The determinants of sovereign bond yield spreads in the EMU

António Afonso (European Central Bank)
Michael G. Arghyrou (Cardiff University)
Alexandros Kontonikas (University of Glasgow)

EMF Meeting 2012

Bank of Greece - 30 March 2012

Introduction

- Since autumn 2009 the European sovereign debt crisis continues unabated.
- In 2010-11 Greece, Portugal and Ireland were bailed-out by EMU partners/IMF.
- In recent months, Italian and Spanish bonds have come under significant pressure.
- Second bailout package for Greece recently agreed.

Proposals to resolve EMU crisis

- European Stability Mechanism emphasising fiscal discipline and sustainable fundamentals
- Enhancing economic governance at European level leading to fiscal union (De Grauwe, 2010)
- Common debt issuance - Eurobond (Favero and Missale, 2011)
- Increased regulation of bond/CDS markets/credit rating agencies (ECB, 2009; EC, 2010)

Identification of sovereign risk determinants is key for optimal response design

Modelling sovereign bond yield spreads

Government yield spreads typically modelled on:

1. ***International risk factor*:** captured by volatility indices and/or corporate rate spreads.

2. ***Credit risk:*** endogenous to fiscal position and macro-performance.

3. ***Liquidity risk:*** difficult to measure, highly correlated with international risk.

Previous literature on pre-crisis period (1)

- Studies on EMU sovereign spreads during pre-crisis period are not unanimous regarding the role of their three main determinants.

- Credit risk variables statistically significant in explaining spreads (Bernoth et al., 2004) but market penalty was not high enough to encourage sustainable fiscal policies (Manganelli and Wolswijk, 2009).

- Liquidity risk and international risk more prominently priced during periods of tight financial conditions (Codogno et al., 2003; Barrios et al., 2009).

Previous literature on pre-crisis period (2)

- Low spreads during pre-crisis period can be explained by combination of *convergence trading* and *implicit fiscal guarantees* (Arghyrou and Tsoukalas, 2011).

- Convergence trading involved purchasing periphery bonds (equally treated with core bonds by ECB as collateral for liquidity provision) in the expectation of periphery converging towards core EMU/Germany.

- Belief in bailout, against Maastricht Treaty rule, if convergence would not materialize (implicit fiscal guarantees).

Previous literature on crisis period (1)

- Banking crisis mutating into EMU sovereign debt crisis and vice-versa (Acharya et al., 2011):

- Banking risk → sovereign: (i) restricted bank credit to the private sector leading to economic slowdown and higher fiscal imbalances; (ii) banks' recapitalisation packages further increasing fiscal liabilities.

- Sovereign risk→ banking: (i) decline in value in the financial sector's holdings of sovereign bonds; (ii) loss of trust to implicit/explicit government guarantees.

Previous literature on crisis period (2)

- Shift in bond pricing model from convergence trading to macro and fiscal fundamentals-based pricing (Arghyrou and Kontonikas, 2011; Oliveira et al., 2011)
- Contagion effects (Arghyrou and Kontonikas, 2011; Caceres et al., 2010)
- Role of liquidity risk rather limited (Barrios et al., 2009)
- Sovereign credit rating matter (Afonso et al., 2011)

This paper

1. Extended set of fundamentals & possibility of structural breaks.
2. Role of contagion.
3. Speculation and institutional intervention.
4. Credit ratings and outlook announcements.
5. We also model credit ratings.
6. 1999 – 2010; 10 EMU members.
7. Panel estimation, FGLS (cross-section weights)

Extended model

$$spr_{it} = \alpha + \beta_1\, spr_{it\text{-}1} + \beta_2\, vix_t + \beta_3\, ba_{it} +$$
$$+ \beta_4\, balance_{it} + \beta_5\, debt_{it} + \beta_6\, q_{it} + \beta_7\, gind_{it}$$
$$+ \beta_8\, pc2_t + \beta_9\, ltsdebt_{it} + \beta_{10}\, debt^2_{it}$$
$$+ \beta_{11}\, spr_{it\text{-}1} * ba_{it\text{-}1} + \beta_{12}\, average\ rating_{it}$$
$$+ \beta_{13}\, average\ outlook_{it} + \gamma_i + \varepsilon_{it}$$

- $\beta_2, \beta_3, \beta_5, \beta_6 > 0$
- $\beta_4, \beta_7, \beta_9, \beta_{12}, \beta_{13} < 0$
- $\beta_8, \beta_{10}, \beta_{11}$ (?)

Multiplicative term intuition

- $spr_{it\text{-}1} * ba_{it\text{-}1}$: bond market stress indicator; a rise is associated with falling bond prices and liquidity.

  - β_{11} >0: market forces push bond prices below their equilibrium value (speculation trading?)

  - β_{11} <0: market forces push bond prices above their equilibrium value (possibly capturing purchases by institutional investors, mainly ECB, to prevent a collapse of the bond market).

Credit crisis slope dummy

- *D2007.08*: to capture the effects of the global financial crisis.

- August 2007 is widely acknowledged to be the starting point of the credit crunch.

- The first large emergency loan by the ECB to European banks took place on 9/8/2007.

- Consistent with previous literature (Arghyrou and Kontonikas, 2011; Attinasi et al., 2009).

Debt crisis slope dummy

- *D2009.03*: to capture the transformation of the global credit crisis into the European sovereign debt crisis.

- Most intense period of credit crisis over by spring 2009 with interbank spreads easing and stocks rebounding.

- By spring 2009 the cost of fiscal activism and the bank bailout packages became apparent.

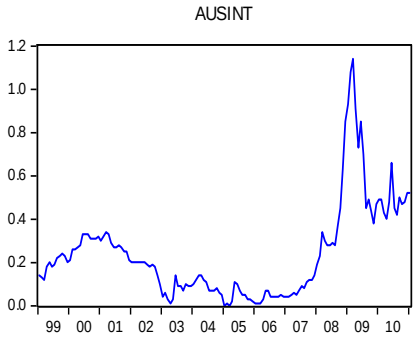
- Major revision of projected EMU government debt in spring 2009, an increase of 19% on average.

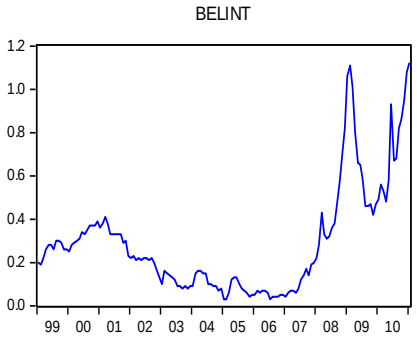
Data

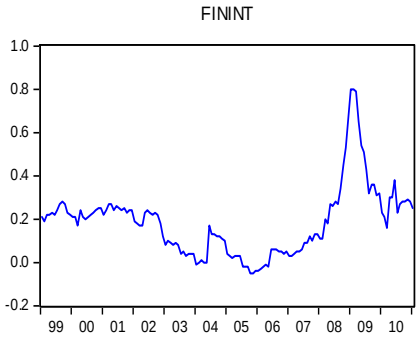
- Monthly data, 1999:01 – 2010:12
- 10 EMU members' spreads vs. Germany

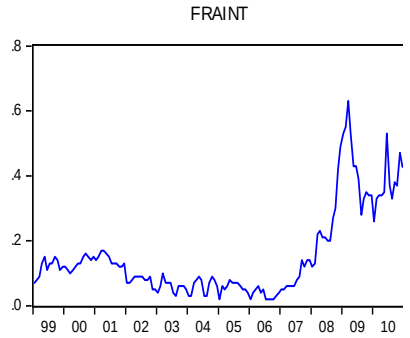
Variable	Description
spr	10 year government bond yield (differential vs. Germany)
vix	(Log of) S&P 500 implied stock market volatility index (VIX)
pc2	(Minus) Second principal component of *spread*
ba	10 year government bond bid-ask spread
q	(Log of) CPI based real effective exchange rate
balance	Expected budget balance/GDP (differential vs. Germany)
debt	Expected debt/GDP (differential vs. Germany)
gind	Industrial production annual growth (differential vs. Germany)
ltsdebt	Long-term/Total general government debt
D2007.08	Dummy variable: 1 from 2007.08 onwards, zero otherwise
D2009.03	Dummy variable: 1 from 2009.03 onwards, zero otherwise
Dper	Dummy variable: 1 if GRE, IRE, POR, SPA, zero otherwise
rating	Credit rating (Fitch, Moody's, S&P, Average of three agencies)
outlook	Credit outlook (Fitch, Moody's, S&P, Average of three agencies)

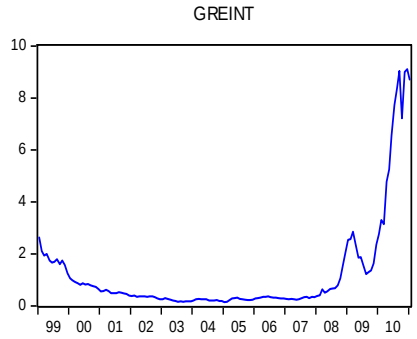
10-year bond yield spreads vs. Germany

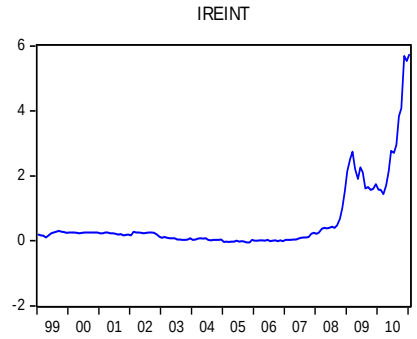


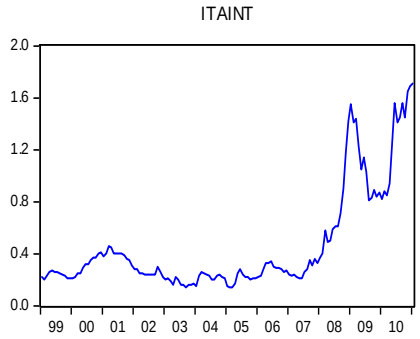


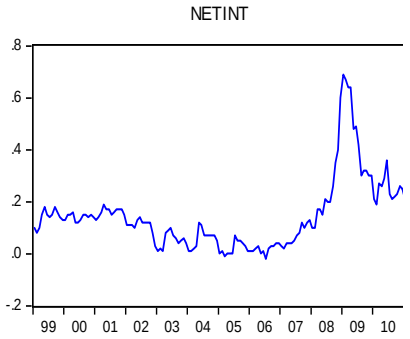


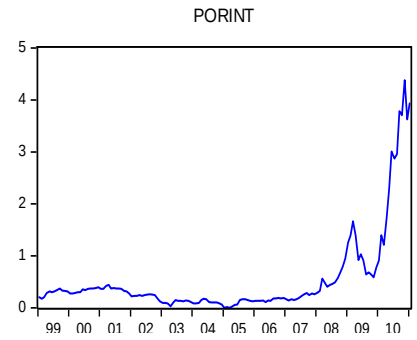


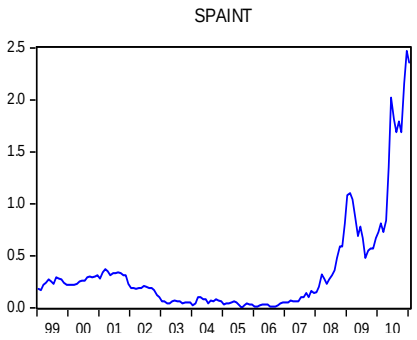




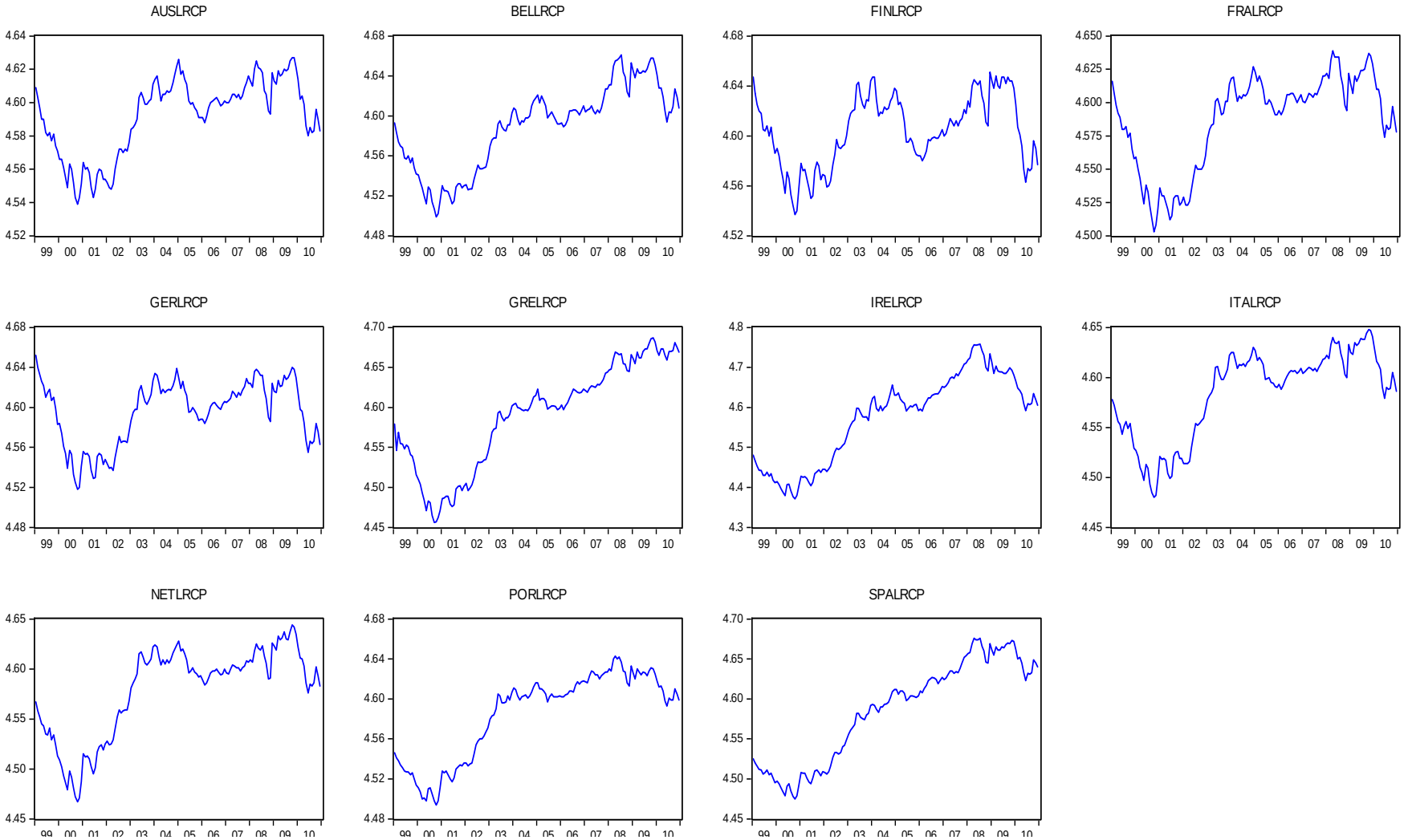




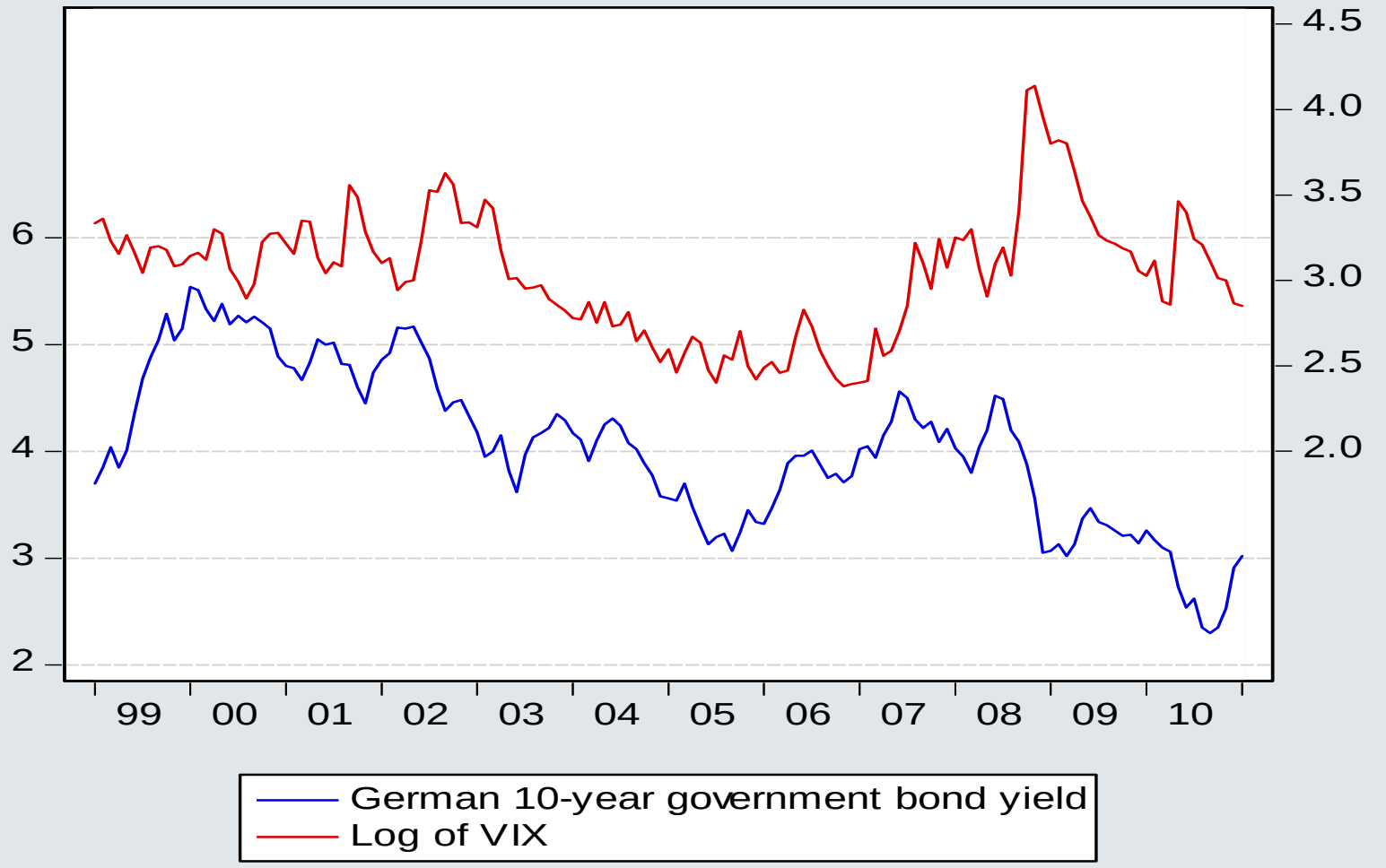




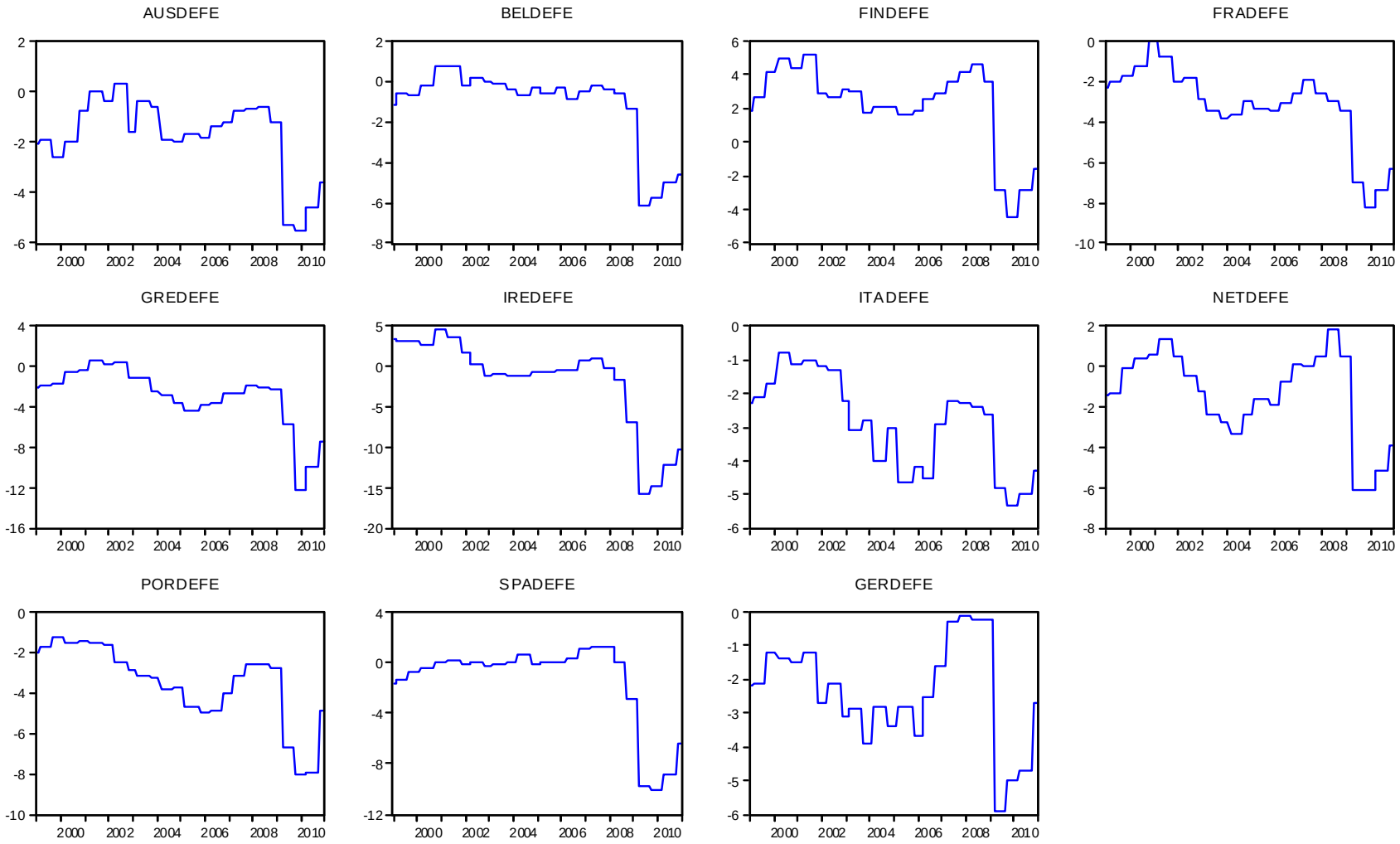
Real effective exchange rate



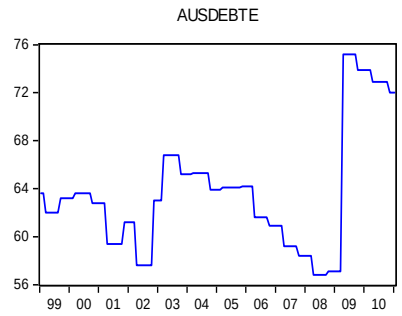
German 10-year bond yield and VIX

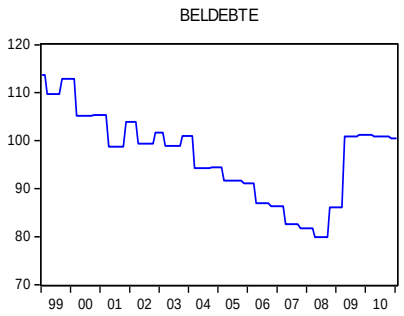


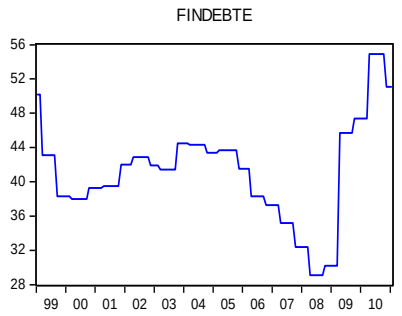
Expected budget balance (% GDP)

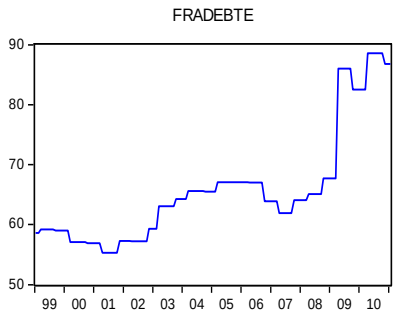


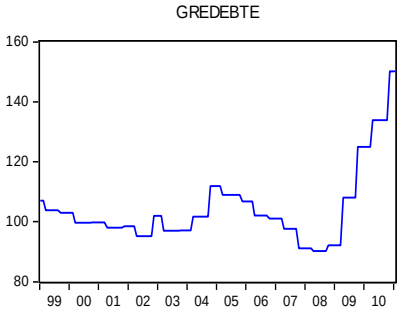
Expected government debt (% GDP)

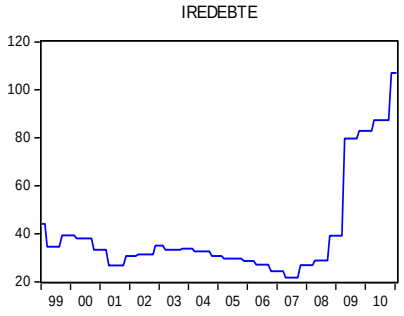


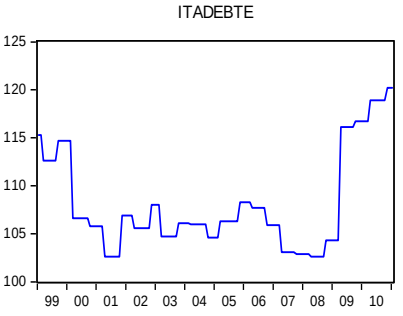


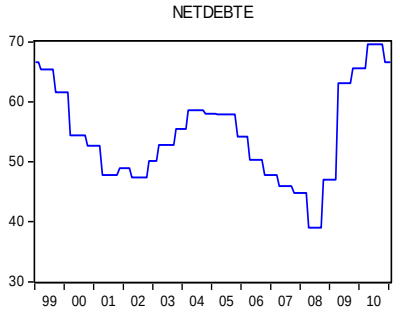


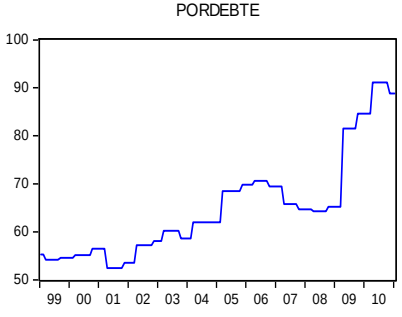


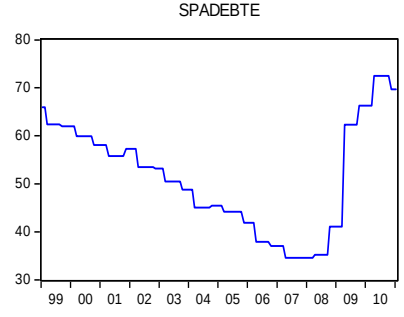


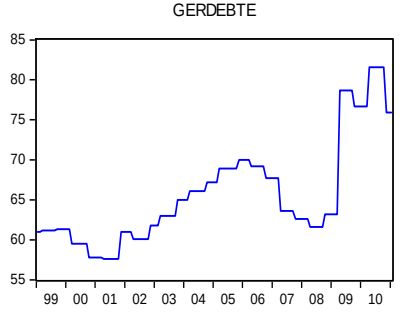




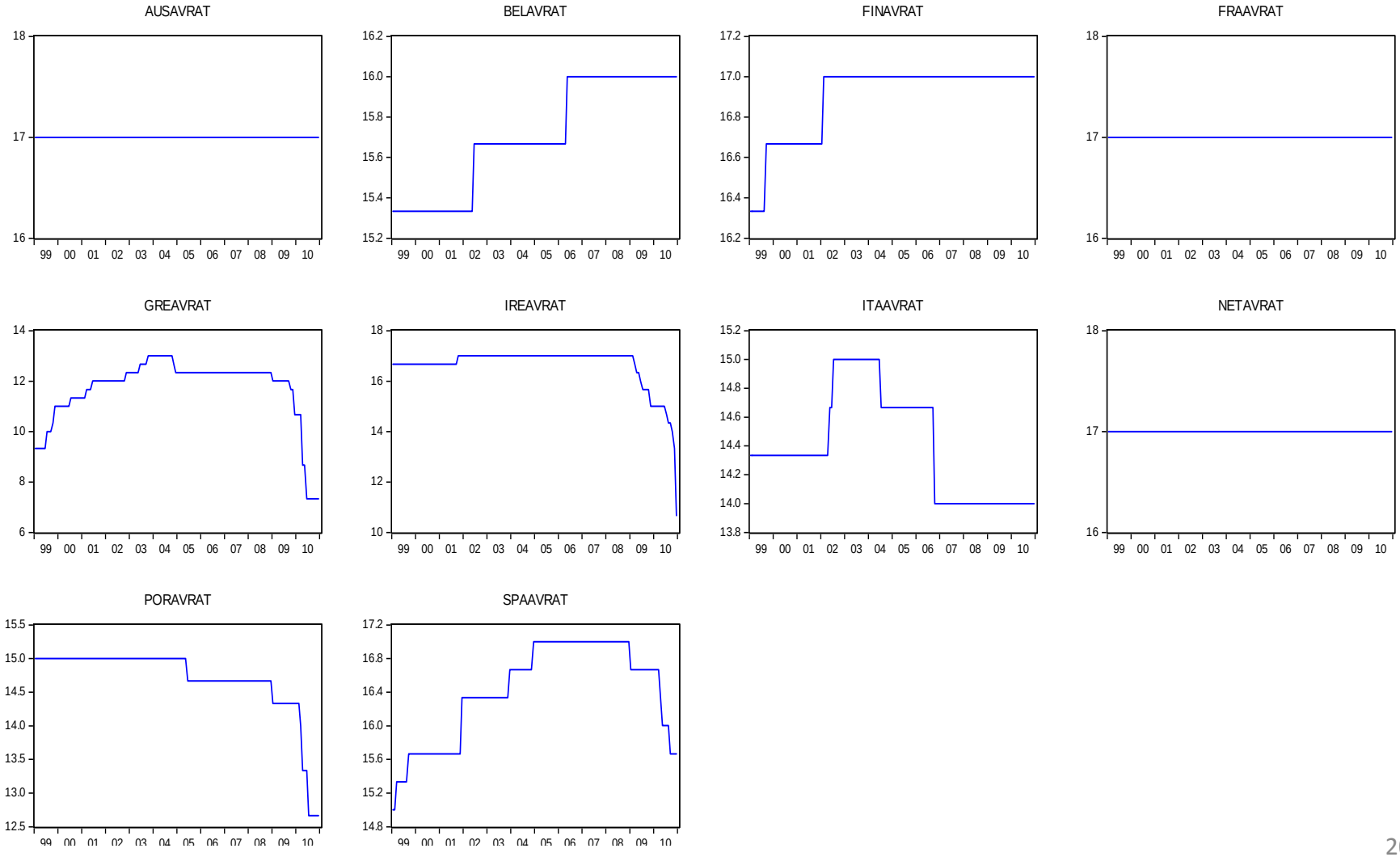




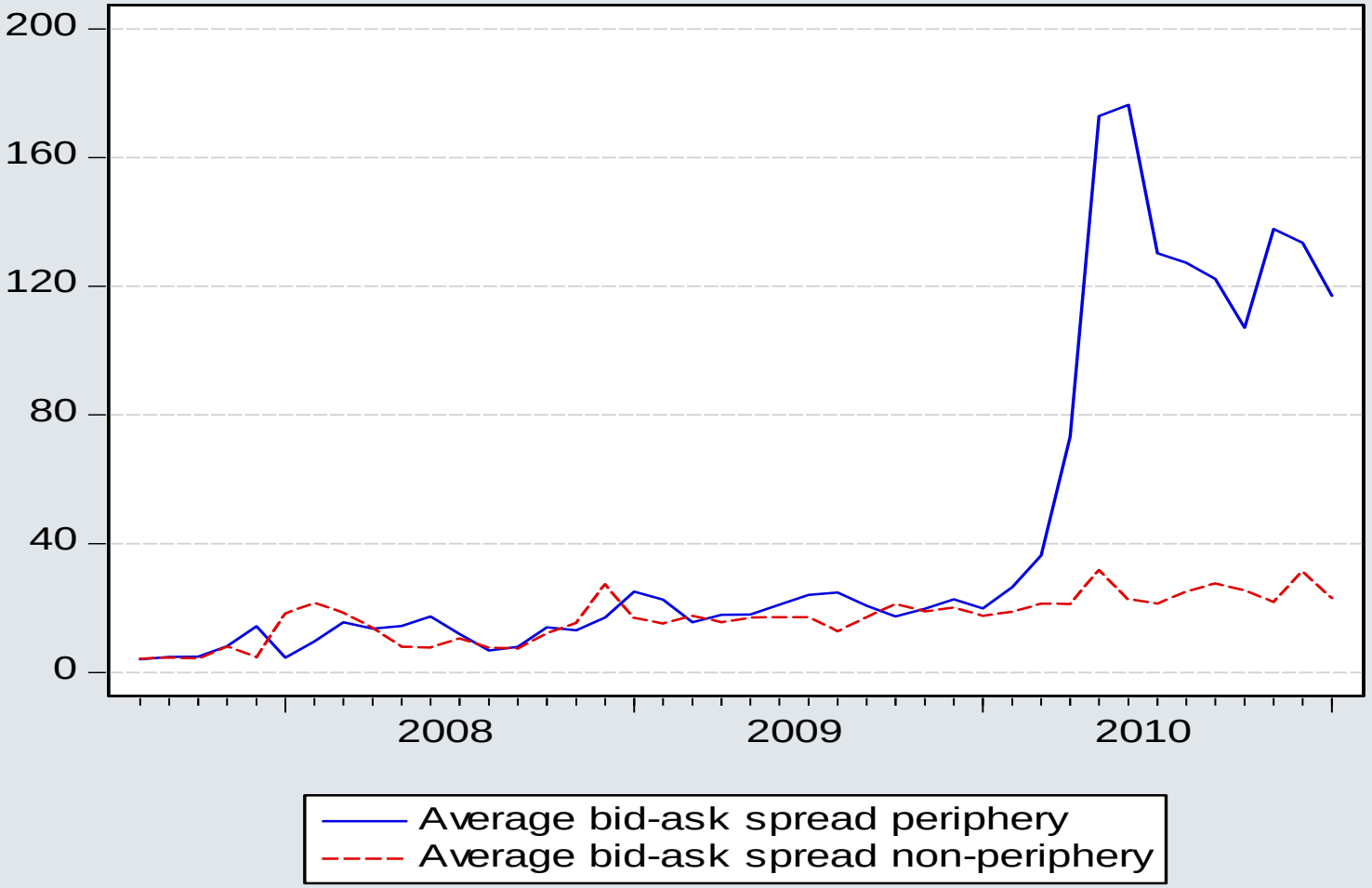




Average credit rating (<8: ‘junk’)



Illiquidity Periphery vs. Core



Measuring contagion (1)

- Principal component analysis (Longstaff et al., 2011).
- First two principal components capture 97% of total variation in spreads.
- First principal component: EMU-wide risk indicator (all countries load with similar weights).
- Second principal component: Measure of divergence between periphery (Greece, Ireland, Italy, Portugal and Spain) and core risk.

Measuring contagion (2)

- Increasing divergence between core and periphery (pc2 widens since early 2009) is linked to contagion via a higher probability of default by a periphery economy:

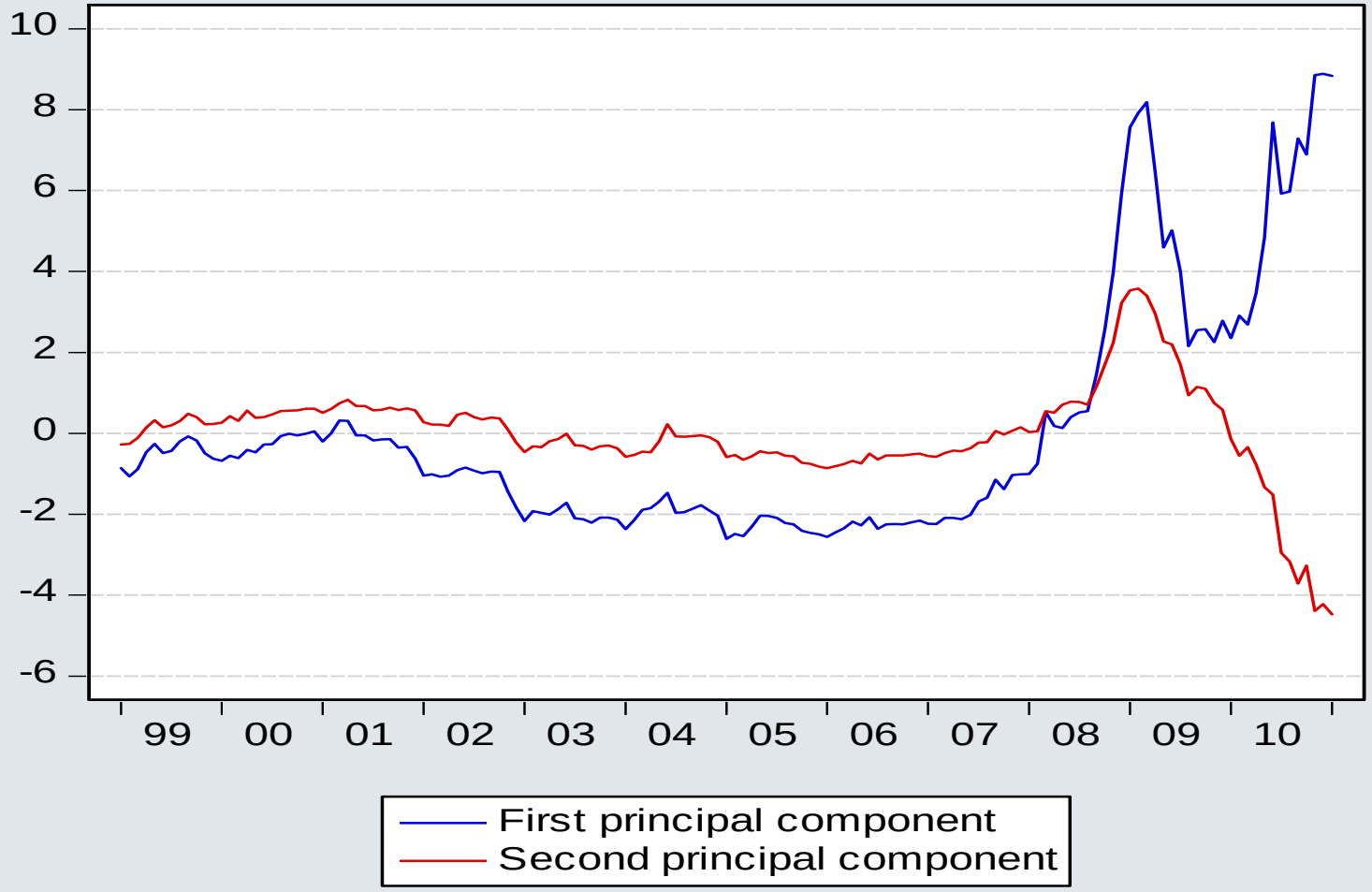
  1. Default within the periphery group may operate as a precedent for more periphery defaults leading to *intra-periphery contagion*.

  2. Increased probability of possible future sovereign rescues, ultimately to be funded by core countries leading to *periphery-to-core contagion* (pc1 rises since early 2010).

Principal components analysis

Number	Eigenvalues	Cumulative proportion	Eigenvectors (Loadings)	*First principal component*	*Second principal component*
1	8.193	0.819	Austria	0.315	0.330
2	1.477	0.967	Belgium	0.343	0.070
3	0.121	0.979	Finland	0.278	0.458
4	0.058	0.985	France	0.336	0.160
5	0.049	0.990	Greece	0.290	-0.424
6	0.034	0.993	Ireland	0.323	-0.265
7	0.022	0.995	Italy	0.340	-0.058
8	0.019	0.997	Netherlands	0.295	0.422
9	0.016	0.999	Portugal	0.307	-0.380
10	0.011	1.000	Spain	0.327	-0.273

First and second PCs



Modelling spreads, Main findings – I

	(1)	(2)	(3)	**(4)**	(5)
vix_t	-0.008	-0.008	-0.008		
vix_t*$D2007.08_t$	0.116 ***	0.122 ***	0.130 ***	**0.108 *****	0.116 ***
vix_t*$D2009.03_t$	-0.005	-0.016	-0.018		
q_{it}	0.021	0.029	0.022		
q_{it}*$D2007.08_t$	0.670 ***	0.532 **	0.525 **	**0.605 *****	0.686 ***
q_{it} *$D2009.03_t$	0.036	0.136	0.215		

- Prior to 2007 markets priced expected fiscal balance while other fundamentals mostly non-priced in line with convergence trading.

- Since August 2007 spreads respond positively to higher international financial risk and real exchange rate appreciation.

Modelling spreads, Main findings – II

	(1)	(2)	(3)	**(4)**	(5)
$balance_{it}$	-0.006 ***	-0.006 ***	-0.006 ***	**-0.006 *****	-0.006 ***
$balance_{it}$ *$D2007.08_t$	0.002	0.003	0.004		
$balance_{it}$ *$D2009.03_t$	-0.008 **	-0.008 **	-0.009 **	**-0.007 ****	-0.008 ***
$debt_{it}$	0.000	0.000	0.000		
$debt_{it}$ *$D2007.08_t$	0.001 *	0.001 **	0.001 **	**0.001 ****	0.0003 *
$debt_{it}$ *$D2009.03_t$	0.001 ***	0.001 ***	0.001 ***	**0.002 *****	0.001 ***

- Since March 2009 markets put greater emphasis on fiscal fundamentals: more pronounced effect on spreads from expected debt and fiscal balance.

Modelling spreads, Main findings – III

	(1)	(2)	(3)	**(4)**	(5)
$pc2_t$	-0.024 ***	-0.024 ***	-0.026 ***	**-0.022 *****	-0.024 ***
$pc2_t$ *$D2007.08_t$	0.002	-0.002	0.005		
$pc2_t$ *$D2009.03_t$	0.032 ***	0.036 ***	0.030 ***	**0.030 *****	0.035 ***
$gind_{it}$	0.000	0.000	0.000		
$gind_{it}$ *$D2007.08_t$	0.000	0.000	-0.001		
$gind_{it}$ *$D2009.03_t$	-0.004 ***	-0.004 ***	-0.003 **	**-0.004 *****	-0.003 ***

- Since March 2009 spreads increase in response to:

- Contagion from periphery crisis.
- Slowdown in growth.

Modelling spreads, Main findings – IV

	(1)	(2)	(3)	**(4)**	(5)
ba_{it}	0.000	0.000	0.000		
ba_{it}*$D2007.08_t$	0.000	0.000	0.000		
ba_{it} *$D2009.03_t$	0.004 ***	0.005 ***	0.005 ***	**0.004 *** **	0.003 ***
$ltsdebt_{it}$		-0.013	-0.027		
$ltsdebt_{it}$ *$D2007.08_t$		0.279 ***	0.262 ***	**0.194 ****	0.232 ***
$ltsdebt_{it}$ *$D2009.03_t$		-0.429 ***	-0.390 ***	**-0.374 *** **	-0.252 **

- Since March 2009 spreads increase in response to:

- Decline in bond market liquidity.
- Decline in long term share of total debt.

Modelling spreads, Main findings – V

	(1)	(2)	(3)	**(4)**	(5)
$spr_{it-1} * ba_{it-1}$			-0.001		
$spr_{it-1} * ba_{it-1} * D2007.08_t$			0.003	**0.001 ***	0.001 **
$spr_{it-1} * ba_{it-1} * D2009.03_t$			-0.002 **	**-0.001 ***	-0.001 **

- Since March 2009 multiplicative term suggests demand for sovereign bonds despite increasingly stressed bond market conditions.

- Very likely this is due to institutional intervention without which spreads would have been even higher.

Modelling spreads, Main findings – VI

	(1)	(2)	(3)	**(4)**	(5)
$debt_{it}^2 * Dper_{it}$					2.99E-05 *
$ba_{it} * D2009.03_t * Dper_{it}$					0.002 ***
$debt_{it} * D2007.08_t * Dper_{it}$					0.001 *
$debt_{it} * D2009.03_t * Dper_{it}$					0.006 ***

- Liquidity, debt and squared debt effect on spreads stronger for periphery group.

Robustness checks

- Define real effective exchange rate variable as differential versus Germany.
- Exclude from the set of regressors the first lag of the dependent variable.
- Alternative proxy for bond market liquidity: size of government bond market relative to Germany.
- Account for observation specific heteroskedasticity in the residuals.

Modelling spreads on credit ratings and credit outlook announcements only

	(1)	(2)	(3)	(4)
	S&P	Moody's	Fitch	**Average**
$rating_{it}$	-0.578 ***	-0.822 ***	-0.583 ***	**-0.925 *****
*N*T*	1440	1440	1440	**1440**
Adj-R^2	0.466	0.366	0.344	**0.556**

	(5)	(6)	(7)	(8)
	S&P	Moody's	Fitch	**Average**
$outlook_{it}$	-0.506 ***	-0.300 ***	-0.611 ***	**-0.931 *****
*N*T*	1440	1440	1440	**1440**
Adj-R^2	0.205	0.155	0.146	**0.230**

Accounting for rating agencies effect

	(1)	(2)	(3)	(4)	**(5)**
average rating$_{it}$	-0.037 ***	-0.027 ***			**-0.032 *****
*average rating$_{it}$ *D2007.08$_t$*	-0.019 **	-0.015 ***			**-0.016 *****
*average rating$_{it}$ *D2009.03$_t$*	-0.031 ***	-0.039 ***			**-0.037 *****

- Controlling for the effect of other fundamentals, credit ratings are statistically significant: a decline in rating increases spreads, especially during crisis.

- However, their role is not critical. Spreads' main drivers remain macro and fiscal fundamentals, contagion, international risk and liquidity.

Modelling credit ratings

	(1)	(2)	(3)	(4)
	Average rating		S&P	
vix_t	0.100 ***	**0.089 *****	0.126 ***	0.099 ***
vix_t*$D2007.08_t$	-0.015		-0.004	
vix_t*$D2009.03_t$	-0.251 **	**-0.255 *****	-0.571 ***	-0.541 ***
$pc2_t$	0.021		0.013	
$pc2_t$ *$D2007.08_t$	-0.016		0.018	
$pc2_t$ *$D2009.03_t$	-0.045 *	**-0.037 *****	-0.105 ***	-0.072 ***
ba_{it}	0.000		0.014 ***	0.014 ***
ba_{it}*$D2007.08_t$	0.001		-0.013 ***	-0.013 ***
ba_{it} *$D2009.03_t$	-0.010 ***	**-0.009 *****	-0.015 ***	-0.014 ***
q_{it}	1.118 ***	**1.191 *****	0.260	
q_{it}*$D2007.08_t$	-0.189		-0.312	
q_{it} *$D2009.03_t$	-7.400 ***	**-7.226 *****	-12.086 ***	-11.65 ***
$balance_{it}$	-1.90E-05		-0.047 ***	-0.047 ***
$balance_{it}$ *$D2007.08_t$	-0.044 ***	**-0.043 *****	-0.002	
$balance_{it}$ *$D2009.03_t$	0.024 **	**0.030 *****	0.039 **	0.039 ***
$debt_{it}$	-0.023 ***	**-0.021 *****	-0.019 ***	-0.020 ***
$debt_{it}$ *$D2007.08_t$	-0.006 ***	**-0.007 *****	-0.008 ***	-0.008 ***
$debt_{it}$ *$D2009.03_t$	-0.002		0.000	
$gind_{it}$	0.003 *		-0.004 *	-0.004 **
$gind_{it}$ *$D2007.08_t$	-0.005		0.003	
$gind_{it}$ *$D2009.03_t$	0.013 ***	**0.010 *****	0.019 ***	0.022 ***
$ltsdebt_{it}$	3.003 ***	**2.951 *****	2.967 ***	2.870 ***
$ltsdebt_{it}$ *$D2007.08_t$	-2.085 ***	**-2.300 *****	-1.610 ***	-1.381 ***
$ltsdebt_{it}$ *$D2009.03_t$	-0.293		0.142	
$debt_{it}^2$	1.29E-05		2E-04 ***	2E-04 ***
*N*T*	1430	**1430**	1430	1430
Adj- R^2	0.963	**0.964**	0.930	0.930

Main findings

- Credit rating model very similar to bond pricing model.

- Pre-crisis & credit crisis periods: Non-pricing, or mispricing, of risk factors (apart from expected debt).

- Debt crisis: Risk factors appropriately priced. Average credit rating declines as response to:

- Higher international risk
- Contagion
- Lower bond market liquidity
- Real appreciation
- Higher budget deficit
- Slowdown in growth.

Summary

- Spreads' movements during crisis period are primarily linked to fundamentals.
- Effect of sovereign credit ratings is statistically significant but their overall role is not critical.
- Liquidity effects are present, as suggested by significance of bid-ask spreads.
- The maturity structure of debt matters.
- It appears that institutional intervention has neutralised speculation effects.

Implications for resolution proposals

- **ESM emphasising sound fundamentals**: Absolutely necessary.
- **Euro-governance:** Important for monitoring and prevention.
- **Increased regulation of credit rating agencies:** Of rather limited importance.
- **Common debt issuance (Eurobond):** Could be helpful by increasing the liquidity and maturity of debt issuances, but:

- On its own will most likely not be sufficient to resolve crisis.
- Benefits to be weighted against costs of moral hazard.