credit risks, which would decrease the relationship between the two markets.

4.5 Results

Before presenting the differences between the corporate bond and the stock markets, the results on the country versus industry factors in the corporate bond and the stock markets respectively are presented first. Our regression analyses show that the European corporate bond markets are significantly different from the stock markets regarding the relative importance of country versus industry factors. Moreover, the differences between the two markets are time-varying. A set of company, stock, and bond-level variables could explain the differences between the two markets.

4.5.1 The Time-series Comparison at the Aggregated Level

At the first step of the analysis, we look at the median difference of the country versus the industry importance in the corporate bond and the stock markets from May 1999 to January 2013. We find that there is significant time variation of the country and industry factors between the two markets during the time sample. The most dramatic change happens during the recent financial crisis and the sovereign crisis. In this section, we will present the empirical results on the time-varying country versus industry effects in the European capital markets. Figure 4.1 show the median value of the monthly difference of the country betas between the corresponding bond and stock of all the companies in our sample.

We find that the country factor becomes less important for corporate bonds relative to stocks after the establishment of the European Economic and Monetary Union (EMU), but takes off again after the recent financial crisis. The European corporate bond markets become more developed and integrated after the introduction of the EMU while the stock markets are in general more developed in Europe. Country factor, thus, reduces its effects in explaining bond returns relative to stock returns. We argue that country risks become more important for

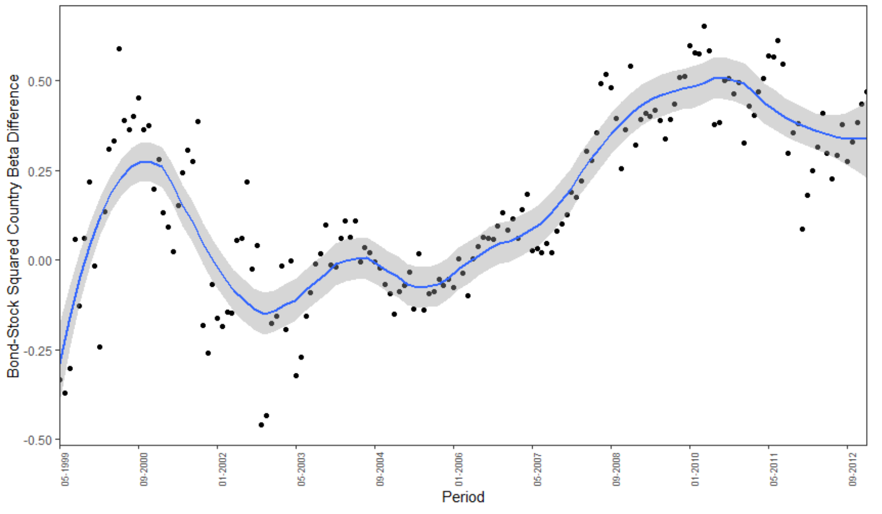

Figure 4.1: Country Beta Difference between the Bond and the Stock

This figure shows the monthly country beta difference of the bond-stock pairs between 1999.5 and 2013.1. We measure the country factor difference as $({\beta^{k}_{nb,t}}^2 - {\beta^{k}_{ns,t}}^2)/({\beta^{k}_{nb,t}}^2 + {\beta^{k}_{ns,t}}^2)$. The sample includes 3739 bonds and 391 stocks.

the corporate bond returns during the crisis partially due to the sovereign ceiling channel and flight to quality phenomenon. Sovereign ceiling effect states that private debt ratings are bounded by the sovereign credit ratings. Therefore, following sovereign credit downgrading during the crisis, country effects play a bigger role in corporate bond markets than the stock markets through closer relationship with sovereign debt ratings.

Figure 4.2 indicates the median value of the monthly industry beta differences between the corporate bond and the stock markets. The magnitude of the time variation of the industry differences is similar to that of the country beta differences. However, the differences in the industry factors decrease around the recent financial crisis and especially after the sovereign crisis. Figure 4.2 also shows that compared with the country differences, the median value of the industry differ-

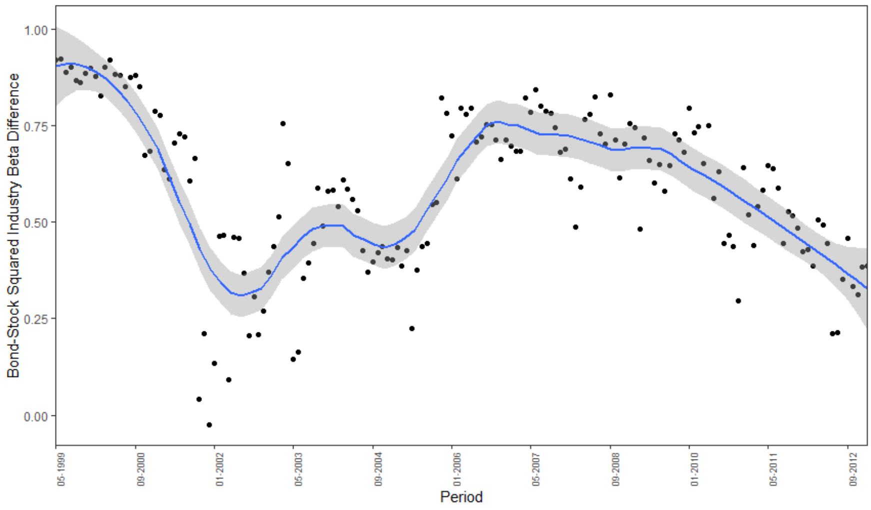

Figure 4.2: Industry Beta Difference between the Bond and the Stock

This figure shows the monthly industry beta difference of the bond-stock pairs between 1999.5 and 2013.1. We measure the industry factor difference as $({\beta^j_{nb,t}}^2 - {\beta^j_{ns,t}}^2)/({\beta^j_{nb,t}}^2 + {\beta^j_{ns,t}}^2)$. The sample includes 3739 bonds and 391 stocks.

ences between the corporate bond and the stock markets remains positive through the years.

Figure 4.3 shows the monthly median differences of the relative country versus industry importance in the European corporate bond markets from May 1999 to January 2013. The relative differences are calculated as the relative importance of country versus industry factors of the bond returns $({\beta^k_{nb,t}}^2 - {\beta^j_{nb,t}}^2)/({\beta^k_{nb,t}}^2 + {\beta^j_{nb,t}}^2)$ for each company. On the aggregated median basis, the relative importance of country versus industry factors for the corporate bond markets decreases after the start of the EMU and increases dramatically after the recent financial crisis Around the start of the sovereign debt crisis, the country effects, relative to the industry effects, shift upward again after a short period of leveling off. The results

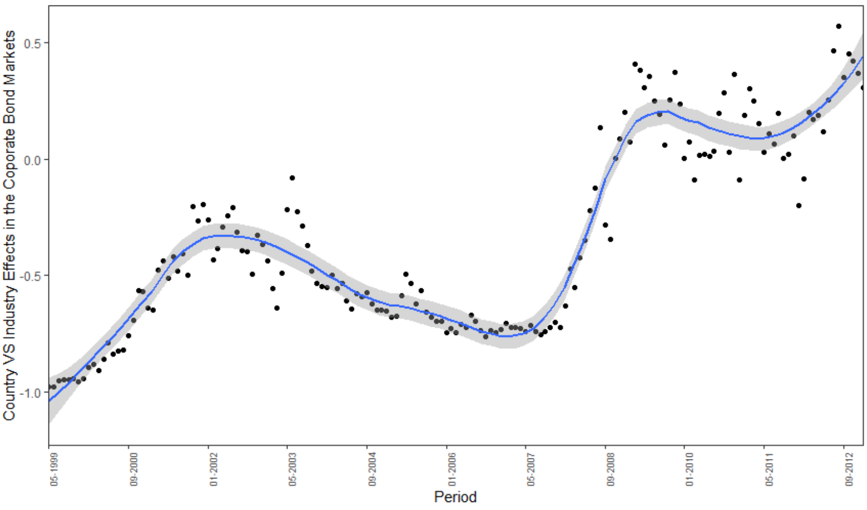

Figure 4.3: Relative Country and Industry Difference in the Corporate Bond Markets

This figure shows the monthly difference of the relative importance of country versus industry factors in the corporate bond markets from 1999.5-2013.1. We measure the country versus industry difference of corporate bond returns as $({\beta^k_{ns,t}}^2 - {\beta^j_{ns,t}}^2)/{\beta^k_{ns,t}}^2 + {\beta^j_{ns,t}}^2)$ for each company and obtain the median value of the differences. The sample includes 3739 bonds and 391 stocks.

further confirm that the recent financial crisis and the sovereign debt crisis hold down the financial integration process in the European corporate bond markets. Figure 4.4 shows the monthly median differences of the relative country versus industry importance in the European stock markets from May 1999 to January 2013. We see that the country-industry beta pattern in the stock market is quite similar to that of the corporate bond markets with general decreases of country effects relative to the industry effects after the start of the EMU and an upward shift after the financial crisis and the sovereign debt crisis. However, the increase in the country versus industry effects after the recent financial crisis is less dramatic in the stock market compared to the corporate bond markets and it falls back

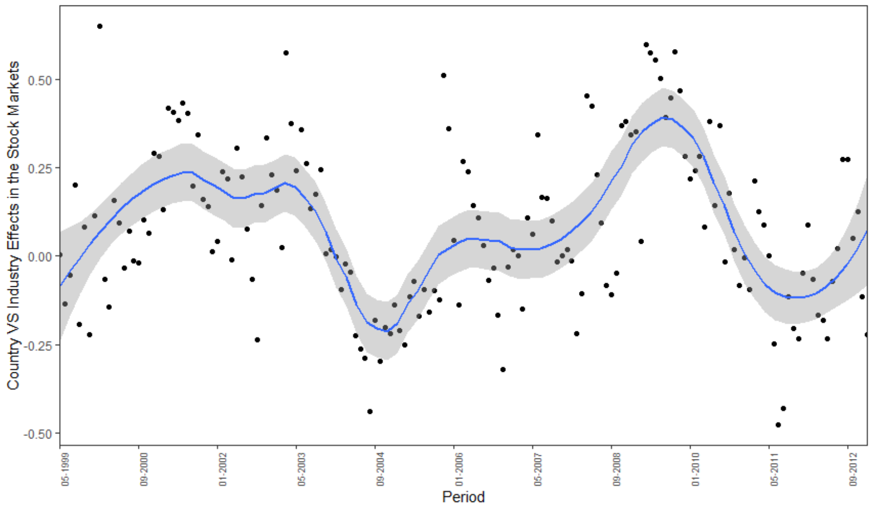

Figure 4.4: Relative Country and Industry Difference in the Stock Markets

This figure shows the monthly difference of the relative importance of country versus industry factors in the stock markets from 1999.5-2013.1. We measure the differences of the stock returns as $({\beta^k_{nb,t}}^2 - {\beta^j_{nb,t}}^2)/{\beta^k_{nb,t}}^2 + {\beta^j_{nb,t}}^2)$ for each company and obtain the median value of the median differences. The sample includes 3739 bonds and 391 stocks.

pretty quickly following the crisis. We argue that the financial crisis especially the sovereign debt crisis is a bigger hurdle for the financial integration in the corporate bond market than in the stock market partially due to the sovereign ceiling effects" and the "flight to quality" phenomenon in the corporate bond markets.

Figure 4.5 shows the monthly median differences of the relative country versus industry importance between the European corporate bond and stock markets from May 1999 to January 2013. We find that in general, relative to the industry, the country factor explains more of the stock returns than the corporate bond returns. However, confirming the findings in 4.3 and 4.4, the corporate bonds see an increasing role of country factors relative to the industry factors after the recent financial crisis and the sovereign debt crisis, which could be explained partially

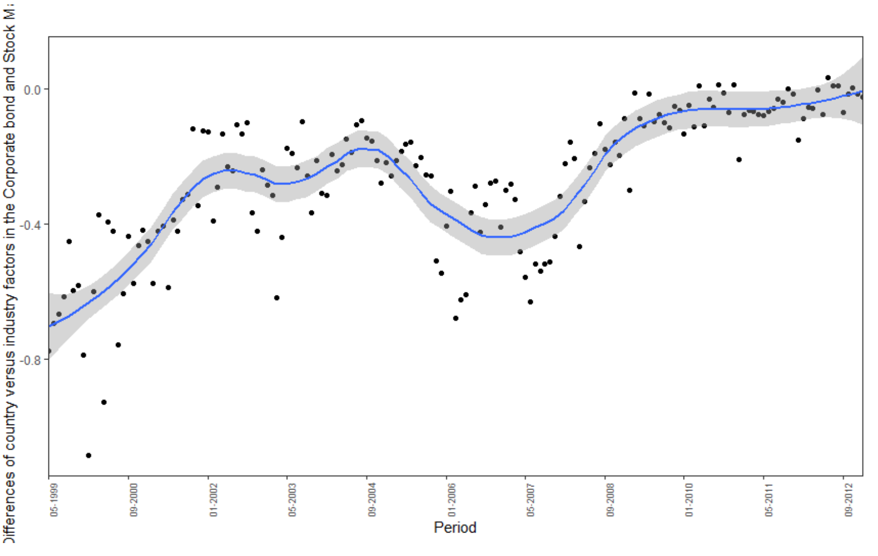

Figure 4.5: Relative Country and Industry Difference between the Bond and the Stock

This figure shows the monthly difference of the relative importance of country versus industry factors between the bond-stock pair from 1999.5-2013.1. We measure the difference by subtracting the relative importance of country versus industry factors of the bond $|((\beta^k_{nb,t}{}^2 - \beta^j_{nb,t}{}^2)/(\beta^k_{nb,t}{}^2 + \beta^j_{nb,t}{}^2))$ by that of its stock pair $((\beta^k_{ns,t}{}^2 - \beta^j_{ns,t}{}^2)/(\beta^k_{ns,t}{}^2 + \beta^j_{ns,t}{}^2))|$ for each company and obtain the median value of the median differences. The sample includes 3739 bonds and 391 stocks.

by the closer relationship between the corporate and the sovereign bond markets. Moreover, the absolute differences of country and industry effects between the two markets decrease after the crisis. We argue that there are contagion effects between the corporate bond and the stock markets during the crisis periods which would lead to closer relationships between the two markets. Figure 4.6 shows the monthly median value of the distance to default measure for all the firms in our sample from 1999.5-2013.1. We see that prior to the financial crisis in 2007, the firms show higher probabilities of defaults which could indicate potential problems in the financial markets before the crisis.

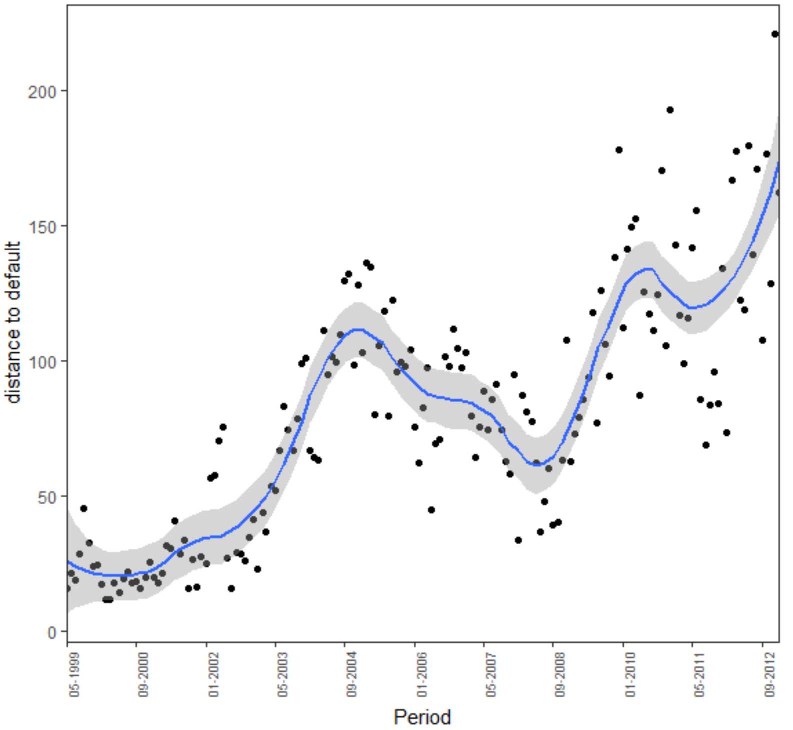

Figure 4.6: Median Distance to Default Measures for the Companies Across Time

This figure shows the monthly median value of the distance to default measure for all the firms in our sample from 1999.5-2013.1. We measure the distance to default using the Merton Distance to Default Model $ln(V_A/Debt) + (r+)/|\beta^j_{ns,t}|)$ for each company and obtain the median value across time.

Table 4.5 examines the effects of a set of stock, bond and company-level characteristics on the differences of the relative country and industry effects in the bond markets. The dependent variable is the difference of the relative importance of country and industry factor in the corporate bond markets which is calculated as $((\beta^k_{nb,t}{}^2 - \beta^j_{nb,t}{}^2)/(\beta^k_{nb,t}{}^2 + \beta^j_{nb,t}{}^2))$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column includes all the variables in the regression. The model is estimated using panel regression including company and time fixed effects. The results show that some stock-level variables have significant influences on the relative importance of country versus industry factors. Firms with larger stock size and higher stock volatility will see an increasing role of country factors relative to industry factors in explaining the corporate bond returns. We argue that bigger firms are more likely to be industry leaders which will be affected by the industry factors less than other firms. Firms with higher stock volatility are generally riskier so their bond ratings and returns would be more affected by sovereign ratings and country risks. Bond-level variables also show significant influences on the relative importance of country versus industry factors. Larger bond size and close to maturity will increase the country risks relative to industry risks. Bonds with larger issuing sizes are more likely to be issued by larger, better-diversified firms whose ratings move closer with sovereign ratings, which could increase the relative role of the country factor. Corporate bonds that are closer to maturity behave more like sovereign bonds through "pull-to-par effect" and are influenced by country risks relative to the industry risks. Compared with EU countries, non-EU countries show bigger effects of country factors relative to industry factors, indicating their corporate bond markets are less integrated than the EU countries. As for the industry category, being in a tradable industry will decrease the relative importance of country versus industry factors. This could be well explained by the fact that tradable industries are more international integrated. On the company-level, we find that higher capital expenditure, lower working capital, lower interest coverage ratio, higher profit margin and longer distance to default will increase the relative importance of country factors relative to the industry factors.

Table 4.6 examines the effects of a set of stock, bond and company-level characteristics on the relative importance of the country and industry effects in the

Table 4.5: Country and Industry Beta Differences of the Corporate Bond Markets

This table examines the effects of a set of stock, bond and company-level characteristics on the absolute differences of the country effects between the stock and the corporate bond markets. The sample consists of 3937 bonds and 379 stocks pair between May 1999 and January 2013. The dependent variable is the relative importance of country and industry factor difference $({\beta^k_{nb,t}}^2 - {\beta^j_{nb,t}}^2)/({\beta^k_{nb,t}}^2 + {\beta^j_{nb,t}}^2)$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column include all the variables in the regression. The model is estimated using panel regression including firm and time fixed effects. Standard errors are clustered at the firm level to correct for heterogeneity and t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Y-variable	*Rel Diff*	*Rel Diff*	*Rel Diff*	*Rel Diff*
Constant	**-0.172*** **	-0.003	-0.021	-0.421
	(0.005)	(0.974)	(0.923)	(0.280)
Stock Size		**-0.022*** **	0.014	**0.068** **
		(0.001)	(0.493)	(0.026)
Stock Liquidity		**-0.001** **	0.005	0.019
		(0.006)	(0.133)	(0.177)
Stock Volatility		**-0.029*** **	**-0.023** **	**0.032*** **
		(0.000)	(0.020)	(0.013)
Price to Book Value		-0.000	0.000	.000
		(0.194)	(0.571)	(0.834)
Bond Size			**0.023*** **	**0.024*** **
			(0.003)	(0.007)
Bond Liquidity			**-0.004** **	**-0.008* **
			(0.001)	(0.06)
Bond Maturity			**-0.002*** **	**-0.002*** **
			(0.000)	(0.000)
Country Groups (Non-EU)				**1.131*** **
				(0.000)
Country Groups (Periphery)				-0.200
				(0.105)
Industry Groups (tradable)				**-0.987*** **
				(0.000)
Company CAPEX				**145.280** **
				(0.013)
Company Working Capital				**-145.790*** **
				(0.000)
Interest coverage ratio				**-0.006*** **
				(0.010)
Gross profit margin				**0.002* **
				(0.092)
Distance to Default Measure				**0.000*** **
				(0.005)
Company Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
N	85,999	84,829	17,732	12,806
adj. R^2	0.367	0.366	0.486	0.490

Table 4.6: Country and Industry Beta Differences of the Stock Markets

This table examines the effects of a set of stock, bond and company-level characteristics on the differences of the country versus industry effects in the stock markets. The sample consists of 3937 bonds and 379 stocks pair between May 1999 and January 2013. The dependent variable is the relative importance of country versus industry factor in the stock markets $({\beta^k_{ns,t}}^2 - {\beta^j_{ns,t}}^2)/({\beta^k_{ns,t}}^2 + {\beta^j_{ns,t}}^2)$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column include all the variables in the regression. The model is estimated using panel regression including firm and time fixed effects. Standard errors are clustered at the firm level to correct for heterogeneity and t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Y-variable	*Rel Diff*	*Rel Diff*	*Rel Diff*	*Rel Diff*
Constant	**0.496*** **	**0.634*** **	**1.236*** **	**1.146*** **
	(0.000)	(0.000)	(0.000)	(0.000)
Stock Size		**-0.015*** **	**-0.029** **	**-0.064*** **
		(0.003)	(0.011)	(0.000)
Stock Liquidity		**0.001*** **	**-0.021*** **	0.019
		(0.007)	(0.000)	(0.117)
Stock Volatility		**-0.006* **	0.004	**0.049*** **
		(0.040)	(0.482)	(0.000)
Price to Book Value		**-0.000* **	**-0.005*** **	**-0.006*** **
		(0.088)	(0.000)	(0.000)
Bond Size			**-0.071*** **	0.006
			(0.000)	(0.216)
Bond Liquidity			**-0.005*** **	**-0.004* **
			(0.000)	(0.082)
Bond Maturity			-0.000	-0.000
			(0.545)	(0.913)
Country Groups (Non-EU)				**1.220*** **
				(0.000)
Country Groups (Periphery)				**-0.703*** **
				(0.000)
Industry Groups (tradable)				**-1.730*** **
				(0.000)
Company CAPEX				-29.127
				(0.304)
Company Working Capital				**-200.900*** **
				(0.000)
Interest coverage ratio				**0.004*** **
				(0.002)
Gross profit margin				**0.013*** **
				(0.000)
Distance to Default Measure				**0.000*** **
				(0.000)
Company Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
N	121,027	120,144	28,445	17,573
adj. R^2	0.514	0.516	0.728	0.722

stock markets. The dependent variable is calculated as $({\beta^k_{ns,t}}^2 - {\beta^j_{ns,t}}^2)/{\beta^k_{ns,t}}^2 + {\beta^j_{ns,t}}^2)$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column includes all the variables in the regression. The model is estimated using panel regression including company and time fixed effects. The results show that smaller stock size, higher volatility and lower price to book value will increase the relative importance of country versus industry factors in the stock market. Smaller firms with higher volatilities have more unpredictable future cash flows and probably more credit risks, which will increase the role of the country risks in explaining bond returns. Firms with higher price to book values are considered as growth firms which are usually concentrated in less mature industries which could be influenced more by the industry risks. Higher bond liquidity decreases the influences of the country factors relative to the industry factors in explaining stock returns. Non-EU countries are more affected by country factors than EU countries, which indicates more segregation of the stock markets in the Non-EU countries. Periphery countries are less influenced by country factors than the Core countries. Flight to quality during the crisis period could be one of the explanations, where core countries' stock markets will be more affected by country factors relative to the industry factors. As for the industry category, being in a tradable industry will decrease the relative importance of country versus industry factors in the stock market just as in the corporate bond markets. On the firm-level, lower working capital, higher interest coverage ratio, higher profit margin and higher distance to default measure will increase the country risks relative to the industry risks in the stock market.

Table 4.7 examines the effects of a set of stock, bond and company-level characteristics on the differences of the relative country and industry effects between the corporate bond and the stock markets. The dependent variable is the

Table 4.7: Country and Industry Beta Differences between the Stock and the Corporate Bond Markets

This table examines the effects of a set of stock, bond and company-level characteristics on the absolute differences of the country versus industry effects between the corporate bond and the stock markets. The sample consists 3937 bonds and 379 stocks pairs between May 1999 and January 2013. The dependent variable is the absolute value of the relative importance of country and industry factor difference $|((\beta^k_{nb,t}{}^2 - \beta^j_{nb,t}{}^2)/(\beta^k_{nb,t}{}^2 + \beta^j_{nb,t}{}^2)) - ((\beta^k_{ns,t}{}^2 - \beta^j_{ns,t}{}^2)/(\beta^k_{ns,t}{}^2 + \beta^j_{ns,t}{}^2))|$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column includes all the variables in the regression. The model is estimated using panel regression including firm and time fixed effects. Standard errors are clustered at the firm level to correct for heterogeneity and t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Y-variable	*Rel Diff*	*Rel Diff*	*Rel Diff*	*Rel Diff*
Constant	**0.738*****	**0.840*****	-0.063	-0.557
	(0.000)	(0.000)	(0.746)	(0.108)
Stock Size		**-0.011***	-0.019	**-0.050***
		(0.084)	(0.291)	(0.065)
Stock Liquidity		**0.001****	**-0.014*****	0.018
		(0.013)	(0.000)	(0.264)
Stock Volatility		**-0.009****	**0.028*****	**0.049*****
		(0.020)	(0.002)	(0.000)
Price to Book Value		-0.000	**-0.002****	-0.002
		(0.666)	(0.047)	(0.132)
Bond Size			**0.042*****	**0.070*****
			(0.000)	(0.000)
Bond Liquidity			**0.003*****	0.004
			(0.000)	(0.281)
Bond Maturity			**0.001*****	**0.001*****
			(0.000)	(0.000)
Country Groups (Non-EU)				0.026
				(0.803)
Country Groups (Periphery)				**0.351*****
				(0.000)
Industry Groups (tradable)				0.164
				(0.107)
Company CAPEX				**-86.026***
				(0.067)
Company Working Capital				**-90.922*****
				(0.002)
Interest coverage ratio				**0.007*****
				(0.000)
Gross profit margin				**0.007*****
				(0.000)
Distance to Default Measure				-0.000
				(0.839)
Company Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
N	85,509	84,829	17,732	12,806
adj. R^2	0.175	0.176	0.310	0.310

absolute value of the relative importance of country and industry factor difference $(({\beta^k_{nb,t}}^2 - {\beta^j_{nb,t}}^2)/{\beta^k_{nb,t}}^2 + {\beta^j_{nb,t}}^2) - ({\beta^k_{ns,t}}^2 - {\beta^j_{ns,t}}^2)/{\beta^k_{ns,t}}^2 + {\beta^j_{ns,t}}^2))$. The first column includes only the constant. The second column adds a set of stock-level characteristics. The third column adds a group of bond-level characteristics. The fourth column adds the firm-level variables and the final column includes all the variables in the regression. The model is estimated using panel regression including company and time fixed effects. The results show that smaller stock size, higher stock volatility increase the differences between the corporate bond and the stock markets. This could be explained by the Merton (1974) model that asset volatility could lead to a negative relationship between the stock and the corporate bond returns. Larger bond size and longer maturity also increase the differences between the two markets. Periphery countries see bigger differences between the stock and the corporate bond markets than core countries, which indicates that the capital markets in the periphery countries are less integrated. Higher interest coverage ratio and better profit margin indicate that the company has better abilities to pay off its debt so the credit risk is lower. Therefore, according to Merton (1974) model, lower credit risks would increase the difference between the stock and the corporate bond returns. Companies with higher capital expenditure would have more predictable future cash flows and thus lower asset volatility, which would reduce the difference between the corporate bond and the stock markets. The results also show that a company with higher working capital has smaller differences between the corporate bond and the stock returns. This could be explained that firms with better working capital management would have less asset volatility, which could most likely reduce the differences between the stock and the corporate bond markets according to the Merton (1974) model. To sum up, our results on the relative importance of country versus industry factors between the corporate bond and stock markets generally confirm the findings in Merton (1974) model, which argues that asset volatility increases the differences between the corporate bond and stock markets while credit risks reduce the discrepancies.

4.6 Conclusion

In this paper, we directly assess the relationship between the European corporate bond and the stock markets at the individual company level between May 1999 and January 2013 from the perspective of country versus industry factors. We match the corporate bond and stock pairs for each individual company in our sample. By decomposing respectively the corporate bond and stock returns into time-varying and asset-specific country and industry factors, we find significant time variation in the differences between the two markets, which can be explained by several stock, bond and firm-level characteristics using regression analyses. The regression results show that smaller stock size, higher stock volatility, larger bond origination amounts, longer time to maturity, less capital expenditure, lower working capital, higher interest coverage ratio, and higher gross profit margin would increase the differences between the European corporate and stock markets. Our results in general confirm the findings in Merton (1974) model and several previous studies, which argue that higher asset volatility (indicated by higher stock volatility) and lower earnings especially with smaller credit risks (indicated by larger bond size, longer time to maturity, less capital expenditure, lower working capital, higher interest coverage ratio) will increase the differences between the corporate bond and stock markets. However, contrary to the findings in Bao and Hou (2013), we did not find that two of the indicators for higher credit risks, namely the lower price to book value and higher distance to default measure, significantly decrease the differences between the bond-stock markets though the signs are as expected. Moreover, compared with the core and non-EU countries, periphery countries show higher differences between the stock and bond markets, which indicates that the financial markets are less integrated in the periphery countries. By including the recent financial crisis and the sovereign debt crisis, our analysis provides new evidence on the dynamic stock-bond relationship in the European capital markets during the stress periods. Further research on the integration process of the European corporate bond and stock markets and multi-asset portfolio management using time-varying country and industry factors are warranted, which could turn out to be quite beneficial for both policymakers and investors.

5 Summary and Conclusion

Stocks and corporate bonds constitute two important financing sources for companies. Most of the previous studies on the integration and investment of the European capital markets mainly focus on the stock markets. The number of corporate bond studies is quite limited, which could be partially attributed to the fact that the corporate bond indexes are less available than their stock peers in Europe. However, the European corporate bond markets are developing rapidly, especially after the start of the EMU, with currently a larger size than the stock market in Europe. Moreover, the recent financial crisis and the sovereign debt crisis significantly impacted the European corporate bond markets no less than the stock markets. Therefore, this PhD dissertation sets its foot in the European capital markets, especially in the corporate bond markets, and provides empirical analyses on financial integration and portfolio management from the perspective of country versus industry debate.

This dissertation bundles three empirical studies in the area of financial integration and portfolio management in the European corporate bond and stock markets. These studies investigate the country versus industry debate in the European capital markets in the areas of financial integration and dynamic portfolio management. Samples in this PhD thesis cover the most recent two decades, which includes several important events in Europe including the establishment of the EMU, the recent financial crisis and the European sovereign debt crisis. By utilizing the time-varying country and industry factor exposures, this dissertation highlights the unique roles of the country and industry factors in the European corporate bond and stock markets over the most recent two decades, which provides new insights for both policymakers and portfolio managers in Europe.

Chapter 2 analyzes the European financial integration process between 1991 and 2013 in the corporate bond markets. The unique dataset constructed in this chapter include all actively quoted European corporate bond returns, which serves as the basis for this dissertation and fills the literature gap of country and industry debate in the European corporate bond markets. Taking one step further than previous studies on bond returns that address the country versus industry debate using static factor loadings, we apply the GARCH-BEKK model to obtain bond specific time-varying country and industry loadings. The main results of the paper show that there are large time-variations in the relative importance of country versus industry betas. We conclude that integration is a dynamic process that does not follow a simple linear path towards full integration. We also find that significant financial fragmentation still remains in the Euro area, especially in the corporate bond market. Even worse, the recent financial crisis and the sovereign debt crisis threatened the very survival of the Euro project itself. We argue that the stability of financial markets and their cross-border integration will largely depend on Europe's success in a sound and resilient economic governance framework, where further research is warranted.

Chapter 3 proposes a dynamic portfolio strategy for European corporate bonds based on a two-factor pricing model capitalizing on the time-varying country and industry betas. We find that it is important to include both country and industry factors to improve diversification benefits. The dynamic strategy based on the two-factor model outperforms several benchmark portfolios. Specifically, on an index level, the dynamic strategy based on forecasted factors beats the benchmark strategies. This outperformance is not statistically significant but does have ample time variation related to market conditions that can be exploited. At the individual bond level, we find a statistically significant out-performance of the dynamic strategy. Our result is noteworthy and a valuable contribution to the literature by linking the dynamic portfolio strategies and country versus industry debate. We extend previous research to dynamic portfolio allocation strategies using time-varying country and industry factors. We find that the gains promised by optimal portfolio choice can actually be realized out of the sample. Since the portfolios from individual bonds using our dynamic country and industry factor model can be replicated, our results are highly relevant for investors and active portfolio managers to achieve higher risk-adjusted returns in the European corporate bond markets.

Chapter 4 directly assesses the differences between the European corporate bond and the stock markets from the perspective of country versus industry debate. By constructing the bond-stock pairs for each individual company and decomposing the asset returns into the time-varying country and industry components, we directly compare the relative country versus industry importance between the two markets. We find significant time variation in the relative country versus industry importance between the two markets. Our regression analyses on the company-level show that higher asset volatility and lower credit risks will increase the differences between the corporate bond and stock markets. Our findings contribute to the bond-stock literature by providing new results from the perspective of the relative importance of the country and industry factors in the European capital markets. In addition, one step further than previous studies that focus on either stocks or bonds, our study contributes to the country versus industry literature by directly comparing the stock and the corporate bond markets both across time and at the individual firm level. Our findings provide new insights on the financial integration in the European capital markets, especially during the recent financial crisis and the sovereign debt crisis, which could serve as a basis for future financial policy research in Europe. In addition, given the integration of these two markets is going at different speeds, European corporate bond and stock markets should be treated differently in terms of multi-asset portfolio optimization, which warrants for future research.

By looking at both the financial integration and portfolio management in the

European capital markets, this PhD thesis contributes to several strands of literature especially adding the perspective from the European corporate bond markets using unique hand-collected bond index data. According to the 2018 ECB report on financial integration, although the European corporate bond markets are becoming more integrated recently, it is still lagging behind those of the US and the level of development varies substantially across the European countries. Moreover, a higher level of cross-border bond investments and integration could lead to financial instability during the crisis period, which calls for continuous macro-level monitoring and strong policy support. Looking forward, extended research on the European corporate bond markets together with the stock markets could prove quite beneficial to both policymakers and investors in Europe.

Nederlandse samenvatting

(Summary in Dutch)

De voorraden en de bedrijfsobligaties vormen twee belangrijke financieringsbronnen voor bedrijven. De meeste vorige studies over de integratie en de investering van de Europese kapitaalmarkten concentreren zich hoofdzakelijk op de effectenbeurzen. Het aantal bedrijfsobligatiestudies is vrij beperkt, dat gedeeltelijk aan het feit dat zou kunnen worden toegeschreven de bedrijfsobligatieindexen dan hun voorraadedelen in Europa minder beschikbaar zijn. Nochtans, ontwikkelen de Europese bedrijfsobligatiemarkten zich snel, vooral na het begin van de EMU, met momenteel een grotere grootte dan de effectenbeurs in Europa. Voorts beinvloedden de recente financiele crisis en de soevereine schuldcrisis niet minder dan beduidend de Europese bedrijfsobligatiemarkten de effectenbeurzen. Daarom plaatst deze Doctoraatverhandeling zijn voet in de Europese kapitaalmarkten, vooral in de bedrijfsobligatiemarkten, en verstrekt empirische analyses bij het financiele integratie en portefeuillebeheer vanuit het perspectief van land tegenover de industriedebat.

Deze verhandeling bundelt drie empirische studies op het gebied van financieel integratie en portefeuillebeheer in de Europese bedrijfsobligatie en de effectenbeurzen. Deze studies onderzoeken het land tegenover de industriedebat in de Europese kapitaalmarkten op het gebied van financiele integratie en dynamisch portefeuillebeheer. De steekproeven in deze Doctoraatthesis behandelen de meest recente twee decennia, wat verscheidene belangrijke gebeurtenissen in Europa met inbegrip van de totstandbrenging van de EMU, de recente financiele crisis en de Europese soevereine schuldcrisis omvat. Door de tijdsafhankelijke de factorenblootstelling van het land te gebruiken en van de industrie, benadrukt deze verhandeling de unieke rollen van de factoren van het land en van de industrie in de Europese bedrijfsobligatie en effectenbeurzen in de loop van de meest recente twee decennia, die nieuw inzicht voor zowel beleidsvormers als portefeuillemanagers in Europa verstrekt.

Hoofdstuk 2 analyseert het Europese financiele integratieproces tussen 1991 en 2013 in de bedrijfsobligatiemarkten. De unieke die dataset in dit hoofdstuk wordt geconstrueerd omvat alle actief geciteerde Europese bedrijfsobligatiewinst, wat als basis voor deze verhandeling dient en het literatuurhiaat van het debat van het land en van de industrie in de Europese bedrijfsobligatiemarkten vult. Treffend een maatregel dan verder vorige studies bij bandwinst die het land tegenover de industriedebat gebruikend statische factorenladingen richt, passen wij het model garch-BEKK toe om ladingen van de van het band de specifieke tijdsafhankelijke land te verkrijgen en industrie. De belangrijkste resultaten van het document tonen aan dat er grote tijd-variaties in het relatieve belang van land tegenover de industriebetas zijn. Wij besluiten dat de integratie een dynamisch proces is dat geen eenvoudige lineaire weg naar volledige integratie volgt. Wij vinden ook dat de significante financiele fragmentatie nog in het Euro-gebied, vooral in de bedrijfsobligatiemarkt blijft. Nog slechter, bedreigden de recente financiele crisis en de soevereine schuldcrisis de eigenlijke overleving van het Euro project zelf. Wij debatteren dat de stabiliteit van financiele markten en hun grensoverschrijdende integratie grotendeels zullen afhangen van het succes van Europa in een correct en veerkrachtig economisch bestuurkader, waar het verdere onderzoek gerechtvaardigd is.

Hoofdstuk 3 stelt een dynamische portefeuillestrategie voor Europese die bedrijfsobligaties voor op een two-factor het tarief model worden gebaseerd voordeel trekkend van tijdsafhankelijke betas van het land en van de industrie. Wij vinden dat het belangrijk is om zowel de factoren van het land te omvatten als van de industrie om diversificatievoordelen te verbeteren. De dynamische die strategie op het two-factor model wordt gebaseerd overtreft verscheidene benchmarkportefeuilles. Specifiek, op een indexniveau, slaat de dynamische die strategie op voorspelde factoren wordt gebaseerd de benchmarkstrategieen. Dit outperformance is niet statistisch significant maar heeft ruime tijdvariatie met betrekking tot marktvoorwaarden die kunnen worden geexploiteerd. Op het individuele bandniveau, vinden wij statistisch significante uit-prestaties van de dynamische strategie. Ons resultaat is opmerkelijk en een waardevolle bijdrage tot de literatuur door de dynamische portefeuillestrategieen en het land tegenover de industriedebat te verbinden. Wij breiden vorig onderzoek tot de dynamische strategieen van de portefeuilletoewijzing gebruikend uit de tijdsafhankelijke factoren van het land en van de industrie. Wij vinden dat de aanwinsten door optimale portefeuillekeus eigenlijk uit de steekproef kunnen worden beloofd worden gerealiseerd die. Aangezien de portefeuilles van individuele banden die ons dynamisch de factorenmodel gebruiken van het land en van de industrie kunnen worden herhaald, zijn onze resultaten hoogst relevant voor investeerders en actieve portefeuillemanagers om hogere risico-aangepaste winst in de Europese bedrijfsobligatiemarkten te bereiken.

Hoofdstuk 4 beoordeelt direct de verschillen tussen de Europese bedrijfsobligatie en de effectenbeurzen vanuit het perspectief van land tegenover de industriedebat. Door de band-voorraad paren voor elk individueel bedrijf te construeren en de activawinst te ontbinden in de tijdsafhankelijke componenten van het land en van de industrie, vergelijken wij direct het relatieve land tegenover de industriebelang tussen de twee markten. Wij vinden significante tijdvariatie in het relatieve land tegenover de industriebelang tussen de twee markten. Onze regressieanalyses op het bedrijfsniveau tonen aan dat de hogere activavluchtigheid en de lagere kredietrisico's de verschillen tussen de bedrijfsobligatie en de effectenbeurzen zullen verhogen. Onze bevindingen dragen tot de band-voorraad literatuur bij door nieuwe resultaten vanuit het perspectief van het relatieve belang van de factoren van het land en van de industrie in de Europese kapitaalmarkten op te leveren. Bovendien draagt een stap verder dan vorige studies die zich op of voorraden of banden concentreren, onze studie tot het land tegenover de industrieliteratuur bij door de voorraad en de bedrijfsobligatiemarkten zowel over tijd als op het individuele bedrijfsniveau direct te vergelijken. Onze bevindingen verstrekken nieuw inzicht op de financiele integratie in de Europese kapitaalmarkten, vooral tijdens de recente financiele crisis en de soevereine schuldcrisis, die als basis voor toekomstig financieel beleidsonderzoek naar Europa konden dienen. Bovendien gezien de integratie van deze twee markten gaat bij verschillende snelheden, zouden de Europese bedrijfsobligatie en de effectenbeurzen verschillend in termen van de optimalisering van de multi-activaportefeuille moeten worden behandeld, welke waarborgen voor toekomstig onderzoek.

Door het bekijken zowel de financiele integratie als portefeuillebeheer in de Europese kapitaalmarkten, draagt deze Doctoraatthesis tot verscheidene bundels van literatuur bij vooral toevoegend het perspectief van de Europese bedrijfsobligatiemarkten gebruikend de unieke hand-verzamelde gegevens van de bandindex. Volgens het rapport van ECB van 2018 over financiele integratie, hoewel de Europese bedrijfsobligatiemarkten onlangs meer geintegreerd worden, blijft het nog achter het niveau van ontwikkeling varieert wezenlijk over de Europese landen. Voorts kon een hoger niveau van grensoverschrijdende bandinvesteringen en integratie tot financiele instabiliteit tijdens de crisisperiode leiden, die ononderbroken controle op macroniveau en sterke beleidssteun verzoekt. Op zich verheugt, vrij voordelig kon het uitgebreide onderzoek naar de Europese bedrijfsobligatiemarkten samen met de effectenbeurzen zowel beleidsvormers als investeerders in Europa blijken.

Appendix

Heston and Rouwenhorst (1994) Model Solution

Equation (2.3) cannot be estimated in its present form because it is unidentified due to perfect colinearity. Intuitively, this is because every bond belongs to both an industry and a country, so that industry and country effects can be measured only relative to a benchmark. To resolve the indeterminacy, we follow Heston and Rouwenhorst (1994) and impose the restriction that the weighted sum of industry and country effects equal zero at every point in time: We start from Eqs (2.3) with imposed restrictions.

$$r_{n,t} = \alpha + \sum_{j=1}^{J} f_{j,t} I_{nj,t} + \sum_{k=1}^{K} f_{k,t} I_{nk,t} + \varepsilon_{n,t} \tag{P1}$$

$$\text{s.t.} \quad \sum_{j=1}^{J} w_{j,t} f_{j,t} = 0, \sum_{k=1}^{K} w_{k,t} f_{k,t} = 0 \text{ and } \sum_{j=1}^{J} w_{j,t} = \sum_{j=1}^{K} w_{k,t} = 1 \tag{P2}$$

where $w_{j,t}$ and $w_{k,t}$ represent the value weights of industry j and country k in the total universe of European corporate bonds at time t, constructed from the USD equivalent of the amounts issued. Imposing such a restriction is equivalent to measuring the size of each industry and country relative to the average size. Rewrite the first two restrictions in Equation P2 as

$$0 = \sum_{j=1}^{J} w_{j,t} f_{j,t} = \sum_{j=1}^{J-1} w_{j,t} f_{j,t} + w_{J,t} f_{J,t} \Leftrightarrow f_{J,t} = -\sum_{j=1}^{J-1} f_{j,t} \frac{w_j}{w_J} \tag{P3}$$

$$0 = \sum_{k=1}^{K} w_{k,t} f_{k,t} = \sum_{k=1}^{K-1} w_{k,t} f_{k,t} + w_{K,t} f_{K,t} \Leftrightarrow f_{K,t} = -\sum_{k=1}^{K-1} f_{k,t} \frac{w_k}{w_K} \tag{P4}$$

and incorporate into the regression equation P1:

$$r_{n,t} = \alpha + \sum_{j=1}^{J-1} f_{j,t} I_{nj,t} - (\sum_{j=1}^{J-1} f_{j,t} \frac{w_j}{w_J}) I_{nj,t} + \sum_{k=1}^{K-1} f_{k,t} I_{nk,t} - (\sum_{k=1}^{K-1} f_{k,t} \frac{w_k}{w_K}) I_{nk,t} + \varepsilon_{n,t}$$
$$= \alpha + \sum_{j=1}^{J-1} f_{j,t} (I_{nj,t} - \frac{w_j}{w_J} I_{nj,t}) + \sum_{j=1}^{K-1} f_{k,t} (I_{nk,t} - \frac{w_k}{w_K} I_{nk,t}) + \varepsilon_{n,t} \tag{P5}$$

The cross-sectional regressions are performed over all bonds that are present at time period t to obtain the fitted values of $f_{j,t}$ and $f_{k,t}$. The systemic part of the returns can be written as:

$$r'_{n,t} = \alpha' + \sum_{j=1}^{J} f'_{j,t} I_{nj,t} + \sum_{k=1}^{K} f'_{k,t} I_{nk,t} \tag{P6}$$

The decomposition into country and industry indexes can be constructed in the following way. Let us focus on the country indexes first by weighing all systematic returns $r'_{n,t}$ with a weight $w_{nk,t}$ which represents the weight a particular bond n has in Country k. This leads us to the following country indexes:

$$R_{K,t} = \sum_{n=1}^{N} w_{nk,t} r'_{n,t} = \alpha' + \sum_{n=1}^{N} w_{nk,t} \sum_{j=1}^{J} f'_{j,t} I_{nj,t} + \sum_{n=1}^{N} w_{nk,t} \sum_{k=1}^{K} f'_{k,t} I_{nk,t}$$
$$= \alpha' + \sum_{n=1}^{N}\sum_{j=1}^{J} f'_{j,t} w_{nk,t} I_{nj,t} + \sum_{n=1}^{N}\sum_{k=1}^{K} f'_{k,t} w_{nk,t} I_{nk,t} \tag{P7}$$
$$= \alpha' + \sum_{j=1}^{J} f'_{j,t} \sum_{n=1}^{N} w_{nk,t} I_{nj,t} + f'_{K,t}$$

For the industry indexes we can do the same. Let $w_{nj,t}$ be the weight a particular bond n has in industry j. Sum again over the N available bonds:

$$
\begin{aligned}
R_{J,t} &= \sum_{n=1}^{N} w_{nj,t} r'_{n,t} = \alpha' + \sum_{n=1}^{N} w_{nj,t} \sum_{k=1}^{K} f'_{k,t} I_{nk,t} + \sum_{n=1}^{N} w_{nj,t} \sum_{j=1}^{J} f'_{j,t} I_{nj,t} \\
&= \alpha' + \sum_{n=1}^{N}\sum_{k=1}^{K} f'_{k,t} w_{nj,t} I_{nk,t} + \sum_{n=1}^{N}\sum_{j=1}^{J} f'_{j,t} w_{nj,t} I_{nj,t} \qquad \text{(P8)} \\
&= \alpha' + \sum_{k=1}^{K} f'_{k,t} \sum_{n=1}^{N} w_{nj,t} I_{nk,t} + f'_{J,t}
\end{aligned}
$$

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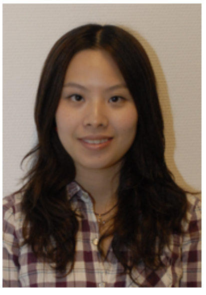
ABOUT THE AUTHOR



Zhaowen was born on 18 April, 1988 in Zhejiang, China. She holds a B.A.in finance from Fudan University in China and B.S.in international business and economics from the university of Groningen, the Netherlands. She moved to Rotterdam to pursue a research master in finance in Erasmus University Rotterdam with a scholarship from ERIM. After graduating with cum-laude, she continued as a PhD candidate in the school of Economics to conduct research in finance.

Her research interests mainly lie in fixed income, portfolio management and international finance. Her PhD project provides new evidence about financial integration and portfolio management in the fixed-income market by hand-collecting a unique and comprehensive dataset of European corporate bonds. She presented her papers and served as a discussant in several international conferences such as the Financial Management Association Europe, European Financial Management Association, and the Infinity conference. One of her papers titled as "Time-varying importance of country and industry factors in European corporate bonds" was published in Journal of Empirical Finance in 2016. During her PhD study, she was a teaching assistant for the course "Fixed Income and portfolio Management" and supervised several bachelor and master theses. Currently, Zhaowen works as a credit risk modeler in a FinTech company in Washington DC.

Portfolio

Publications

Publications in Journals:

Pieterse-Bloem, M., Qian, Z., Verschoor, W., Zwinkels, R. (2016). Time-varying importance of country and industry factors in European corporate bonds. *Journal of Empirical Finance*, 38, 429-448.

Work in Progress:

Pieterse-Bloem, M., Verschoor, W. F., Qian, Z., Zwinkels, R. C. (2018). Dynamic Portfolio Strategies in the European Corporate Bond Market.

Pieterse-Bloem, M., Verschoor, W. F., Qian, Z., Zwinkels, R. C. (2019). Determinants of country and industry factors in Explaining the European corporate bond and stock returns.

Teaching & Supervising activities

Teaching assistant for the course "Fixed Income and Portfolio Management", 2011-2016

Bachelor and master thesis supervision, 2011-2016

PhD. Courses

Behavior Foundations

Economic Foundations

Management Foundations

Research Methodology & Measurement

Economic Foundations

Management Foundations

Research Methodology Measurement

Applied Econometrics

Statistical Methods

Philosophy of Science

Corporate Finance Theory

Experimental Methods in Business Research

Risk Management

MA and Restructuring
Asset Pricing
Financial Econometric
Empirical Corporate Finance
Network Theory
Advanced Asset Pricing
English Skills
Presentation Skills
Research Clinic
Publishing Strategy

Conference attended

Australian Finance and Banking Conference, Sydney, 2017
The Financial Management Association Conference (Presenter and discussant), Venice, Italy, 2015
The European Financial Management Association Conference (Presenter and discussant), Amsterdam, The Netherlands, 2015
The Infiniti Conference (Presenter and discussant), Ljubljana, Slovenia, 2015
The European Sovereign Debt Crisis Conference (Presenter), Monaco, 2015
APG Asset Management Quantround, Amsterdam, The Netherlands, 2014
Ph.D. brown bag seminar, Erasmus University, Rotterdam, The Netherlands, 2014

Certificates

Chartered Financial Analyst (CFA) Charterholder
Certified Financial Risk Manager (FRM)

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