Do Eurozone yield spreads predict recessions?

Matthias Schock

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Abstract

An OLS and probit framework is used to examine the predictive power of yield spreads with respect to GDP growth and recessions in the Eurozone from the 1990s to the recent past. Credit default swap (CDS) data on sovereign bonds, which provide a direct measure of default risk, are employed as part of a new risk-adjustment method that significantly enhances the predictive accuracy of the yield-spread approach. The results show that the accuracy of predictions of growth and recessions using the commonly employed yield spread remains high, provided that biases associated with Eurozone sovereign default risk are accounted for.

JEL-Classification: G1, E37, E43, E44

Keywords: yield curve, CDS spreads, economic activity

Matthias Schock, Institute of Public Economics, Leibniz University of Hannover, Königsworther Platz 1, 30167 Hannover, Germany; e-mail: schock@fiwi.uni-hannover.de; Tel ++49 511 7625667

1 Introduction

After the Great Moderation ended with a hard landing at the end of the last decade, efforts to predict economic growth and recessions have attracted renewed scholarly and public attention. The classical method of prediction, used in the 1980s and 1990s, relies solely on the yield spread, defined as the difference between the interest rate on long-term treasury bonds and that on short-term treasury bills, to forecast economic growth approximately one year in the future (Fama (1986), Estrella and Hardouvelis (1991)). The present paper follows this basic approach but introduces a new method of risk adjustment.

The financial crisis of recent years has led to the use of default risk measures to predict GDP growth, as in Gilchrist and Zakrajsek (2012), who employ credit spreads, defined as the difference between the interest rate on private debt instruments and that on theoretical risk-free government securities with comparable maturities. By contrast, this paper investigates the predictive power of the yield spread itself and introduces an alternative risk-adjustment method. For the Eurozone, where the ability of the yield spread to predict growth and recessions has not yet been examined[1], the yield spread is adjusted for default risk by accounting for CDS spreads on long-term government bonds. The results suggest that the risk-adjusted yield spread is highly reliable as an indicator of recessions and growth in the Eurozone.

The paper is structured as follows. Section two presents the data, while section three describes the methodology employed. In section four, the results of OLS and probit estimations are presented. Section five concludes.

2 Data

Data on yield spreads and real GDP growth in the Eurozone are provided by the OECD[2]. Throughout the paper, quarterly data are used. The yield spread is calculated using the short-term yield on the 3-month EURIBOR and the long-term yield on government debt with a duration of 10 years. GDP growth is measured annually. Because the relationship between the

[1] Chionis et al. (2009) use European Union data and examine deviations from a long-term trend of growth instead of real GDP growth. Bleaney et al. (2013), Guender and Tolan (2013), and Gilchrist and Mojon (2014) investigate only a subset of Eurozone countries and do not attempt to predict recessions.

[2] http://stats.oecd.org/index.aspx?#; GDP growth: National Accounts -> QNA -> QNA -> Real GDP and components; interest rates: Finance -> MFS -> MEI -> Interest Rates

yield spread and growth is given for a horizon of approximately 1 year, annual growth data are more appropriate than quarter-over-quarter data. Hence, recessions are analogously defined by 2 quarters of negative growth on a yearly rather than a quarterly basis. CDS data are taken from Datastream Thomson Reuters (Markit). CDS spreads, first available for the beginning of 2008, are now available for every country of the Eurozone except Luxembourg from the end of 2009 onward. CDS price premia in basis points are assumed to be equivalent to the risk premia of long-term government debt.

Although the Eurozone was established as a currency union in 1999, the decision to move toward a currency union was made earlier. In 1990, as a result of expected parallelism of inflation rates across the union and an implicit bailout promise, long-term yields on the debt of projected currency union members started to converge. These expectations continued until the outbreak of the financial crisis in the autumn of 2008, when long-term yields diverged (see figure 1).

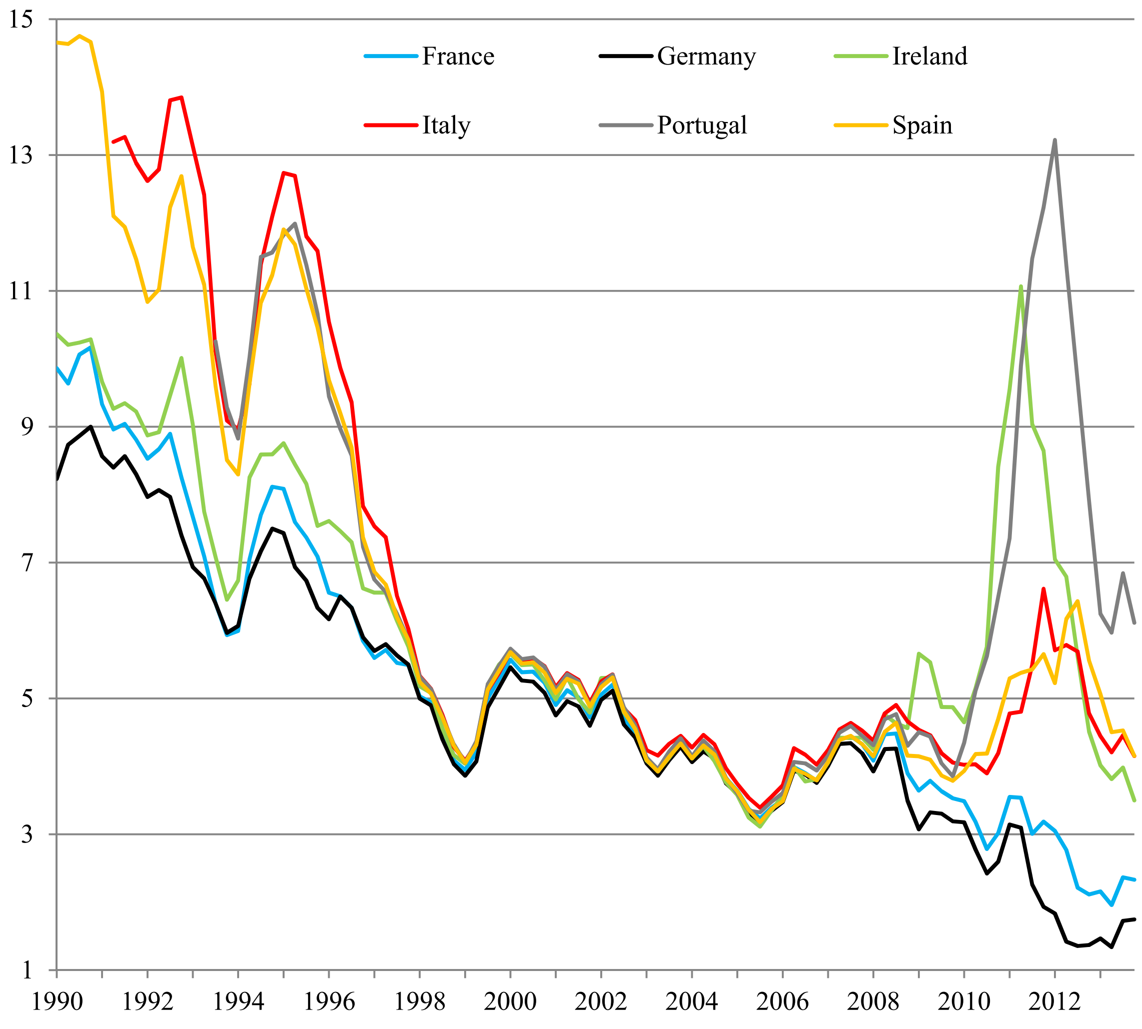

Figure 1: Long-term yields in percent of selected countries from 1990 to 2013.

Combined with fixed short-term rates, imminent or actual payment difficulties of several countries led to considerably higher yield spreads. Hence, three distinct yield curve phases can be identified in the Eurozone: convergence, parallelism, and divergence. The convergence phase lasted until the end of 1999; the parallelism phase, in which short- and long-term yields were equal for all countries, lasted from 2000 until the third quarter of 2008; and the divergence phase lasted from the fourth quarter of 2008 until the end of 2013.

3 Methodology

The relationship between the yield spread and GDP growth is examined within an OLS design. GDP growth at time t is predicted solely by the yield spread 4 quarters earlier:

$$GDP\ growth_{\mathrm{t}} = \propto + \beta * yieldspread_{t-4} + \varepsilon_{\mathrm{t}} \quad (1)$$

The parameter β is estimated using two models: first, with the raw yield spread, and second, with the CDS-corrected yield spread. Equation 1 is estimated for the complete dataset and for the three phases of the currency union: convergence, parallelism, and default risk-induced yield divergence.

Whether the occurrence of a recession can be predicted by the yield spread is tested using a probit model. The dependent variable is a binary variable that takes a value of 1 if a recession occurs in a given quarter and 0 otherwise.

$$y_{\mathrm{t}} = \begin{cases} 1, if\ a\ recession\ occurs\ in\ quarter\ t \\ 0, otherwise \end{cases}$$

The nonlinear model relates the probability of a recession in quarter t to the yield spread 4 quarters earlier:

$$Pr[y_{\mathrm{t}} = 1 \mid yieldspread_{\mathrm{t}-4}] = F(\alpha + \beta * yieldspread_{\mathrm{t}-4}), \quad (2)$$

where Pr denotes probability and F is the cumulative normal distribution function. The log-likelihood function of the model, which is maximized with respect to α and β, is given by:

$$\log L = \sum_{y_t=1} \log F(\alpha + \beta * yieldspread_{t-4}) + \sum_{y_t=0} \log F(1 - \alpha - \beta * yieldspread_{t-4}) \ (3)$$

4 Results

4.1 Growth prediction

The results are presented in table 1. When CDS spreads are considered, 32.3% of the variance in the growth data can be explained solely by the risk-adjusted yield spread. The quality of the prediction depends significantly on the time period considered. During the convergence process, there is no significant relationship between the yield spread and growth. In the phase of yield parallelism, 40.4% of the variance can be explained by the yield spread, a proportion that rises to 73.5% in the divergence phase. The use of the non-risk-adjusted yield spread severely weakens the relationship[3].

	All data	**until Q4-99**	**Q1-00 – Q3-09**	**Q4-09 – Q4-13**
	Model 1: yield spread with CDS correction			
β	1.411**	-0.428	1.778**	1.543**
R^2	0.323	0.054	0.404	0.735
	Model 2: yield spread without CDS correction			
β	0.510*	-0.428	1.753**	1.083*
R^2	0.063	0.054	0.359	0.291

Table 1: significance level: ** = 0.01; * = 0.05. All R^2 values are adjusted R^2.

A graphical comparison of growth data for the Eurozone and the results of the OLS prediction with the risk-adjusted yield spread for the three phases of the currency union is presented in figure 2.

[3] Both models were checked for robustness by including the real short-term interest rate as a second explanatory variable. In line with earlier research, inclusion of further explanatory variables generally does not change the results for the yield spread coefficient.

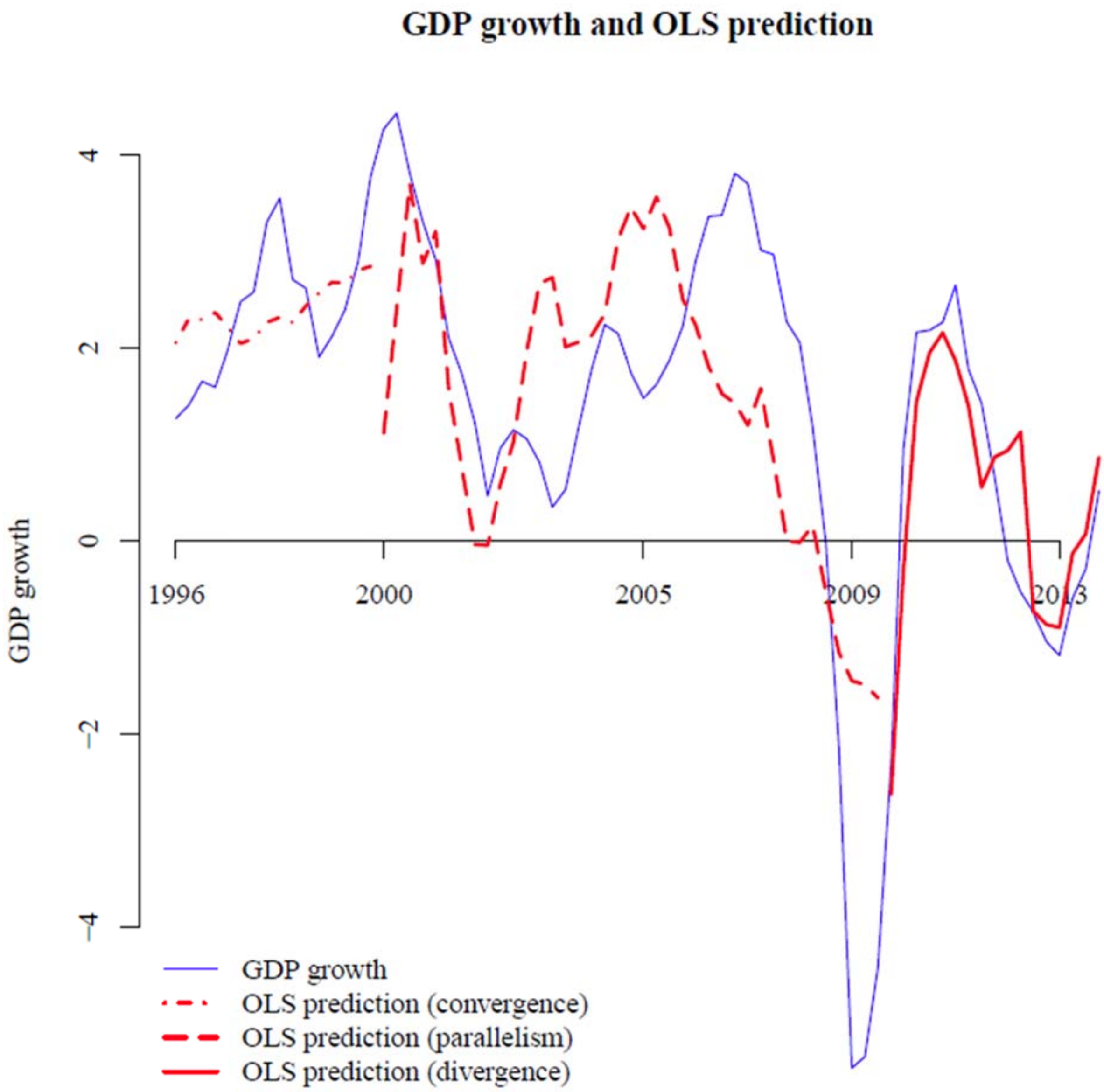

Figure 2: Estimated and real values of real GDP growth in percent in the Eurozone.

The weakened relationship between the non-risk-adjusted yield spread and growth in the third phase reflects divergent effects in individual countries of the Eurozone. The relationship between the raw yield spread and growth remains significant in the economically stable core of the currency union (Austria, Finland, France, Germany, the Netherlands) but is not significant in the so-called periphery countries (Spain, Ireland, Italy, Portugal, Slovenia), which are typically most strongly affected by risk premia[4]. For the latter countries, the yield spread does not remain significant as a predictor of GDP growth, as risk premia on long-term government debt appear to negate the relationship between the yield spread and GDP growth[5].

[4] The average difference in risk premia between countries in the first group and countries in the second group is 201 basis points.
[5] Detailed results for individual countries are available from the author.

4.2 Recession prediction

Yield curve inversion, usually considered the most reliable indicator of future recessions, occurs before a recession both in the Eurozone and other single-currency areas, as shown by the data for the phase of yield parallelism. In the phase of risk-induced yield divergence, the picture becomes less clear. Raw yield spread data do not show an inversion before the recession that began in Q1-2012. In view of the high risk premia of some countries, this result is unsurprising. After CDS spreads are taken into account, the yield curves invert in some countries (Germany, the Netherlands) and generally flatten in all other countries, with the yield spread for the Eurozone as a whole decreasing to 0.5%[6].

The results of the probit estimation (table 2) for the whole time horizon show a significant relationship between the risk-adjusted yield spread and the probability of a recession (model A). The quality of prediction increases further when the two phases of yield parallelism and divergence are estimated separately (model B). A graphical comparison of the estimated probabilities of recession with actual recession quarters is presented in figure 3.

	model A	**model B (Q1-00 – Q3-09)**	**model B (Q4-09 – Q4-13)**
β	-1.061**	-3.216*	-1.731*
Pseudo-R^2	0.288	0.873	0.399

Table 2: significance level: ** = 0.01; * = 0.05.

[6] Own calculation; for details, see Appendix.

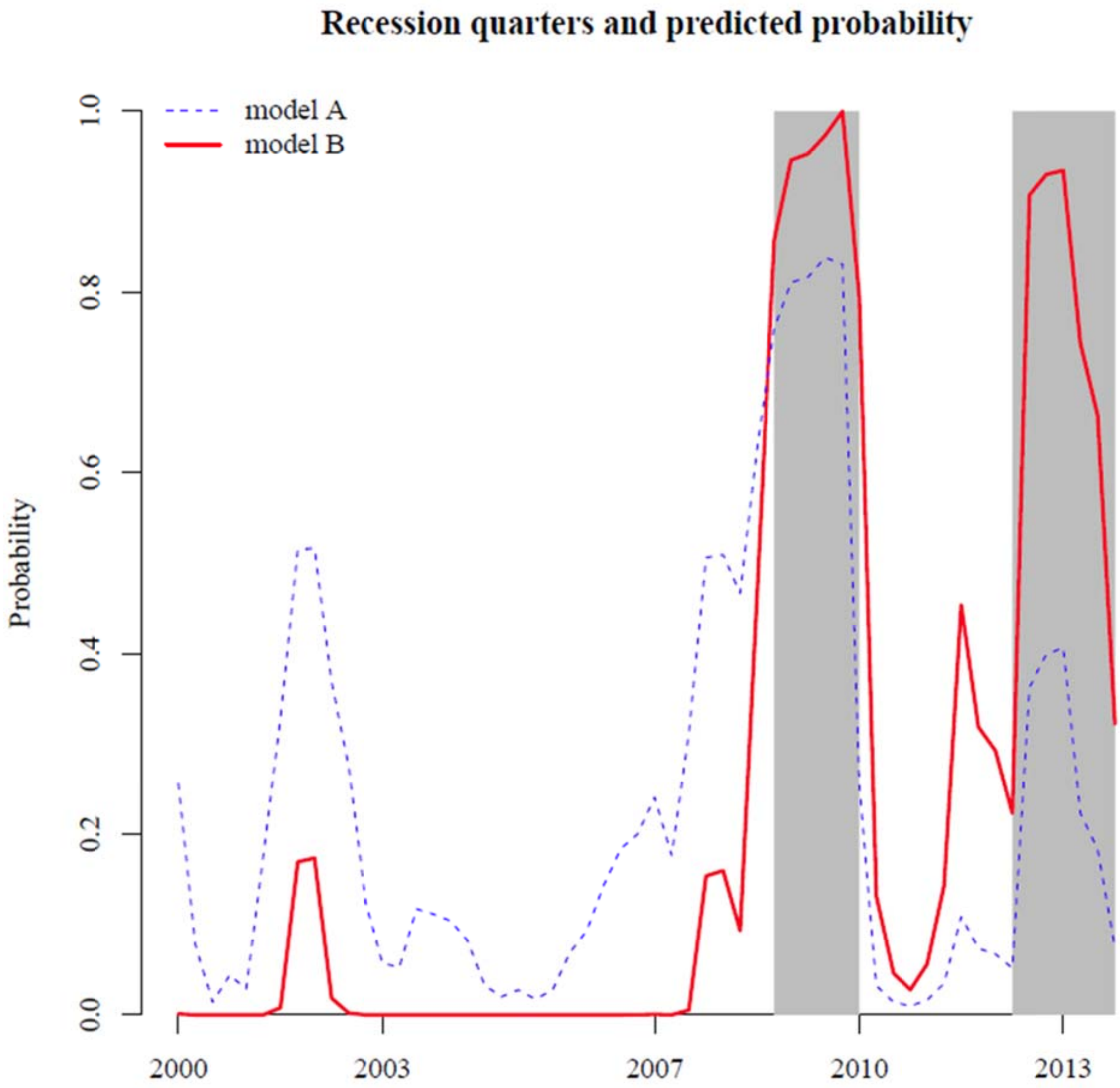

Figure 3: Predicted probabilities of recession and actual recessions in the Eurozone.

5 Conclusion

The above results suggest that the yield spread can be used to predict recessions and growth in the Eurozone. The quality of such predictions, however, requires consideration of risk premia. Yield spreads determined solely by inflation and growth expectations can reliably forecast economic activity. However, if the yield spread is biased by default risk, CDS data must also be considered.

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Appendix

Calculation of CDS-corrected Eurozone yield spreads:

The CDS-corrected Eurozone yield spread is calculated by multiplying individual countries' yield spreads by their extrapolated ECB capital shares. Capital shares are obtained by weighting the official shares of Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, the Slovak Republic, Slovenia, and Spain to sum to one. Luxembourg is excluded because of missing long-term debt data.

This method is used as a proxy for the OECD method of calculating Eurozone yield spreads, based on yield observations (in Euros) of actively traded government bonds of Eurozone countries, weighted by the stocks of bonds issued by each country in Euros. The OECD method cannot be replicated because of missing data.