Sovereign Bond Risk Premiums

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Abstract

Sovereign credit risk has become an important factor driving government bond returns. We therefore introduce an asset pricing model which exploits information contained in both forward interest rates and forward CDS spreads. Our empirical analysis covers eurozone countries with German government bonds as credit risk-free assets. We construct a market factor from the first three principal components of the German forward curve as well as credit risk factors from the principal components of forward CDS curves. We find that predictability of risk premiums of sovereign eurozone bonds improves substantially if the market risk factor is augmented by a common euro zone and an orthogonal country-specific credit risk factor, measured by an increase in the average R^2 over eurozone sovereigns from 0.37 to 0.61 . Furthermore, the results show that most of the variation of sovereign bond risk premiums is attributable to the common eurozone credit risk factor while country-specific credit risk factors play a lesser role.

Keywords: Sovereign bond risk premiums, market and credit risk factors, eurozone debt crisis.

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1 Introduction

Risk premiums of sovereign bonds vary substantially over time. This has been documented in several seminal studies such as Fama & Bliss (1987) and Campbell & Shiller (1991) or, more recently, by Cochrane & Piazzesi (2005) and Duffee (2011).[2] Cochrane & Piazzesi (2005), for example, find that risk premiums for U.S. government bonds can be predicted by a linear combination of one-year forward rates with an R^2 as high as 44%. These findings confirm that forward interest rates contain important information about time-varying sovereign risk premiums. A central feature in Cochrane & Piazzesi (2005) is that government bond risk premiums are explained exclusively via the cross section of essentially default-free yields. While this is an approach consistent with the majority of existing term structure models, recent sovereign debt crises have demonstrated forcefully that government bond yields can no longer be considered to be without credit risk. In past years even most developed countries' term structures of government bond yields have been driven by two factors: the term structure of default-free spot rates and the term structure of sovereign credit spreads.

In this paper we make use of data for sovereign credit default swap (CDS) contracts of nine eurozone countries and of interest rates extracted from the German term structure to construct separate yield and credit factors. On a weekly basis we calculate one-year forward interest rates starting in one, three, five and seven years implicit in the German term structure. As these forward rates are highly correlated, we extract the first three principal components (PCs) and use these to construct a linear riskless term-structure factor. For simplicity, we refer to this factor as the market factor. This factor is identical for all eurozone countries. In addition, we calculate one-year forward CDS spreads starting in one, three, five and seven years to construct credit factors for each country, except for Germany. These credit factors are calculated in a three-step approach. First, we extract the first principal component from each country's CDS forward curve. We find that the first three PCs explain more than 99% of the variation in CDS forward spreads. In a second step, we calculate the first principal component from the country-specific first principal components. This provides us with a credit factor that captures common eurozone credit risk, which we call a European credit factor. In a third step, we regress the country-specific PCs on the European credit factor to isolate the orthogonal component, i.e. the error term of this regression. This error term is used as the

[2] Additional references studying the time variation of bond risk premiums include Ferson & Harvey (1991), Ilmanen (1995) and Dahlquist & Hasseltoft (2011).

country-specific credit factor.

Using this approach to construct market and credit risk factors, we find that the inclusion of credit risk factors improves predictability of excess bond returns substantially. Very similar to Cochrane & Piazzesi (2005) we find that predicting government bond excess returns exclusively by the market risk factor yields an average R^2 over our sample of eurozone sovereigns of 0.37. However, including our credit risk factors increases the average R^2 to 0.61 ranging from 0.42 for France to 0.80 for Ireland. The results show that market and credit risk factors are significant for most countries in the sample. Moreover, the decomposition of credit risk of eurozone sovereigns into a common eurozone component and an orthogonal country-specific component reveals that while most of the variation of sovereign bond risk premiums is attributable to the common eurozone factor the country-specific factor plays only a subordinate role. In line with Longstaff et al. (2011) who document that CDS spreads are driven by a common credit factor that is highly correlated to the US stock and high-yield markets we find that the common eurozone credit risk factor is also related to the European stock market. Finally, checking the robustness of our sovereign bond pricing model we find that neither a change in the decomposition of the credit factors nor switching to a shorter sample that includes Greece changes our overall conclusions.

The analysis of risk premiums of sovereign bonds has become an active area of research and our paper relates to several existing empirical studies. Cochrane & Piazzesi (2005) analyze the time variation of expected excess bond returns and find that a tent-shaped lagged linear factor of one-year forward interest rates contains information about future excess bond returns. According to their findings, this factor predicts excess bond returns with differing maturities remarkably well. It is shown to be counter-cyclical and to have predictive power also for stock returns. Duffee (2011) challenges this approach and argues that yields as factors for risk premiums are neither theoretically necessary nor empirically supported. He shows that almost half of the variation in bond risk premiums cannot be detected using the cross-section of yields as in Cochrane & Piazzesi (2005). Instead, he identifies a factor that goes beyond the cross section of yields and refers to this as the hidden factor. He finds that fluctuations in this hidden component have strong forecasting power for both future short-term interest rates and excess bond returns. Our paper is consistent with these findings. In our framework the credit factor takes the role of the hidden factor used in Duffee (2011). Dahlquist & Hasseltoft (2011) study international bond risk premiums and identify local and global factors that are not spanned by the cross section of yields but have strong forecasting power. It turns out that the global factor is closely related to the international business cycle and the US bond risk premiums. Ludvigson & Ng (2009) also do not rely on the cross section of yields when forecasting government bond risk premiums but identify macroeconomic factors, instead. They find that real and inflation factors have important forecasting power for future excess returns on US government bonds, above and beyond the predictive power contained in forward rates and yield spreads. As a consequence, risk premiums in their model have a marked counter-cyclical component, which is consistent with existing theories that investors get compensated for the risk associated with macroeconomic fluctuations. Cieslak & Povala (2011) decompose yields into long-horizon expected inflation and maturity-related cycles and study the predictability of bond excess returns. The maturity related cycles are used to construct a forecasting factor that explains up to and above 50% of the in-sample and 30% of the out-of-sample variation of yearly excess bond returns. In contrast to our paper, none of the papers discussed above utilizes credit factors to explain government bond risk premiums.

In a recent paper, Longstaff et al. (2011) study sovereign credit risk using CDS data. They find that a large fraction of sovereign credit risk can be attributed to global factors. Up to 64% of the variation of sovereign credit spreads during the period 2000-2010 is accounted for by the first principal component of CDS spreads. This value increases to 75% during the period of the financial crisis 2007-2010. The first principal component of CDS spreads has a negative correlation of -0.74 with the US stock market and a correlation of 0.61 with changes in the VIX-index. As credit spreads are driven by a global factor, Longstaff et al. (2011) analyze whether this factor is priced and find that a third of the total CDS spread can be attributed to a global CDS risk premium. Our paper differs from Longstaff et al. (2011) by focussing on government bond risk premiums as a function of the riskless term structure of interest rates, a common European, and a country-specific credit factor. Caceres et al. (2010) also study sovereign credit spreads and explore how much of their movements are due to a shift in global risk aversion or due to country-specific risks, arising from worsening fundamentals or from spillovers originating in other sovereigns. They find that, while at the beginning of the crisis shifts in risk aversion contributed a major share to increased credit spreads, later in the crisis, country-specific factors have started to play a more important role. Bernoth et al. (2012) study bond yield differentials among EU government bonds. They show that government spreads contain a risk premium that increases with fiscal imbalances and depends negatively on the size of the issuer's bond market. Finally, Haugh et al. (2009) analyze large recently observed movements in yield spreads for sovereign bonds in the euro zone. While the increase in average risk aversion is an important factor that explains the levels of CDS spreads, it is found that fiscal performance plays an important role, too. They present evidence that incremental deteriorations in fiscal performance lead to larger increases in the spread, with the consequence that financial market reactions could become an increasingly important constraint on fiscal policy for some countries.

Overall, our results integrate well with the existing empirical literature discussed above. As in Cochrane & Piazzesi (2005), we construct a factor that is based on the cross section of risk-free yields that we identify with the German term structure. We then augment this factor with a common and a country-specific credit factor, which we derive from the forward curve of sovereign CDS spreads. As the CDS market is driven by credit fundamentals of a country, it is clear that these factors cover fundamentals that cannot be captured by the cross section of the riskless German term structure. Hence, in this way our analysis complements the results found in Duffee (2011), Ludvigson & Ng (2009), and on an international level, in Dahlquist & Hasseltoft (2011).

Our paper is organized as follows. In the next Section we present a description of the empirical model. In Section 3 we present the dataset and report our main findings of the paper. We summarize our regression results and the predictive power of our factors and then quantify the estimated risk premiums. In Section 4 we redo the empirical analysis using an alternative model where we omit the decomposition of credit risk into a common eurozone component and a country-specific component. Section 5 considers robustness checks by using eurozone swap rates as our riskless interest rates, and Section 6 concludes.

2 Model Specification

This Section introduces the empirical model of sovereign bond excess returns. Our approach builds on the existing findings discussed in the introduction that forward prices contain valuable information to explain and predict risk premiums. As our focus is on decomposing sovereign bond risk premiums into market and credit risk factors, we start with a single term structure of riskless spot rates as well as country-specific term structures of CDS spreads for each country in the sample. We identify the German term structure of spot rates as riskless interest rates. To construct the single market factor we derive one-year forward rates from the term structure of riskless spot rates. We denote the one-year forward interest rate between dates

$t+n-1$ and $t+n$ by:

$$f_t^{(n)} = \frac{P_t^{(DE,n-1)} - P_t^{(DE,n)}}{P_t^{(DE,n)}}, \tag{1}$$

where $P_t^{(DE,n)}$ denotes the German zero-coupon bond price at time t with maturity n years. The construction of the market factor is not done by employing the forward rates directly but by making use of their first three principal components, instead. To be consistent with the construction of our credit factors, we utilize one-year forward rates starting in one, three, five, and seven years, i.e. $f_t^{(2)}$, $f_t^{(4)}$, $f_t^{(6)}$, and $f_t^{(8)}$, to calculate the first three principal components denoted by:

$$\boldsymbol{MF_t} = \left[MF_t^{(1)},\ MF_t^{(2)},\ MF_t^{(3)}\right]. \tag{2}$$

A linear combination of these PCs defines the market factor, which is identical for each country in the eurozone.

The credit factors are obtained in the following way. First, we use the most liquid spot CDS maturities of one, three, five, seven, and ten years to derive the spreads of forward CDS contracts starting in one, three, five and, seven years with a maturity of one year, respectively. The forward CDS rates are denoted by $cf_t^{(i,n)}$, where $n \in \{2,4,6,8\}$. Hence, $cf_t^{(i,4)}$ denotes the forward CDS rate at time t of a contract starting in three years with a maturity of one year for country i.

From the time series of these forward CDS rates the first PCs are calculated for each country i, denoted by $PC_t^{(i)}$. Using these PCs we perform a second principal component analysis to extract the eurozone credit factor, $CF_t^{(Euro)}$. Hence, the common eurozone credit factor is the first PC of the individual countries' first PCs. Finally, we regress each country's first PC on the eurozone credit factor,

$$PC_t^{(i)} = \beta^{(i)}\, CF_t^{(Euro)} + \epsilon_t^{(i)}, \tag{3}$$

and define the orthogonal error term as the country-specific credit factor $CF_t^{(Country,i)} \equiv \epsilon_t^{(i)}$. This procedure results in a common credit factor among eurozone countries and orthogonal country-specific credit factors for all countries except Germany. Following the approach of Cochrane & Piazzesi (2005), we then regress excess bond returns on market and credit risk factors. We use $P_t^{(i,n)}$ for the n-year zero-coupon bond price of sovereign i and define one year holding period returns as:

$$r_{t+1}^{(i,n)} = \frac{P_{t+1}^{(i,n-1)} - P_t^{(i,n)}}{P_t^{(i,n)}}. \tag{4}$$

Excess holding period returns for maturity n over the period $(t, t+1)$ are calculated as:

$$rx_{t+1}^{(i,n)} = r_{t+1}^{(i,n)} - r_{t+1}^{(DE,n)}, \tag{5}$$

with $r_{t+1}^{(DE,n)}$ being the one year holding period return of a German zero-coupon bond with maturity n years over the period t to $t+1$. Having specified the excess returns for different maturities we next define the average excess return as the mean between maturities of 1 to 8 years:

$$\overline{rx}_{t+1}^{(i)} = \frac{1}{8}[rx_{t+1}^{(i,1)} + rx_{t+1}^{(i,2)} + rx_{t+1}^{(i,3)} + rx_{t+1}^{(i,4)} + rx_{t+1}^{(i,5)} + rx_{t+1}^{(i,6)} + rx_{t+1}^{(i,7)} + rx_{t+1}^{(i,8)}]. \tag{6}$$

In our baseline model, we regress average excess holding period returns on the market and credit risk factors:

$$\overline{rx}_{t+1}^{(i)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}, \tag{7}$$

where $\varepsilon_{t+1}^{(i)}$ represents the error term for country i and $\boldsymbol{\gamma^{(i)}} = \left[\gamma_1^{(i)},\ \gamma_2^{(i)},\ \gamma_3^{(i)}\right]'$ is a vector of exposures of average excess bond returns to the market factor. Note that the market factor $\boldsymbol{MF_t}$ is identical among all countries, implying that there is a single market risk factor in the euro zone. Equation (7) additionally documents our modeling of a common and a country-specific credit factor. In addition to the baseline model we estimate individual maturity regressions of the form:

$$rx_{t+1}^{(i,n)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}. \tag{8}$$

Taking expectations on both sides of equation (8) we find that the total risk premium is the sum of the estimated market risk premium (MRP), the eurozone credit risk premium (ECRP), and the country-specific credit risk premium (CCRP). The eurozone and the country-specific credit risk premiums can be added to yield the total credit risk premium (TCRP) for country i. Summing up we have:

$$\begin{aligned} MRP &\equiv \hat{\gamma}^{(i)} \boldsymbol{MF_t}, \\ ECRP &\equiv \hat{\delta}_1^{(i)} CF_t^{(Euro)}, \\ CCRP &\equiv \hat{\delta}_2^{(i)} CF_t^{(Country,i)}, \\ TCRP &\equiv \hat{\delta}_1^{(i)} CF_t^{(Euro)} + \hat{\delta}_2^{(i)} CF_t^{(Country,i)}. \end{aligned} \tag{9}$$

3 Bond Risk Premiums

3.1 Dataset

We use weekly CDS spreads of USD-denominated contracts for nine eurozone countries. Countries included are Austria, Belgium, France, Ireland, Italy, Netherlands, Portugal, Slovakia, and Spain. The tenth country is Germany with its term structure being assumed to represent the risk-free curve. Out of the nine eurozone countries included we have peripheral states as well as core countries such as Austria, Belgium, France, and the Netherlands. Our data sources are Bloomberg and Datastream, with the sample period ranging from January 6, 2006 to July, 2013. We do not include Greece since its CDS data is available only until February 2012. The sample period covers roughly two and a half years of pre-crisis data as well as the entire crisis period. We include CDS maturities of 1, 3, 5, 7, and 10 years since these represent the most frequently traded tenors. In total, our data set yields 15,435 observations of the CDS term structure for nine sovereigns. The restriction to eurozone countries comes with the big advantage that we need not deal with exchange-rate risk and can identify the term structure of a single country, Germany, as the risk-free term structure.

For the same sample period, we collect weekly zero-coupon yields from Bloomberg. We obtain these data for maturities of 1, 2, 3, 4, 5, 6, 7, and 8 years so that our data set comprises 30,184 observations of zero yields. The descriptive statistics of the zero coupon-yield and CDS data are summarized in tables (23) and (24).

3.2 Principal Components as Risk Factors

The German term structure as well as the country-specific CDS curves are the basis for the construction of the market and credit risk factors. In the appendix we discuss the procedure used to calculate implied forward CDS spreads. As outlined in Section 2, we do not use forward rates directly to measure the market risk factor but extract principal components, instead. In Section 4 we take an alternative approach and use forward interest rates and forward CDS spreads directly to construct the market and credit risk factors. The first three PCs for the German spot rates are reported in Table (1). The results confirm previous findings that the first three PCs explain almost all variation contained in the spot rates, with the first factor being a level, the second a slope and the third a curvature factor (see Litterman & Scheinkman (1991)).

Next we extract PCs from the term structure of forward CDS spreads for each country separately. Tables (2) to (10) present the corresponding results. We find that all CDS forward curves are largely driven by a single factor, explaining at least 97% of the individual country's variation in CDS spreads. In the analysis below we will therefore represent the information in the entire CDS Forward curve by its first PC.

For completeness we also report the second and the third PCs. Analogous to the case of the German term structure, the first PC of the CDs spreads also represents a level factor, with loadings across countries and across maturities being close to 0.5. The second PC represents a slope and the third a curvature factor. This applies across all nine countries.

The PC analysis reveals that the loadings across countries are quantitatively very similar and that they share identical patterns. We therefore investigate whether the country-specific PCs are driven by a common underlying factor. To extract this common European factor we apply a principal components analysis to the first PCs of each country. The result of this approach is presented in table (11). The common credit factor explains 92% of the variation of country-specific CDS forward spreads. Given that the loadings of the common factor are quantitatively very similar and range for all eurozone countries from 0.3232 (Austria) to 0.3432 (France), the common eurozone credit factor can be interpreted as a level factor.

To identify the remaining country-specific credit risks, we run a simple linear regression that uses the first principal component for each country as the dependent and the common European factor as the independent variable. The residual of the regression specified in equation (3)represents an orthogonal country-specific credit factor.

3.3 Excess Bond Return Regressions

We first estimate the baseline model as given by equation (7). As discussed above, the estimation is done under the assumption that the market factor, capturing variations in the risk-free term structure, is identical for each single eurozone country. Since we use yearly holding period returns and estimate the model with weekly frequency we face an overlapping data problem and use Newey-West (HAC) covariance estimators with a lag length of 52 weeks in all estimations.

Table (12) summarizes the main results for the baseline model. Turning first to the results on the market factors, we find that the most significant factor is the second PC, which represents the slope of the German term structure. This factor positively predicts excess returns for the other European countries with high levels of significance, i.e. p-values of two percent or lower. Thus, a positive slope of the German term structure predicts that other eurozone countries' bond markets will outperform relative to the German bond market. This is in accordance with findings that risk premiums seem to be high when the riskless term structure is upwards sloping, as documented in several earlier studies, such as Harvey (1988), Estrella & Hardouvelis (1991), Estrella & Mishkin (1997), Fama & French (1989), Siegel (1991), Fama & Bliss (1987), or Nyberg (2013).

The results on the first and the third PC representing the level and the curvature of the term structure are less clear. The slope coefficients $\gamma_1^{(i)}$ and $\gamma_3^{(i)}$ are frequently insignificant and sometimes exhibit opposite signs for different countries. Thus, we conclude that the level and the curvature of the term structure do not have a clear cut and significant effect on subsequent excess returns in different countries sovereign bond markets.

We next turn to the results on the credit risk factors. They reveal a highly significant and positive effect of the common eurozone credit factor on future excess returns. The p-values of the slope coefficients $\delta_1^{(i)}$ do not exceed 0.02, with the only exception being Spain with a p-value of 0.06. Thus, increased eurozone wide sovereign risk levels are significantly and positively associated with risk premiums in the government bond markets of all countries covered.

Finally, we focus on the effects of country-specific credit factors, captured by the coefficients $\delta_2^{(i)}$. Table (12) reveals that for Austria, Ireland, Italy, Netherlands and Slovakia the country-specific credit factors have a highly significant and positive effect on future risk premiums of respective government bond markets. For Belgium the relationship is reversed and for France, Portugal and Spain the estimates are insignificant. The latter result may reflect the fact that these countries are important sources of systemic risk within the eurozone, so that there are no significant orthogonal country-specific factors in their bond markets.

Overall, the model seems to exhibit substantial explanatory power. The average R^2 of the baseline model amounts to 0.61 ranging from 0.43 for France to 0.80 for Ireland. By contrast, estimating the baseline model without the common eurozone and the country-specific credit factors yields an average R^2 of only 0.37. Hence, including credit risk factors substantially increases the explanatory power of the model.

Figures (1) to (10) show the realized average excess holding period returns ($\overline{rx}_t^{(i)}$) as well as risk premiums (MRP, ECRP, CCRP, TCRP) estimated using the baseline model as given by equation (7) for all countries in the sample. These Figures show that both realized excess returns as well as ex-ante risk premiums vary substantially over the sample period. The standard deviation of the excess returns in comparison to the standard deviations of the estimated market risk premiums (MRP), the common eurozone credit risk premiums ($ECRP$), and the country-specific risk premiums ($CCRP$) reveal the relative contributions of risk factors and corresponding risk premiums to the total variation of excess returns of sovereigns. A comparison of these standard deviations is given in table (25). Focussing on the bottom line of this table which displays averages, we find that the estimated eurozone credit risk premium exhibits the highest volatility with a standard deviation of almost 0.06, followed by the market and country-specific credit risk premiums with standard deviations of 0.04 and 0.01, respectively. Hence, it appears that over our sample period most of the variation of excess bond returns of eurozone countries is attributable to the common eurozone credit risk factor, whereas country-specific credit risk premiums seem to play a limited role only. The dominance of the common eurozone factor implies that investors cannot eliminate these risks through diversification. Hence, government bonds exposed to common European credit risk will only be attractive for investors if they offer a positive risk premium.

Tables 13 to 20 report the results of the individual maturity regressions as given by equation (8). The results are similar to those of the baseline regression given in Table 12. The slope of the term structure and the euro-wide credit factor remain highly significant and positive predictors of subsequent excess returns. Only for bonds with the shortest maturities, i.e. one year, are the results somewhat weaker. The R^2's remain high, comparable to the ones in the baseline model. For excess returns with a maturity of one year the average R^2 amounts to 0.69. It monotonically decreases with increasing bond maturities to 0.56 for an eight year maturity.

4 Forward Rates as Risk Factors

The approach introduced in the preceding Section makes use of information contained in forward rates extracted through principal components. While the principal components allow us to construct a common eurozone and an orthogonal country-specific credit factor, they are latent factors and, hence, do not directly represent economic variables. In this Section we choose an alternative route and construct market and credit risk factors, using forward rates directly. Since this approach uses the full term-structure of forward CDS spreads, we will not be able to differentiate between a common eurozone and a country-specific credit factor.

We denote the market and credit risk factor by:

$$\begin{aligned} \boldsymbol{MF_t^{(A)}} &= \left[f_t^{(2)},\ f_t^{(4)},\ f_t^{(6)},\ f_t^{(8)}\right], \\ \boldsymbol{CF_t^{(i,A)}} &= \left[cf_t^{(i,2)},\ cf_t^{(i,4)},\ cf_t^{(i,6)},\ cf_t^{(i,8)}\right]. \end{aligned}$$

These factors are translated into an estimated market and credit risk premium by estimating the alternative model:

$$\overline{rx}_{t+1}^{(i)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)}}\boldsymbol{MF_t^{(A)}} + \boldsymbol{\delta^{(i)}}\boldsymbol{CF_t^{(i,A)}} + \varepsilon_{t+1}^{(i)}, \tag{10}$$

where the parameter vectors are given by:

$$\begin{aligned} \boldsymbol{\gamma^{(i)}} &= \left[\gamma_1^{(i)},\ \gamma_2^{(i)},\ \gamma_3^{(i)},\ \gamma_4^{(i)}\right]', \\ \boldsymbol{\delta^{(i)}} &= \left[\delta_1^{(i)},\ \delta_2^{(i)},\ \delta_3^{(i)},\ \delta_4^{(i)}\right]'. \end{aligned}$$

In line with Section 2 we define the estimated market and credit risk premium by:

$$\begin{aligned} MRP^{(A)} &\equiv \boldsymbol{\widehat{\gamma}^{(i)}}\boldsymbol{MF_t^{(A)}}, \\ TCRP^{(A)} &\equiv \boldsymbol{\widehat{\delta}^{(i)}}\boldsymbol{CF_t^{(i,A)}}. \end{aligned} \tag{11}$$

Table 21 reports the results for the model given by equation (10). Comparing these results with those from the standard model reported in Table 12 reveals two important findings. First, using forward rates directly instead of PCs increases the average R^2 from 0.61 to 0.72. However, if we only use the market factors as explanatory variables, the R^2 is basically unchanged as we switch from PCs to use the full set of forward rates, i.e. R_M^2 is nearly identical for the alternative model and the baseline model. Therefore the overall increase in R^2 must be largely due to the decomposition of the credit risk factor into a eurozone and a country-specific component in the baseline model. In particular, representing the eurozone risk factor by the first PC of the individual country's first PCs and the country-specific risk factors by the orthogonal part of its first PC, as outlined in Table 11, is associated with a loss of information that results in a lower R^2.

Second, we find that the majority of forward CDS spreads representing the credit risk factors is significant for most countries in the sample. These results document that information contained in forward CDS spreads is valuable for predicting excess bond returns. What remains to be addressed is the check if forward interest rates and forward CDS spreads are complementary to explain the composition of bond risk premiums. Table 21 reveals that the forward interest rates summarizing the market risk factor are rarely significant in the estimates presented. In particular, for the Netherlands and Portugal no forward interest rate turns out to be statistically significant. This is in contrast to our findings for the baseline model, where the second PC of the German term structure, i.e. its slope, is always highly significant.

Again we can explore the relative contributions of risk factors and corresponding risk premiums to the total variation of excess returns. Table 26 reports the standard deviations of excess holding period returns, market risk premiums, and credit risk premiums. The average standard deviation amounts to 0.06 for the estimated credit risk premium and to 0.02 for the estimated market risk premium. Hence, in line with Section 2 the results suggest that for our sample period most of the variation of excess bond returns can be attributed to variations in the credit risk factor.

5 Swap Rates as Riskless Interest Rates

In Section 2 we used the German term structure of interest rates to calculate the market risk factor and the excess holding period returns. One might argue, however, that even Germany is exposed to some sovereign risk. Hence, using the German term structure may not be appropriate when modelling default free interest rates. In this Section we therefore follow an alternative approach and use eurozone swap rates obtained from Bloomberg as riskless interest rates. Comparing the swap rates with the German zero-coupon yields shows that over the sample period the average swap rates are higher than the German zero-coupon yields. The differences range from 55 basis points for a two year maturity to 30 basis points for an eight year maturity.

In line with Section 2 we use the term structure of swap rates to compute one-year forward rates starting in one, three, five, and seven years, denoted by $f_t^{(2,s)}$, $f_t^{(4,s)}$, $f_t^{(6,s)}$, and $f_t^{(8,s)}$. Again we extract the first three principal components from these forward rates which together constitute our market risk factor:

$$\boldsymbol{MF_t^{(s)}} = \left[MF_t^{(1,s)},\ MF_t^{(2,s)},\ MF_t^{(3,s)}\right]. \tag{12}$$

We then redefine excess holding period returns on the basis of swap rates. Hence, we replace equation (5) by:

$$rx_{t+1}^{(i,n,s)} = r_{t+1}^{(i,n)} - r_{t+1}^{(n,s)}, \tag{13}$$

where $r_{t+1}^{(n,s)}$ denotes the swap rate with maturity (n). Finally, we define average excess holding period returns:

$$\begin{aligned} \overline{rx}_{t+1}^{(i,s)} &= \frac{1}{8}[rx_{t+1}^{(i,1,s)} + rx_{t+1}^{(i,2,s)} + rx_{t+1}^{(i,3,s)} + rx_{t+1}^{(i,4,s)} \\ &+ rx_{t+1}^{(i,5,s)} + rx_{t+1}^{(i,6,s)} + rx_{t+1}^{(i,7,s)} + rx_{t+1}^{(i,8,s)}]. \end{aligned} \tag{14}$$

With these definitions we can specify the alternative model as:

$$\overline{rx}_{t+1}^{(i,s)} = \delta_0^{(i)} + \boldsymbol{\gamma}^{(i)}\boldsymbol{MF_t^{(s)}} + \delta_1^{(i)}CF_t^{(Euro)} + \delta_2^{(i)}CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}. \tag{15}$$

Table 22 reports the estimation results based on equation (15). Overall, the results from this specification appear much weaker than the ones obtained for the specification using the German term structure. None of the coefficients of the forward swap rates is consistent in sign across all countries, and several coefficients are insignificant. Thus, in contrast to the results in Section 3, the slope of the term structure, $\gamma_2^{(2)}$, no longer exhibits statistical significance. Similarly, the eurozone factor is not significant for Austria, France, and Slovakia while the country-specific credit risk factor is not significant for Belgium, France, Portugal, and Spain.

A comparison of Tables (12) and (22) shows that the average R^2 drops from 0.61 to 0.47 when we use swap rates to proxy for the riskless term structure. Hence, swap rates seem to be a less suitable proxy for the risk-free interest rates than German zero-coupon yields.

6 Conclusion

This paper explores risk premiums in eurozone government bond markets. In the spirit of Fama & Bliss (1987) and Cochrane & Piazzesi (2005), we hereby use the term structure of forward interest rates as explanatory variables for subsequent risk premiums. Since Germany was considered the safe haven by investors throughout the recent episodes of European sovereign risk, we use the yield curve of zero-coupon German government bonds as a proxy for the term structure of riskless interest rates. In the baseline specification of the econometric model we use the first three principal components of the resulting term structure of forward rates, representing the level, the slope and the curvature.

The main contribution of the paper is to extend the model of risk premiums in eurozone government markets to account for sovereign credit risk. To this end we collect CDS spreads for each of nine eurozone countries and calculate the corresponding one-year forward CDS spreads one year, three years, five years and seven years out. For each of the nine countries we find that the first principal component of the forward CDS spreads explains at least 97% of their variation. In the baseline model we therefore focus on the first principal component. To analyze whether there exists a eurozone credit factor, we extract the first principal component from the nine countries' first principal components. Country-specific credit risk factors are then defined by the error term of a simple linear regression of each country's first principal component on the eurozone-wide credit factor.

We demonstrate that the yield curve of zero-coupon German government bonds, the eurozone credit factor and the country-specific credit factors provide a robust model of risk premiums in eurozone government bond markets. Specifically we find that the slope of the forward term-structure of German interest rates represents a highly significant predictive variable for government bond risk premiums in all countries analyzed. The eurozone credit factor is also a significant predictor of bond risk premiums for all countries. Finally country-specific credit factors also have predictive power for most countries. For a few countries, the country-specific risk factors are not statistically significant. These are countries that are important sources of systemic risk within the eurozone. As a consequence there seem to be no significant orthogonal country-specific factors in their bond markets.

The good overall fit of the model is supported by a relatively high average R^2 of 0.65, ranging from 0.43 for France to 0.80 for Ireland. Leaving out the credit factors reduces the average R^2 substantially to 0.37. The importance of the eurozone credit risk factors as explanatory variables is supported by the volatility of the component of the risk premiums which is due to this factor. This volatility amounts to 0.0574 whereas the volatility of the component of the risk premiums due to the term-structure of interest rates and to the country-specific credit risk factors is only 0.0133 and 0.0392, respectively.

We perform a number of robustness tests. First, we use the forward interest rates and the forward CDS spreads directly as explanatory variables, rather than their PCs. Here we confirm the main results from the baseline model and obtain even higher R^2's. Second, the baseline regressions exclude Greece since there are no CDS data available after February 2012. We therefore re-estimate our baseline model for a shorter sample period ending in February 2012. Again we find that all main results are robust to this alternative sample period that includes Greece. Finally, we re-estimate the model using swap rates as a proxy of riskless interest rates rather than the German yield curve. We find that the swap rates were substantially higher during the sample period than the German zero curve, indicating that German government bonds were the safe haven instrument, rather than swap rates. Consistent with this observation we find that the results based on swap rates are weaker than for the baseline model. Several of our explanatory variables are not statistically significant or even switch signs. Also the R^2's of this specification is lower.

Overall we find that the term-structures of forward interest rates and of forward CDS spreads contain important information about future risk premiums on eurozone government bonds. The credit risk factor can be decomposed into a eurozone-wide one and in nine country-specific ones. The eurozone credit risk factor contributes the lion's share of the time-variation of risk premiums, followed by the slope of the term structure and the country-specific credit risk factors.

7 Appendix

7.1 CDS Valuation & Forward CDS Spreads

Forward CDS spreads are extracted from the term structure of spot CDS spreads with discount factors computed from German zero-coupon yields for euro-area countries. The fair premium c_t^T of a CDS equates the premium and protection leg of a contract. The premium leg V_t^{prem} is the expected present value of premium payments made by the protection buyer to the protection seller until the contract matures or a credit event occurs:

$$V_t^{prem} = c_t^T RPV_t^T, \tag{16}$$

$$\begin{aligned} RPV_t^T &= \sum_{n=1}^{N} \delta(t_{n-1}, t_n) Z(t, t_n) Q(t, t_n) \\ &+ \sum_{n=1}^{N} \int_{t_{n-1}}^{t_n} \delta(t_{n-1}, u) Z(t, u) Q(t, u)(-dQ(t, u)), \end{aligned} \tag{17}$$

where $t_0 = t$, $t_N = t + T$, N denotes the number of premium payments over the life of the CDS contract, and $\delta(t_{n-1}, t_n)$ refers to the day count fraction between two consecutive premium payment dates t_{n-1} and t_n. The variable $Z(t, u)$ denotes the price of a risk-free zero coupon bond at time t maturing at time u and $Q(t, u)$ refers to the risk-neutral survival probability until time u. Hence, the first term on the right-hand side of equation (17) is the expected present value of premium payments conditional on surviving to the respective payments dates, while the second term captures the accrued premium to be paid if a credit event occurs between payment dates.

The protection leg V_t^{prot} is the expected present value of the protection payment made by the protection seller to the protection buyer if a credit event occurs:

$$V_t^{prot} = (1 - R) \int_t^{t+T} Z(t, u)(-dQ(t, u)), \tag{18}$$

where R denotes the recovery rate. Equating the premium and protection leg yields:

$$c_t^T = \frac{(1 - R) \int_t^{t+T} Z(t, u)(-dQ(t, u))}{RPV_t^T}. \tag{19}$$

Given observed market CDS spreads we bootstrap the survival curve $Q(t, t_i)$ for various maturities t_i assuming a recovery rate R of 40% and computing risk-free zero-coupon bond prices $Z(t, u)$ based on the German zero yield curve for euro-area countries.

A forward CDS contract is a hypothetical CDS contract that provides protection against default of a reference obligation for a future time period of length T starting at a forward date $t + \tau,\ \tau > 0$. The premium to be paid over this future protection period is determined today at contract inception. For such a forward CDS contract, market participants should be indifferent between trading a $\tau + T$-period spot contract or a combination of spot and forward contracts covering the same period of time:

$$c_t^{\tau+T} RPV_t^{\tau+T} = c_t^{\tau} RPV_t^{\tau} + cf_t^{\tau\times T} RPV_t^{\tau\times T}, \tag{20}$$

where $RPV_t^{\tau\times T} = RPV_t^{\tau+T} - RPV_t^{\tau}$ and $cf_t^{\tau\times T}$ is the spread of a forward contract with forward date $t + \tau$ and maturity date $t + T$. Hence, the expected present value of a stream of spot CDS premiums $c_t^{\tau+T}$ of a contract with maturity date $t + \tau + T$ is equal to the expected present value of a stream of CDS premiums c_t^{τ} of a contract with maturity date $t+\tau$ plus the expected present value of a stream of forward CDS premiums $cf_t^{\tau\times T}$ of a forward contract with forward date $t + \tau$ and maturity date $t + \tau + T$.

7.2 Constructing Credit and Market Risk Factors

Table 1: Principal Components Analysis – Forward Interest Rates

Principal Components Analysis – Forward Interest Rates			
Principal Component	**Percent explained**	**Total**	
First	0.89	0.89	
Second	0.09	0.98	
Third	0.02	1.00	
Loadings	**First**	**Second**	**Third**
$f^{2,DE}$	0.4684	0.7534	0.3420
$f^{4,DE}$	0.5259	0.1254	-0.2761
$f^{6,DE}$	0.5168	-0.2495	-0.6311
$f^{8,DE}$	0.4868	-0.5954	0.6391

Table 2: Principal Components Analysis – Forward CDS Austria

Principal Components Analysis – Forward CDS Austria			
Principal Component	**Percent explained**	**Total**	
First	0.98	0.98	
Second	0.02	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Austria}$	0.4930	0.8477	0.1943
$cf^{4,Austria}$	0.5032	-0.0991	-0.8118
$cf^{6,Austria}$	0.5023	-0.3316	0.0787
$cf^{8,Austria}$	0.5013	-0.4020	0.5450

Table 3: Principal Components Analysis – Forward CDS Belgium

Principal Components Analysis – Forward CDS Belgium			
Principal Component	**Percent explained**	**Total**	
First	0.99	0.99	
Second	0.00	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Belgium}$	0.4980	0.8661	0.0049
$cf^{4,Belgium}$	0.5006	-0.3048	0.7694
$cf^{6,Belgium}$	0.5008	-0.2466	-0.1542
$cf^{8,Belgium}$	0.5006	-0.3101	-0.6199

Table 4: Principal Components Analysis – Forward CDS France

Principal Components Analysis – Forward CDS France			
Principal Component	**Percent explained**	**Total**	
First	0.99	0.99	
Second	0.01	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,France}$	0.4962	0.8634	0.0854
$cf^{4,France}$	0.5015	-0.2022	-0.8364
$cf^{6,France}$	0.5011	-0.3447	0.3046
$cf^{8,France}$	0.5012	-0.3079	0.4477

Table 5: Principal Components Analysis – Forward CDS Ireland

Principal Components Analysis – Forward CDS Ireland			
Principal Component	**Percent explained**	**Total**	
First	0.98	0.98	
Second	0.02	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Ireland}$	0.4910	0.8179	0.1083
$cf^{4,Ireland}$	0.5040	-0.1927	-0.8419
$cf^{6,Ireland}$	0.5057	-0.0714	0.3146
$cf^{8,Ireland}$	0.4992	-0.5375	0.4249

Table 6: Principal Components Analysis – Forward CDS Italy

Principal Components Analysis – Forward CDS Italy			
Principal Component	**Percent explained**	**Total**	
First	1.00	1.00	
Second	0.00	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Italy}$	0.4988	0.8625	0.0018
$cf^{4,Italy}$	0.5002	-0.3181	0.7573
$cf^{6,Italy}$	0.5007	-0.2066	-0.1162
$cf^{8,Italy}$	0.5003	-0.3350	-0.6427

Table 7: Principal Components Analysis – Forward CDS Netherlands

Principal Components Analysis – Forward CDS Netherlands			
Principal Component	**Percent explained**	**Total**	
First	0.97	0.97	
Second	0.02	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Netherlands}$	0.4879	0.8623	0.1337
$cf^{4,Netherlands}$	0.5053	-0.1614	-0.8312
$cf^{6,Netherlands}$	0.5040	-0.2967	0.2068
$cf^{8,Netherlands}$	0.5026	-0.3773	0.4984

Table 8: Principal Components Analysis – Forward CDS Portugal

Principal Components Analysis – Forward CDS Portugal			
Principal Component	**Percent explained**	**Total**	
First	0.98	0.98	
Second	0.01	0.99	
Third	0.01	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Portugal}$	0.4961	0.7640	0.3125
$cf^{4,Portugal}$	0.5012	-0.0267	-0.8531
$cf^{6,Portugal}$	0.5044	-0.0949	0.1586
$cf^{8,Portugal}$	0.4983	-0.6377	0.3866

Table 9: Principal Components Analysis – Forward CDS Slovakia

Principal Component	**Percent explained**	**Total**	
First	0.99	0.99	
Second	0.01	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Slovakia}$	0.4982	0.7105	0.4892
$cf^{4,Slovakia}$	0.5009	0.2093	-0.7445
$cf^{6,Slovakia}$	0.5014	-0.3349	-0.1644
$cf^{8,Slovakia}$	0.4995	-0.5825	0.4236

Table 10: Principal Components Analysis – Forward CDS Spain

Principal Component	**Percent explained**	**Total**	
First	1.00	1.00	
Second	0.00	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Spain}$	0.4989	0.8261	0.2585
$cf^{4,Spain}$	0.5004	-0.0549	-0.8303
$cf^{6,Spain}$	0.5006	-0.2872	0.0869
$cf^{8,Spain}$	0.5001	-0.4817	0.4861

Table 11: Principal Components Analysis – Country Components

Principal Components Analysis – Country Components

Principal Component	**Percent explained**	**Total**	
First	0.92	0.92	
Second	0.05	0.97	
Third	0.02	0.99	
Loadings	**First**	**Second**	**Third**
Austria	0.3232	0.4976	0.3709
Belgium	0.3420	-0.1606	0.0257
France	0.3432	-0.0732	-0.2916
Ireland	0.3243	-0.3612	0.6936
Italy	0.3417	-0.0127	-0.3738
Netherlands	0.3320	0.4087	0.1704
Portugal	0.3276	-0.4434	-0.1742
Slovakia	0.3285	0.4071	-0.3006
Spain	0.3368	-0.2476	-0.0787

7.3 Baseline Regression

Table 12: Baseline Regression

Model: $\overline{rx}^{(i)}_{t+1} = \delta^{(i)}_0 + \boldsymbol{\gamma^{(i)} MF_t} + \delta^{(i)}_1 CF^{(Euro)}_t + \delta^{(i)}_2 CF^{(Country,i)}_t + \varepsilon^{(i)}_{t+1}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta^{(i)}_0$	0.0020	0.0036	0.0007	0.0153	-0.0022	0.0005	0.0221	0.0020	-0.0071
	(0.09)	(0.01)	(0.80)	(0.01)	(0.75)	(0.27)	(0.31)	(0.08)	(0.27)
$\gamma^{(i)}_1$	-0.0019	0.0110	0.0009	0.0452	0.0186	-0.0005	0.0216	-0.0022	-0.0015
	(0.16)	(0.00)	(0.44)	(0.01)	(0.00)	(0.33)	(0.07)	(0.22)	(0.74)
$\gamma^{(i)}_2$	0.0132	0.0277	0.0063	0.1260	0.0233	0.0033	0.1824	0.0059	0.0362
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
$\gamma^{(i)}_3$	0.0164	0.0064	-0.0126	0.0304	-0.0429	0.0003	0.1590	-0.0056	0.0010
	(0.02)	(0.00)	(0.09)	(0.07)	(0.02)	(0.78)	(0.00)	(0.25)	(0.93)
$\delta^{(i)}_1$	0.0034	0.0156	0.0040	0.0583	0.0209	0.0014	0.0655	0.0030	0.0069
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.06)
$\delta^{(i)}_2$	0.0180	-0.0153	0.0190	0.0442	0.0985	0.0102	-0.0231	0.0163	0.0027
	(0.00)	(0.02)	(0.22)	(0.00)	(0.00)	(0.00)	(0.41)	(0.00)	(0.85)
$\boldsymbol{R^2}$	0.65	0.60	0.43	0.80	0.61	0.67	0.60	0.66	0.45
$\boldsymbol{R^2_M}$	0.35	0.36	0.34	0.40	0.34	0.31	0.48	0.35	0.42

This table reports the results of estimating equation (8). The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R^2_M}$ denotes the R^2 of a regression without credit risk factors.

7.4 Individual Maturity Regressions

Table 13: Individual Maturity Regression – 1Y

Model: $rx_{t+1}^{(i,1)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0016	0.0028	0.0010	0.0204	0.0081	0.0006	0.0273	0.0016	0.0082
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\gamma_1^{(i)}$	-0.0003	0.0007	0.0003	0.0015	0.0022	0.0003	0.0042	-0.0003	-0.0001
	(0.13)	(0.05)	(0.15)	(0.03)	(0.16)	(0.03)	(0.07)	(0.05)	(0.84)
$\gamma_2^{(i)}$	-0.0008	0.0004	-0.0001	0.0058	0.0006	-0.0001	0.0109	-0.0011	0.0024
	(0.00)	(0.02)	(0.19)	(0.00)	(0.39)	(0.49)	(0.00)	(0.00)	(0.00)
$\gamma_3^{(i)}$	0.0014	0.0007	0.0001	0.0106	0.0011	0.0004	0.0150	0.0004	0.0041
	(0.05)	(0.00)	(0.61)	(0.00)	(0.26)	(0.44)	(0.00)	(0.25)	(0.01)
$\delta_1^{(i)}$	0.0001	0.0017	0.0005	0.0091	0.0051	0.0002	0.0170	0.0000	0.0038
	(0.67)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.59)	(0.00)
$\delta_2^{(i)}$	0.0007	0.0044	0.0008	0.0128	0.0132	0.0007	0.0206	0.0005	0.0051
	(0.00)	(0.00)	(0.28)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
$\boldsymbol{R^2}$	0.55	0.68	0.60	0.87	0.89	0.35	0.88	0.52	0.86
$\boldsymbol{R^2_M}$	0.46	0.42	0.44	0.60	0.69	0.09	0.67	0.46	0.75

This table reports the results of estimating equation (7) for a 1Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R^2_M}$ denotes the R^2 of a regression without credit risk factors.

Table 14: Individual Maturity Regression – 2Y

Model: $rx_{t+1}^{(i,2)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0023	0.0065	0.0025	0.0258	0.0113	0.0013	0.0387	0.0023	0.0096
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\gamma_1^{(i)}$	0.0001	0.0036	0.0009	0.0165	0.0078	0.0003	0.0151	0.0001	-0.0005
	(0.75)	(0.00)	(0.07)	(0.00)	(0.00)	(0.04)	(0.01)	(0.76)	(0.81)
$\gamma_2^{(i)}$	0.0015	0.0062	0.0008	0.0441	0.0073	0.0003	0.0660	0.0004	0.0115
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.11)	(0.00)
$\gamma_3^{(i)}$	0.0042	0.0038	-0.0012	0.0206	-0.0068	0.0013	0.0433	0.0008	0.0082
	(0.00)	(0.00)	(0.25)	(0.00)	(0.11)	(0.05)	(0.00)	(0.09)	(0.02)
$\delta_1^{(i)}$	0.0014	0.0059	0.0016	0.0263	0.0118	0.0006	0.0398	0.0013	0.0062
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\delta_2^{(i)}$	0.0027	0.0061	0.0039	0.0351	0.0382	0.0022	0.0269	0.0023	0.0059
	(0.00)	(0.10)	(0.12)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.18)
$\boldsymbol{R^2}$	0.67	0.64	0.59	0.75	0.83	0.53	0.73	0.65	0.76
$\boldsymbol{R^2_M}$	0.44	0.38	0.40	0.34	0.55	0.19	0.55	0.44	0.67

This table reports the results of estimating equation (7) for a 2Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R^2_M}$ denotes the R^2 of a regression without credit risk factors.

Table 15: Individual Maturity Regression – 3Y

Model: $rx_{t+1}^{(i,3)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0045	0.0074	0.0032	0.0209	0.0088	0.0024	0.0357	0.0045	0.0046
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.20)
$\gamma_1^{(i)}$	0.0004	0.0086	0.0017	0.0391	0.0146	0.0004	0.0288	0.0003	0.0006
	(0.07)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.68)	(0.83)
$\gamma_2^{(i)}$	0.0041	0.0155	0.0016	0.0914	0.0152	0.0007	0.1258	0.0014	0.0224
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.00)
$\gamma_3^{(i)}$	0.0029	0.0066	-0.0054	0.0332	-0.0193	0.0010	0.0876	-0.0050	0.0072
	(0.00)	(0.00)	(0.01)	(0.00)	(0.04)	(0.02)	(0.00)	(0.00)	(0.30)
$\delta_1^{(i)}$	0.0029	0.0117	0.0034	0.0469	0.0182	0.0015	0.0615	0.0027	0.0081
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\delta_2^{(i)}$	0.0066	-0.0019	0.0091	0.0503	0.0645	0.0044	0.0200	0.0061	0.0046
	(0.00)	(0.76)	(0.04)	(0.00)	(0.00)	(0.00)	(0.33)	(0.00)	(0.62)
$\boldsymbol{R^2}$	0.66	0.62	0.60	0.76	0.74	0.73	0.63	0.67	0.62
$\boldsymbol{R^2_M}$	0.41	0.34	0.42	0.29	0.44	0.41	0.47	0.41	0.54

This table reports the results of estimating equation (7) for a 3Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R^2_M}$ denotes the R^2 of a regression without credit risk factors.

Table 16: Individual Maturity Regression – 4Y

Model: $rx_{t+1}^{(i,4)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0036	0.0050	0.0022	0.0149	0.0015	0.0010	0.0228	0.0036	-0.0028
	(0.00)	(0.00)	(0.09)	(0.01)	(0.80)	(0.01)	(0.35)	(0.00)	(0.62)
$\gamma_1^{(i)}$	-0.0010	0.0105	0.0008	0.0519	0.0181	-0.0003	0.0251	-0.0013	-0.0002
	(0.41)	(0.00)	(0.40)	(0.00)	(0.00)	(0.63)	(0.08)	(0.35)	(0.96)
$\gamma_2^{(i)}$	0.0086	0.0250	0.0050	0.1291	0.0232	0.0032	0.1795	0.0043	0.0350
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)
$\gamma_3^{(i)}$	0.0136	0.0074	-0.0089	0.0348	-0.0352	-0.0001	0.1427	0.0012	0.0065
	(0.00)	(0.00)	(0.06)	(0.02)	(0.02)	(0.91)	(0.00)	(0.66)	(0.53)
$\delta_1^{(i)}$	0.0038	0.0152	0.0042	0.0604	0.0218	0.0017	0.0665	0.0035	0.0091
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\delta_2^{(i)}$	0.0103	-0.0070	0.0162	0.0508	0.0873	0.0076	-0.0145	0.0100	0.0049
	(0.00)	(0.33)	(0.08)	(0.00)	(0.00)	(0.00)	(0.65)	(0.00)	(0.72)
$\boldsymbol{R^2}$	0.66	0.62	0.59	0.77	0.65	0.69	0.58	0.69	0.54
$\boldsymbol{R_M^2}$	0.46	0.37	0.47	0.33	0.39	0.40	0.46	0.46	0.49

This table reports the results of estimating equation (7) for a 4Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without credit risk factors.

Table 17: Individual Maturity Regression – 5Y

Model: $rx_{t+1}^{(i,5)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0037	0.0074	0.0018	0.0178	-0.0029	0.0020	0.0225	0.0037	-0.0067
	(0.01)	(0.00)	(0.51)	(0.03)	(0.73)	(0.00)	(0.35)	(0.00)	(0.39)
$\gamma_1^{(i)}$	-0.0006	0.0149	0.0018	0.0571	0.0232	0.0004	0.0268	-0.0012	-0.0011
	(0.68)	(0.00)	(0.13)	(0.00)	(0.00)	(0.46)	(0.05)	(0.56)	(0.84)
$\gamma_2^{(i)}$	0.0169	0.0333	0.0077	0.1516	0.0300	0.0049	0.2133	0.0083	0.0425
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\gamma_3^{(i)}$	0.0185	0.0057	-0.0138	0.0346	-0.0520	-0.0017	0.1874	-0.0059	0.0018
	(0.03)	(0.00)	(0.09)	(0.09)	(0.01)	(0.21)	(0.00)	(0.25)	(0.88)
$\delta_1^{(i)}$	0.0050	0.0197	0.0052	0.0697	0.0252	0.0024	0.0760	0.0044	0.0084
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)
$\delta_2^{(i)}$	0.0205	-0.0161	0.0223	0.0556	0.1121	0.0114	-0.0284	0.0202	0.0008
	(0.00)	(0.05)	(0.20)	(0.00)	(0.00)	(0.00)	(0.37)	(0.00)	(0.96)
$\boldsymbol{R^2}$	0.63	0.61	0.44	0.79	0.59	0.66	0.58	0.68	0.43
$\boldsymbol{R_M^2}$	0.32	0.34	0.33	0.37	0.33	0.32	0.46	0.32	0.39

This table reports the results of estimating equation (7) for a 5Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without credit risk factors.

Table 18: Individual Maturity Regression – 6Y

Model: $rx_{t+1}^{(i,6)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0011	0.0013	-0.0009	0.0117	-0.0118	-0.0009	0.0161	0.0011	-0.0171
	(0.56)	(0.55)	(0.83)	(0.22)	(0.24)	(0.14)	(0.60)	(0.57)	(0.08)
$\gamma_1^{(i)}$	-0.0036	0.0153	0.0004	0.0628	0.0244	-0.0017	0.0297	-0.0039	-0.0036
	(0.10)	(0.00)	(0.84)	(0.01)	(0.01)	(0.01)	(0.07)	(0.16)	(0.62)
$\gamma_2^{(i)}$	0.0194	0.0406	0.0088	0.1784	0.0329	0.0048	0.2559	0.0080	0.0512
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.00)
$\gamma_3^{(i)}$	0.0220	0.0076	-0.0184	0.0404	-0.0654	-0.0008	0.2243	-0.0126	-0.0035
	(0.04)	(0.00)	(0.10)	(0.12)	(0.01)	(0.68)	(0.00)	(0.13)	(0.83)
$\delta_1^{(i)}$	0.0046	0.0218	0.0050	0.0794	0.0265	0.0015	0.0859	0.0041	0.0069
	(0.03)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.05)	(0.21)
$\delta_2^{(i)}$	0.0279	-0.0250	0.0267	0.0547	0.1355	0.0149	-0.0431	0.0244	-0.0009
	(0.00)	(0.01)	(0.24)	(0.00)	(0.00)	(0.00)	(0.28)	(0.00)	(0.97)
$\boldsymbol{R^2}$	0.64	0.59	0.42	0.80	0.56	0.64	0.58	0.63	0.40
$\boldsymbol{R_M^2}$	0.34	0.36	0.33	0.41	0.31	0.34	0.46	0.34	0.38

This table reports the results of estimating equation (7) for a 6Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without credit risk factors.

Table 19: Individual Maturity Regression – 7Y

Model: $rx_{t+1}^{(i,7)} = \delta_0^{(i)} + \boldsymbol{\gamma}^{(i)} \boldsymbol{MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0003	-0.0007	-0.0022	0.0061	-0.0172	-0.0017	0.0109	0.0003	-0.0238
	(0.88)	(0.75)	(0.69)	(0.61)	(0.15)	(0.01)	(0.76)	(0.88)	(0.02)
$\gamma_1^{(i)}$	-0.0051	0.0169	0.0005	0.0662	0.0273	-0.0016	0.0237	-0.0056	-0.0043
	(0.06)	(0.00)	(0.85)	(0.01)	(0.01)	(0.01)	(0.23)	(0.10)	(0.60)
$\gamma_2^{(i)}$	0.0237	0.0480	0.0124	0.1982	0.0396	0.0064	0.2919	0.0107	0.0594
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)
$\gamma_3^{(i)}$	0.0325	0.0102	-0.0211	0.0446	-0.0688	0.0026	0.2750	-0.0065	-0.0042
	(0.02)	(0.00)	(0.12)	(0.16)	(0.03)	(0.25)	(0.00)	(0.54)	(0.82)
$\delta_1^{(i)}$	0.0048	0.0240	0.0058	0.0857	0.0287	0.0018	0.0893	0.0042	0.0063
	(0.07)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.12)	(0.31)
$\delta_2^{(i)}$	0.0317	-0.0331	0.0331	0.0503	0.1588	0.0166	-0.0699	0.0282	0.0003
	(0.00)	(0.00)	(0.25)	(0.00)	(0.00)	(0.00)	(0.13)	(0.00)	(0.99)
$\boldsymbol{R^2}$	0.62	0.59	0.40	0.81	0.55	0.62	0.58	0.62	0.38
$\boldsymbol{R_M^2}$	0.35	0.36	0.32	0.44	0.30	0.31	0.46	0.35	0.37

This table reports the results of estimating equation (7) for a 7Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without credit risk factors.

Table 20: Individual Maturity Regression – 8Y

Model: $rx_{t+1}^{(i,8)} = \delta_0^{(i)} + \boldsymbol{\gamma^{(i)} MF_t} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	-0.0012	-0.0006	-0.0023	0.0048	-0.0151	-0.0006	0.0027	-0.0012	-0.0290
	(0.69)	(0.70)	(0.76)	(0.69)	(0.30)	(0.52)	(0.94)	(0.64)	(0.02)
$\gamma_1^{(i)}$	-0.0051	0.0180	0.0008	0.0667	0.0309	-0.0015	0.0194	-0.0059	-0.0032
	(0.06)	(0.00)	(0.79)	(0.02)	(0.00)	(0.05)	(0.36)	(0.09)	(0.74)
$\gamma_2^{(i)}$	0.0326	0.0524	0.0142	0.2093	0.0376	0.0067	0.3158	0.0149	0.0654
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)
$\gamma_3^{(i)}$	0.0361	0.0094	-0.0323	0.0242	-0.0965	0.0001	0.2968	-0.0168	-0.0125
	(0.04)	(0.00)	(0.04)	(0.49)	(0.01)	(0.97)	(0.00)	(0.19)	(0.54)
$\delta_1^{(i)}$	0.0049	0.0250	0.0059	0.0886	0.0296	0.0013	0.0878	0.0039	0.0062
	(0.10)	(0.00)	(0.04)	(0.00)	(0.00)	(0.07)	(0.00)	(0.16)	(0.39)
$\delta_2^{(i)}$	0.0432	-0.0493	0.0399	0.0443	0.1789	0.0239	-0.0965	0.0389	0.0007
	(0.00)	(0.00)	(0.25)	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.98)
$\boldsymbol{R^2}$	0.63	0.57	0.34	0.79	0.51	0.64	0.57	0.64	0.34
$\boldsymbol{R_M^2}$	0.28	0.34	0.26	0.45	0.24	0.24	0.46	0.28	0.33

This table reports the results of estimating equation (7) for a 8Y maturity. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without credit risk factors.

7.5 Alternative Model

Table 21: Baseline Regression – Alternative Model

Model: $\overline{rx}_{t+1}^{(i)} = \delta_0^{(i)} + \boldsymbol{\gamma}^{(i)} \boldsymbol{MF_t^{(A)}} + \boldsymbol{\delta}^{(i)} \boldsymbol{CF_t^{(i,A)}} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0075	0.0825	0.0134	-0.0154	0.0750	0.0104	0.2199	0.0171	0.0362
	(0.41)	(0.11)	(0.58)	(0.84)	(0.29)	(0.18)	(0.06)	(0.08)	(0.07)
$\gamma_1^{(i)}$	1.2232	0.5772	0.9820	8.5644	1.9091	0.1823	0.3346	0.2710	2.7036
	(0.00)	(0.28)	(0.00)	(0.00)	(0.02)	(0.18)	(0.82)	(0.28)	(0.01)
$\gamma_2^{(i)}$	-1.5781	2.3569	-0.6605	-3.1852	0.9619	0.3392	6.0366	0.3266	-3.2203
	(0.00)	(0.15)	(0.52)	(0.47)	(0.69)	(0.39)	(0.15)	(0.37)	(0.32)
$\gamma_3^{(i)}$	-0.1692	-2.1970	0.0634	1.3005	-1.6666	-0.6375	-9.6150	-0.2539	1.2597
	(0.68)	(0.10)	(0.95)	(0.70)	(0.56)	(0.11)	(0.20)	(0.58)	(0.48)
$\gamma_4^{(i)}$	0.2815	-2.6931	-0.6347	-5.7267	-1.8734	-0.1959	-0.9414	-0.8033	-1.2411
	(0.18)	(0.03)	(0.19)	(0.07)	(0.25)	(0.48)	(0.86)	(0.02)	(0.33)
$\delta_1^{(i)}$	0.0005	0.0008	0.0007	0.0001	0.0012	0.0004	0.0014	0.0006	0.0005
	(0.00)	(0.00)	(0.00)	(0.71)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\delta_2^{(i)}$	-0.0004	-0.0004	0.0003	0.0011	-0.0000	-0.0001	-0.0002	-0.0003	0.0007
	(0.04)	(0.43)	(0.27)	(0.00)	(0.96)	(0.48)	(0.30)	(0.00)	(0.01)
$\delta_3^{(i)}$	0.0011	0.0020	0.0009	0.0004	0.0009	0.0004	-0.0019	0.0002	0.0001
	(0.00)	(0.02)	(0.03)	(0.56)	(0.12)	(0.03)	(0.00)	(0.26)	(0.87)
$\delta_4^{(i)}$	-0.0008	-0.0020	-0.0015	-0.0012	-0.0021	-0.0004	-0.0000	-0.0002	-0.0013
	(0.02)	(0.01)	(0.00)	(0.10)	(0.00)	(0.03)	(0.97)	(0.02)	(0.00)
$\boldsymbol{R^2}$	0.66	0.68	0.67	0.84	0.73	0.69	0.89	0.71	0.60
$\boldsymbol{R_M^2}$	0.35	0.36	0.34	0.40	0.34	0.31	0.49	0.35	0.44

Table (21) reports the results of estimating equation (10). The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R^2_M}$ denotes the R^2 of a regression without and credit risk factors.

7.6 Robustness Checks

Table 22: Baseline Regression – Swap Rates

Model: $\overline{rx}_{t+1}^{(i,s)} = \delta_0^{(i)} + \boldsymbol{\gamma}^{(i)} \boldsymbol{MF_t^s} + \delta_1^{(i)} CF_t^{(Euro)} + \delta_2^{(i)} CF_t^{(Country,i)} + \varepsilon_{t+1}^{(i)}$

	Austria	**Belgium**	**France**	**Ireland**	**Italy**	**Netherl.**	**Portugal**	**Slovakia**	**Spain**
$\delta_0^{(i)}$	0.0005	0.0021	-0.0009	0.0137	-0.0037	-0.0010	0.0206	0.0005	-0.0087
	(0.86)	(0.41)	(0.69)	(0.24)	(0.57)	(0.41)	(0.45)	(0.85)	(0.06)
$\gamma_1^{(i)}$	-0.0053	0.0044	-0.0044	0.0323	0.0052	-0.0054	0.0322	-0.0072	-0.0026
	(0.06)	(0.20)	(0.01)	(0.05)	(0.28)	(0.00)	(0.11)	(0.01)	(0.34)
$\gamma_2^{(i)}$	0.0050	0.0177	-0.0029	0.1158	0.0161	-0.0069	0.2072	-0.0038	0.0435
	(0.40)	(0.00)	(0.41)	(0.00)	(0.17)	(0.00)	(0.00)	(0.36)	(0.00)
$\gamma_3^{(i)}$	-0.0334	-0.0627	-0.0168	-0.1666	-0.0092	-0.0416	0.1773	-0.0546	0.0393
	(0.05)	(0.00)	(0.44)	(0.02)	(0.85)	(0.00)	(0.42)	(0.00)	(0.36)
$\delta_1^{(i)}$	-0.0008	0.0090	-0.0012	0.0448	0.0104	-0.0035	0.0657	-0.0021	0.0036
	(0.68)	(0.00)	(0.23)	(0.00)	(0.00)	(0.00)	(0.00)	(0.20)	(0.03)
$\delta_2^{(i)}$	0.0108	-0.0134	0.0151	0.0429	0.0675	0.0047	0.0098	0.0110	0.0051
	(0.00)	(0.16)	(0.09)	(0.00)	(0.00)	(0.00)	(0.74)	(0.01)	(0.73)
$\boldsymbol{R^2}$	0.44	0.50	0.27	0.71	0.50	0.41	0.55	0.42	0.41
$\boldsymbol{R_M^2}$	0.27	0.33	0.19	0.38	0.28	0.19	0.37	0.27	0.39

This table reports the results of estimating equation (8) where excess holding period returns are based on swap rates. The sample period ranges from January 2006 to July 2013 and the estimation is based on weekly data covering 343 observations. Numbers in parentheses represent p-values based on Newey-West (HAC) covariance estimators. $\boldsymbol{R_M^2}$ denotes the R^2 of a regression without and credit risk factors.

Table 23: Descriptive Statistics (1)

Country	$\boldsymbol{\mu_{\overline{rx}}}$	$\boldsymbol{\sigma_{\overline{rx}}}$	$\boldsymbol{Min}$	$\boldsymbol{Max}$
Austria	0.0020	0.0201	-0.0560	0.0881
Belgium	0.0036	0.0359	-0.1077	0.1877
France	0.0007	0.0172	-0.0464	0.0619
Ireland	0.0153	0.1168	-0.2996	0.5503
Italy	-0.0022	0.0540	-0.1405	0.1961
Netherlands	0.0005	0.0089	-0.0246	0.0293
Portugal	0.0221	0.2182	-0.3649	0.8833
Slovakia	0.0020	0.0201	-0.0560	0.0881
Spain	-0.0071	0.0426	-0.1065	0.2042

This table shows the mean ($\mu_{\overline{rx}}$), standard deviation ($\sigma_{\overline{rx}}$), minimum (Min), and maximum (Max) of the average excess holding period returns as defined in (6) over the full sample period ranging from January 2006 to July 2013.

Table 24: Descriptive Statistics (2)

Country	$\boldsymbol{\mu_{\overline{cf}}}$	$\boldsymbol{\sigma_{\overline{cf}}}$	$\boldsymbol{Min}$	$\boldsymbol{Max}$
Austria	72.5154	68.0455	1.9025	254.8562
Belgium	90.7673	94.1749	2.9325	386.8506
France	64.0948	70.3522	1.9625	264.5328
Ireland	218.9003	225.3261	2.5100	905.1741
Italy	143.3497	143.7756	11.6725	550.1658
Netherlands	45.4158	42.9783	1.7450	151.3550
Portugal	235.9594	292.3888	7.2850	1028.6232
Slovakia	96.1068	86.3781	6.6575	319.4032
Spain	144.1256	149.3124	4.0825	556.3256
$\overline{\boldsymbol{cf}}^{(i)} = \frac{1}{4}\left[cf^{(i,2)} + cf^{(i,4)} + cf^{(i,6)} + cf^{(i,8)}\right]$				

This table shows the mean ($\mu_{\overline{cf}}$), standard deviation ($\sigma_{\overline{cf}}$), minimum (Min), and maximum (Max) of the average forward CDS spreads as defined above for the full sample period ranging from January 2006 to July 2013.

Table 25: Risk Premium Volatility

Country	$\sigma_{\overline{rx}}$	σ_{MRP}	σ_{ECRP}	σ_{CCRP}	σ_{TCRP}
Austria	0.0201	0.0098	0.0099	0.0129	0.0163
Belgium	0.0359	0.0269	0.0451	0.0050	0.0454
France	0.0172	0.0053	0.0114	0.0053	0.0126
Ireland	0.1168	0.1153	0.1683	0.0309	0.1711
Italy	0.0540	0.0393	0.0603	0.0334	0.0689
Netherlands	0.0089	0.0022	0.0040	0.0058	0.0071
Portugal	0.2182	0.1255	0.1891	0.0150	0.1897
Slovakia	0.0201	0.0057	0.0087	0.0104	0.0136
Spain	0.0426	0.0224	0.0198	0.0013	0.0198
Average	0.0593	0.0392	0.0574	0.0133	0.0605

This table shows the standard deviations of average excess holding period returns as well as the standard deviations of the estimated market risk premium (MRP), euro-zone credit risk premium ($ECRP$), country-specific credit risk premium ($CCRP$), and total credit risk premium ($TCRP$) of the baseline model given by equation (7).

Table 26: Risk Premium Volatility – Alternative Model

Country	$\sigma_{\overline{rx}}$	$\sigma_{MRP^{(A)}}$	$\sigma_{TCRP^{(A)}}$
Austria	0.0201	0.0070	0.0164
Belgium	0.0359	0.0142	0.0297
France	0.0172	0.0072	0.0152
Ireland	0.1168	0.0774	0.1366
Italy	0.0540	0.0213	0.0498
Netherlands	0.0089	0.0026	0.0079
Portugal	0.2182	0.0239	0.1946
Slovakia	0.0201	0.0041	0.0171
Spain	0.0426	0.0164	0.0278
Average	0.0593	0.0194	0.0550

This table shows the standard deviations of average excess holding period returns as well as the standard deviations of the estimated market risk premium ($MRP^{(A)}$) and the total credit risk premium ($TCRP^{(A)}$) of the alternative model given by equation (10).

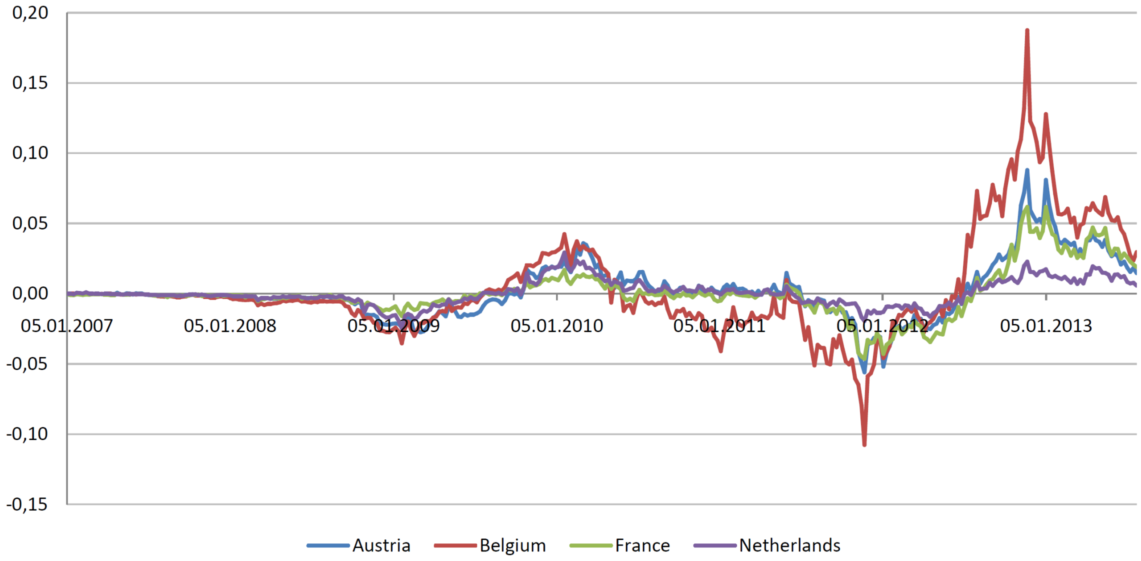

Figure 1: Average Excess Holding Period Returns ($\overline{rx}_t^{(i)}$) – Core Countries

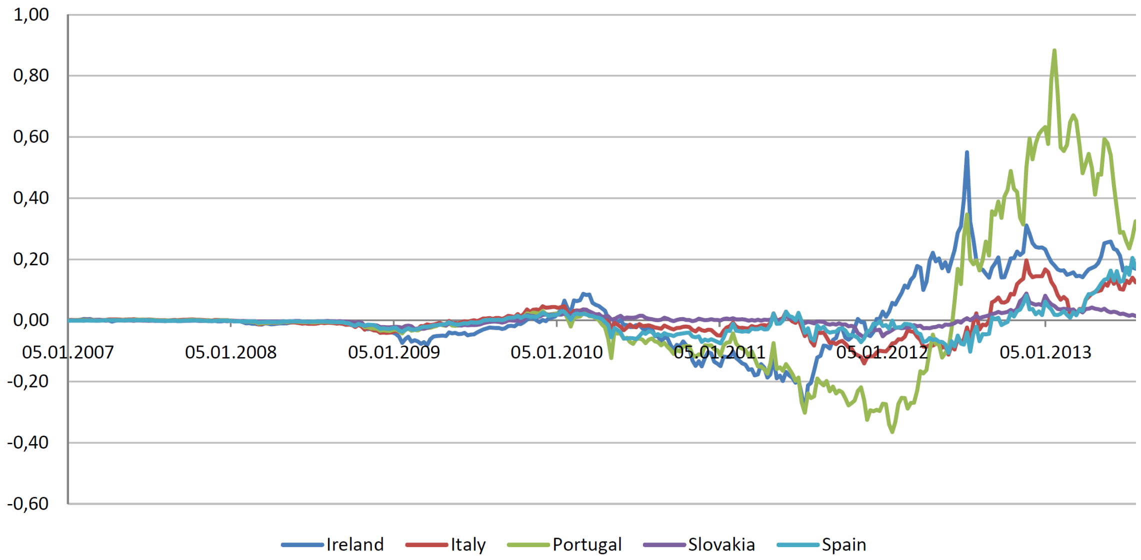

Figure 2: Average Excess Holding Period Returns ($\overline{rx}_t^{(i)}$) – Peripheral Countries

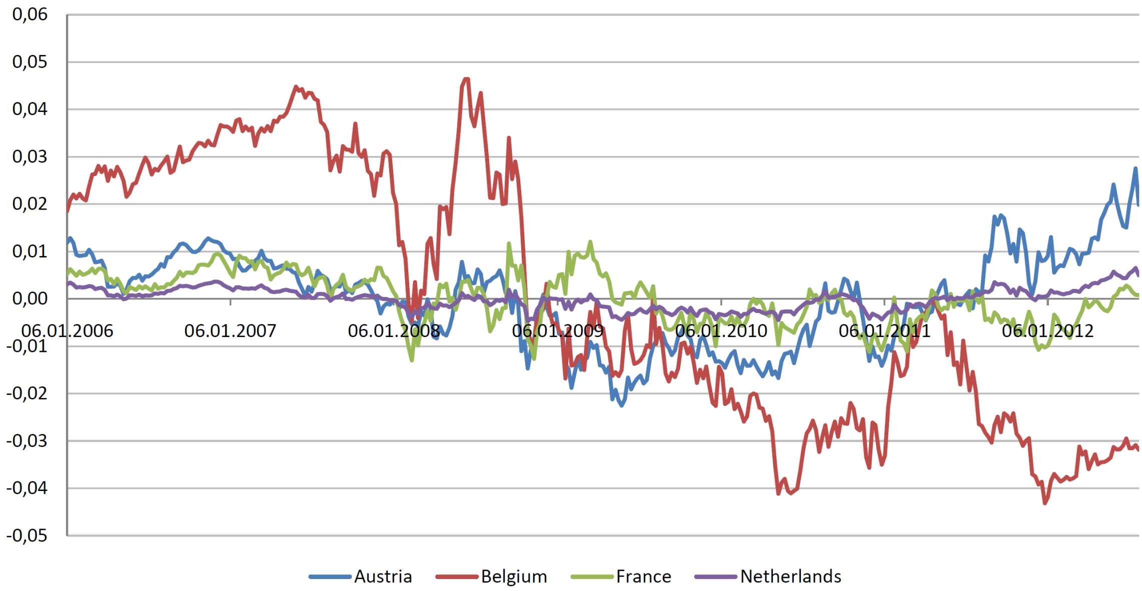

Figure 3: Market Risk Premium (MRP) – Core Countries

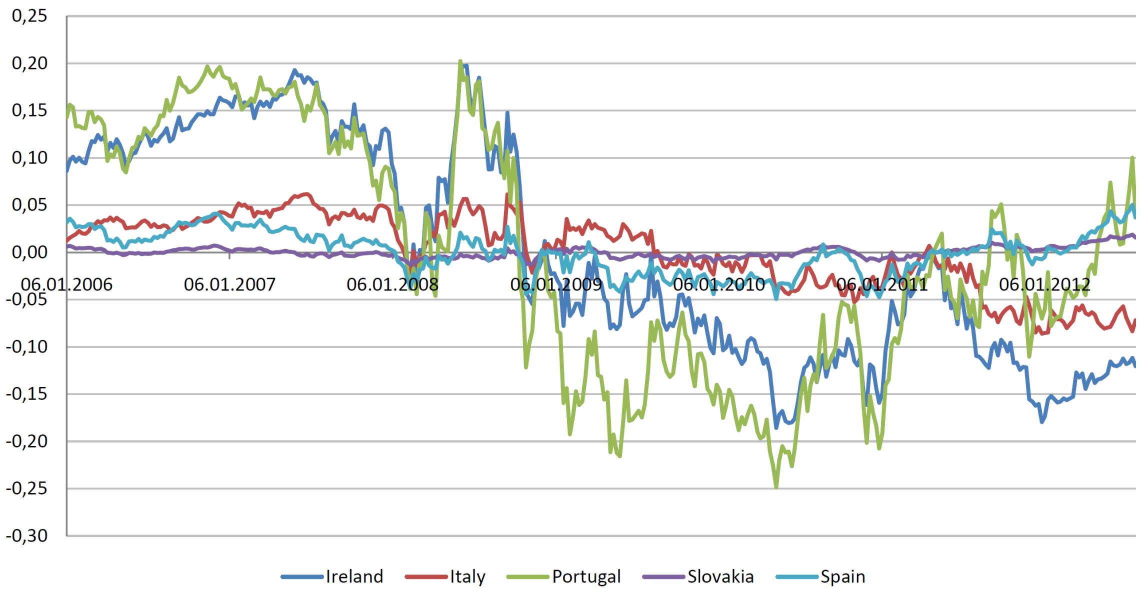

Figure 4: Market Risk Premium (MRP) – Peripheral Countries

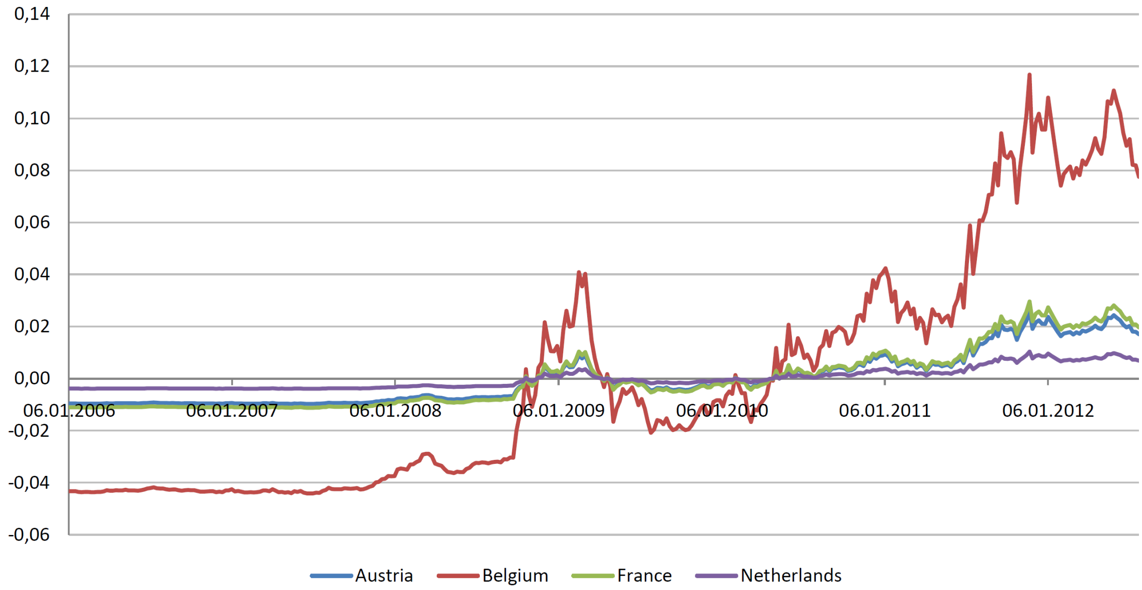

Figure 5: eurozone Credit Risk Premium (ECRP) – Core Countries

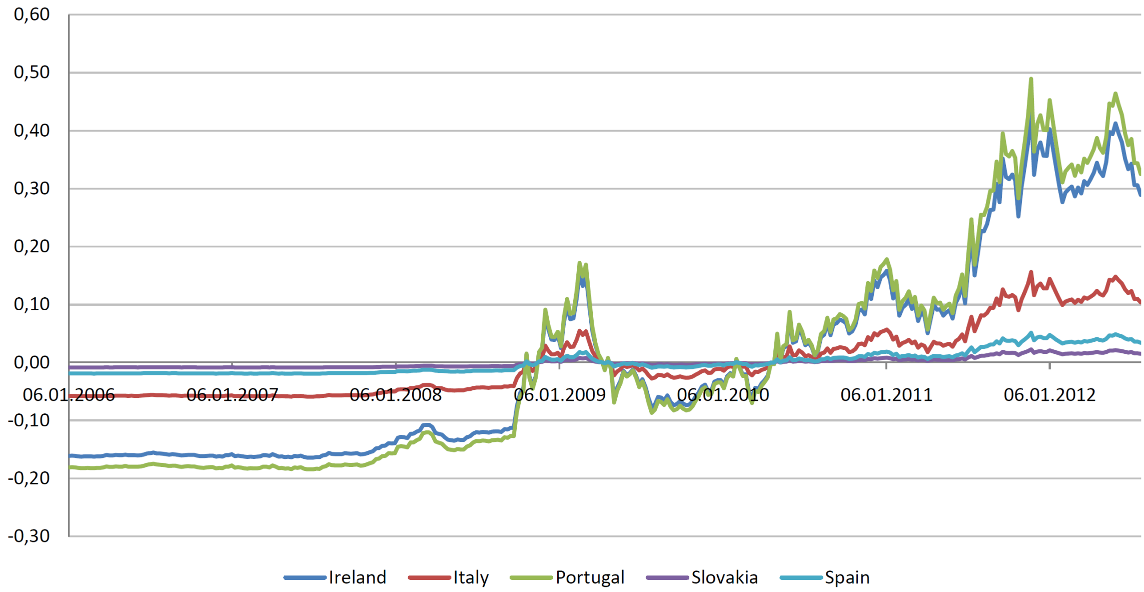

Figure 6: eurozone Credit Risk Premium (ECRP) – Peripheral Countries

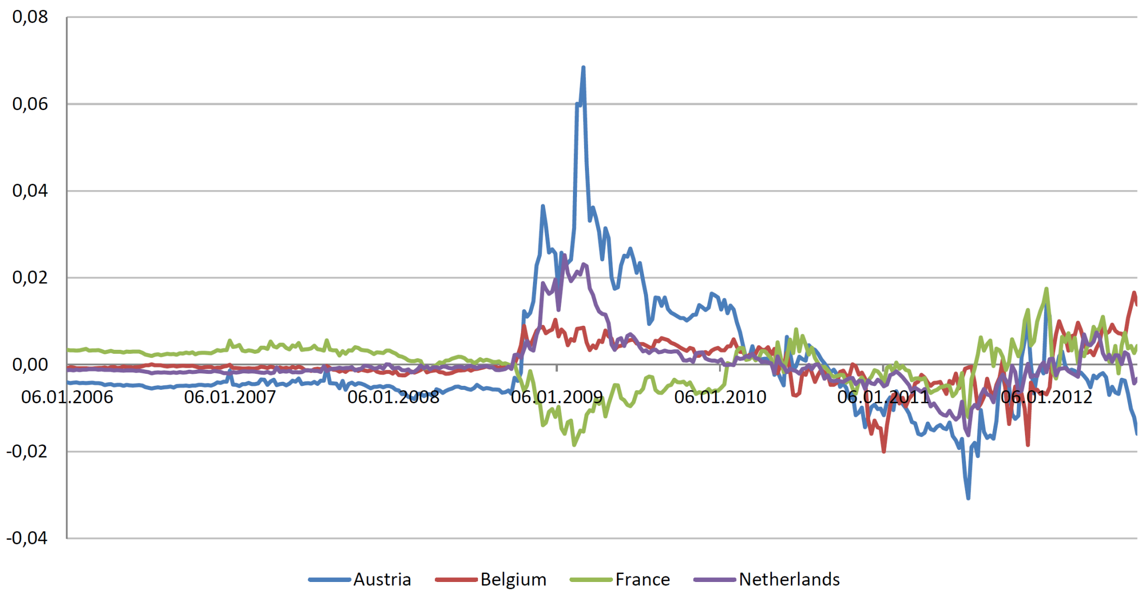

Figure 7: Country Credit Risk Premium (CCRP) – Core Countries

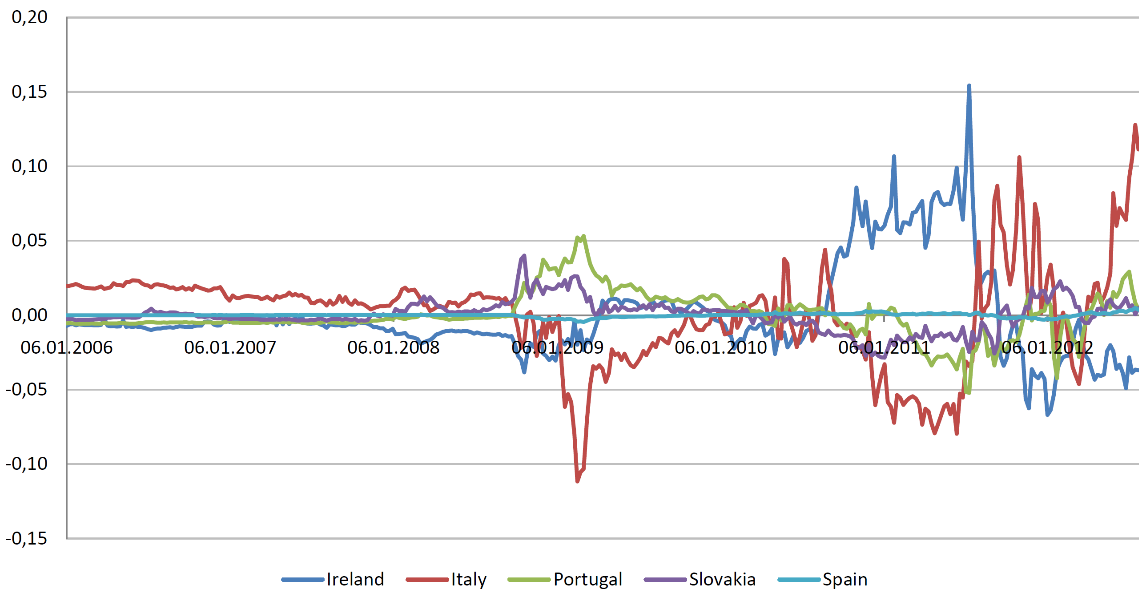

Figure 8: Country Credit Risk Premium (CCRP) – Peripheral Countries

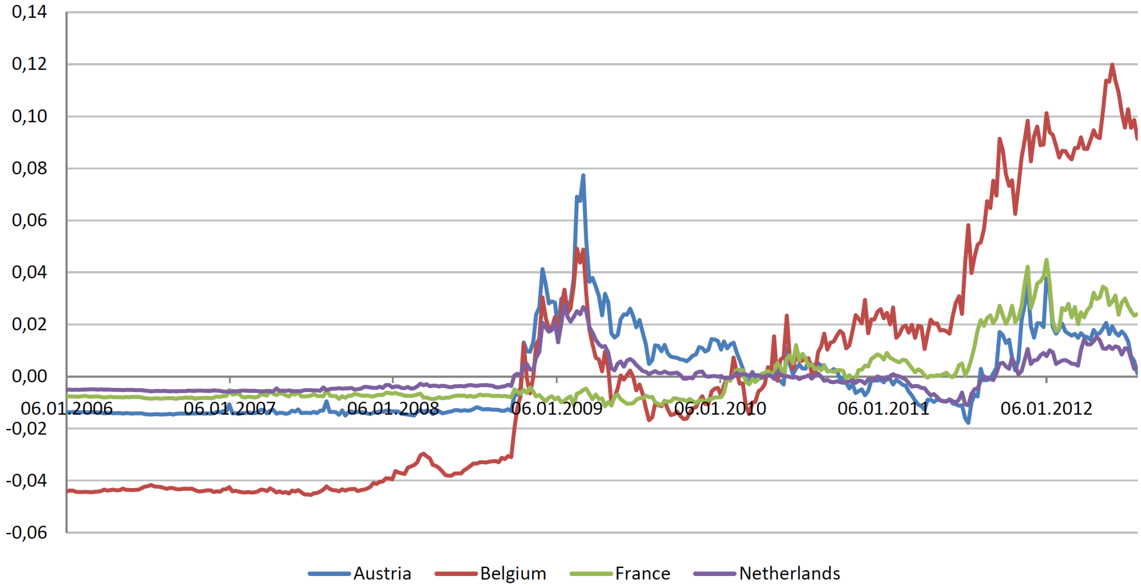

Figure 9: Total Credit Risk Premium (TCRP) – Core Countries

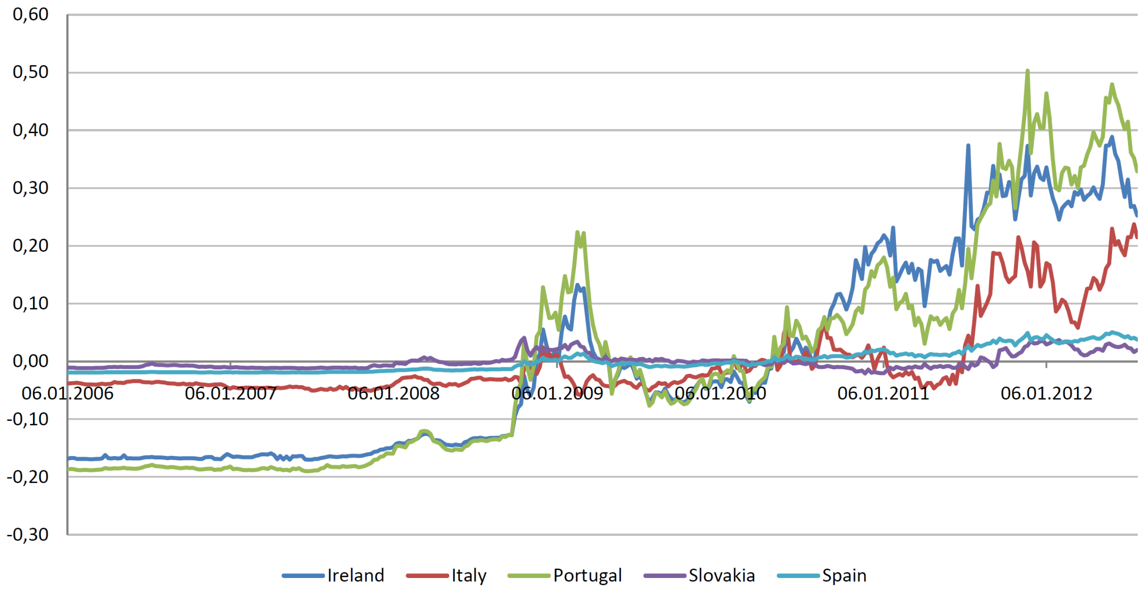

Figure 10: Total Credit Risk Premium (TCRP) – Peripheral Countries

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