Time-varying importance of country and industry factors in European corporate bonds

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Abstract

The start of EMU and the global financial crisis constitute two major shocks to European financial market integration. Therefore, in this paper we study the time-varying importance of country versus industry factors in the European corporate bond market over a period that covers these two events. Using a unique dataset that is representative for the universe of actively quoted Eurobonds, we find that although unconditionally the country factor dominates the industry factor, there is substantial time variation. Following the introduction of the Euro, country factors become less important. The global financial crisis though reverses this trend and the country factor regains its importance in explaining bond returns.

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I Introduction

The country versus industry debate is important for both academics and practitioners in finance. Since international portfolio strategies tend to be made first and foremost on a country and industry allocation for a more optimal diversification, it is critical to know which factor explains more of the variance in returns. In Europe, the relative importance of country versus industry factors has also been used as a means to determine the success of creating a single financial market in the European Economic and Monetary Union (EMU). The extent of the integration of capital markets under the single currency can be measured by the degree in which the importance of country effects in asset returns fade (Baele et al., 2004).

The benchmark study for the importance of country and industry effects is Heston and Rouwenhorst (1994). They introduce a factor decomposition model with static and unit betas, which they apply to equity markets. They 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 bigger proportion in return variation than industry factors until 1999-2000 (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; Phylaktis and Xia, 2006). For Europe, where this result comes through quite strongly, the turning point coincides with the introduction of the Euro.

While the relative strength of country and industry effects in returns is equally important for bond as for equity markets, the number of bond studies is vastly smaller than for stocks. Varotto (2003) and Pieterse-Bloem and Mahieu (2013) apply the standard decomposition methodology of Heston and Rouwenhorst (1994) to corporate bond returns. Both studies find that country factors dominate over industry factors and other bond-related factors such as credit rating, maturity and liquidity. Pieterse-Bloem and Mahieu (2013) compare the periods before and after the creation of the Euro with a unique database of European corporate bond returns from January 1991 to March 2008. They find that post-EMU, country factors gain relative importance, mostly because the importance of industry factors diminishes under the single currency.

This paper adds to the relatively bare field of studies for bonds on the country versus industry debate by reconsidering this factor decomposition for European corporate bond returns. Relative to the previous literature, our paper makes two important contributions. First, we examine the effect of the global financial crisis on the relative importance of country versus industry factors. Second, we make both factor loadings time-varying. To our knowledge, this is the first study that brings the analysis of the importance of country and industry factors in corporate bond returns to the territory of the global financial crises and time-varying betas. As such, we are able to look into the dynamic properties of country and industry factors over a period of more than two decades. Through break point analysis we also analyze the effects of two major events that are likely to have left a significant mark on European corporate bond returns. Besides the creation of the single currency, this is the global financial crises as it morphs into a sovereign debt crisis in the Euro zone.

There are not many studies, not even for stocks, that address the country versus industry debate in the crisis or a high volatility period. Brooks and Del Negro (2004) are 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 crises and thereafter, the importance of industry factors is set back. This is also confirmed by the recent study of I-Chou and Zhou (2013), which finds that country factors play a more important role in the global financial crisis period in the equity market. There are no such studies for bond returns according to our knowledge. The sample period of Pieterse-Bloem and Mahieu (2013) only captures the early months of the global financial crises and none of the Euro zone sovereign debt crisis, which started after March 2008. This paper extends their study to January 2013. This gives us the opportunity to look into the influence of the recent crisis on the relative importance of the country and industry factors in the corporate bond market.

The results of Pieterse-Bloem and Mahieu (2013) are with unit and fixed factor betas and hence contingent on the sample period selection for calculating the pure country and industry effects. In equity markets, there are several studies for stocks that make factor loadings different and time varying. 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 the sensitivities to country and industry factors to differ across each stock. They find a more important role for industry factors than Heston and Rouwenhorst (1994). However, the betas in March and Pfleiderer (1997) are still time-invariate. Studies like Bekaert and Harvey (1997) and Fratzscher (2002) make betas conditional on some structural information variables. Baele (2005) models betas conditional on a latent variable. Baele and Inghelbrecht (2009) 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 just a short-lived, temporary phenomenon. Not accounting for time-varying factor exposure leads to large errors in measuring country and industry risks. These studies suggest that time-varying factor loadings are methodologically preferred to static and unit factor loadings. It is therefore of significant importance to apply time-varying factor loadings in analyzing bond returns.

The two methods we use in this paper to make betas time-varying are rolling-window regressions and a multivariate GARCH specification of the standard factor decomposition model of Heston and Rouwenhorst (1994). These methods do not impose any pre-defined structures on the factor loadings. The dynamic properties of the factor loadings can be directly observed. This makes them 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).

Our main results show that in general, country factors dominate industry factors in explaining bond returns in the Eurobond market over the whole sample period from January 1991 to January 2013. However, the relative importance of country and industry factors changes over time, suggesting that there is significant time variation in the country and industry betas of European corporate bond returns. After the establishment of EMU, country factors reduce their importance relative to the industry factors, which indicates that countries in EMU become more integrated and the industry composition of countries becomes more specialized. However, the recent financial crisis interrupts the trend in Europe and country factors regain their importance in explaining bond returns. The break point analysis of the country and the industry factor loadings further confirms that the establishment of EMU and the recent financial crisis significantly change the country and industry factor loadings at both the absolute and the slope level.

The rest of the paper is organized as follows. Section II develops four 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 Section V. The last section concludes the paper.

II Hypothesis Development

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

Pieterse-Bloem and Mahieu (2013) use the standard factor decomposition of Heston and Rouwenhorst (1994) with unit and time invariant betas. They find over their sample period of January 1991 to March 2008 as a whole that country effects explain more of the variance than industry effects in European corporate bond returns. Extending this analysis to January 2013 incorporates more of the global financial crisis, which develops into a sovereign debt crisis in the Euro zone. The European sovereign debt crisis results in an increased focus on country specific issues and reassessment of the differences in the creditworthiness of countries. Therefore, ex ante it can be expected that increasing the number of observations in the global financial crisis period has the effect of increasing the importance of country factors relative to that of industry factors. If true, then over the full sample period that our dataset comprises, country effects will continue to dominate industry effects. We test this hypothesis with the standard Heston and Rouwenhorst (1994) decomposition method using the data from January 1991 to January 2013.

HYPOTHESIS 2: there is significant time variation in the country and industry betas of European corporate bond returns.

Country and industry betas of stock returns have proven to contain significant time-varying properties 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. Given that a company's equity is sensitive to time variation in factor loadings, we also expect this to be true for a company's debt. We establish the statistical significance of the time varying betas through the likelihood comparison of the static regressions and the GARCH models. If true, we can gain additional insights from time-varying betas obtained through the rolling window regressions and the GARCH-BEKK model.

HYPOTHESIS 3a: After the start of EMU, industry factors decline.

Pieterse-Bloem and Mahieu (2013) document that following the start of EMU country factors gain in relative importance mostly because industry factors fade. This carries our ex ante expectation that, consistent with previous findings, following the start of EMU, we will mostly see industry factors declining.

HYPOTHESIS 3b:After the start of the global financial crises, industry factors rise again and country factors even more so.

Since the effect of the global financial crisis on the relative importance of country and industry factors has thus far not been analyzed, we formulate an ex ante expectation from economic intuition. Given that the global financial crises morphs into a sovereign debt crisis in the Euro zone, we expect ex ante to see the larger impact through rising country factors in European corporate bond returns. However, since the crisis starts in the financial sector and since this is by far the largest sector of the European corporate bond market, we also expect industry factors to increase, though not by as much as county factors do in this period. We plot the time-varying betas over the sample period to see if the patterns described in hypotheses 3a and 3b can be directly observed.

HYPOTHESIS 4: Both the start of EMU and the start of the global financial crisis significantly impact both the level and the direction of country and industry betas of European corporate bond returns.

Both the establishment of EMU and the global financial crisis are documented to be events of large magnitude for European financial markets. The hypothesis is that we expect ex ante that January 1999 and July 2007 are statistically significant break points regarding the level (direct effect) and trend (anticipation effect) of the importance of country and industry factors. We test the hypothesis using break point analysis. Specifically, we regress a set of time dummies and time trends on the estimated time-varying country and industry betas.

III Data

Country and industry return indexes are required for the empirical analysis of the importance of those factors in return variation. For equities, those types of indexes are readily available for academic researchers, but this is not the case for Eurobonds. This may play a role in the fact that contributions on equity returns outnumber contributions on bond returns in the country versus industry debate.

In absence of the required Eurobond indexes, we utilize the bond database used by Pieterse-Bloem and Mahieu (2013) and extend the daily prices of the bonds to January 2013 from Bloomberg. This set of bonds is representative for the actively quoted Eurobond market[1]. The price series are all collected in

[1] Whenever a Eurobond is issued, Bloomberg registers the bond with its own ISIN and when they are quoted a price by one of the banks that is a price source provider. 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 Eurobonds. We have made an indiscriminate selection from that universe. We omit Eurobonds that do

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 Eurobonds 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 Eurobond belongs to one country and one industry. In total, we have eight country indexes and seven industry indexes. The countries that are represented 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), consumer goods (CO), communications and technology (CT), basic materials and energy (BE), industries (IN) and utilities (UT).

< Insert Table 1 here >

Table 1 shows how the bonds distribute over different countries and industries. Panel A of Table 1 describes that Germany constitutes 37.8% in our sample, which is the largest proportion of Eurobonds among the eight countries. France and the United Kingdom follow with 15.4% and 15.1% of total Eurobonds each. For the industries, Panel B shows that the financial and funds

not provide a price quote for at least two consecutive months from our dataset.

sector dominates with 67.0% of corporate bonds in the whole sample. On a value-weighted basis, 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 one of the largest issuing countries besides Germany. Among the industry the dominance of the financial industry is likewise reduced. On a value-weighted basis the financial sector accounts for 43.4% of the sample, which is still large of course.

Table 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 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.

< Insert Table 2 here >

Table 2 lists the summary of the monthly percentage mean and standard deviation of Eurobond 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, above-average performing countries are the United Kingdom and Spain, while the Netherlands and France are below the average. For the value-weighted industry index mean returns, the best performing sector is utilities and the industries sector is the worst. 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 matrixes in the table indicate that different countries are less correlated with each other than different industries are, both on an equal and a value-weighted basis. The difference between the equally-weighted and value-weighted indexes is not large and does not change these observations.

IV Methods

In this section, we introduce the methods applied in our paper. The main focus of this paper is to make country and industry factor loadings time-varying. There are several methods available in the literature, mainly applied to equity markets. Mergner and Bulla (2008) apply a state space model using the Kalman filter algorithm to model and estimate the time-varying structures of betas. However the state space model needs to impose certain structures on the betas and is computationally more demanding. The Markov switching framework by Hamilton (1989, 1990) can also be used to introduce time variation in betas. The implicit assumption that models switching between different regimes is usually that the data result from a process that undergoes abrupt changes, induced, for example, by political or environmental events. Given that the main goal of our paper is to analyze the time-series pattern of the factor loadings, we prefer not to impose any regime structures to the factor loadings as in Markov switching model. Moreover, the Markov switching model is rarely used to model time-varying betas because it is relatively difficult to estimate. Given our research question, we therefore choose rolling window regressions and a multivariate GARCH specification as our basic tools to estimate time-varying betas. Since we mainly focus on two episodes of especially high volatility namely the introduction of the EMU and the global financial crisis, it is natural to have betas conditional on market volatility.

Rolling-windows regressions are commonly used in the literature to estimate time-varying betas. First proposed by Fama and Macbeth (1973), rolling OLS estimation of the market model is one simple way to obtain time series estimates of betas. The main advantage of this method is that it does not force any structure on the betas. However, some studies show that rolling-window regressions suffer from "ghost feature". By this is meant that one extreme event in the market influences the T-day moving average estimate for exactly T days until that very large event falls out of the data window (Alexander, 1998). Therefore we complement rolling OLS estimation with a second method in our paper: Generalized autoregressive conditional heteroskedasticity (GARCH) model by Bollerslev(1986). More specifically, we employ the bivariate BEKK(1,1,1) by Engle and Kroner (1995) which has the advantage that the conditional covariance matrix is guaranteed to be positive-definite by construction. Compared with other methods, the GARCH based beta estimator has the advantage of taking into account the potential conditional heteroscedasticity of the returns.

A 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 can be decomposed into a country, industry, and an idiosyncratic component, 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 returns that can be assigned to a specific industry and country respectively.

Equation (1) cannot be estimated in its present form because it is unidentified due to perfect multicollinearity. 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:

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

and

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

where $w_{j,t}$ and $v_{k,t}$ represent the weight of industry j and country k in the total universe of Eurobonds at time t. In this paper, we focus on market value weights[2]. The value weights are constructed from the USD equivalent of the amounts issued. Imposing such restriction is equivalent to measuring the size of each industry and country relative to the average size. The country and

[2] Experiments with equal weights give qualitatively similar results. Results are available on request.

industry weights sum to unity:

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

and

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

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 Eurobond 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 Eurobonds 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:

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

where $w_{nj,t}$ represents the weight a particular Eurobond n has in industry j at time t.

B Creating Time Varying Betas

In the second step, we employ the time-series context. 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 two methods in the paper. The first one is the rolling window regression and the second is the multivariate GARCH-BEKK model.

B.1 Rolling OLS Estimation

The time series regression model of individual bond returns can be summarized as follows:

$$r_{n,t} = \alpha + \beta^j_{n,t} f_{j,t} + \beta^k_{n,t} f_{k,t} + \varepsilon_{n,t} \tag{8}$$

where $r_{n,t}$ represents the return of individual bond n at time t. $f_{j,t}$ and $f_{k,t}$ are the time-series industry and country factors obtained in the first step.

We introduce time variation in $\beta^j_{n,t}$ and $\beta^k_{n,t}$ by applying a rolling OLS estimation of the model (Fama and Macbeth, 1973). We use a window of 36 monthly observations in the empirical analysis yielding a total of 230 time-series observations of $\beta^j_{n,t}$ and $\beta^k_{n,t}$

B.2 Multivariate GARCH Model

The second method we use to obtain time-varying factor loadings is the multivariate GARCH (MGARCH) model. Two different MGARCH structures are often used in the literature: BEKK and DCC. The bivariate BEKK(1,1,1) 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 as our basic model to obtain covariance between and variance of the individual bond and factor returns.[3].

First, we perform the MGARCH analysis on individual bond returns and the country factor that are obtained in the first step. With the conditional covariance and variance of bond returns and country factor, we can estimate the conditional country beta for each bond using the following equation:

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

Similarly, we obtain the conditional covariance between and variance of individual bond and industry factors by estimating the MGARCH model on bond returns and the industry factor. The conditional industry beta can then be calculated as:

$$\beta^j_{n,t} = \frac{Cov(r_{n,t}, f_{j,t})}{var(f_{j,t})} \tag{10}$$

C Break Point Analysis

Our second focus in the paper is to analyze whether the time-varying country and industry betas change significantly following two important events in our time span. For this purpose, we apply a break point analysis to the country and industry factor loadings we obtained. We first test for January 1999 when EMU was established and one single currency was introduced. Secondly, we look at July 2007 when the financial crisis started. Our main regression equation for the break point analysis can be described as follows:

[3] 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.

$$\beta_t' = \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \gamma_1 D_1 T_t + \gamma_2 D_2 T_t + \gamma_3 D_3 T_t + \varepsilon_t \quad (11)$$

where β_t' are the country and industry loadings obtained in the second step and T_t is time. D_1,D_2 and D_3 represent the three time periods in our time sample, respectively January 1991 to January 1999, February 1999 to July 2007 and August 2007 to January 2013. The estimated coefficients α_1, α_2 and α_3 allow us to draw inferences on different levels of country versus industry exposures, whereas the estimated coefficients γ_1, γ_2, and γ_3 measure the difference in time trends in the three periods.

V 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.

< Insert Table 3 here >

The first column of Table 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. Compared to the variance of pure country effects in the country indexes (Panel A), the variance of 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 during the whole 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 3 shows the standard decomposition model for the period before and after the start of global financial crises in July 2007. It can be directly compared with the first column in Table 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 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 a remarkable result given that the financial sector is the source of the crises and yet the variance of returns of precisely this sector halves.

The decomposition results from Table 3 only give us a general picture of the relative importance of the country and industry factors. In order to get the movement of their relative importance, we need to generate the time pattern of the two factors throughout the whole sample period. To this end we apply rolling-window regressions and MGARCH model in the second step of our analysis for the estimation of the time-varying betas. Likelihood comparison between static regression and GARCH models show that the latter has higher likelihood than the former and thus is more efficient. This finding supports our Hypothesis 2 that there is significant time variation in the country and industry betas of European corporate bond returns. The exact movement of the country and industry betas over the sample period can be observed by plotting the factor loadings over time, as per Figure 1 and Figure 2.

< Insert Figure 1 here >

Figure 1 represents the median value of the time-series country factor loadings (in the left graph) and the industry factor loadings (in the right graph) from January 1991 to January 2013 for all bonds. These factor loadings are obtained using value-weighted country and industry indexes in the first step and rolling-window regressions of 36 months in the second step. The left graph shows that country betas decrease already around 1995, after the Maastricht Treaty has been signed and go down again around 2002 when the Euro has irreversibly replaced the legacy currencies. It signals that countries in the EU become more integrated after the political sign-up to EMU and the introduction of the single currency some years later. However, following 2007 when the financial crisis starts, this trend is interrupted. The country betas increase significantly. This signals financial fragmentation in the Euro zone after the crisis. The time pattern of the industry loadings is more random.

< Insert Figure 2 here >

Figure 2 shows the median value of the time-series country and industry loadings obtained from the MGARCH model for the period from January 1991 to January 2013 for all bonds. We use value-weighted country and industry indexes in the first step of the estimation process. The country betas from the MGARCH model (in the left graph) decrease around 1999 when the Euro zone was established and increase significantly after 2007 when the financial crisis starts. Both Figure 1 and Figure 2 give support to Hypothesis 3b that country factor loadings rise after the financial crisis. The same cannot be said for Hypothesis 3a. The pattern of the industry factor loadings in the right graph of Figure 2 is quite different from that in Figure 1. The industry betas calculated from the MGARCH model increase around 1996. This could signal that the European countries are more diversified and specialized in their industry compositions after the signing of the Maastricht Treaty. Such finding goes against Hypothesis 3a that industry factors decline in the single market. At the same time, industry betas decrease after 2007 which also contradicts Hypothesis 3b.

< Insert Figure 3 here >

Figure 3 shows the relative importance of country and industry factors over the whole sample period from January 1991 to January 2013. It does so by taking the difference between the absolute value of the country factor loadings and the absolute value of the industry factor loadings and dividing this difference by the absolute value of the industry factor loadings from January 1991 to January 2013. The graph shows that the country factors become less important relative to the industry factors around 1995 and level off afterwards. After the crisis, country factors regain their relative importance over industry factors. We argue that although the recent crisis starts from the financial industry which composes nearly half of our total bond sample on a value-weighted basis, 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 after the crisis.

From Figures 1 through to 3, we can clearly see that the introduction of EMU and the recent financial crisis coincides with an alteration in the relative importance of country versus industry factors. This observation is formally proven by the results of the break point analysis, listed in Table 4.

< Insert Table 4 here >

Table 4 tells us whether the country loadings and industry loadings differ across three different periods marked by the start of EMU and the start of the global financial crisis in our sample, at both the absolute and the slope level. The first period is from January 1991 to January 1999, the second is from February 1999 to July 2007 and the last period is from August 2007 to January 2013. For the country factor loadings, period 1 versus period 2 and period 2 versus period 3 of the break point analysis results show significant differences both at the absolute and the slope level at the 95% confidence level. We argue that country factor loadings and also its trend change significantly after the establishment of EMU and also after the recent financial crisis. For the industry factor loadings, all three periods differ significantly with each other at the 95% confidence level both at the absolute and the slope level. We conclude that industry factor loadings and its trend differ both after EMU and the recent crisis. The results of the break point analysis strongly support Hypothesis 4 that the start of EMU and the start of the global financial crises significantly impact both the level and the direction of country and industry betas of European corporate bond returns.

VI Conclusion

In this paper, we analyze how the relative importance of country versus industry factors evolves from 1991 to 2013 in the European corporate market. To our knowledge, our paper is the first to apply time-varying factor loadings to address the country versus industry debate in the Eurobond market over a period that includes the recent crisis. To know whether country or industry factors play a more important role is of significant importance for understanding optimal international asset portfolio diversification. In addition, the relative importance of country over industry factors can also be used as a measure of the success of the monetary union in creating an integrated capital market in Europe. Therefore, to know the relative importance of country versus industry effects in returns can be very beneficial for market practitioners and policy makers alike.

We manually collect daily prices of Eurobonds, yielding a unique dataset representative of the entire actively quoted corporate bond universe. Different from previous studies on bond returns which address the country versus industry debate using static factor loadings, we apply rolling window regression and a multivariate GARCH model to obtain time-varying country and industry loadings. We are thus able to analyze which of the two plays a more important role in explaining bond returns in the Eurobond market. These methods suit our research design, as we can directly observe the time pattern of the relative importance of country versus industry factor throughout the sample period.

The main results of the paper show that country betas decrease in importance after the introduction of one single currency in the EMU. However, after the financial crisis in 2007, country factors increase significantly relative to industry factors in explaining bond returns. This could signal that the recent crisis stops the integration process in the EMU and the capital market becomes more fragmented. These findings have important implications for international investors interested in diversification opportunities and policy makers in European integration. Our results indicate that the trends in the relative importance of country versus industry factors are highly conditional on market circumstances. Therefore, it is premature to speak of a continuous trend towards one or the other.

References

[1] Adjaoute, K., & Danthine, J. P., 2001. EMU and portfolio diversification opportunities (No. 2962). Centre for Economic Policy Research.

[2] Adjaoute, K., & Danthine, J. P., 2003. European financial integration and equity returns: a theory based assessment. European Central Bank, Frankfurt, 185-246.

[3] Alexander, C., 1998. Volatility and correlation: measurement, models and applications. Risk Measurement and Analysis, 1, 125-171.

[4] Bekaert, G., & Harvey, C. R., 1997. Emerging equity market volatility. Journal of Financial economics, 43(1), 29-77.

[5] Baele, L., 2005. Volatility spillover effects in European equity markets. Journal of Financial and Quantitative Analysis, 40(2), 373-401.

[6] Baele, L., Ferrando, A., Hördahl, P., Krylova, E., & Monnet, C., 2004. Measuring European financial integration. Oxford Review of Economic Policy, 20(4), 509-530.

[7] Baele, L., Inghelbrecht, K., 2009. Time-varying integration and international diversification strategies. Journal of Empirical Finance 16(3), 368-387.

[8] Baele, L., Inghelbrecht, K., 2010. Time-varying integration, interdependence and contagion. Journal of International Money and Finance 29(5), 791-818.

[9] Baca, S. P., Garbe, B. L., & Weiss, R. A., 2000. The rise of sector effects in major equity markets. Financial Analysts Journal 56(5), 34-40.

[10] Bekaert, G., & Harvey, C. R., 1997. Emerging equity market volatility. Journal of Financial Economics, 43(1), 29-77.

[11] Bekaert, G., Hodrick, R.J., Zhang, X., 2009. International Stock return co-movements. Journal of Finance 64 (6), 2591 – 2626.

[12] Bollerslev, T., 1986. Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307-327.

[13] Brooks, R., Del Negro, M., 2004. The rise in comovement across national stock markets: market integration or IT bubble? Journal of Empirical Finance 11(5), 659-680.

[14] Cavaglia, S., Brightman, C., & Aked, M., 2000. The increasing importance of industry factors. Financial Analysts Journal 56(5), 41-54.

[15] Engle, R. F., & Kroner, K. F., 1995. Multivariate simultaneous generalized ARCH. Econometric Theory, 11(1), 122-150.

[16] Fama, E. F., & MacBeth, J. D., 1973. Risk, return, and equilibrium: Empirical tests. The Journal of Political Economy 81(3), 607-636.

[17] Fratzscher, M., 2002. Financial market integration in Europe: on the effects of EMU on stock markets. International Journal of Finance & Economics, 7(3), 165-193.

[18] Flavin, T. J., 2004. The effect of the Euro on country versus industry portfolio diversification. Journal of International Money and Finance, 23(7), 1137-1158.

[19] Griffin, J. M., & Karolyi, A.G., 1998. Another look at the role of the industrial structure of markets for international diversification strategies. Journal of financial economics, 50(3), 351-373.

[20] Hamilton, J. D., 1989. A new approach to the economic analysis of non-stationary time series and the business cycle. Econometrica: Journal of the Econometric Society 57(2), 357-384.

[21] Hamilton, J. D., 1990. Analysis of time series subject to changes in regime. Journal of Econometrics, 45(1), 39-70.

[22] Heston, S.L., Rouwenhorst, G.K., 1994. Does industrial structure explain the benefits of international diversification? Journal of Financial Economics 36(1), 3-27.

[23] I-Chou,H and Zhao.J, 2013. Factor reversal in the Euro Zone Stock Returns: Evidence from the Crisis Period.

[24] Mergner, S., & Bulla, J., 2008. Time-varying beta risk of Pan-European industry portfolios: A comparison of alternative modeling techniques. The European Journal of Finance, 14(8), 771-802.

[25] Marsh, T., Pfleiderer, P., & Tien, D., 1997. The role of country and industry effects in explaining global stock returns. Unpublished working paper, UC Berkeley and Stanford University.

[26] Phylaktis, K., & Xia, L., 2006. The changing roles of industry and country effects in the global equity markets. The European Journal of Finance, 12(8), 627-648.

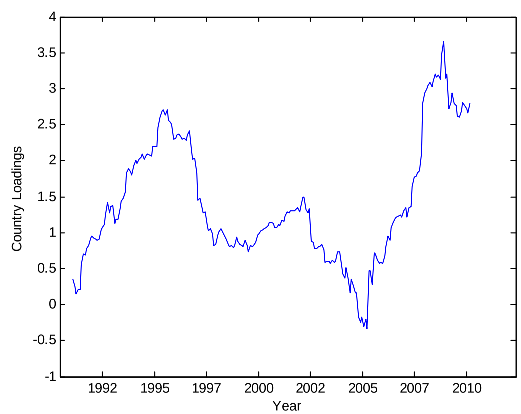
[27] Pieterse-Bloem, M., & Mahieu, R. J., 2013. Factor decomposition and diversification in European corporate bond markets. Journal of International Money and Finance, 32, 194-213.

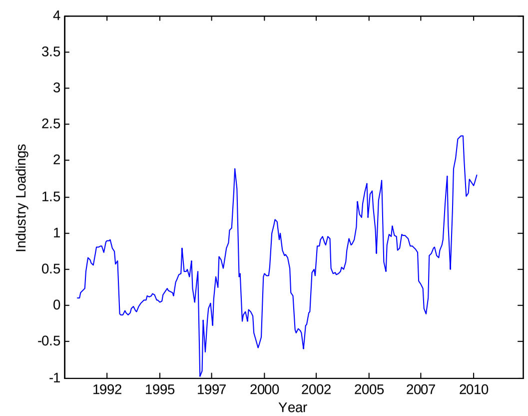
[28] Rouwenhorst, K. G., 1999. Local return factors and turnover in emerging stock markets. The Journal of Finance, 54(4), 1439-1464.

[29] Steliaros, M., & Thomas, D. C., 2006. The cross-sectional variability of stock-price returns: Country and sector effects revisited. Journal of Asset Management, 7(3), 273-290.

[30] Varotto, S., 2003. Credit risk diversification: evidence from the Eurobond market. Bank of England Working Papers 199.

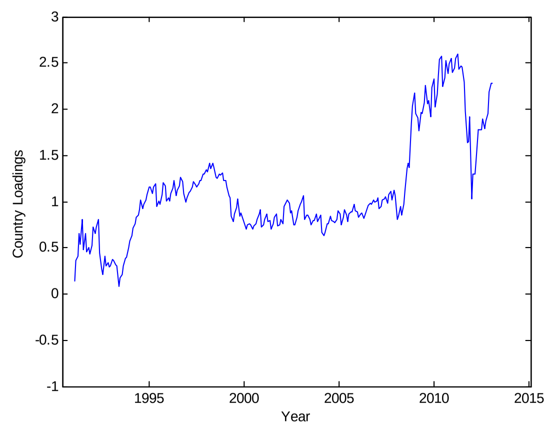
Figure 1: Average Time-series Country and Industry Betas From Rolling-window Regressions

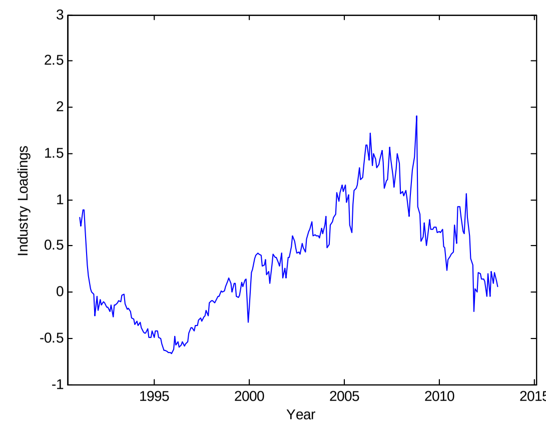




Notes: The left graph shows the median value of the country betas for all bonds over the total sample period (January 1991-January 2013). The right graph shows the median value of the industry betas for all bonds over the same period. In both graphs, the x-axis represents the time from 1991 to 2013 and 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 rolling-window regressions of 36-month window period in the second step to obtain the time-varying country and industry betas.

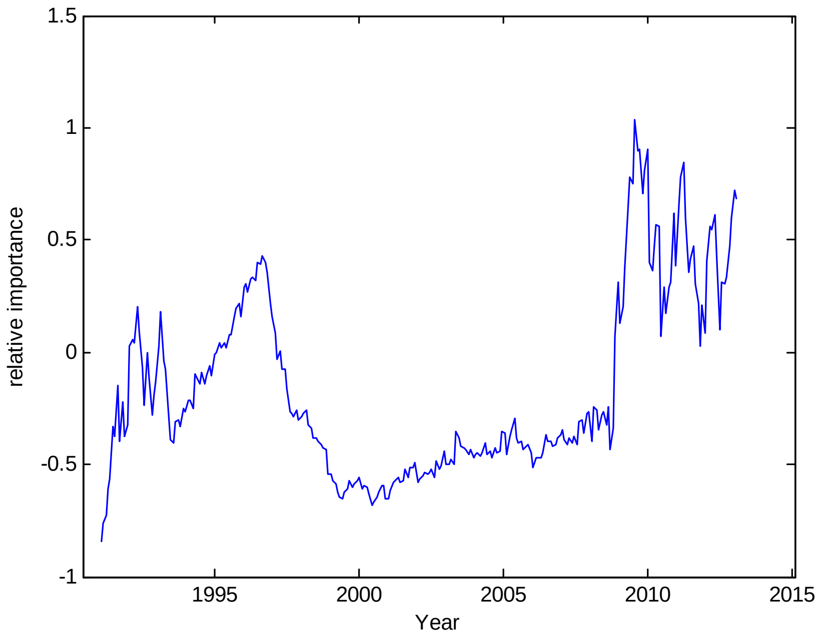
Figure 2: Average Time-series Country and Industry Betas From GARCH-BEKK Model





Notes: 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 get the time-varying country and industry betas.

Figure 3: The Relative Importance of Time-varying Country over Industry Factors from GARCH-BEKK Model



Notes: 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 get the time-series country and industry betas.

Table 1: Country and Industry Composition

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 Eurobonds 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

Notes: Panel A and B give for each country and industry the number of eurobonds included in the total sample and as a percentage of the total number of eurobonds. Panel C gives for each country by industry the number of eurobonds included in the total sample. Panel D gives the average weight of the (live) eurobonds in the country by industry cross-sector in the total value-weighted market over the whoel sample. Percentages do not add up to precisely 100 due to rounding.

Table 2: Summary Performance Statistics

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

Notes: 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 are between the equal-weighted returns.

Table 3: Decomposition of Excess Eurobond Index Returns (Full Period and Sub-periods)

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

Notes: The table gives the variance of the components of the value-weighted (VW) excess country index returns in panel A and excess industry index returns in panel B over the total market 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 ratio to the index in excess of the market.

Table 4: Break Point Analysis for Country and Industry Factor Loadings

Panel A: Country Factor Loadings				Panel B: Industry Factor Loadings		
	Coef.	t	P>t	Coef.	t	P>t
D1	-4.07927	-14.04	0	1.57387	2.47	0.014
D2	0.38448	1.84	0.067	-7.32250	-23.81	0
D3	-5.91398	-3.30	0.001	11.96553	13.79	0
D1*T	0.00039	17.79	0	-0.00014	-2.84	0.005
D2*T	0.00003	2.30	0.022	0.00051	25.79	0
D3*T	0.00042	4.34	0	-0.00062	-13.15	0
Period Comparison for Country Factor Loadings				Period Comparison for Industry Factor Loadings		
	F	Prob > F		F	Prob > F	
D1 VS D2	155.28	0		158.57	0	
D1 VS D3	1.02	0.31		93.32	0	
D2 VS D3	12.20	0.0006		439.15	0	
D1*T VS D2*T	197.97	0		148.75	0	
D1*T VS D3*T	0.14	0.71		49.14	0	
D2*T VS D3*T	15.97	0.0001		488.24	0	

Notes: The table gives the results for the break point analysis for both country and industry factor loadings. D1 represents the period from January 1991 to January 1999. D2 represents the period from February 1999 to July 2007. D3 represents the period from August 2007 to January 2013. T represents time. The top half of Panel A shows the estimated coefficients and their t-statistics and p-values of the country factor loadings regression. The bottom half indicates the comparisons between the coefficients for the time dummies. Panel B shows the regression results (top half) and the comparison between the coefficients for industry factor loadings (bottom half). Both regressions use robust standard errors clustered by time.