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Cross Asset Research

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Sovereign risk spill-over into Euro corporate spreads

- We document and quantify the spill-over of sovereign risk onto corporate credits throughout the eurozone.
- We characterize the dynamics of spread movement in Euro corporates and show how this has changed over time due to the effects of the sovereign crisis.
- We show that when analyzing risk exposures in a portfolio of European corporate bonds, it has become important to partition by country, in addition to, or even instead of, partitioning by industry.
- We document a clear relationship between the peer spreads of corporate bonds in a given country over industry-matched German corporates and the sovereign spread of the country of domicile: once sovereign spreads exceed 100bp, every additional 100bp of sovereign spread is associated with about 50bp of corporate peer spread.
- We introduce changes to the POINT Global Risk Model that account for the sovereign risk exposures in European corporate bonds. We document the advantages of the specific model selected for implementation over several possible alternatives, and provide some examples of the effect of the new model on projected portfolio risk.
- How much sovereign exposure is embedded in a given corporate bond position? We propose a model that can be applied at the level of individual issuers, both for purposes of hedging the sovereign risk in a corporate portfolio, and for the decomposition of corporate spreads into sovereign and corporate components.

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Motivation

Throughout the past three years, concerns about the financial viability of peripheral European sovereigns, and even of the monetary union itself, have dominated the investment risk landscape in Europe and across the globe. As the contagion has spread from one country to another, and as successive rescue packages have been proposed, debated and implemented, waves of retrenchment and risk appetite have flowed across global markets. It is not particularly surprising that the credit spreads of European corporations have been carried along with these waxing and waning tides.

We systematically study the spread changes in European corporate credits in an attempt to characterize the extent to which sovereign spread volatility has spilled over into different sectors of the European corporate bond and CDS markets. Is this effect felt more keenly in some industrial sectors than others? Is this a concern only for corporates domiciled in peripheral countries, or does it affect those in core countries as well? Is it possible to measure the exposure of a corporate bond portfolio to sovereign risk?

We analyse the effect of peripheral EMU sovereign risk on the spreads of European corporate bonds. There is strong evidence that sovereign spreads beyond a certain level translate into additional spread premium for the domestic corporate debt market, making the access to capital in the affected geographies more difficult and expensive. While corporate sectors in peripheral markets (e.g., Italy and Spain) are affected the most, the effect is also significant for core European issuers[1]. We present and discuss several alternate specifications of a credit risk model for European corporate bonds. We show that the proportion of systematic risk in bond excess returns has dramatically increased over recent years and a significant portion of this risk is attributed to geographic segmentation or domestic sovereign risk. Our results suggest that the geography factor has become a dominant risk component and, as a result, should be carefully accounted for. We propose a risk model specification that efficiently represents the sovereign dimension in eurozone corporate risk.

Finally, we use a statistical technique to attribute the credit risk and spread premium of EMU corporate issuers to sovereign risk. The proposed decomposition can be used to identify companies and sectors that are most affected by the changes in sovereign spreads.

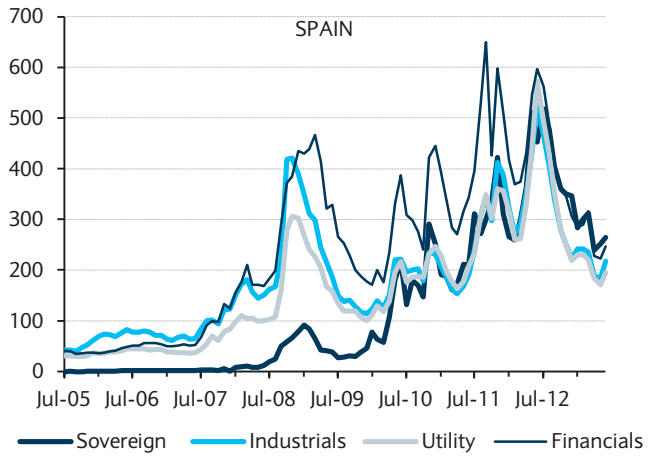
Sovereign risk has "spilled over" to corporate markets

Spread levels across corporate sectors have moved with sovereign spreads

We begin with an overview of how the spread environment has evolved over the past few years in two key European countries: Spain and Italy. Similar developments can be seen for issuers domiciled in Spain (Figure 1) and Italy (Figure 2). Before the global financial crisis of 2008, sovereign spreads (relative to the German Treasury curve[2]) were low and stable; average corporate bond spreads were significantly higher, but fairly stable at levels of about 50bp to 100bp. With the advent of the financial crisis in 2007-2008, there was a widening of corporate spreads – mildly at first, then more dramatically after the Lehman default in September 2008. Sovereign spreads were largely unaffected at this point, and clearly followed a different dynamic. The first big wave of sovereign spread risk arrived in early 2009, in the aftermath of the crisis, but corporate spreads remained far wider than those of sovereigns,

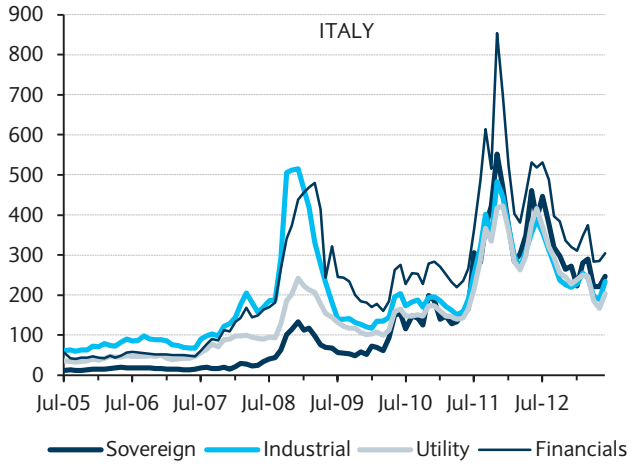
[1] There may be a spillover effect onto non-European corporate spreads as well. We believe that this effect is smaller; in any event, it is outside the scope of the current study, which focuses on European corporate spreads.
[2] Unless otherwise noted, we adopt the convention of expressing corporate and sovereign spreads relative to the German Treasury curve. Later in this article, we explore other spread relationships within these markets.

Figure 1
Historical Spreads of Spanish-Domiciled Bonds



Source: Barclays Research

Figure 2
Historical Spreads of Italian-Domiciled Bonds

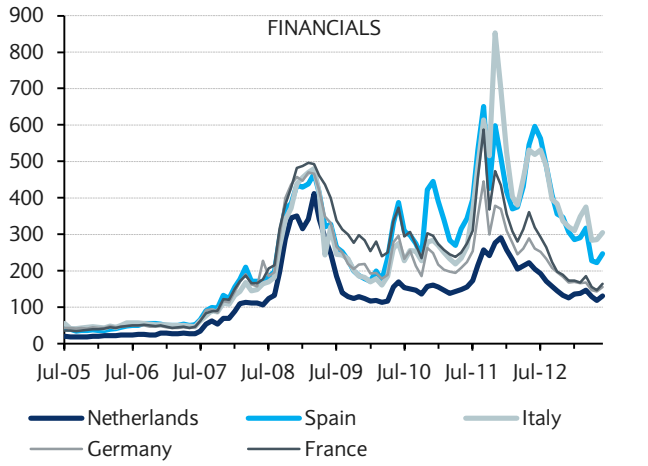


Source: Barclays Research

even as they recovered over the course of 2009. As the focus of risk shifted to sovereigns in 2010, the average spreads of non-financial corporate issuers domiciled in Spain converged towards the Spanish sovereign spread. Spanish financials seem to have largely moved together with the sovereign spread, but remained significantly wider than the sovereign until 2012. Similar patterns, with minor differences, are shown for Italian-domiciled bonds in Figure 2. Another interesting development in both these markets is that non-financials have been trading through their respective sovereigns over the past two years.

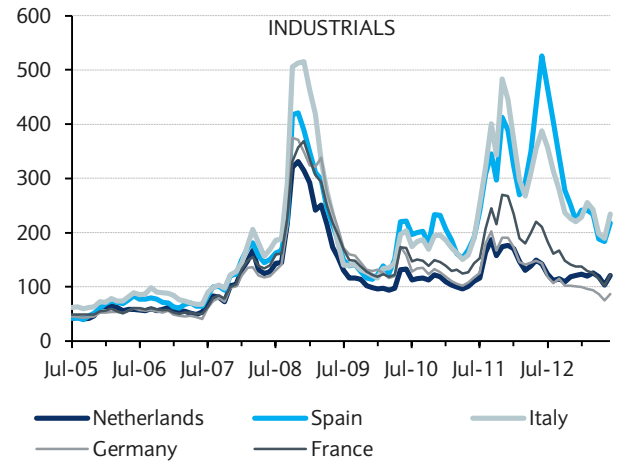
A more nuanced view of the way spreads have moved within the European corporate bond market can be obtained by comparing the spreads of bonds within the same sectors domiciled in different countries. We limit ourselves to five countries that have sufficiently large samples of corporate bond issuers: Germany, France, the Netherlands, Spain and Italy. Figure 3 shows the average spreads of financial issuers in each of these countries; Figure 4 shows the corresponding industrial spreads. It is apparent from the different scales on the two figures that financial spreads have widened by substantially more than industrial spreads. Furthermore, the industrial spreads in Figure 4 show a clear divergence between issuers from peripheral countries and those from core countries, starting in 2011. This divergence is not as

Figure 3
Financial Spreads by Country of Domicile



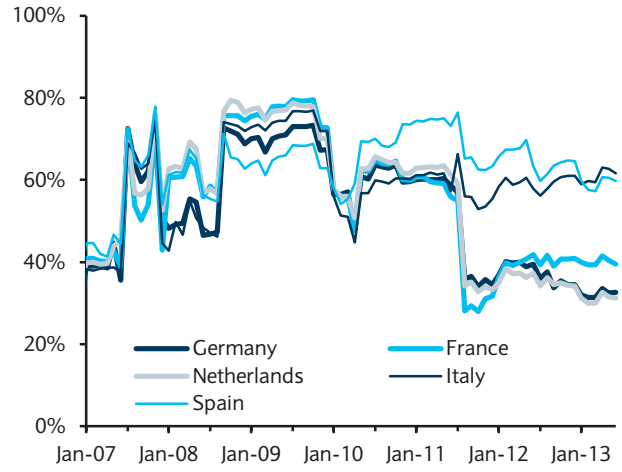
Source: Barclays Research

Figure 4
Industrial Spreads by Country of Domicile



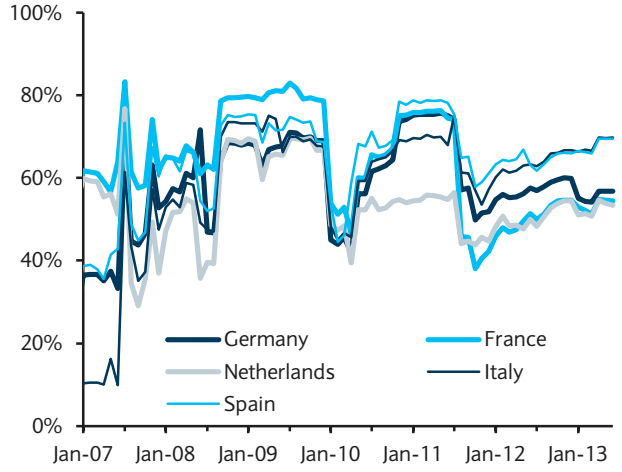
Source: Barclays Research

Figure 5
Correlations of relative spread changes of industrial bonds with sovereigns, by country of domicile



Note: Monthly data, exponential weighting, 12-month half-life
Source: Barclays Research

Figure 6
Correlations of relative spread changes of financial bonds with sovereigns, by country of domicile



Note: Monthly data, exponential weighting, 12-month half-life
Source: Barclays Research

clear in the financial sector; the spreads of financials, even from core countries, have widened quite substantially, especially at the peak of the crisis in late 2011.

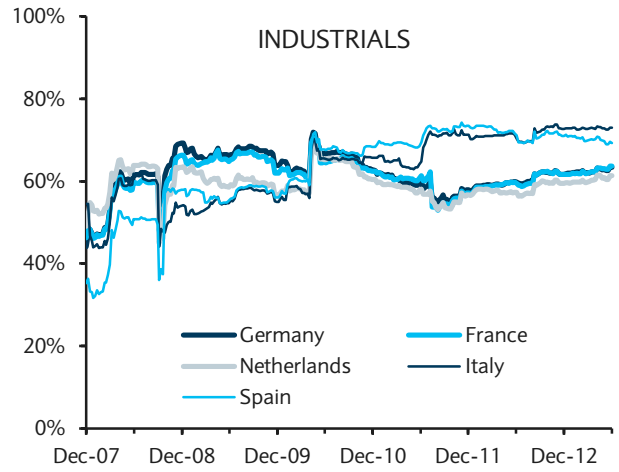
The evolving dynamics of spread changes

We have seen that spreads of all European corporate bonds have responded to some extent to episodes of sovereign risk, but that the strength of this relationship seems to vary by sector and country of domicile. We next take a closer look at the extent to which the spreads in different sectors of the European credit market are correlated with changes in sovereign spreads, and how the correlation structure has changed over time.

For the purposes of this exercise, we have chosen to represent sovereign spreads as the average spread of Italian and Spanish government bonds over the German Treasury curve. We measure the m/m relative spread changes of this sovereign benchmark, line these up with the corresponding monthly relative spread changes of different corporate sectors, and compute correlations. Figure 5 plots these correlations for industrial issuers domiciled in different European countries. Perhaps unsurprisingly, we see a marked divergence between the behaviour of Spanish and Italian industrials, which continue to maintain high correlations of 60-80% with their sovereign spreads all the way through to the present, and that of core industrials, which jumped down to a much lower level of correlation around the middle of 2011. Figure 6 illustrates that within financials, the divergence by country of domicile is much less pronounced. On average, German, French and Dutch issuers in the financial sector have remained more exposed to sovereign risk than their industrial counterparts.

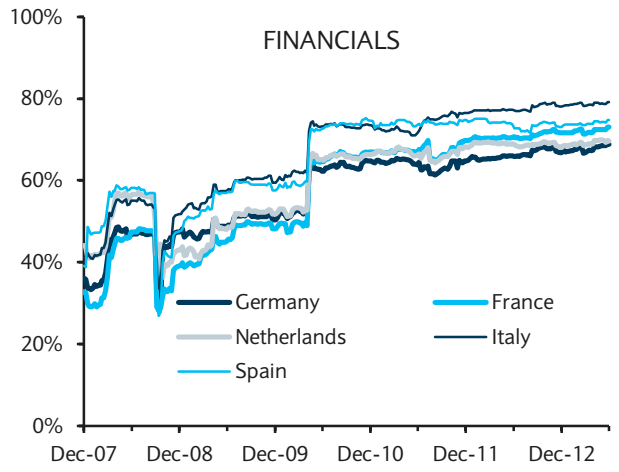
Given the rapid pace at which events have unfolded in the sovereign crisis, it would be interesting to look at correlations based on higher-frequency data. We have repeated our correlation analysis using weekly data from CDS markets, both to enable this higher-frequency analysis, and because of the potential use of CDS for hedging purposes. In the CDS space, we use the relative changes in the average spread of Spanish and Italian sovereign CDS to represent our sovereign risk factor; we then choose several representative issuers from each country/industry cell of the Euro Corporate bond index, and take an average of their CDS spreads to represent the spread of each cell. The relative spread change correlations of industrial issuers from different domiciles with sovereign spread

Figure 7
Correlations of relative spread changes of industrial and sovereign CDS, by country of domicile



Note: Weekly data, exponential weighting, 52-week half-life
Source: Barclays Research

Figure 8
Correlations of relative spread changes of financial and sovereign CDS, by country of domicile



Note: Weekly data, exponential weighting, 52-week half-life
Source: Barclays Research

changes are shown in Figure 7, and the corresponding correlations for financial issuers are shown in Figure 8. Once again, we see clear evidence of decoupling in the industrial markets, with CDS spreads of industrial issuers from Spain and Italy becoming very highly driven by sovereign risk over the last two years, while industrials from core countries indicate lower levels of correlation. In financials, however, this decoupling is much less pronounced; the sovereign risk correlations of financials from all five countries shown have remained high and stable.

Another mathematical tool that can help us characterize the dynamics of spread markets is principal component analysis (PCA). In this technique, we first take the historical spread changes over a given time period and calculate a correlation matrix. Applying PCA to this matrix identifies the key patterns of changes that tend to drive the market and also measures how much of the variance observed in the data can be traced to the effect of each factor.[3] To illustrate the profound changes that have affected the European credit markets over the last few years, we carry out this analysis twice: once using data from the global financial crisis of 2008, and once near the peak of the European sovereign crisis in 2011.

It was clear that our analysis should be based on relative spread changes (monthly spread change as a percentage of beginning-of-month spread) rather than absolute spread changes (in bp). This derives from our extensive research on Duration Times Spread[4] (DTS), in which we showed conclusively that systematic spread changes tend to take this form: when a wave of risk hits a sector, wider spreads tend to widen by more. In the initial stages of the sovereign crisis, we found that this model formed a good empirical fit to the spread movement of European sovereign spreads as well.[5] In the "risk-on, risk-off" behaviour that has characterized all European spread products throughout the crisis period, the DTS framework has once again shown its value. Even a single market-wide European spread

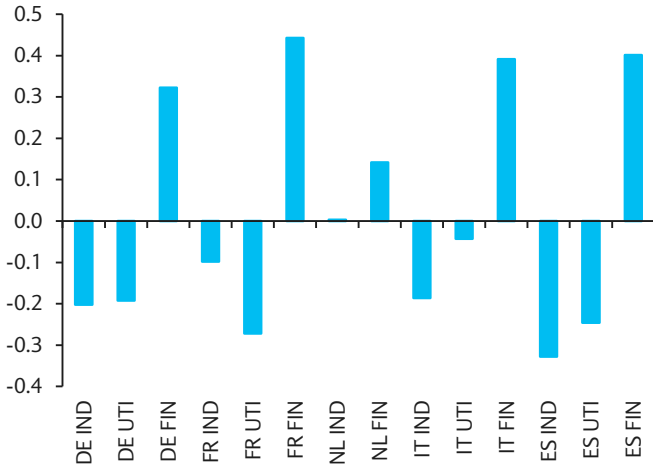
[3] One well-known financial application of PCA is its use to characterize the typical patterns of yield changes across the US Treasury Curve. It has been shown that the first principal component, which can be identified roughly as a parallel shift in yields, can explain about 90% of yield variance; adding in the contributions of the next two components, which correspond roughly to yield curve twist and curvature, brings the explanatory power up to about 97%.
[4] Ben Dor, A., Dynkin, L., Houweling, P., Hyman, J., van Leeuwen, E. and Penninga, O., "A New Measure of Spread Exposure in Credit Portfolios", Lehman Brothers, 2005.
[5] See Ben Dor, A., Desclée, A., Hyman, J., Polbennikov, S., "Managing European Sovereign Spread Risk", Barclays, 12 August 2010, as well as an update published 5 August 2011.

factor, expressed as a relative spread change, could capture a fairly large percentage of spread variance. However, the different sectors of this market have not always moved in perfect lockstep. By applying our PCA analysis to relative spread changes, we seek finer patterns within these market developments.

We started with the same dataset used above, based on monthly relative spread changes for European corporate bonds partitioned by sector and country of domicile. In each case, the dominant principal component (not shown) was one in which spreads in all sectors moved in the same direction, widening (or tightening) by approximately the same relative amount across all sectors and domiciles. This is expected; the first principal component is generally considered to represent the market factor. We found the second principal component much more interesting; the changes in its shape over time indicate a shift in the typical patterns of spread change across the market. Figure 9 shows the second principal component calculated for the European corporate bond market as of December 2008, using a trailing window of data, exponentially weighted with a half-life of 12 months. In this data sample, driven primarily by data from 2007-08, the driving force was the global financial crisis, with its epicentre in the US financial industry, not in Europe. As seen in Figure 9, the key systematic relative value opportunity during this period was a widening or tightening of financials relative to non-financials. In Figure 10, we repeat the analysis near the peak of the sovereign crisis, calibrated using the same exponential weighting scheme as of the end of December 2011: in this period, the key systematic relative value pattern was peripheral versus core corporates. However, there is a distinct sector theme superimposed on this: the behaviour of core financials is somewhere between that of peripherals and core industrials.

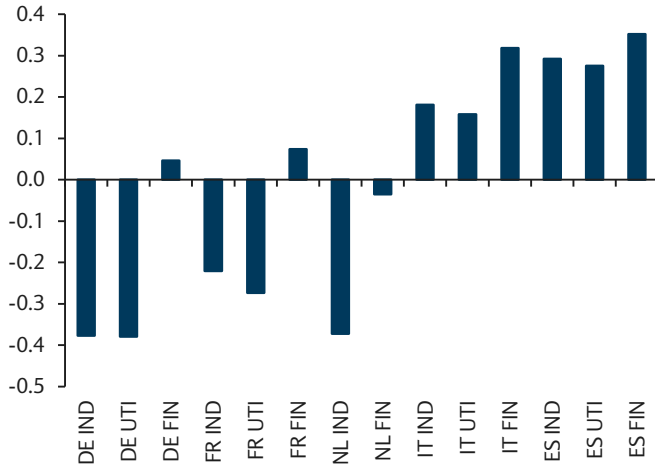
We repeated the PCA analysis using CDS data, and found roughly the same results. Figure 11 shows the second principal component for CDS spread changes before the Euro sovereign crisis. As for bonds, we see a pattern in which financial spreads widen (or tighten) relative to industrial spreads, in a manner fairly independent of the country of domicile. Figure 12 repeats this analysis during the sovereign crisis. The CDS data indicate a spread change pattern in which the combination of country and sector effects is more pronounced. As in Figure 10, the pattern is a combination of two themes, core versus peripherals and financials versus industrials. However, we now find core financials more sensitive to

Figure 9
Second principal component of spread change in European corporate bond market, December 2008



Note: Monthly data, exponential weighting, 12-month half-life
Source: Barclays Research

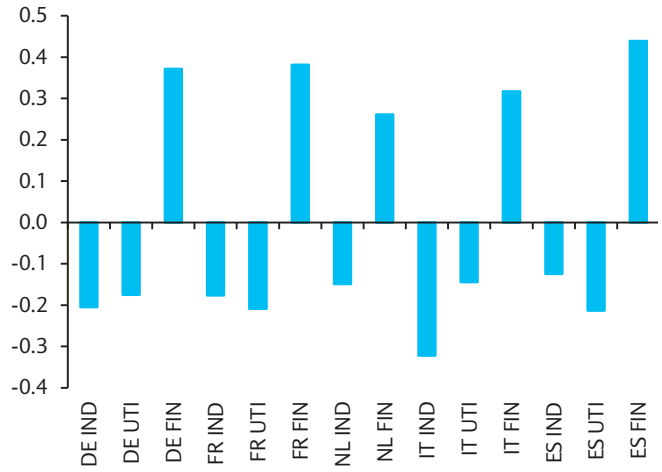
Figure 10
Second principal component of spread change in European corporate bond market, December 2011



Note: Monthly data, exponential weighting, 12-month half-life
Source: Barclays Research

Figure 11

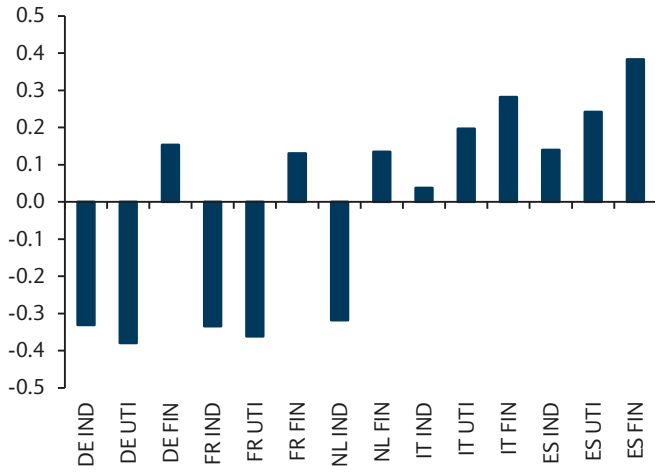
Second principal component of spread change in European CDS market, December 2008



Note: Weekly data, exponential weighting, 52-week half-life
Source: Barclays Research

Figure 12

Second principal component of spread change in European CDS market, December 2011



Note: Weekly data, exponential weighting, 52-week half-life
Source: Barclays Research

sovereign risk: as peripheral issuers widened, core-domiciled spreads tended to tighten for industrial and utility issuers, but widen for financials.

Speed of propagation

When risk flares up in sovereign markets, are the effects reflected in corporate spreads immediately, or only after some delay? To investigate this, we repeated our correlation analysis of relative spread changes in bond and CDS markets with the addition of a variable lag. We now measure the correlation between the relative spread change for sovereigns in period *t* with the relative change of the selected corporate spread in period *t+n*, where *n* is the number of periods of lag.

The results of this analysis are shown in Figure 13. The differences in the results for corporate bonds and CDS are striking. In the CDS space, the effect of sovereign spreads on corporate issuers is immediate. As we have seen before, the contemporaneous (lag 0) correlations are high, ranging from about 50% for corporates in core countries to 60% or 70% in peripheral countries. But if we introduce a lag of even just one or two weeks, we find that the correlations decline to near zero. In corporate bonds, for which we have chosen to use a dataset of monthly spreads, we are not able to test weekly lags, but we find that even at a lag of one month we see substantial correlations – in some cases, even larger than the contemporaneous ones. One possible explanation for this phenomenon is that it is a liquidity effect. If an increase in concerns about sovereign risk prompts investors to reduce exposures to corporate issuers deemed to be vulnerable, they are able to do so more quickly by buying CDS protection than by selling corporate bonds. If they would then continue to try to sell the bonds over the following month or two as opportunities arise, this could explain why corporate spreads might continue to rise in the wake of a sovereign spread wave.

Figure 13

Relative spread correlations of bonds and CDS from European corporate issuers with sovereign spreads at different lags, January 2008 – June 2013

		Corporate Bonds (Lag in months)			CDS (Lag in weeks)		
		Lag 0	Lag 1	Lag 2	Lag 0	Lag 1	Lag 2
Spain	Industrials	56%	56%	4%	65%	-1%	9%
	Utilities	53%	63%	10%	66%	-3%	10%
	Financials	68%	37%	7%	71%	-5%	7%
Italy	Industrials	69%	44%	11%	67%	10%	11%
	Utilities	69%	47%	13%	68%	1%	7%
	Financials	71%	35%	10%	74%	-1%	5%
France	Industrials	58%	39%	11%	54%	9%	10%
	Utilities	56%	36%	8%	42%	9%	10%
	Financials	54%	24%	17%	55%	0%	10%
Netherlands	Industrials	58%	32%	9%	52%	-1%	9%
	Financials	58%	45%	25%	52%	-2%	4%

Source: Barclays Research

What is the sovereign exposure in a European corporate credit?

Estimating sovereign spread exposures

A key concern for investors in European corporate bonds is the estimation and management of sovereign risk exposures. For a particular portfolio of corporate bonds, this concern can be expressed as a set of related questions:

- To what extent is the portfolio exposed to a sudden widening of sovereign spreads in general, or those of a particular sovereign?
- How much of the credit risk of the portfolio can be attributed to sovereign risk?
- How much of the spread premium can be attributed to sovereign risk?
- How can we hedge the sovereign risk in a corporate portfolio?

Various approaches can be useful in addressing these questions, and can be supported by different types of empirical analysis. However, we have found that the terms “spread” and “sovereign risk” are used to refer to several different types of spread relationships and risks, and that special care is needed to make sure that we maintain clarity as we shift viewpoints. Therefore, we start by defining some terminology to help distinguish among them.

The different dimensions of eurozone corporate spreads

As we have studied the spreads of European corporates, and discussed them with different investors, we have found that there are several different types of spreads of possible interest. Each of these represents a slightly different viewpoint, and can be useful for certain types of analysis. To help illustrate this point, the figures on Pages 9 and 10 show four distinct ways of looking at the spreads of European corporate bonds. Figure 14 summarizes the average yields of government bonds and financials in Germany, Spain and Italy as of September 2011, near

the height of the crisis. The next few figures give a graphical representation of four different ways of viewing these yields in terms of spread relationships. While the same yields are shown in each case, each of these viewpoints can lead to a different set of modelling assumptions by which to manage portfolio risk. Each has its advantages and disadvantages. We will first present these different approaches to measuring spreads, and then discuss their strengths and weaknesses by way of some empirical studies.

In Figure 15, the overall yield of Financials in each country is evaluated as a spread over the German Treasury curve. This corresponds to the way spreads tend to be reported and quoted in the market; much of the analysis found earlier in this paper therefore is based on this paradigm. For example, Figure 3 reported time series data for spreads of this type, and Figure 5 through Figure 9 calculated correlations of these spreads with sovereign spreads. When analyzing spreads of this type, we found clear evidence that changes in these spreads of financial bonds in different countries have been highly correlated with each other and with the changes in sovereign spreads.

FIGURE 14

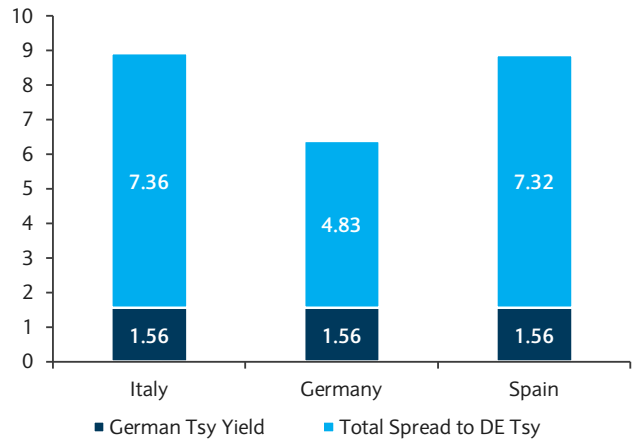
Average Yields (%) of 5y-10y Treasuries and Financials, from three countries, as of September 30, 2011

Country	Treasuries	Financials
Germany	1.56	6.39
Spain	4.65	8.88
Italy	5.31	8.92

Source: Barclays Research

Figure 15

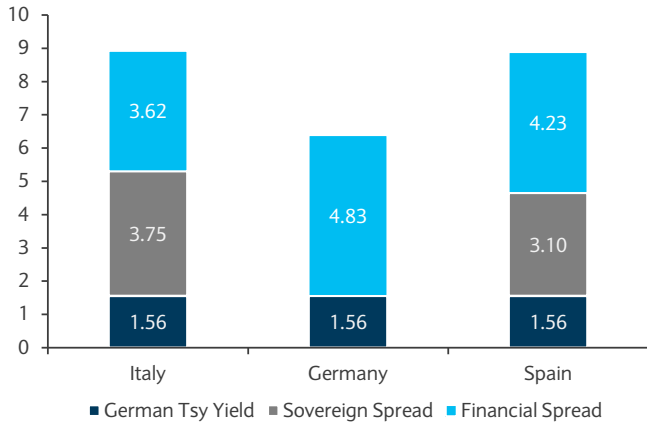
Financial yields broken down as overall spreads over German Treasury curve



Source: Barclays Research

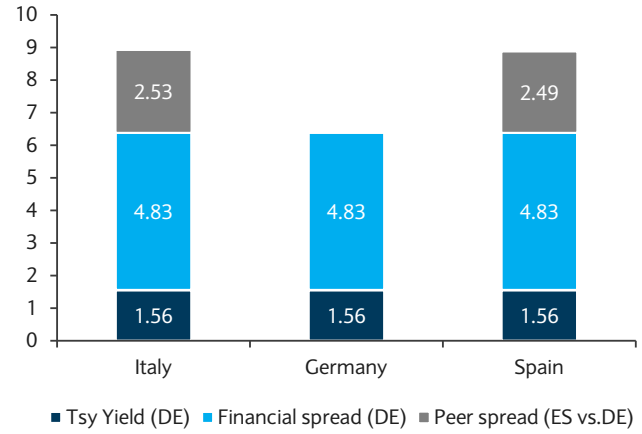
Figure 16

Financial yields as spreads over their respective domestic sovereign curves



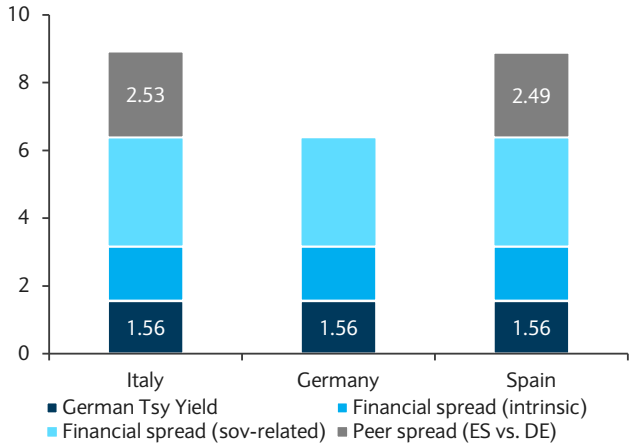
Source: Barclays Research

Figure 17
Financial yields as country spreads over German corporate peers



Source: Barclays Research

Figure 18
Financial spreads as country spreads over German corporate peers… which contain some sovereign risk



Source: Barclays Research

There have been times during which the spreads of corporate bonds in Spain and Italy tended to move nearly in lockstep with the sovereign spreads. We saw evidence of this phenomenon in Figure 1 and Figure 2. This would suggest that perhaps the most sensible way to view Spanish financials is via their spread to the Spanish sovereign curve. This viewpoint is reflected in Figure 16. Spanish and Italian corporate bonds are here seen to trade at a spread over the local sovereign curve; this, in turn, can be characterized by a sovereign spread to the German curve.

Figure 17 takes a different approach to spreads. Here we assume that the spread to the curve that the market has determined for the average German financial issuer gives us the best characterization of the generic risk of a European financial. For issuers in other countries, we look at their spread relative to German peer corporates, and consider this as an additional penalty that the market is imposing due to country-specific risk. In what follows, we will find this "peer spread" viewpoint particularly useful in modelling risk.

Figure 16 and Figure 17 both break down the spreads of peripheral financial bonds into two components, corresponding to sovereign and corporate risk, using two different approaches. Yet neither one attempts to break down the spread of German financials. However, one of the running themes throughout the first part of this article was to emphasize that the spreads of German financials have indeed been strongly linked to those of peripheral sovereigns and corporates. Figure 18 illustrates this by showing that German financial spreads themselves are composed of two components – one due to the innate riskiness of the corporate issuers, and one due to their exposures to peripheral sovereign risk. This figure underscores an ambiguity that often makes it difficult to discuss "sovereign risk": this phrase can be used either in a generic sense, referring to exposures to all European sovereigns, or to specifically refer to the risk of being domiciled in a particular country. Figure 18 depicts German financials as being subject to two types of systematic risk: the generic effect of the sovereign crisis events on financial institutions, and other risks specific to the financial industry. Peripheral financials are considered subject to both of these, as well as to a country-specific spread representing the further risk from being domiciled where they are.

Figure 18 helps to reconcile between the "overall spread" viewpoint of Figure 15, in which we have shown that German financials have a significant sovereign exposure, and the "peer spread" viewpoint of Figure 16, in which only peripheral financials have sovereign spread

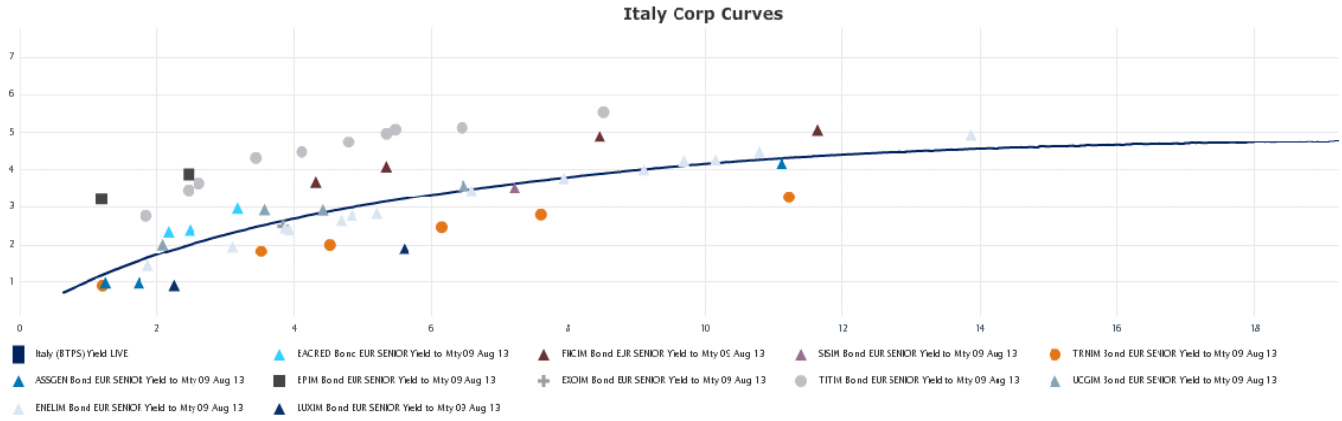
components. We now understand that in the peer spread paradigm, the country spreads based on the country of domicile represent exposures to that specific sovereign, which are above and beyond the generic effect of the sovereign crisis on all European financials. However, note that we have not assigned numeric values to these two components. To actually carry out the decomposition of German financial spreads into the two components shown is not so simple in practice. We can attempt to approximate it by empirical analysis of past returns, but any such model will be subject to estimation errors.

As we proceed in our analysis, it is important to remember that we are most interested in the way all of these quantities change over time. When looking at a single snapshot of the market, as in Figures 15 through 18, all of these different ways of measuring spreads are equivalent. One can seem more intuitive than another, but mathematically all add up to the same yields. The distinctions among these different approaches become important when we look at how they evolve over time. Which characterization of spreads does the best job of capturing the systematic spread changes in different months? Which will lead to the most efficient techniques for hedging these risks?

Analyzing corporates in terms of spread to the local sovereign curve

We now turn our attention to the task of measuring the sovereign exposures of corporate bonds. One way to express our goal is that we seek the "beta" of a given corporate spread to changes in the sovereign spread of its government. The simplest approach to this would be to assume that $\beta = 1$; this is consistent with the notion of measuring individual bond spreads relative to the domestic government curve, and assuming that as the government curve moves, the corporate bonds maintain a constant spread to this curve. This, of course, is the paradigm illustrated in Figure 16, in which corporate yields are explained as spreads over their local government yield curve. This approach is supported by Figure 1 and Figure 2, which show that since the middle of 2010, the average yields of industrial bonds in both Spain and Italy have largely followed the average yields of their respective sovereigns. As a result, some investors have sought to adopt this approach across the board. A yield curve is constructed from the bonds issued by each eurozone sovereign, and corporate bonds are evaluated in terms of their spreads to the domestic sovereign curve. An example of such an analysis is shown in Figure 19, which plots bond yields against maturity for various Italian corporate issuers, as well as the Italian government curve.

Figure 19
Spreads of Italian Corporate CDS over the Italian sovereign curve, as of August 9, 2013



Source: Barclays Live – Chart

We can see quite clearly that for quite a number of these issuers, bond yields seem to follow the government curve quite closely. By the same token, we find that for some issuers, spreads relative to the sovereign have become negative. In fact, this spread spans a wide range, from strongly negative to strongly positive.

The fact that some corporate issuers can trade through their domestic sovereign by so much underscores one difficulty with the paradigm illustrated in Figure 16, in which corporate yields are presumed to trade at a spread over their government counterparts. If, as the market seems to assume, corporations with sufficiently strong international operations are not directly linked to the yields of the domestic sovereign, then expressing the spread relationship in this way could distort our perceptions of risk. Such credits should not be expected to react one-for-one with any changes in sovereign yields; forcing such a relationship will lead to very strong negative correlations between the sovereign and corporate spreads, on which we would then need to rely to correctly model the risk of these higher-quality domestic corporates.

Another somewhat disconcerting result of this approach is that when we compare spreads across the region, the results can be counterintuitive. In Figure 16, it appears that the pure corporate component of spread for German financials is greater than those of either Italian or Spanish financials. Yet this is only because they are being compared to the much lower yields of the German treasury curve. In this paradigm, in which "sovereign risk" is assumed to relate only to the spread of the country of domicile, we do not capture the secular effect of cross-border sovereign exposures on all European corporate issuers.

We have identified two difficulties in working with spreads over the domestic sovereign. One is that it does not help us explain the spill-over effect of peripheral sovereign risk into core-country corporates. The second is that even within a given peripheral market, the wide dispersion seen in Figure 19 indicates that thinking in terms of spread over the domestic sovereign curve is not appropriate for all issuers at all times. Nevertheless, for a group of issuers near the middle of this chart, it could be a very useful tool for analyzing relative rich/cheap opportunities within the local corporate bond market.

Keying off spreads to German peers

We pointed out several shortcomings with the modelling of spreads over the domestic sovereign curve. The modified approach of finding the betas of each issuer to the domestic sovereign market instead of forcing them to 1 offers an improvement for analysis within a single sovereign market. However, this approach leaves us with uncertainty in the estimation of betas, and does not help us address the treatment of corporate bonds domiciled in Germany and other "core" European countries.

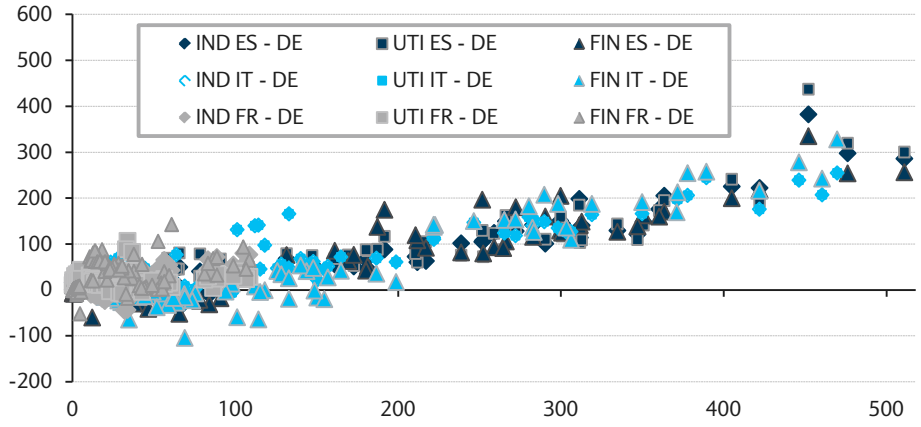
We now take a different direction, keying off of Figure 17, which focuses on the spread differentials between issuers from the same industry domiciled in different countries. We assume that the spreads of German issuers reflect industry-wide effects from all sources, both those deriving from the industry itself and those from market-wide exposure to sovereign or financial market risk. Issuers domiciled in countries whose sovereign spreads are themselves under pressure will then be subject to an additional country-specific risk factor. This behaviour is evident in Figure 3 and Figure 4, which show how the spreads of industrials and financials from different countries have tended to move together, with the spread over German peers providing an additional level of risk for peripheral issuers.

With this approach, we can highlight a very clear relationship between sovereign and corporate risk. We have found that once the spread of a given sovereign becomes elevated above a certain level, the additional spread over German peers for corporate issuers

domiciled there rises accordingly. This relationship is shown in Figure 20. For each corporate sector shown (defined by an Industry x Country grid), using a monthly time series of observations from July 2005 through June 2013, we plot the average spread over German same-industry peers against the CDS spread of the domestic sovereign. (That is, we plot the spread of Italian industrials over German industrials against the Italian sovereign spread, and the spread of French financials over German financials against the French sovereign spread.) The results show that for sovereign spreads below a threshold of about 100bp, there is no clear relationship, but for those above this level, about half of the sovereign spread spills over onto the domestic corporates as excess spread relative to their German peers. This relationship seems to hold up well for different countries and industries.

Figure 20

Spreads over German Peers (by Industry x Country) vs. Sovereign Spreads, July 2005 – June 2013



Source: Barclays Research

Managing and modelling risk in eurozone corporates

Having demonstrated the extent to which the behaviour of corporate spreads in Europe have been affected by considerations of sovereign risk, both on a systematic and country-specific basis, we turn our attention to portfolio management practice. What should a manager do to adapt to the new reality, and how should we change our tools for measuring and managing portfolio risk in this environment?

Finding the right partition

As a first step, we start with the way the portfolio's macro exposures are viewed. Typically, a "market structure" report may be used to view the portfolio's allocations to different market sectors, by market weight, contributions to spread duration, or contributions to DTS. For corporate bonds, in particular, the partition along which the portfolio's exposures are compared to those of the benchmark has traditionally been expressed in terms of industry groups. However, as summarized above, the sovereign risk crisis has led to clear performance divergence based on country of domicile. Thus, a portfolio that exactly matches the industry exposures of the benchmark, but differs in its country exposures, may appear to be completely passive while in fact being exposed to substantial risks. Clearly, to match the macro exposures of the benchmark as well as possible, we can switch to a two-dimensional partition, by country and industry, and match the benchmark exposures to all country-industry cells. There is no question that this should lead to more precise tracking, but this involves matching a

much greater number of exposures, and hence brings additional complexity. Can we quantify how much this extra complexity would improve tracking performance? If we wish to maintain the simplicity of a one-dimensional partition, should we continue to partition by industry, or should we instead partition by country of domicile?

To investigate, we check how well the excess returns of all bonds in our selected five-country, three-sector dataset are explained by each of three regression models. In each case, we assume that the systematic part of excess returns within a given market cell follow the DTS paradigm, and are thus proportional to Duration Times Spread. This implies that all the bonds in that market cell are exposed to a common factor that represents a common proportional spread change. In the industry-only model, this risk factor is considered to affect all the bonds within a given industry across the eurozone. In the country-only model, each risk factor is assumed to affect all the bonds domiciled in a particular country. In the country-industry model, a separate risk factor is assigned to each country-industry cell.

(1) $$Exret_{it} = OASD_{it-1} \times LOAS_{it-1} \times F_t^{Industry(i)} + \varepsilon_{it}$$

(2) $$Exret_{it} = OASD_{it-1} \times LOAS_{it-1} \times F_t^{Country(i)} + \varepsilon_{it}$$

(3) $$Exret_{it} = OASD_{it-1} \times LOAS_{it-1} \times F_t^{Industry(i),Country(i)} + \varepsilon_{it}$$

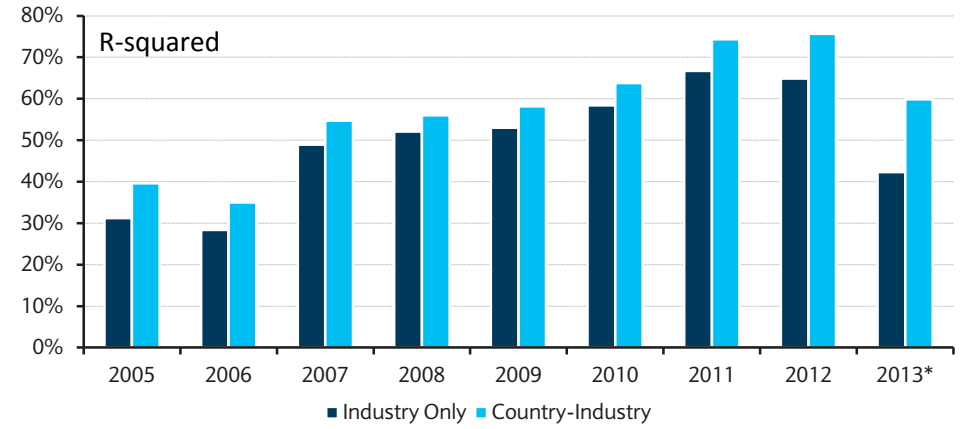
We carry out such regressions each month, and tally up the R-squared results that show how much of the variance in corporate bond excess returns is captured by each model. There is no question that the country-industry model (3), which uses a far greater number of factors, should always explain more of the variance; the only question is by how much. In Figure 21, we see that while the industry-country model explains more of the overall variance in each year shown, its advantage over the industry-only model increased steadily from 2008 to 2012. In 2012, this advantage reached 11%: 77% of variance was explained by the industry-country model, versus 66% for the industry-only model[6]. Furthermore, the overall percentage of variance explained by either model has continued to rise.[7] As the systematic risks from first the global financial crisis and then the sovereign crisis roiled the markets, issuer-specific effects have become responsible for a much smaller percentage of variance.

[6] In our first-half results for 2013, the overall explanatory power of both models is lower, but the advantage of the industry-country model continues to grow.

[7] Recall that we have selected to focus on bonds from only five countries: Germany, Netherlands, France, Spain and Italy. Had we included bonds from Greece, Ireland and Portugal, we should have found earlier evidence of both the increased importance of systematic risk and of the bigger improvement in explanatory power from adding country-specific risk factors.

Figure 21

Explained Variance: Industry-only vs. Country-Industry Model



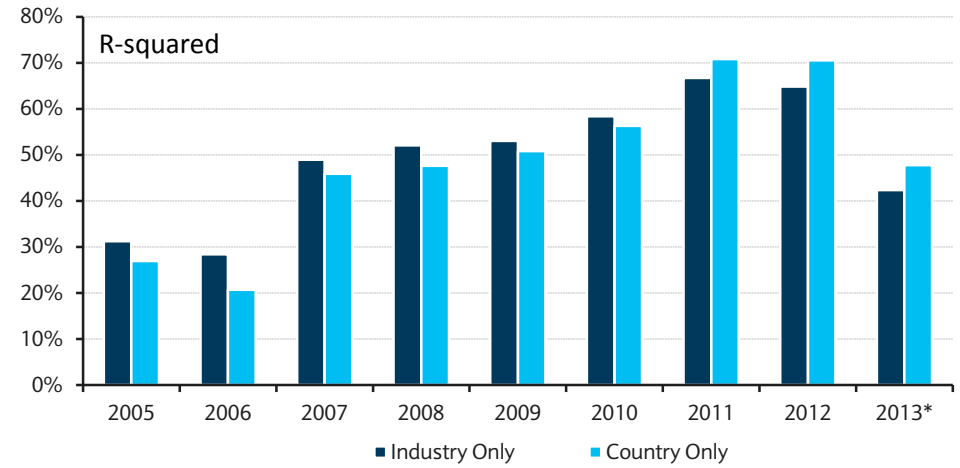
Note: * Results for 2013 are part-year results, January through June. Source: Barclays Research

Encouraged by the improvement in explanatory power offered by the industry-country model, we next check which single dimension is most important: industry or country. Figure 22 compares the performance of these two models. We find that up until 2010, the industry-only model explained more of the variance across our sample; in 2011 and 2012, the country-only model explained more.

During the global financial crisis of 2007-08 centred in the US, and continuing through the early part of the sovereign crisis in 2009-10, when the focus was on Greece, and then Portugal and Ireland, the key distinction was between financial and non-financial issuers. Financials were considered to be much more exposed to these various cross-border stresses. In 2011-12, when sovereign risk concerns shifted directly to Spain and Italy, it became much more important to keep track of how much of the portfolio was in issuers domiciled in these at-risk countries.

Figure 22

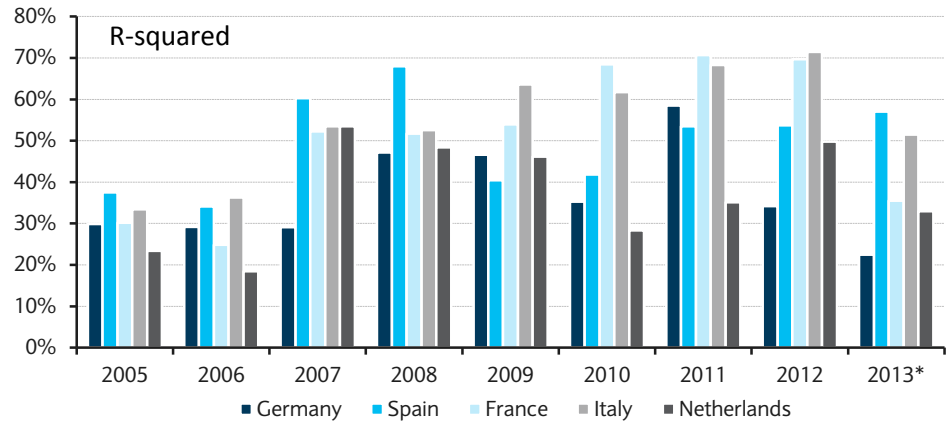
Explained Variance: Industry-only versus Country-only Model



Note: * Results for 2013 are part-year results, January through June Source: Barclays Research

To better understand these results, we tried to see how the explanatory power of the industry-only model varied by country. This breakdown, shown in Figure 23, contained some results that we found surprising at first. While we fully expected results to vary by country, we would have expected Italy and Spain to be in one group, with the core countries in another. However, for 2012, for example, we find that the industry-only model achieves far better results for two countries – France and Italy – and much lower explanatory power in Germany, Netherlands, and Spain. What do Germany and Spain have in common? A closer look revealed that the realized volatility of relative spread change in 2012 was lowest in Germany and Netherlands, and highest in Spain. The values for France and Italy, in the middle of this range, were closest to the average for the group. Therefore, when fitting a single relative spread change factor to all European financials, for example, this factor would tend to strongly overestimate the returns to German financials and underestimate the returns to Spanish financials, resulting in similarly poor explanatory power for both.

Figure 23
Explained Variance by Country: Industry-only



Source: Barclays Research

Enhancing the risk model: Country exposures for corporates

The above examples, while limited to only five countries and three industry groups, give a good illustration of the shortcomings of the industry-only approach at capturing risk in European credit portfolios over the past few years. The POINT Global Risk Model is much broader in scope. For European corporates, it covers bonds from all eurozone countries, and provides a much more detailed industry breakdown, with separate factors for twelve industry groups. Nevertheless, the same fundamental issue applies: the industry-only model used in POINT did not distinguish between issuers within the same industry group but domiciled in different countries. We now study possible enhancements to the risk model that introduce the country dimension in different ways, and discuss the pros and cons of each approach. We also document the final design used for POINT implementation.

Several key decisions faced us concerning the model's implementation, including those already discussed and some additional issues that arose along the way. Should the risk of corporate bonds be modelled as directly linked to those of sovereign bonds from the same country, or should we model corporate bond risk based purely on data from within the corporate bond universe? Should our risk model use only industry factors, only country factors, or a combination? Should a combination model use factors corresponding to a full

two-dimensional industry-country partition, or is it sufficient to combine two separate sets of factors from one-dimensional partitions by industry and country? How can we most effectively calibrate the risk parameters of these factors given the strong inter-relation between the different components of risk?

The model that we have chosen to implement has the following characteristics:

- No direct linkage to sovereigns; we look for commonality in corporate bond returns
- We use separate sets of risk factors for industry and country, assumed to be additive
- To keep industry and country factors from interfering with each other, they are not given equal priority in a single calibration
- Industry factors are calibrated first, to a universe of bonds from core countries only
- Country factors are calibrated as country-specific effects beyond the industry effect

The criteria that we used to help guide us in these decisions are those that have governed the design of all the components of our risk model:

- Do the model volatility forecasts agree with realized volatilities?
- Do the systematic factors of the model well represent the perceived sources of systematic risk in the market?
- Does the model have the needed flexibility to adapt quickly to changing market conditions?

In short, we seek a model that is an up-to-date reflection of the volatility dynamics in the markets. We are specifically interested in finding the best way to incorporate sovereign risk into our risk model for corporate bonds. One major source of concern is how to guarantee that the model well reflects the difference in experiences (past and potential) of corporates across countries, as well as through time (what if sovereign risk subsides in the near future for peripherals, or instead hits hard in core countries?). All these concerns should be addressed with the correct model design. In particular, for this market and the current conditions, we want to focus on the following: 1) Does the model capture the dynamic nature of the relationship between sovereign and credit risk across time; 2) Does the model have sufficient granularity to differentiate between different country experiences; and 3) can we differentiate the effect of this country component across firms of the same country.

In the following section, we demonstrate why we believe the model we have designed best meets these criteria.

Alternative modelling approaches

Explicit linkage to sovereign risk factors

One option would be to assume explicitly that corporates in a given country have exposures to changes in the sovereign spread of their country of domicile. This would correspond to the notion of corporates trading relative to a sovereign curve, as illustrated in Figure 16. However, as discussed previously, this option is too coarse. Figure 19 demonstrates that the modelling of European corporates as a spread over the local sovereign curve is not a good fit for all issuers and markets. In the final section of this article, we will investigate whether such a model can be useful on an issuer-by-issuer basis. However, for the purposes of the risk model, we will seek factors backed out from corporate bond spreads alone.

Joint estimation of industry and country risk

Let's consider a version of the POINT credit risk model. Specifically, a simplified version of the industry-only model that has been in use until now represents changes in spreads as:

$$\Delta LOAS_{it} = LOAS_{it-1} \times \left(F_t^{Industry(i)} + \varepsilon_{it} \right) \text{ (EQ1)},$$

Where $LOAS_{it}$ is the option-adjusted spread to the Euribor curve of bond *i* at time *t*, $F_t^{Industry(i)}$ is the systematic source of risk across the industry to which bond *i* belongs and ε_{it} is the residual, i.e., the component not explained by $F_t^{Industry(i)}$. Note that here – and throughout this section, unless otherwise noted – both $F_t^{Industry(i)}$ and ε_{it} are in units of percentage change in spreads (PCS)[8]. Thus, a factor realization of 0.1 represents a relative spread widening of 10% across the industry, consistent with the DTS approach.

One way to introduce both country and industry factors into the analysis would be to introduce a separate factor for each combination of country and industry:

$$\Delta LOAS_{it} = LOAS_{it-1} \times \left(F_t^{Industry(i),Country(i)} + \varepsilon_{it} \right)$$

However, this specification requires a number of factors equal to the product of the number of countries and the number of industries. While we tested an approach like this for the study of partitions in the previous section, this was for a much-simplified subset of the market with five countries and three industries. In a full model covering all the bonds in the Euro Corporate Index, with the full modelling of industries, this approach is wholly impractical. Furthermore, creating a covariance matrix using this approach would require the estimation of a large number of parameters using an insufficient amount of data, and would very likely lead to a numerically unstable model.

Therefore, to jointly model industry and country risk, we consider the use of two sets of factors, for industry and for country, as follows:

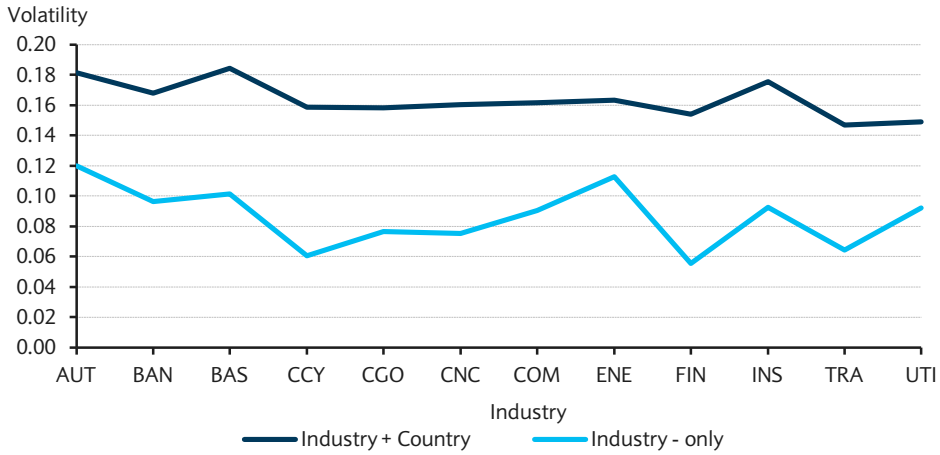
$$\Delta LOAS_{it} = LOAS_{it-1} \times \left(F_t^{Industry(i)} + F_t^{Country(i)} + \varepsilon_{it} \right).$$

In this case, the relative spread change experienced by each bond is assumed to be composed of both an industry-specific and a country-specific effect. We would regress against the full cross-section of securities each month to determine the realizations of both factors. This specification has a major advantage: it incorporates country risk, but not in a mechanical way. Specifically, it allows the data to reveal the importance of the country factors. There may be countries (e.g., core countries) for which the sovereign component is irrelevant, while for others it is fundamental. Moreover, the relative importance of the two sets of factors may vary over time. This specification – allied with good volatility and correlation models – allows for a reasonable characterization of these dynamics. However, this model also embeds one major assumption: an equal standing for both sets of factors. Though clearly reasonable, this assumption does have important implications. In particular, we can no longer interpret the industry factors as pure factors. The estimated realizations of these factors are influenced by idiosyncratic country considerations. A portfolio manager who focuses mainly on industry allocation (even with regional allocation considerations) may find this setting noisy and less informative.

[8] To see this, note that we can represent the relationship as:
$PCS_{it} = \Delta LOAS_{it} / LOAS_{it-1} = F_t^{Industry(i)} + \varepsilon_{it}$.

This kind of model specification has been widely used in other asset classes, namely for modeling risk in the equity space. However, for the particular universe of bonds being analyzed, there is a significant hurdle in this implementation. The two sets of factors seem to be too collinear to present a good representation of risk. To help illustrate this, Figure 24 compares the volatility of the industry factors under the industry + country specification being analyzed to those from the industry-only model. The results are striking: the volatilities of the industry factors are about 50% higher in the industry-country model. This result seems counterintuitive at first: if the same risk explained by the industry factors is now shared among two sets of factors, it would seem that the volatility of the industry factors should decrease. That they rise instead implies that the two sets of factors are largely offsetting. This is confirmed by examination of the correlations between these two sets of factors (not shown), which are highly negative – typically around -90%. These signs of instability can indicate that the model is overfitting the data within its calibration sample in a way that could give very large errors out of sample. This is troubling, as the use of such a model could lead to erroneous judgment concerning risk measurement, risk hedging, and risk budgeting. To alleviate this concern, we turn to a third potential specification.

Figure 24
Volatility of industry factors under two model specifications



Source: Barclays Research

Stepwise estimation of industry and country risk

The last specification considered changes the one-step estimation above to a two-step one.[9] In particular, in the first step, we run the initial specification of the model (see EQ1):

STEP1: $\Delta LOAS_{it} = LOAS_{it-1} \times \left(F_t^{Industry(i)} + u_{it}\right)$

This step allows a clean extraction of industry factors. Then, in a second step, we use the residuals of this first step (u) to further look for systematic country risk:

STEP2: $u_{it} = F_t^{Country(i)} + \varepsilon_{it}$

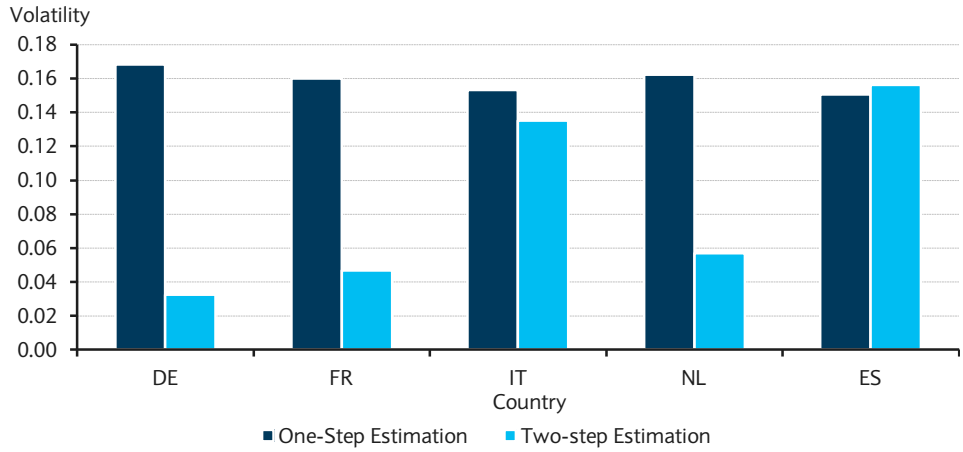
This model shares the main advantages of the previous one – it allows the capture of both industry and country effects with a reasonable number of risk factors. In particular, note that the explanatory power of both models will be exactly the same. However, it takes a

[9] This two-step estimation process is similar to the one currently used in POINT to model the risk of European equities. For details, see Ural, C., *The European Equity Risk Model*, Barclays, 13 July 2010.

significantly different stand in approaching the risk calibration (and attribution) for specific corporate portfolios. Specifically, industry factors can now be interpreted in the traditional fashion – they represent the average behaviour of bonds in that industry across Europe. In particular, there may be some sovereign risk embedded in the industry factors (see comments below).

Equally important, the two-step approach ensures no problems with collinearity between industry and country factors, as we are using the residuals orthogonal to industry factors as the starting point to calculate the country risk factors. This has significant effect on the forecasted volatility for both the industry factors (which revert back to those of the industry-only factors shown in Figure 24) and the country factors (Figure 25). In particular, note that the volatility of all core country factors decrease significantly – and to reasonable numbers – under the two-step approach, once the collinearity effect is dealt with. This striking volatility difference is explained again by the large negative correlations between the two types of factors under the one-step approach.

Figure 25
Volatility of country factors under two model specifications



Source: Barclays Research

The stepwise approach gives us another element of flexibility. We can use a different set of bonds to calibrate the industry factors in Step 1 and the country factors in Step 2. Specifically, we can choose to calibrate the industry factors to bonds from a set of core markets – as described above - where sovereign risk is not a substantial factor. We can then proceed to estimate the country factors in Step 2 for a broader set of countries[10]. These will represent the spread changes for corporates in these countries above and beyond the changes in their core-country peers. This corresponds conceptually to the view illustrated in Figure 17, in which the country spread for peripherals is computed relative to German corporate peers.

Restricting the industry factors to bonds from core countries does not give rise to a substantive change in their volatilities. Some rise and some fall, but no systematic effect is seen and the changes are relatively small. However, the use of different calibration universes for the two steps of the regression affects both the volatilities estimated for the country factors and their correlation with the industry factors. Figure 26 shows that when we

[10] Note that this is made at the expense of some statistical purity of the model. Given the two different calibration sets, we cannot guarantee that the residual returns used in step 2 are orthogonal to the industry factors. However, we believe this to be a minor point.

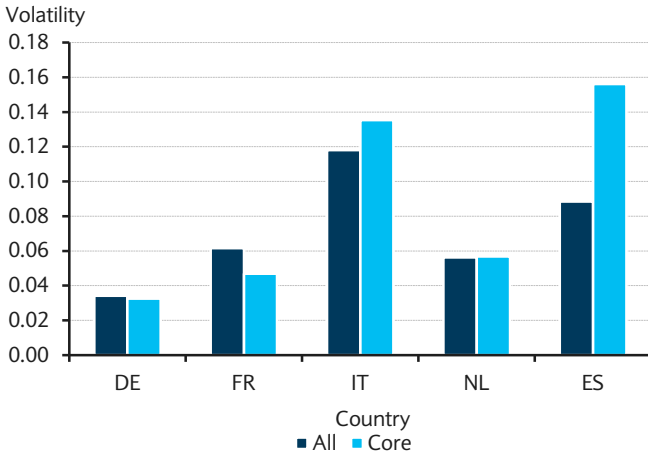
restrict the calibration universe used for the industry factors to bonds from core countries only, the volatility of the country factor tends to increase for peripheral countries – by 15% for Italy and by 75%for Spain – and decrease mildly for core countries. Figure 27 shows the average correlation between country and industry factors. As we narrow the calibration universe, there is an increase in correlation between country and industry factors for core countries, but a significant drop in this correlation for the peripheral countries. This seems to suggest that the restricted calibration set creates a clear separation between country and industry sources of risk.

One other important issue pertains to whether this outcome is actually driven by a single "distressed" factor that we are capturing by using the individual country factors. Evidence – not shown – suggests this not to be the case. The correlation of country factors is relatively low (e.g., 42% between Italy and Spain). Though sovereign risk is being driven by the same set of issues, their timing and incidence varies widely across the different countries. This justifies the more granular approach to sovereign risk presented here.

The one difficulty created by this approach is the need to distinguish *a priori* between core countries that will be included in the Stage 1 calibration of industry factors and peripheral countries that will be excluded. A larger group is desirable, to help ensure that the industry factors are truly representative; yet we want to exclude any country with a substantial amount of sovereign risk, so that the industry factors are not distorted by differences in sovereign exposures. As of now, for the POINT GRM model, only the AAA-rated countries contribute to the estimation of industry DTS factors (the core universe referred to above): Germany, Netherlands, Finland, Luxembourg, Austria, Switzerland, Denmark, Sweden and Norway. Note that the non-Euro countries have significant Euro issuance, so we decided to include them. France is the only exception to this rule: it is included, though its rating was downgraded from AAA. There are two reasons for the exception: it is the largest corporate market and it still has a significantly high rating. We will continue to monitor and review this set of countries as the situation evolves.

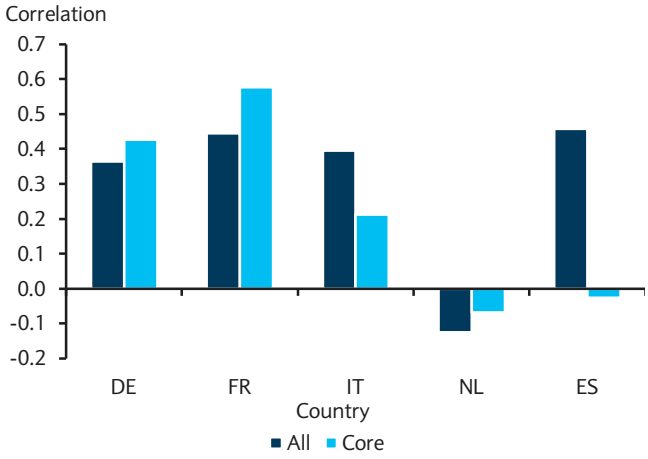
To test these enhancements to the risk model, we compare the percentage of variance explained by a model with just industry factors against the two-step industry-country model described above. Figure 28 shows the results for a list of European countries. The biggest improvements in terms of variance explained by the country factor come from the

Figure 26
Volatility of country factors under different estimation universes for the industry factors



Source: Barclays Research

Figure 27
Correlation between country and industry factors under different estimation universes for industry factors



Source: Barclays Research

countries that have experienced an intervention: Greece, Ireland and Portugal. For these countries, the inclusion of a country factor dramatically increases the percentage of variance explained. In particular, it is interesting to note what a small percentage of variance is explained by the industry factors alone. However, it is interesting to see that even for other countries, the increases are significant (about 10 percentage points).[11]

Figure 28
Percentage of variance explained by the two-stage industry-country model, by country

MODEL	GR	ES	PT	LU	BE	IT	IE	CH	FR	NO	SE	FI	DE	AT	NL	DK
Industry-only	0.05	0.43	0.23	0.27	0.31	0.30	0.09	0.30	0.29	0.17	0.21	0.14	0.16	0.14	0.16	0.14
Industry + Country	0.70	0.53	0.50	0.38	0.38	0.37	0.37	0.35	0.35	0.31	0.29	0.28	0.27	0.24	0.23	0.21

Source: Barclays Research

The approach in action – POINT® Global Risk Model

We now illustrate these concepts in a real portfolio setting. Specifically, we analyze the risk report coming from POINT for the Barclays Euro Corporate Index. We analyze this report with and without the sovereign risk factors and analyze how the risk changes per country under these two settings. To try to isolate the credit component of the risk, we run this index against the Barclays Euro Germany Corporate Index. These two indices have similar duration, allowing us to focus on spread volatility. Note that in this example, German corporates are in both the portfolio and benchmark. The results are as of the end of May 2013 and run using the weighted calibration.

Figure 29 shows that the inclusion of sovereign risk has a significant effect on the forecasted risk for these portfolios. The forecasted volatility increases 15% for the Germany Index and more than 30% for the whole European index: the inclusion of sovereign considerations has a significant impact on forecasted risk across the universes. The figure also shows that the tracking error volatility (the projected volatility of the return difference between the two indices) increases about 50%. This suggests that the inclusion of sovereign risk increases the return divergence between these two indices. This is expected: the inclusion of (sovereign) factors with significant volatility and relatively low correlation with existing (industry) factors increase the potential for return mismatches. Interestingly, the figure also shows a relatively stable beta. How would one interpret that? Recall that beta is not a measure of correlation, but of absolute comovement. In particular, it is the product of the correlation between the returns of the two indices and the ratio of volatilities of those indices. In this case, if the ratio of volatilities increased but the beta remained unchanged, the implication is that the correlation decreased. This is consistent with the increase in tracking error volatility.

[11] The results shown here are similar in spirit to those shown in Figure 21, but the numeric values shown can be very different, due to several key differences between the two analyses. First, the results here pertain to a model for the entire index dataset, and can thus show results for many more than the five countries included in our pilot study. Second, the results here span the entire time period of the study, and are not broken down year by year. Third, we now analyze the percentage of variance within the bonds from each country, rather than across the overall market. Finally, due to the nature of the two-step calibration process, in which only core-country bonds participate in the first step and the full corporate universe is used in the second, these percentage of variance numbers are technically not r-squared statistics.

Figure 29

Risk Statistics under two model specifications

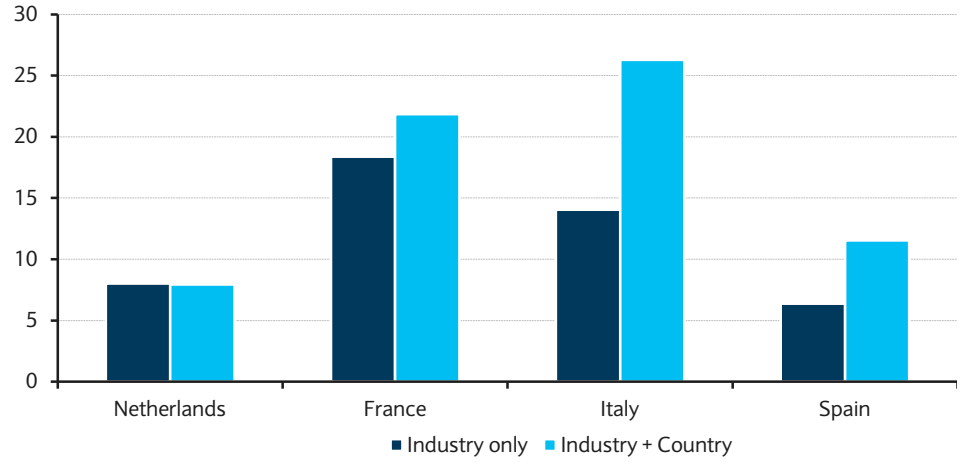
Universe	Industry only	Industry + Country
Barclays Euro Corporate Index (A) - Forecasted Volatility	71	95
Barclays Euro Corporate Germany Index (B) - Forecasted Volatility	63	74
Tracking Error Volatility (A-B)	33	46
Portfolio Beta (A on B)	1.00	1.06

Source: Barclays Research

We now turn to the analysis of risk due to overweights to individual countries. As we analyze the risk of the broad Euro Corporate Index relative to the benchmark of German corporates only, we have overweights to all other countries. The POINT risk model allows us to partition the portfolio by country and see how much Tracking Error Volatility (TEV) can be traced to each such overweight. This calculation can be carried out two ways: looking at the effect of each overweight in isolation, or taking into account its interaction with the other active positions in the portfolio. Figure 30 shows that the isolated risk for the countries under analysis may change significantly when sovereign risk is brought into the analysis. As expected, we see significant risk increases for Spain and Italy, much less so for France and a small decrease for the Netherlands. These results come as a consequence of the very different volatility dynamics allowed by the two-step industry-country approach compared with a model with only industry factors. Spain and Italy have country factors with high volatility, given the market concerns about their financial stability. Conversely, the country risk for corporates in the Netherlands is small and actually negatively correlated (on average) with the industry factors. That is, Dutch "nationality" conveys a smoothing effect on their corporates.

Figure 30

Isolated contributions to TEV from each country under two model specifications (bp/m)

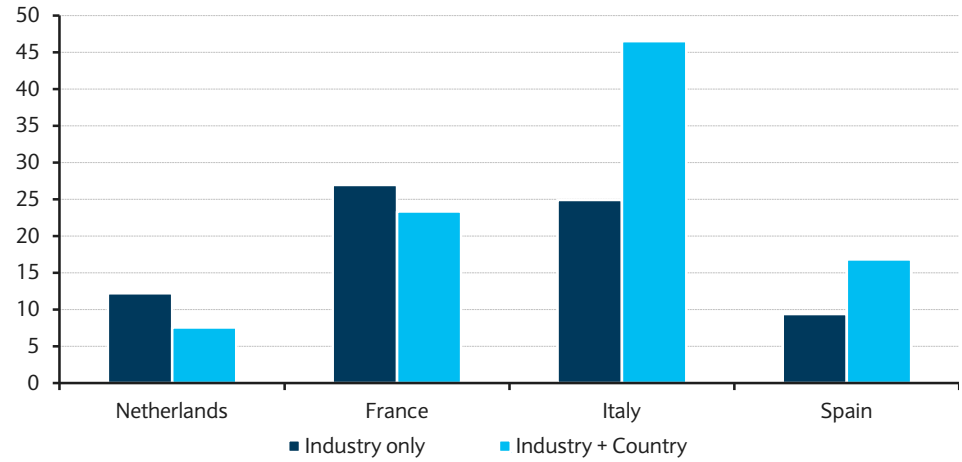


Source: Barclays Research

This point is made stronger in Figure 31, which analyzes the net contributions to TEV due to country exposures, including the effect of correlations. For Spain and Italy, we see a similar message: the inclusion of country factors magnifies the contributions these countries bring to the risk of the index. These two countries represent 20% of the index by market value.

Under the industry-only model, their contribution to the overall risk of the index is 30%. Once country risk is included, this number jumps to 60%. Interestingly, though, the inclusion of country factors for both France and the Netherlands – due to their correlations with the industry and other country factors – allows these countries' contributions to risk to decrease. The overweights to these core countries are seen to provide a partial hedge against those to the peripheral countries.

FIGURE 31
Contributions to TEV from each country under two model specifications (bp/m)



Source: Barclays Research

As discussed, the enhancement of the risk model by the addition of country-specific factors to represent the sovereign risk spill-over effect provides several advantages. First and foremost, the new model will more accurately project the overall risk of a particular corporate bond portfolio, as well as its active risk relative to its benchmark. Furthermore, the correlation of these factors with the sovereign risk factors already present in the model should enable the risk model to help us address the key challenges posed in the previous section – quantifying and hedging the implicit sovereign exposures of a corporate bond portfolio.

Issuer-specific hedging and credit spread decomposition

In the context of the Global Risk Model, the risk characteristics of a given bond are assumed to be determined by its corporate sector, country of domicile, and DTS level. However, it is likely that some issuers within a given country are more vulnerable than others to country-specific risks. In addition, we have decided against imposing a direct linkage of corporate spreads to those of the domestic sovereign within the risk model, as discussed above, because such an assumption is not universally appropriate. Nevertheless, in certain situations such an approach can be very effective on a standalone basis.

In this section, we directly measure the sensitivity of individual corporate issuers within a single domestic market to the local sovereign. Such a model could be used for direct hedging of sovereign risk; we also show how this analysis can be used to decompose spreads into corporate and sovereign components.

Let us assume that issuer i can be affected by both systematic regional effects across its corporate industry, and by country-specific effects linked to changes in the domestic sovereign spread. One way to model this is to start with the assumption that the issuer will track the relative spread changes typical to its industry across Europe, but that it will

additionally express a sensitivity $\beta_i^{Sovereign(i)}$ to spread changes in its domestic sovereign above and beyond this level. This can be written as:

$$PCS_t^i = PCS_t^{Industry(i)} + \beta_i^{Sovereign(i)}\left(PCS_t^{Sovereign(i)} - PCS_t^{Industry(i)}\right) + \varepsilon_t^i$$

The systematic percentage spread changes for the industry and the sovereign are taken directly from observations of the core country industry peer group and the sovereign; the only parameter estimated by the regression is the beta. This measures the extent to which issuer *i* has followed the relative spread changes of its sovereign above and beyond those of its industry peer group.

Note that this same relationship can be rewritten as follows:

$$PCS_t^i = \left(1 - \beta_i^{Sovereign(i)}\right) PCS_t^{Industry(i)} + \beta_i^{Sovereign(i)} PCS_t^{Sovereign(i)} + \varepsilon_t^i$$

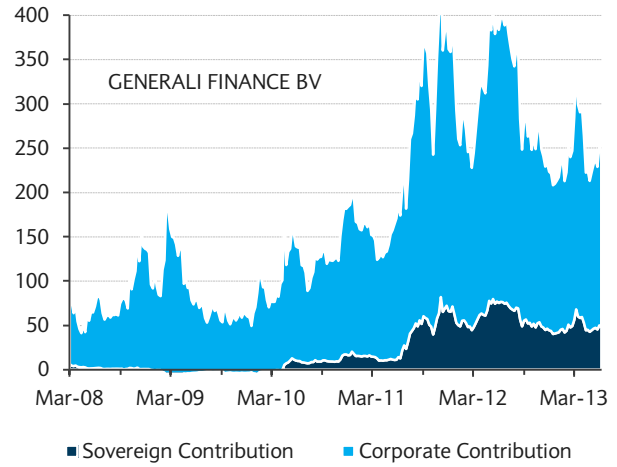
This latter formulation makes it clear that we have set up this model as a competition between the sovereign and the corporate influences on issuer *i*. As the two sensitivities are forced to sum to one, the model will assign sensitivity to the country factor only to the extent that it improves the fit relative to the industry factor. This property enables us to use this model to decompose spreads into a sovereign and a corporate component:

$$s_i^{sov} = s_i \beta_i^{Sovereign(i)}$$

$$s_i^{corp} = s_i \left(1 - \beta_i^{Sovereign(i)}\right)$$

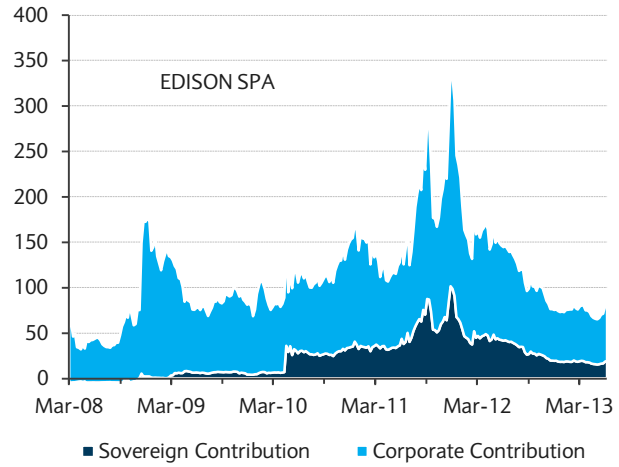
As an example, we used this approach to calculate empirical sovereign betas in this way for the CDS of several large Italian corporate issuers. For the purposes of this exercise, we used CDS spread data for both the Italian sovereign and the corporate issuers. We used a trailing window of weekly relative spread changes[12] to estimate the empirical betas for each issuer, and then used these betas to carry out a spread decomposition in which the spread of each corporate is divided into sovereign and corporate components. A time series of this breakdown is shown for two selected issuers in Figure 32 and Figure 33. Based on

Figure 32
Spread Decomposition for Generali Finance BV



Source: Barclays Research

Figure 33
Spread Decomposition for Edison SPA



Source: Barclays Research

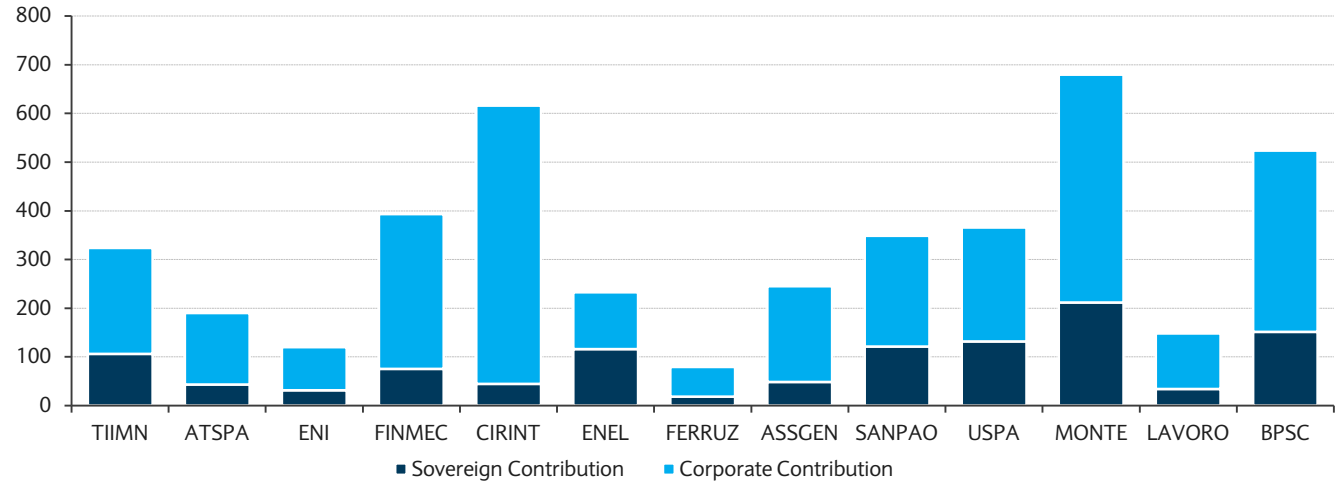
[12] As with the correlations reported earlier, we use exponential weighting with a 52-week half-life to carry out the estimation of empirical betas. This approach uses the full available history, while giving greater weight to more recent observations.

differences in the extent to which the changes in the two corporate spreads have been correlated to those of the sovereign, a different proportion of the overall risk is designated as stemming from sovereign risk.

This proportion can vary widely across issuers. Figure 34 displays the decomposition of spreads as per this calculation for 13 Italian issuers. There is a striking difference, for example, between the treatment of ENEL, for which half of the spread is attributed to the sovereign exposure, and CIRINT, which has a much larger overall spread but a much smaller sovereign component.

Figure 34

Spread Decomposition of Italian Corporate CDS, as of 28 June 2013



Source: Barclays Research

This analysis can help offer insight into the dynamics of the local market, and distinguish between issuers that are particularly vulnerable to sovereign risk and those that are more exposed to other industry-related or idiosyncratic factors. However, this exercise is subject to various difficulties arising from availability of data, pricing noise, and market illiquidity. Some of these effects are further exacerbated when we try to apply them to bond markets in addition to CDS.

Estimating betas based on issuer fundamentals

A second possible mechanism for direct estimation of sovereign betas would be to build a model based on the fundamental characteristics of corporate issuers. Presumably, those issuers whose international business model is deemed sufficiently strong to survive a default of the domestic sovereign would react only mildly to sovereign spread widening. Those whose business is entirely domestic would be much more exposed. Various financial measures may be useful in making this assessment, such as revenue from domestic vs. foreign operations, leverage ratio, and distance from default. Furthermore, the most important details to consider in such an analysis may vary by country and/or by industry. A detailed analysis of this type was undertaken last October by our colleagues in Euro Credit Strategy Research[13]. For example, they selected the percentage of earnings from international sources as a key differentiator among peripheral utilities; leverage ratios were used to highlight the fundamental health of telecom issuers. However, due to the need to use a different approach (and gather different information) within each sector, this type of model is beyond the scope of this paper.

[13] Hamid, S., N. Seyffert, Z. Davies, D. Harar, R. Preclaw, D. Rekrut, E. Owusu-Darkwa, and J. Horner, "Assessing Risk/Reward in Peripheral Credit", ***European Credit Alpha***, Barclays, 5 October 2012, pp. 4-35.

Conclusion

We have studied the spill-over effect of sovereign risk onto European corporate spreads. We have found that there has been a complex interaction between the effects of industry and country of domicile. A certain amount of risk is systematic in nature and has affected all European corporates. However, the magnitude of the effect varies greatly. When the concern has been mainly on the cross-border effect of crisis conditions in other countries, the effect has been much stronger on financial issuers than on industrials and utilities. Once the markets have begun to express serious doubts regarding the ongoing solvency of a particular sovereign, this systematic risk has spread to issuers of all industries domiciled there, financials and non-financials alike.

We have outlined several different approaches towards the market relationships between corporate and sovereign spreads, and believe that each has value in a particular setting. For example, one approach is to view the corporate bond yields within a given country in terms of spreads to the domestic government bond yield curve. When a full-blown confidence crisis was in force in Spain and Italy, many corporate issuers indeed seemed to trade at a spread over the domestic government curve. The ability to calculate bond analytics in this framework was found to be particularly useful in exploring relative value opportunities within the local corporate market. However, this approach, which forces all sovereign betas to 1, is perhaps too rigid for more general application. We have discussed how it can be modified to allow sovereign risk sensitivities to be calculated on an issuer-specific basis, based either on empirical estimation or fundamental issuer statistics.

An alternative approach, which seems to be more stable over the long term, is to view peripheral corporate spreads as country-specific spreads over industry-matched peers from core European markets.

For portfolio managers, there is no question that measuring the portfolio exposures to specific countries has become extremely important. Maintaining a full matrix of country x industry exposures would enable the most accurate tracking of a benchmark, but can become rather onerous. We have shown that over the past three years, if the portfolio exposures were to be tracked along just a single dimension, it would have been more efficient to track exposures by country rather than by industry.

Finally, we have discussed ways in which the empirical relationships explored in this paper can be reflected within the framework of a portfolio risk model. The model selected for implementation in the POINT risk model incorporates several innovations that help make the model concise and intuitive. We use a set of industry factors and a set of country factors, whose effect is additive. Calibration follows a two-step procedure, in which the industry factors are fit to core-country corporates and the country factors explain country-specific effects above and beyond those implied by the industry factors. The enhanced model should allow managers to more effectively project and manage risk, and to measure and hedge portfolio exposures to specific sovereigns.

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