Sovereign Credit Ratings, the Macroeconomy and Credit Default Swap Spreads

by

Yang Liu and Bruce Morley*

(Department of Economics, University of Bath)

Abstract

The aim of this study is to determine the main factors affecting sovereign credit default swap (CDS) spreads, with particular emphasis on the relationship between the credit rating scores and the CDS spreads. Other macroeconomic affects are also included in the estimation which uses panel data from the main EU countries, USA and Japan. The results indicate there is little evidence to show any relationship between the credit ratings and the sovereign CDS spreads, and the main drivers of sovereign CDS spreads are macroeconomic fundamentals which reflect the 'health' of the economy.

Key Words: Sovereign credit default swap spread; macroeconomy; credit rating; risk.

J.E.L. F3,F4.

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Address: Department of Economics, University of Bath, Bath, UK, BA2 7AY, Tel. +44 1225 386497, Fax: +44 1225 383423. E-mail: bm232@bath.ac.uk.

1. Introduction

The aim of this study is to assess the relationship between sovereign credit ratings and the information contained in sovereign credit default swap (CDS) spreads in the context of a macroeconomic model. Following the financial crisis in 2008, there have been discussions on the reliability of the credit ratings in general and suggestions that more market-based measures of sovereign risk may be more efficient. The CDS market, particularly in terms of the CDS contracts associated with sovereign bonds have been put under the spotlight since they have become increasingly used as a market-based proxy for credit risk. This market is used to hedge the credit risk arising from holding risky debt obligations. The main contribution of this study is to assess the relationship between CDS spreads and the credit ratings in the context of the sovereign bond market and emphasising the importance of open macroeconomic effects.

CDS markets have developed substantially over the last twenty years[1], with the outstanding notional value of debt insured by credit default swaps soaring from $631.5 billion in early 2001 to a peak of around $62 trillion at the end of 2007. During the financial crisis in 2008 the CDS market played a significant role, coinciding with a substantial widening in CDS spreads as the scale of the crisis emerged and there was a subsequent increase in the supply of sovereign bonds. The Eurozone has suffered particular problems over the issuing of sovereign bonds, resulting in the need for financial support for a number of countries within the Eurozone, as their economies as a whole have been perceived as increasingly risky.

As the markets have become more liquid and trade volumes increased, arguably CDS spreads have become an increasingly accurate representation of the inherent credit risks

[1] See J.P. Morgan (2003) for more information on the CDS markets.

within an economy. Along with the more traditional credit ratings, CDS spreads reflect the riskiness of sovereign bonds and both are linked to the sovereign bond yields spreads, which have also been used as an important market-based proxy for credit risk. The widely used proxies for credit risk; CDS spreads, bond yields spreads and credit ratings should be theoretically close to each other.

In the following sections, we review the literature on the relationship between CDS spreads and bond yields spreads, as well as the relationship between CDS spreads and credit ratings in section 2. There is then a discussion of the model and the data applied in this study in section 3 and the estimation results are then presented in section 4. Finally in section 5 we draw some conclusions and suggest some policy implications.

2. CDS spreads, bond yield spreads and credit ratings

2.1 *CDS spreads and bond yield spreads*

In theory, CDS spreads should be equal to the bond yield spreads, but the evidence regarding this equivalence tends to be mixed. Bond yield spreads reflect the difference between the quoted rates of return on two different fixed income instruments (normally short- or long-term bonds). They typically can be seen as a measure of riskiness of a bond relative to a risk-free benchmark security. The CDS 'spread' is the premium of a CDS contract paid by the CDS buyer to the CDS seller in order to get 'protection' from financial losses due to the default of the underlying reference entity – by delivering the defaulted debt obligation at par value to the sellers or receiving the difference between the par value and the post-default market value of the debt obligation from the sellers.

In theory, the CDS spread should be equal to the bond yield spread (or the excess yields to risk-free government bonds), through a process of arbitrage otherwise there would be the

opportunity to make an excess profit. (We assume the maturities of the CDS, underlying bond and risk-free bond yield are the same). This relationship can be expressed as:

CDS spread = Underlying bond yield –Risk-free bond yield

The relationship between CDS spreads and bond yields has mainly been analysed using corporate bonds, although the underlying principle is the same with sovereign bonds. For instance Hull *et al*. (2004) studied the relationship between CDS spreads and bond yields, and their empirical results found strong support for the theoretical equivalence of CDS spreads and bond yield spreads. Blanco *et al.* (2003) also found that corporate CDS spreads are very close to bond yield spreads for all of the US and some of the European firms studied. However, they found some firm cases from the sample where this relationship clearly did not hold and where CDS spreads were substantially greater than bond yield spreads. They pointed to two possible explanations: firstly physically settled CDS prices may contain cheapest-to-deliver (CTD) options. Holding other things equal, this will induce higher CDS spreads than bond yield spreads. Secondly, given the presence of repo costs, bond yield spreads represent a lower bound on the true price of credit risk. The deviation between bond yield spreads and CDS spreads have also been found by Longstaff *et al*. (2005) and a similar finding by Duffie, (1999).

Zhu (2006) has also compared the pricing of credit risk in the bond market and the CDS market. The CDS data used in this study consists of bank CDS and corporate CDS, across different ratings (from AA- to BBB-) and different regions. Using a sample period from 1 January 1999 to 31 December 2002, Zhu found that the theoretical equivalence between bond yields spreads and CDS spreads holds in the long-run, but in the short run there is substantial deviation from the equilibrium. He explained this deviation with reference to different

responses to changes in the credit quality of reference entities. However, the CDS market seems to lead the bond market in anticipating credit rating events and in price adjustment. The empirical results also suggested that the relative importance of these two markets in terms of price discovery can vary substantially across entities.

To sum up, CDS spreads and bond yield spreads, as two important proxies for credit risk, they should theoretically reflect the same level of credit risk associated with the underlying assets, but there is evidence showing that a gap exists between these two spreads. This gap may be introduced through various channels. In this paper, we attempt to explain this gap by capturing the influences from both the credit ratings and a macroeconomic perspective. The macroeconomic factors can potentially affect both corporate and sovereign CDS markets, although when analysing the corporate bonds the in general the interest rate has been used to represent the macroeconomy as in Fabozzi *et al.* (2007), whereas with sovereign CDS models, a greater variety of macroeconomic factors tend to be included.

There is evidence that macroeconomic fundamentals have a strong effect on credit risk, thereby affecting CDS spreads, as many studies suggest that credit risk is related to the macroeconomy. For instance Pesaran et al. (2006) and Pesaran and Schuermann (2003) have analysed the impact of a shock to a set of macroeconomic variables on the expected default[2] and found that the impact was asymmetric and non-proportional. Other studies which concentrate on how macroeconomic effects impact on the CDS spreads directly include Fabozzi et al. (2007), Fender *et al.* (2011) and Liu and Morley (2012), finding that the interest rate and exchange rate among other factors are related to the CDS spreads. Therefore,

[2] Other studies in a similar vein finding relationships between credit risk and macroeconomic factors include Bonfim (2009) who examined the determinants of credit risk, including firm-specific idiosyncratic factors, as well as systematic factors which simultaneously impact all economic agents. Whilst Virolainen (2004) analysed the relationship between default rates and macroeconomic factors in the Finnish corporate sector

it is appropriate to use the macroeconomic fundamentals as complements to bond yield spreads in explaining CDS spreads.

2.2 CDS spreads and credit ratings

Besides market-based credit risk proxies (CDS spreads and bond yields spreads), a credit rating is another important reference for credit risk, which has been used as a proxy for the creditworthiness of an individual, corporation or a country. It is an evaluation of a borrower's overall credit history, typically made by credit rating agencies (e.g. Standard & Poor, Moody's and Fitch). There is a literature suggesting a close relationship between CDS spreads and credit ratings, such that if a credit rating reflects the quality of a company or a country, then it should be negatively correlated to the CDS spread with the same underlying reference entity: the worse the credit rating, the wider the CDS spread. To date most of the literature has concentrated on corporate CDS markets, these include for example, Micu *et al.* (2006), who investigated the relationship between credit rating changes and CDS spreads, and found that all types of rating announcements (including outlooks, reviews and rating changes) have a significant impact on CDS spreads. Their empirical results also indicate that much of the CDS price adjustment occurs prior to the rating announcement, which also suggests there may be bi-causality, as in Alphonso *et al.* (2012).

However, other research has found a significant gap between CDS spreads and the credit ratings again based on corporate CDS markets. Callen *et al*. (2007) argued that if credit ratings indicate the relative likelihood of a corporation defaulting on its debt, then all CDS on companies with a given credit rating should be priced similarly. However, they found that there is quite a wide variation in CDS spreads observed for reference entities with a given credit rating. Similar arguments were developed by Jacobs *et al*. (2010), whose results

suggested that credit ratings did not always correspond with the relative riskiness of a reference entity, because financial markets are quicker to price risk than rating agencies. They used data from 28 February 2003 to 28 February 2008, and found that CDS spreads associated with a given rating did not reflect the level which the rating dictates. Their results indicated that a CDS spread reflects a higher level of risk than its credit rating would indicate.

There has been only limited research so far into sovereign CDS markets and credit rating agencies. These include Ismailescu and Kazemii (2010), who concentrate on the effects of credit rating announcements on sovereign CDS spreads for the event country and also how this spills over into other emerging markets. They find that overall positive events have a stronger impact on CDS spreads than negative events. They also find that positive events are more likely to spill over into other emerging economies. In addition Afonso *et al.* (2012) find that there is a close relationship between CDS spreads and ratings and other financial markets across the EU, with evidence of bi-causality between the ratings and CDS spreads. Based on the existing literature on CDS spreads and credit ratings, we aim to investigate whether the deviation exists between sovereign CDS spreads and credit ratings among developed economies, where we use credit ratings as one of the explanatory variables to estimate sovereign CDS spreads within a panel data framework.

Authors	Countries tested	Main Results
Ismailescu and Kazemi (2010)	Emerging economies	Positive events impact CDS spreads more than negative ones.
Afonso *et al.* (2012)	Main EU countries	Evidence of bi-directional causality between CDS spreads and bond yields.
Beirne and Fratsche (2013)	Combination of main EU countries, other major	Fundamentals and fundamentals contagion are

	economies and emerging countries.	the main determinants of credit risk.

Table 1. Main Studies of sovereign CDS spreads.

3. Data and methodology

This study uses a panel of EU countries along with Japan and the USA[3] with the data being collected from the IMF's *International Financial Statistics* and Datastream, whilst the credit ratings are from Fitch. The panel is unbalanced with the data running from January 2004 to February 2010.[4] The countries selected are limited by the availability of monthly data over this time span.

The sovereign CDS spread data is based on 10-year maturity CDS contracts[5] and correspondingly the bond yield is the 10-year government bond yield. Figure 1 and Figure 2 show that during the financial crisis there was a substantial widening in the sovereign CDS spreads in almost all countries, as sovereign credit risk soared, although government bond yields tended to be more stable but a greater disparity emerged among these yields in the following period.

Based on previous studies, CDS spreads should be equal to bond yield spreads, suggesting that bond yield spreads could be expected to have some explanatory power in determining

[3] The countries included are: Belgium, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, the UK and USA. The choice of countries is mainly based on data availability, Japan and the USA are included because they have large technically advanced economies where the CDS markets and developed..

[4]Because of the data limitations, the countries used in this paper cover different time periods. The longest period is from January 2004 to February 2010. The data for Italy and Portugal begins in February 2004, in April 2004 for Spain, in July 2004 for the Netherlands, in August 2004 for France and in July 2007 for the UK and USA.

[5] Other CDS maturities could also have been used in this study, but the spreads for different maturities are highly correlated, so the results are not sensitive to the CDS maturity.

CDS spreads. To calculate sovereign bond yield spreads, the 10-year government bond yields minus the risk-free interest rate (proxied by 3-month Libor rate[6]) have been used. Initially we use the bond yield spreads as an explanatory variable in the models. However, after performing the regression, the bond yield spreads were not significant determinants of the sovereign CDS spreads, which is consistent with many other empirical studies (Duffie, 1999; Longstaff, et. al. 2005). As a result the bond yield spreads were divided into the two component parts and used as two separate independent variables in the model.

The result of the insignificance of the bond yield spread suggests that there are other influences on sovereign CDS spreads that are not captured by them. Therefore some other key fundamental indicators have been included as explanatory variables to reflect these influences, namely exchange rates, inflation rates, industrial production indices, international reserves, share price indices, and unemployment rates. The choice of these fundamentals is based on the previous literature on macroeconomic determinants of credit risk[7]. Beirne and Fratsche (2013) also choose the main macroeconomics factors as the determinants of credit risk in general and the CDS spreads in particular, finding that the empirical evidence tends to support the choice of macroeconomic determinants. The approach used here is different in that the emphasis is on open economy measures, such as the exchange rate and levels of foreign reserves. Since sovereign CDS spreads are an important indicator of sovereign credit risk, sovereign CDS spreads might also be affected by the same determinants.

[6] LIBOR is used as the risk free rate throughout the time period.

[7] In general this strand of the literature hasn't been based on a specific theoretical model, instead macroeconomic fundamentals have been incorporated into a general econometric specification along with policy dummy variables.

The basic model to assess the macroeconomic and credit rating determinants of sovereign CDS spreads, which broadly follows other similar studies, although with the emphasis on open economy factors [8], is as follows:

$$\begin{aligned} CDS_{it} = {} & \beta_0 + \beta_i + \beta_1 interest\ rate_{it} + \beta_2 bond\ yield + \beta_3 exchange\ rate_{it} \\ & + \beta_4 CPI_{it} + \beta_5 industrial\ production_{it} + \beta_6 international\ reserves_{it} \\ & + \beta_7 share\ price\ index_{it} + \beta_8 unemployment + \delta_1 rating2 \\ & + \delta_2 rating3 + \delta_3 rating4 + \lambda_1 year2005 + \lambda_2 year2006 + \lambda_3 year2007 \\ & + \lambda_4 year2008 + \lambda_5 year2009 + \lambda_6 year2010 + \varepsilon_{it} \end{aligned} \quad (1)$$

In Equation (1), besides the macroeconomic indicators, and fixed effects (β_i), dummy variables have been added for different sovereign credit ratings. There are four rating classes across the sample of countries[9]: rating1 indicates AAA, rating2 indicates AA+, rating3 indicates AA and rating4 indicates AA-. In addition, considering the impact of the financial crisis in 2008, we add annual dummy variables to capture the effects of individual years, which given the relatively short time period being estimated was felt to be a more effective way of capturing changes over this time span rather than doing structural break tests and splitting the data accordingly.

With regard to the model, which includes the macroeconomic effects[10], the 10-year government bond yield[11] can be seen as a monetary policy signal as well as a measure of fiscal policy. Gruber and Kamin (2011) found a significant impact from fiscal performance on long-term bond yields. They argued that there are several reasons that can explain larger

[8] Due to data limitations we didn't include government debt measures, as they weren't available on a monthly basis in most cases. In addition the bond yield should proxy a government's fiscal position.

[9] These were the credit ratings for these sovereign bonds over the time span estimated.

[10] Unit root tests have not been conducted as there is only six years of data, so this should not be a serious problem and also such a short period of time would not produce sufficiently reliable results.

[11] The bond yield could potentially be endogenous, future research could determine the extent of any endogeneity.

government deficits inducing a widening in sovereign yields, including crowding out, portfolio balance effects, inflation expectations and default risk.[12] We usually expect a positive relationship between the bond yield and CDS spread as a fall in the yield indicates a strengthening fiscal position which reduces the sovereign risk.

The risk-free interest rate, as the other determinants of bond yield spreads, is a key indicator in financial markets and it is common to use Libor as a proxy for the risk-free interest rate (e.g. Fabozzi et al., 2007). We expect that there will be a negative relationship between it and the CDS spreads.

The nominal effective exchange rate (NEER) is used as the measure of the exchange rate. The NEER[13] is a trade-weighted index of exchange rates, and is a well-known measure of international competitiveness. Furthermore, since exchange rates play a major role in determining the cost of countries' imports and exports, exchange rates can have a big impact on the wider macro-economy through this transmission mechanism. Barrell et al. (2006) argued that exchange rates influence policy decisions with respect to the macroeconomic management of inflation, unemployment and the balance of payments. The expected sign on this relationship could be either positive or negative, as although an appreciation indicates a strengthening macroeconomy, in general a depreciation would benefit the balance of payments.

The inflation rate is based on the consumer price index (CPI). Inflation indicators reflect economic stability and consumer welfare, high or unpredictable inflation rates are commonly

[12] Gruber and Kamin's results suggest that the marginal effect of the projected deterioration in fiscal positions related to the recent financial crisis will add about 60 basis points to the U.S. bond yields by 2015.

[13] The real effective exchange rate (REER) could also have been used, however given the very low and similar rates of inflation in the countries tested during this time span, it shouldn't make much of a difference which is used.

regarded as harmful to an overall economy. Therefore, inflation targeting is a key objective of central bank interest rate policies. Again the expected sign for the relationship with the CDS spreads is ambiguous, as it can have negative and positive effects on the macroeconomy. The negative effects of inflation include decreasing the real value of money and other monetary items, discouraging investment and saving and redistributing purchasing power domestically and internationally. In international trading, if fixed exchange rates are imposed, the country with high inflation will reduce exports as its products become more expensive in international markets. Some potentially positive impacts of inflation are that a low-to-moderate level of inflation can ensure nominal interest rates stay sufficiently above zero to leave room for the downward adjustment by central banks to mitigate recessions. A moderate level of inflation also encourages investors to switch from monetary assets to tangible projects that increase productivity in the real economy (Tobin 1965).

The Industrial Production Index (IPI) represents the growth of production in various sectors in an economy. It has been seen as a good alternative to GDP when seeking to measure overall economic activity on a monthly basis. Since IPI can reflect the general strength of an economy, we expect a negative relationship between sovereign CDS spreads and IPI.

International reserves include foreign exchange, gold, SDRs and IMF reserves held by central banks and monetary authorities. Large amounts of international reserves can provide more scope for a government to manage the exchange rate, thereby keeping it stable and providing a more favourable economic environment for investment and growth. In addition, a large quantity of international reserves enables a government to more easily defend speculative attacks on the domestic currency. , although we wouldn't expect this to be a significant problem for the countries included over this time span In this case we would expect a

negative relationship, as more reserves can create a larger buffer for the central bank in times of financial difficulties.

Share price indices are widely used as benchmarks for measuring the performance of investment portfolios such as mutual funds. In addition, a share price index is an important indicator of the general performance of the stock market in an economy, as it captures the mood and direction of the overall market. A broad share price index (e.g. FTSE 100, S&P 500) represents a broad cross section of the economy, and rises in these indices indicate expectations of improved overall economic performance and increased confidence among investors. So we would expect a negative relationship between these two variables.

The unemployment rate reflects the overall health of the macroeconomy, and a high rate of long-term unemployment may impact negatively on a country's economic growth potential (Figlewski et al., 2006) as well as its fiscal position as more transfer payments are required. So we would expect a positive relationship as increased unemployment would increase the riskiness of the fiscal position and macroeconomy as a whole.

4. Results

Table 1 shows the results from the fixed and random effects models. According to the Hausman test, the null hypothesis is rejected at the 1% level, therefore we have opted for the fixed effects model as the base model. Tests for heteroscedasticity, cross-sectional dependence and serial correlation have all been conducted along with the Hausman test. In terms of heteroscedasticity, for panel data, it is likely that the error process may be homoscedastic within cross-sectional units, but its variance may be different across units. The

results from the Modified Wald test[14] for groupwise heteroscedasticity, the Breusch-Pagan (1980) LM test[15] for cross-sectional correlation and Wooldridge test[16] for serial correlation are shown in Table 2, and the null hypothesis is rejected at the 1% significance level for all the tests. Based on these results, the Driscoll and Kraay (DK) (1998) standard errors[17] have been used to ensure the error term is Gaussian.

The results overall are fairly similar except the credit ratings become insignificant in the fixed effects model when the standard errors are adjusted to account for the serial correlation. With particular emphasis on the DK adjusted results, there are four main findings. Firstly, the risk-free interest rate is not significant, which can help explain why the bond yield spread (the difference between the bond yield and the risk-free interest rate) was not significant in the initial primary regression. It could also be that as a result of both the financial crisis and the subsequent Eurozone crisis, the effects of LIBOR on the CDS spreads has been reduced, as central banks have used monetary policy to counteract the effects of these crises. However, the bond yield variable is significant and with the expected positive sign, so if the 10-year government bond yield increases, sovereign CDS spreads also increase, since long-term government bond yields can be interpreted as a signal of both monetary and fiscal policy of a country (Gruber and Kamin, 2011). The results suggest if there is a deterioration in a country's fiscal position with larger government deficits, the 10-year government bond yield

[14] The null hypothesis is $\sigma_i^2 = \sigma^2$ for all i (i=1,…,N), where N is the number of cross-sectional units.

[15] The null hypothesis is that the residual correlation matrix is an identity matrix of order N, where N is the number of cross-sectional units.

[16] The null hypothesis of no serial correlation, the residuals from the regression of the first-differenced variables should have an autocorrelation equal to -0.5, viz.Corr $(\Delta\varepsilon_{it}, \Delta\varepsilon_{it-1}) = -0.5$, where ε_{it} is the idiosyncratic error (Wooldridge, 2002).

[17] Driscoll and Kraay have developed a non-parametric covariance matrix estimator that can produce heteroscedasticity and autocorrelation consistent standard errors.

will increase as the government attempts to finance the extra borrowings and consequently the expectation of default risk will also rise, thereby widening the sovereign CDS spreads.

Secondly, the exchange rate, industrial production, share price index and unemployment rate all have a statistically significant effect on CDS spreads. All of these indicators reflect the general macroeconomic status of a country and have the expected signs. So as the economy deteriorates, with falling output, asset prices and depreciating exchange rate, so the credit risk of their sovereign bonds increases, leading to a widening of the sovereign CDS spreads. However, along with the interest rate, inflation and international reserves do not appear to have a statistically significant effect on sovereign CDS spreads.

In terms of inflation, the countries investigated in this chapter generally have low-to-moderate levels of inflation and this range of inflation constitutes a relatively favourable environment for national economies. Therefore it may not have much of an impact on sovereign credit risk. However, if inflation is high or the country suffers from deflation, it would have a negative impact on an economy, causing sovereign credit risk to increase and sovereign CDS spreads to widen. With regards to international reserves, all countries in the sample have relatively stable reserve levels due to the formation of the Euro. After the financial crisis broke out, sovereign credit risk increased as the macroeconomy deteriorated, but international reserves remained at similar levels for most of the countries and in some countries even increased (e.g. Japan and USA). This suggests that international reserves do not reflect changes in sovereign credit risk during the period under study. Overall our results tend to follow other studies that find macroeconomic fundamentals have a significant effect on CDS spreads and credit risk in general, such as Beirne and Fratsche, (2013) and Pesaran *et al.* (2006).

The dummy variables representing different sovereign credit ratings are not significant in this model after adjusting the standard errors. In theory, sovereign credit ratings reflect the credit quality of a country and sovereign CDS spreads represent the sovereign credit risk, so it would have been expected in theory that the sovereign CDS spreads should have been related to sovereign credit ratings. We would expect that the higher the sovereign credit rating, the lower the sovereign CDS spreads. However the dummy variables for different ratings are not significant in any of the cases.

A possible explanation is related to the markets' suspicion about the ratings that the agencies issued. After the subprime debacle began in mid-2007, the rating agencies have been treated more cautiously by the markets. Following the subprime crisis, it appears that the risk aversion of investors has increased as investors began to demand more compensation for taking on the default risk of the underlying financial instrument, which is captured by the CDS spreads but not necessarily by the credit ratings. As a result, the impacts of these market conditions (e.g. increased risk aversion) may have broken the correlation between credit ratings and CDS spreads.

Finally, in terms of the dummy variables representing different years, they have a highly significant effect on the sovereign CDS spreads. According to the value of the coefficients, except for 2008, the value increases every year. It suggests that, after controlling for the impacts of the other variables, the main trend in sovereign CDS spreads has been upward during the sample period, reflecting the increased riskiness of sovereign debt, especially in the Euro area.

5. Conclusions

The results of this study suggest that there is little evidence of any relationship between credit ratings and CDS spreads and sovereign bonds, although CDS spreads and government bond yields do appear to have a significant relationship. Given the recent financial crisis and the important parts played by both the CDS markets and credit rating agencies, this finding has important implications for their relationship as providers of risk assessment. The finding that the credit ratings have little effect on the CDS spreads indicates that when the market determines sovereign risk over recent years, it lays greater emphasis on the macroeconomic fundamentals of a particular economy than the credit ratings.

The main policy implications arising from this study are that the use of credit ratings alone to determine the riskiness of bonds may not always provide sufficient information. So to determine the risk of a bond and economy, it could be more appropriate to use CDS spreads or a mix of the CDS spreads and credit ratings. Also CDS spreads are market determined and from the evidence presented here are affected by macroeconomic factors and risks, which may be a better way of grading sovereign debt in the future. The study would have benefited from more data and future research needs to concentrate on a longer time series and more countries, as the data becomes available.

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Figure 1. Sovereign CDS premia

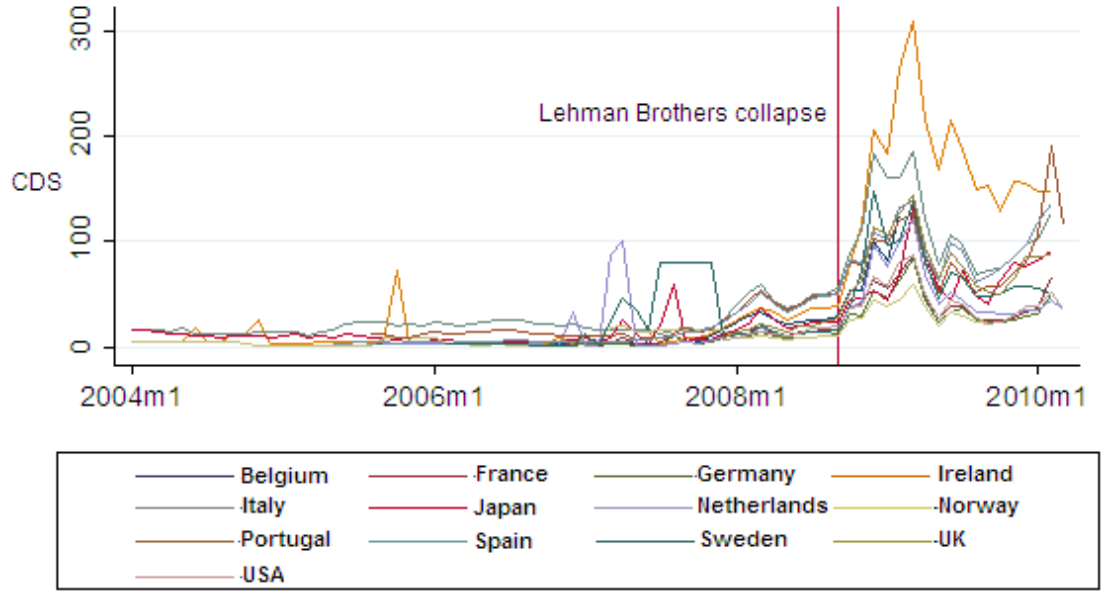

Figure 2. 10 year government bond yields

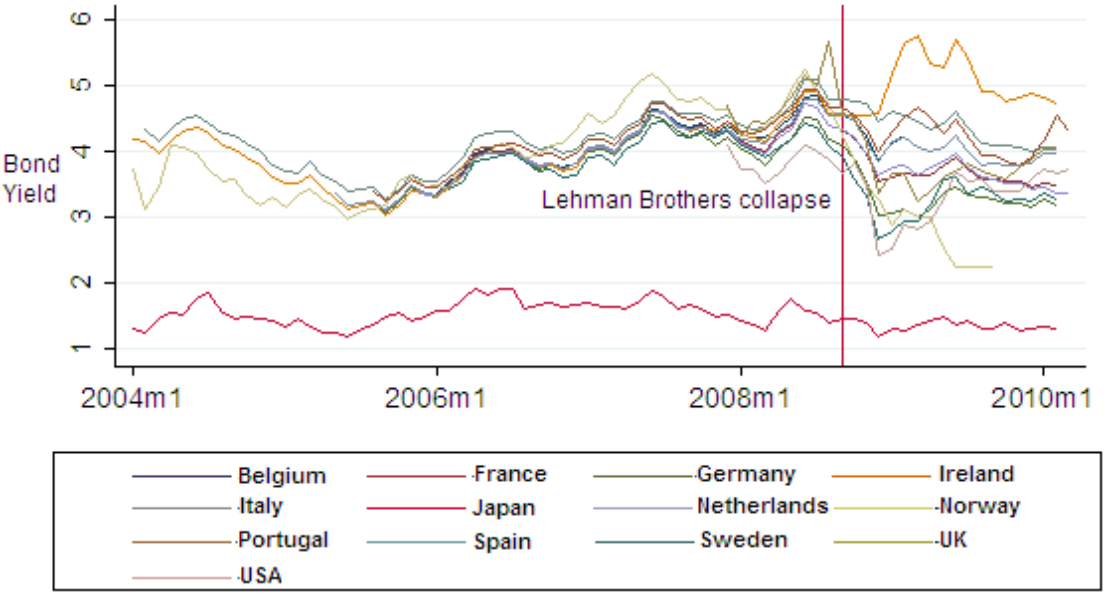

Table 1. The panel data model results

	Random Effects Model	Fixed Effects Model	Fixed Effects Model (DK)
Risk-free interest rate	1.6267	1.5077	1.5077
	(1.18)	(1.07)	(0.59)
Bond yield	5.1908***	11.6395***	11.6395**
	(2.90)	(5.04)	(2.29)
Exchange rate	-68.558***	-85.9457***	-85.9457**
	(4.86)	(-4.56)	(-2.60)
Inflation	-4.439***	-1.9933**	-1.9933
	(6.41)	(-2.39)	(-1.37)
Industrial production	-72.3079***	-93.5712***	-93.5712**
	(4.86)	(-5.61)	(-2.96)
International reserves	-4.0957***	-6.6745**	-6.6745
	(5.42)	(-2.00)	(-1.48)
Share price index	-74.5507***	-79.1915***	-79.1915***
	(16.25)	(-17.11)	(-4.80)
Unemployment	1.8007***	2.2687***	2.2687***
	(5.43)	(3.64)	(3.29)
rating 2	3.873	37.7925***	37.7925
	(1.10)	(3.98)	(1.65)
rating3	7.1985***	22.7774**	22.7774
	(2.87)	(2.17)	(1.05)
rating4	19.5715***	19.8017*	19.8017
	(6.32)	(1.88)	(0.92)
2005	19.1263***	23.9084***	23.9084***
	(4.74)	(6.26)	(3.89)
2006	29.9696***	34.6221***	34.6221***
	(7.08)	(8.35)	(4.45)
2007	47.3324***	51.3742***	51.3742***
	(9.17)	(10.00)	(4.36)
2008	47.5325***	48.0797***	48.0797***
	(9.17)	(10.15)	(4.10)
2009	46.0447***	50.9636***	50.9636***
	(11.54)	(12.47)	(5.29)
2010	67.0033***	73.348***	73.348***
	(12.36)	(13.68)	(9.59)
Constant	996.0488***	1.20E+03***	1.20E+03***
	(10.66)	(9.37)	(4.58)
Hausman Chi-sq	191.5		

Note: t statistics in parentheses. *** indicates significance at the 1 % level, ** indicates significance at the 5 % level, * indicates significance at the 10 % level.
Model Fixed Effects represents fixed effects model with normal standard errors.
Model Fixed Effect (DK) represents fixed effects model with Driscoll-Kray standard errors.

Table 2. Diagnostic tests on the fixed effects model

Diagnosis tests	Statistic	P-value
Modified Wald test for groupwise heteroscedasticity	Chi_sq: 284.27	0.0000
B-P LM test for cross-sectional correlation	Chi_sq: 788.001	0.0000
Wooldridge test for serial correlation	F-stat : 220.935	0.0000