Online appendix

Additional results adding industrial production and the composite leading indicator for the US and Germany to Real GDP, Employment and Investment

We added industrial production and the composite leading indicator for the US and Germany, and we find these variables have some significant coefficients in equations for real GDP at different horizons (see below). The bond spread retains its negative and significant coefficient, but the sign on US composite leading indicator is negative rather than positive. Overall these variables do not make a substantial contribution to the goodness of fit, which is about the same as a model that excludes them.

Alternative Table 2: Additional Results for Real GDP, Employment and Investment

Forecast Horizon: 4 quarters			
Financial Indicator	**RGDP (1)**	**EMP (2)**	**INV (3)**
Bond Spread	-0.673	-0.404**	-2.425***
	(0.428)	(0.174)	(0.793)
Germany Cons Conf	-0.0974***	-0.0242*	-0.215***
	(0.032)	(0.013)	(0.078)
Germany CLI	0.580**	0.264**	1.198**
	(0.235)	(0.109)	(0.546)
US CLI	-0.519**	-0.239**	-1.200**
	(0.213)	(0.097)	(0.502)
US IP Growth	0.202**	0.0720**	0.507**
	(0.087)	(0.033)	(0.192)
Within R-sq	0.523	0.540	0.555
Observations	255	255	255
Number of countries	8	8	8

Notes: As per original Tables

Results of adding one control variable at a time

We add each control variable one at a time to the model in successive columns. The results are reported for DFE and MGE estimators in the Tables below.

Alternative Table 3: Results for addition of variables one at a time (dynamic fixed effects estimator)

Real GDP Growth - Forecast Horizon: 1 quarter

Financial Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bond Spread	-2.002***	-2.001***	-2.000***	-1.350***	-1.536***	-1.336***	-1.189***
	(0.547)	(0.547)	(0.535)	(0.226)	(0.392)	(0.316)	(0.211)
Real Interest Rate		-0.0294					0.0188
		(0.208)					(0.213)
Term spread			-0.00858				-0.0828
			(0.262)				(0.261)
OECD CLI				1.039***			0.859***
				(0.202)			(0.218)
Consumer Confidence					0.141***		0.0479**
					(0.024)		(0.023)
Economic Sentiment						0.191***	0.0278
						(0.037)	(0.037)
Within R-sq	0.513	0.513	0.513	0.693	0.598	0.636	0.708
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Real GDP Growth - Forecast Horizon: 4 quarters

Financial Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bond Spread	-1.653***	-1.648***	-1.698***	-1.301***	-1.414***	-1.474***	-1.347***
	(0.461)	(0.434)	(0.487)	(0.373)	(0.448)	(0.492)	(0.412)
Real Interest Rate		-0.214					-0.0889
		(0.241)					(0.253)
Term spread			0.198				0.0624
			(0.291)				(0.391)
OECD CLI				0.561***			0.695***
				(0.185)			(0.252)
Consumer Confidence					0.0720***		0.0837**
					(0.023)		(0.039)
Economic Sentiment						0.0513*	-0.113*
						(0.026)	(0.065)
Within R-sq	0.336	0.346	0.341	0.419	0.372	0.350	0.455
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Real GDP Growth - Forecast Horizon: 8 quarters

Financial Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bond Spread	-1.057***	-1.053***	-1.127***	-1.042***	-1.089***	-1.270***	-1.286***
	(0.349)	(0.322)	(0.358)	(0.388)	(0.380)	(0.396)	(0.367)
Real Interest Rate		-0.172					0.11
		(0.240)					(0.257)
Term spread			0.305				0.403
			(0.356)				(0.362)
OECD CLI				0.024			0.338***

				(0.107)			(0.114)
Consumer Confidence					-0.0096		0.0635***
					(0.024)		(0.019)
Economic Sentiment						-0.0611	-0.159***
						(0.037)	(0.045)
Within R-sq	0.182	0.194	0.201	0.182	0.183	0.217	0.287
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Notes: As per original Tables

Alternative Table 3: Results for addition of variables one at a time (mean group estimator)

Real GDP Growth - Forecast Horizon: 1 quarter							
Financial Indicator	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Bond Spread	-2.327***	-2.502***	-2.599***	-1.713***	-1.731***	-1.596***	-1.356***
	(0.254)	(0.233)	(0.234)	(0.284)	(0.267)	(0.306)	(0.375)
Real Interest Rate		-0.429**					-0.706*
		(0.209)					(0.369)
Term spread			0.370*				-1.032**
			(0.194)				(0.471)
OECD CLI				1.383***			0.882***
				(0.189)			(0.118)
Consumer Confidence					0.194***		-0.0307
					(0.034)		(0.038)
Economic Sentiment						0.247***	0.159***
						(0.042)	(0.061)
RMSE	1.789	1.702	1.738	1.172	1.463	1.326	0.920
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Real GDP Growth - Forecast Horizon: 4 quarters							
Financial Indicator	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Bond Spread	-2.167***	-2.360***	-2.397***	-1.799***	-1.774***	-1.860***	-1.349***
	(0.275)	(0.232)	(0.267)	(0.287)	(0.237)	(0.315)	(0.429)
Real Interest Rate		-0.820***					-1.598***
		(0.219)					(0.486)
Term spread			0.505**				-1.538***
			(0.222)				(0.565)
OECD CLI				0.848***			0.806***
				(0.205)			(0.207)
Consumer Confidence					0.0883***		0.0389
					(0.028)		(0.035)
Economic Sentiment						0.0880**	-0.0493
						(0.043)	(0.059)
RMSE	1.629	1.444	1.571	1.434	1.539	1.533	1.036
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Real GDP Growth - Forecast Horizon: 8 quarters							
Financial Indicator	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Bond Spread	-1.540***	-1.687***	-1.780***	-1.568***	-1.558***	-1.729***	-1.503***
	(0.237)	(0.179)	(0.236)	(0.242)	(0.236)	(0.249)	(0.295)
Real Interest Rate		-0.794***					-1.080***
		(0.202)					(0.355)
Term spread			0.685***				-0.508*
			(0.237)				(0.292)
OECD CLI				0.0341			0.104
				(0.083)			(0.186)
Consumer Confidence					-0.0362		-0.0237
					(0.026)		(0.061)
Economic Sentiment						-0.0612**	-0.029
						(0.030)	(0.088)
RMSE	1.326	1.138	1.247	1.311	1.267	1.226	0.800
Observations	287	287	287	287	287	287	287
Number of countries	8	8	8	8	8	8	8

Notes: As per original Tables

Compare models with and without the spreads

We have estimated the model using dynamic fixed effects with 5 lags and an identical specification to Table 3 in the paper but without the bond spread included in the regression. We report the result below for Table 3. The R-squared goodness of fit measure falls for 1, 4 and 8 quarter models, and the fall is greater the longer the forecast horizon. The measures of within R-squared in the original model were 0.696, 0.423 and 0.201.

Alternative Table 3. Real GDP without the Bond Spread

Estimator: Dynamic FE			
Financial Indicator	**1 quarter (1)**	**4 quarters (2)**	**8 quarters (3)**
Real Interest Rate	-0.821***	-2.048***	-1.868***
	(0.269)	(0.410)	(0.345)
Term Spread	-1.545***	-2.329***	-1.670***
	(0.422)	(0.583)	(0.426)
Country CLI	1.580***	0.903***	0.0636
	(0.144)	(0.173)	(0.097)
Within R-sq	0.627	0.317	0.062
Observations	287	287	287
Number of countries	8	8	8

Results of using weighted averages for the bond spread instead of simple averages.

The result of using weighted instead of simple averages in construction of the bond spreads does not alter the results. We report Tables 2 and 3 from the paper with weighted average bond spread measures below. The results are reported in Alternative Tables 2 and 3.

Alternative Table 2. Weighted-average bond spread

Forecast Horizon: 12 months/4 quarters				
Financial Indicator	**RGDP**	**EMP**	**INV**	**IP**
	(1)	**(2)**	**(3)**	**(4)**
Weighted Bond Spread	-1.635***	-0.691***	-4.094***	-4.198***
	(0.418)	(0.147)	(1.025)	(1.215)
Real Interest Rate	-0.124	-0.162	-0.534	-0.988
	(0.260)	(0.115)	(0.680)	(0.682)
Term Spread	-0.0202	-0.0673	0.203	0.437
	(0.356)	(0.106)	(0.874)	(0.964)
Country CLI	0.503***	0.210***	1.250***	1.887***
	(0.155)	(0.042)	(0.234)	(0.393)
Within R-sq	0.453	0.559	0.505	0.800
Forecast Horizon: 12 months/4 quarters				
Financial Indicator	**RGDP**	**EMP**	**INV**	**IP**
	(5)	**(6)**	**(7)**	**(8)**
Weighted Bond Spread	-1.476***	-0.384**	-3.688**	-3.980***
	(0.431)	(0.189)	(1.703)	(0.654)
Real Interest Rate	-1.659***	-0.638***	-4.509***	-5.639***
	(0.422)	(0.226)	(1.137)	(1.242)
Term Spread	-1.694***	-0.658***	-4.409***	-3.982***
	(0.533)	(0.146)	(1.440)	(1.246)
Country CLI	0.726***	0.436**	1.556***	2.482***
	(0.160)	(0.216)	(0.420)	(0.359)
RMSE	1.1929	0.4397	2.8897	4.4194
Observations	287	287	287	872
Number of countries	8	8	8	8

Notes: As per original Tables

Alternative Table 3. Weighted-average bond spread

Real GDP Growth			
Financial Indicator	**1 quarter**	**4 quarters**	**8 quarters**
	(1)	**(2)**	**(3)**
Weighted Bond Spread	-1.571***	-1.635***	-1.407***
	(0.253)	(0.418)	(0.405)
Real Interest Rate	0.0889	-0.124	0.0201
	(0.210)	(0.260)	(0.260)
Term Spread	-0.113	-0.0202	0.326
	(0.246)	(0.356)	(0.382)
Country CLI	1.028***	0.503***	-0.0349
	(0.198)	(0.155)	(0.111)
Within R-sq	0.706	0.453	0.237

Real GDP Growth			
Financial Indicator	**1 quarter**	**4 quarters**	**8 quarters**
	(4)	**(5)**	**(6)**
Weighted Bond Spread	-1.559***	-1.476***	-1.525***
	(0.414)	(0.431)	(0.249)
Real Interest Rate	-0.414	-1.659***	-1.442***
	(0.261)	(0.422)	(0.324)
Term Spread	-0.831**	-1.694***	-0.924***
	(0.335)	(0.533)	(0.310)
Country CLI	1.411***	0.726***	-0.188**
	(0.200)	(0.160)	(0.087)
RMSE	1.066	1.193	1.054
Observations	287	287	287
Number of countries	8	8	8

Notes: As per original Tables

Estimates with a truncated sample

When we compare the results from Table 3 with a sample of data that ends in 2008Q4 we find that the coefficients on bond spreads are slightly larger than the estimates for a sample period extending to 2011 reported in the Table. Coefficients on bond spreads retain their negative sign and significance, and although there are differences in the point estimates they do not change the argument in the paper. The results are provided below.

Alternative Table 3. Estimates with a truncated sample

Real GDP Growth			
Financial Indicator	**1 quarter (1)**	**4 quarters (2)**	**8 quarters (3)**
Bond Spread	-2.060***	-2.087***	-1.716***
	(0.257)	(0.674)	(0.385)
Real Interest Rate	0.0812	-0.149	0.0444
	(0.172)	(0.231)	(0.239)
Term Spread	-0.442**	-0.162	0.392
	(0.200)	(0.339)	(0.428)
Country CLI	0.844***	0.501**	-0.0332
	(0.187)	(0.238)	(0.145)
Within R-sq	0.796	0.560	0.378
Real GDP Growth			
Financial Indicator	**1 quarter (1)**	**4 quarters (2)**	**8 quarters (3)**
Bond Spread	-1.816***	-0.966*	-0.491
	(0.471)	(0.582)	(0.478)
Real Interest Rate	0.172	-2.003***	-1.625***
	(0.278)	(0.523)	(0.445)
Term Spread	-1.195**	-1.708***	-0.674*
	(0.473)	(0.540)	(0.357)
Country CLI	1.240***	0.842***	0.365
	(0.236)	(0.187)	(0.237)
RMSE	0.864	1.143	1.017
Observations	215	215	215
Number of countries	8	8	8

Notes: As per original Tables

Additional Results for Real GDP, Employment and Investment

When we include additional regressors such as German consumer confidence, German industrial production growth, US composite leading indicator and industrial production growth to estimated equation (2) for growth in real GDP, employment and investment, we find some significance, but the explanatory power of the regression equation is not much improved.

Alternative Table 5. Additional Results for Real GDP, Employment and Investment

Forecast Horizon: 4 quarters			
Financial Indicator	**RGDP (1)**	**EMP (2)**	**INV (3)**
Bond Spread	-0.673	-0.404**	-2.425***
	(0.428)	(0.174)	(0.793)
Germany Cons Conf	-0.0974***	-0.0242*	-0.215***
	(0.032)	(0.013)	(0.078)
Germany CLI	0.580**	0.264**	1.198**
	(0.235)	(0.109)	(0.546)
US CLI	-0.519**	-0.239**	-1.200**
	(0.213)	(0.097)	(0.502)
US IP Growth	0.202**	0.0720**	0.507**
	(0.087)	(0.033)	(0.192)
Within R-sq	0.523	0.540	0.555
Forecast Horizon: 4 quarters			
Financial Indicator	**RGDP (4)**	**EMP (5)**	**INV (6)**
Bond Spread	-0.906*	-0.317*	-2.811***
	(0.489)	(0.181)	(0.998)
Real Interest Rate	-0.24	-0.197	-0.605
	(0.298)	(0.135)	(0.828)
Term Spread	-0.177	-0.173	0.261
	(0.478)	(0.160)	(1.227)
Country CLI	0.510**	0.253***	1.556***
	(0.218)	(0.092)	(0.392)
IP Growth	0.000601	-0.00019	0.00108
	(0.001)	(0.000)	(0.001)
US CLI	-0.458*	-0.170**	-1.288**
	(0.255)	(0.072)	(0.526)
US IP Growth	0.192***	0.0685**	0.436***
	(0.072)	(0.029)	(0.154)
Within R-sq	0.473	0.543	0.539
Observations	255	255	255
Number of countries	8	8	8

Notes: As per original Tables

Out of sample forecasts

We report out-of-sample estimates of our European model for real GDP growth for observations from 2008. We compare the one-step ahead forecast performance of our preferred model from Table 6, which allows country differences in the response to bond spreads to influence real GDP growth versus alternative models. We have three alternative models: a) a random walk model; b) a model identical to ours but excluding the bond spreads; and c) an autoregressive model in which the growth of real GDP is predicted by lagged values of itself. The preferred model and the three alternatives are compared using the ratio of mean squared forecast errors (MSFE); if the ratio is greater than one the alternative model outperforms the model from Table 6. We evaluate the performance in two columns in Table 7. The first column allows forecasts to be made using a model with a fixed estimation period ending December 2008 (fixed window), while the second allows the end of the estimation period to roll forward by one period at a time (expanding window).

The reported forecasts from our preferred model versus the random walk alternative show the MSFE ratio is less than one for nine out of sixteen cases. The MSFE ratio results versus the model excluding bond spreads are less than one for eleven out of sixteen cases, while versus the autoregressive model, fourteen out of sixteen cases have a ratio less than one. We take these results as evidence that the model has reliable out-of-sample predictive ability one-step ahead versus three alternative models. However, the forecasts from the baseline model including bond spreads for Austria appear consistently worse than all three alternatives, possibly due to the much higher bond spread and expected default risk associated with this country. We exercise further caution due to the short sample (which does not include a previous large recession) and the overlap of the forecasting period with the financial crisis, which may be reasons to interpret these results with care.

Mean Square Forecasts Error Ratios for Out-of-Sample Predictions of Real GDP Growth

Real GDP Growth						
Ratio value (by country)	Random Walk		Baseline excl. spread		Autoregressive	
	Fixed Window	Expanding Window	Fixed Window	Expanding Window	Fixed Window	Expanding Window
AT	2.129	3.731	3.296	3.955	2.547	1.539
BE	0.815	1.044	1.209	0.823	0.895	0.400
FR	0.286	0.759	0.307	0.527	0.276	0.226
DE	0.888	0.955	1.448	0.928	0.853	0.349
GB	0.351	1.477	0.286	0.525	0.277	0.420
IT	1.049	1.096	0.965	0.723	0.990	0.400
NL	0.667	0.703	0.743	0.488	0.508	0.301
SP	0.320	2.235	0.285	1.363	0.333	0.795

Notes: The estimates above show the prediction using dynamic fixed-effects (DFE) estimates of equation (3) using a baseline model including 5 lags of the first-difference growth of the dependent variable, monetary policy indicators (Real Interest Rate and Term Spread), the country composite leading indicator (Country CLI) and the bond spread measure (Bond Spread) interacted with respective country dummies, reported in Table 6. The upper panel in this Table shows the MSFE ratio for a model with a constant estimation period (ending 2008Q1), and the lower panel shows the MSFE ratio for expanding window forecasts with a lengthening estimation period. The reported ratios are derived from a comparison of the out-of-sample residuals from the DFE estimator versus a forecast alternative, where the alternative takes the form of a random walk model, the baseline model excluding the bond spreads, and an autoregressive model. Sample period: July 1994 – May 2011. Euroarea countries are included from October 2001. Standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Further evidence on the relationship between the excess bond premium and the bank lending survey measure of tightness of credit standards.

To investigate the relationship between EBP and the ECB Bank Lending Survey, we regress the bond spread and the change in the bond spread and other control variables on net percentage balance reporting a tightening of credit supply provided by the ECB Bank Lending Survey. We include one lag of the BLS tightness measure, and find that the bond spread has a significant (positive) coefficient, which implies that the tightness of financial markets indicated by our bond spread measure is positively associated with the tightness of bank lending recorded by the ECB in their surveys. This provides us with evidence that the spread should have a credit supply interpretation. The results are reported below (we have not included these tables in the paper due to space constraints).

Relationship between the ECB Bank Lending Survey credit supply tightness and the bond spread

BLS Credit Supply Tightness			
Financial Indicator	**Dynamic FE**		
	(1)	**(2)**	**(3)**
Credit Supply Tightness (lag)	0.683***	0.532***	0.638***
	(0.099)	(0.066)	(0.056)
Bond Spread	4.313**	5.570***	
	(2.041)	(1.498)	
Bond Spread change			8.525***
			(1.685)
Real Interest Rate		5.737**	5.974*
		(2.763)	(2.993)
Term Spread		2.729	5.359**
		(2.376)	(2.515)
Country CLI		-1.696**	-1.687***
		(0.697)	(0.607)
Within R-sq	0.689	0.775	0.815
Observations	242	242	238
Number of countries	8	8	8

Notes: As per original Tables

Relationship between Change in ECB Bank Lending Survey credit supply tightness and the bond spread

BLS Change in Credit Supply Tightness			
Financial Indicator	**Dynamic FE**		
	(1)	**(2)**	**(3)**
Credit Supply Tightness (lag)	0.193	-0.135	-0.169
	(0.169)	(0.162)	(0.137)
Bond Spread	-0.964	6.422***	
	(2.519)	(1.848)	
Bond Spread change	10.53***		
	(2.268)		
Real Interest Rate		1.493	2.613
		(2.369)	(2.680)
Term Spread		-6.096**	-1.232
		(2.219)	(2.055)
Country CLI		1.015	0.206
		(0.602)	(0.521)
Within R-sq	0.037	0.295	0.359
Observations	230	230	230
Number of countries	8	8	8

Notes: As per original Tables

Results using German Bunds as the benchmark (based on Gilchrist-Mojon spreads)

A Banque de France working paper by Gilchrist and Mojon (2014) uses the German Bund as a benchmark to create spreads for non-financial corporations. We checked the correlation of our spreads with the four major Euro area spreads that they construct and find the correlation coefficient is very high. When we replaced our spread with theirs (for four economies in the panel not eight) we obtained the results below. These confirm our findings. We have put a footnote in our revised paper to indicate that our results are similar to the ones we report in our tables if we use a German Bund benchmark instead of our constructed risk free rate. In the interest of space we have not put these tables in the revised paper, but they could be included in an online appendix.

Table 3: Results Using German Bunds as the Benchmark (based on Gilchrist-Mojon spreads)

Estimator: Dynamic FE			
Financial Indicator	**1 quarter (1)**	**4 quarters (2)**	**8 quarters (3)**
G&M Spread	-1.118***	-0.974***	-1.008**
	(0.378)	(0.354)	(0.391)
Real Interest Rate	-0.546	-2.134***	-1.958***
	(0.352)	(0.576)	(0.354)
Term Spread	-0.746*	-1.840***	-1.325***
	(0.391)	(0.465)	(0.305)
Country CLI	1.253***	0.489***	-0.266
	(0.208)	(0.129)	(0.185)
Within R-sq	0.778	0.624	0.464
Estimator: MGE			
Financial Indicator	**1 quarter (1)**	**4 quarters (2)**	**8 quarters (3)**
G&M Spread	-0.921***	-0.913***	-1.450***
	(0.244)	(0.284)	(0.493)
Real Interest Rate	-0.671**	-2.159***	-2.024***
	(0.321)	(0.399)	(0.196)
Term Spread	-0.875**	-1.765***	-1.097***
	(0.441)	(0.547)	(0.235)
Country CLI	1.420***	0.703**	-0.521***
	(0.262)	(0.277)	(0.124)
RMSE	1.063	1.180	0.956
Observations	135	135	135
Number of countries	4	4	4

Notes: As per original Tables

Test of reverse causation between the real activity measures and bond spreads

Tests of reverse causation

Bond Spread			
Financial Indicator	**(1)**	**(2)**	**(3)**
Real Interest Rate	0.101*	0.101	0.102*
	(0.047)	(0.054)	(0.052)
Term Spread	0.0886	0.12	0.114
	(0.067)	(0.082)	(0.080)
European CLI	-0.0531**	-0.110***	-0.101***
	(0.018)	(0.022)	(0.021)
RGDP Growth	-0.0529***		
	(0.012)		
EMP Growth		0.000184	
		(0.012)	
INV Growth			-0.00443**
			(0.002)
Within R-sq	0.794	0.777	0.78

Bond Spread			
Financial Indicator	**(1)**	**(2)**	**(3)**
Real Interest Rate	0.0526	0.109	0.0648
	(0.204)	(0.148)	(0.194)
Term Spread	0.0973	0.205	0.21
	(0.226)	(0.170)	(0.144)
European CLI	-0.137***	-0.199***	-0.145***
	(0.035)	(0.043)	(0.030)
RGDP Growth	-0.0517***		
	(0.019)		
EMP Growth		0.00592	
		(0.048)	
INV Growth			-0.023
			(0.017)
RMSE	0.2788	0.2882	0.2766
Observations	247	247	247
Number of countries	8	8	8

Notes: Top panel dynamic fixed effects estimates using monetary policy indicators, the European composite leading indicator, 5 lags of the bond spread, and the *first-difference* growth rates of Real GDP, Employment and Investment as explanatory variables. The bottom panel reports the same specification but uses a mean group estimator. Sample period: July 1994 – May 2011. Euroarea countries included from October 2001. Standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The top panel reports the dynamic fixed effects estimates showing some significance on coefficients associated with the real activity measures and high values of the within R-squared measures. The results indicate higher growth of GDP and investment imply lower bond spreads. However the results from the mean group estimator are less supportive since only higher growth of GDP implies higher bond spreads. There is some evidence of reverse causation (it is a sensible hypothesis) but we do not think it undermines the results we have reported, which prove very robust to alternative specifications.