Msc DOFIN

SOVEREIGN FINANCIAL ASSET MARKET LINKAGES ACROSS EUROPE DURING THE EUROZONE DEBT CRISIS

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1. Introduction – motivation and objectives

- The vast **majority of papers** studying sovereign financial asset market interactions during the eurozone sovereign debt crisis are obviously **focused on countries from eurozone**

- The **present paper extends the analysis** to (almost) all the countries within the EU, without regard to their affiliation to EMU

- Ongoing greek crisis, lack of economic growth, low inflation and zero bound interest rate limitations in the current macro landscape of eurozone
- In such circumstances, a sovereign yield curve analysis/forecasting by itself has limited usefulness for policy makers or fixed income fund managers

- In the present paper, the **sovereign variables (bond spreads and CDS differentials) are jointly modeled using the GVAR methodology**
- A dynamic analysis is performed to study linkages and propagation of shocks and to uncover transmission channels across sovereign financial asset markets

2. Literature review

- ***Impact of fundamental macro factors*** (real GDP growth, inflation, public debt-to-GDP ratio, government balance-to-GDP ratio, current account balance-to-GDP ratio, real effective exchange rate) ***and global risk aversion factors*** (VIX or a US corporate spread) ***on sovereign spreads***: Dewachter et. al (2014), D'Agostino and Ehrmann (2013), Cimadomo et. al (2014), Di Cesare et al. (2012), De Grauwe and Ji (2013, 2014) and many more

- ***The „forward-looking" nature of spreads***: Arghyrou and Kontonikas (2011), Hordahl and Tristani (2013) use <u>DG-ECFIN forecasts</u>

- ***Interlinkages among the two main segments of the sovereign financial asset markets***, the sovereign ***bond*** and sovereign ***CDS*** markets: Calice et al. (2011), Gyntelberg et al. (2013), Badaoui et al. (2013) and O'Kane (2012)

2. Literature review

- ***Evidence of contagion across EMU sovereign financial asset markets***: Calice et al. (2011), Fontana and Scheicher (2010), Gyntelberg et al. (2013), Palladini and Portes (2011), Badaoui et al. (2013) and O'Kane (2012)

- ***GVAR methodology***: Favero and Missale (2011) and Favero (2013) – weights based on a "fiscal distance" between eurozone countries

- ***Extension of analysis to EU countries outside EMU***: Claeys and Vasicek (2012) - sovereign spreads of european countries grouped in four regions; Csonto and Ivaschenko (2013) - sovereign spreads of Bulgaria, Hungary and Poland; Heinz and Sun (2014) – sovereign CDS markets for 24 european countries (14 CESEE countries , 5 Eurocore countries and 5 Europeriphery countries)

3. Econometric research methodology
3.1. Variables and time frame

- ***10-year sovereign bond spreads with respect to German Bunds***: Maastricht criterion on long term interest rates, approach similar to many of the above mentioned studies

- ***5-year USD-denominated CDSs differentials with respect to their German counterpart***: most traded maturity and currency denomination, approach similar to Calice et al. (2012) or Bai et al. (2012)

- ***VIX, "The Fear Index"***, investigated as a possible factor explaining sovereign spreads, as in Csonto and Ivaschenko (2013), D'Agostino and Ehrmann (2013), Heinz and Sun (2014), Dewachter et al. (2014) and others

- ***3-month EURIBOR-EONIA spread***, the European correspondent of the USD LIBOR-OIS spread, "barometer of fears of bank insolvency" (A. Greenspan), included to investigate shocks coming through the eurozone money markets, approach similar to Giordano et al. (2013), Schwarz (2014) or Monfort and Renne (2014)

3. Econometric research methodology
3.1. Variables and time frame

- ***10-year EUR-denominated sovereign German CDS spread*** included to capture the effect of a fundamental shock in the „engine” of the eurozone; choice of CDS over the corresponding German Bund yield tries to better quantify the sovereign credit risk of Germany as Bunds double status, of „safe-haven” asset as well as collateral in the repo markets, would prevent their yields to fully reflect a fundamental macro shock originating from the German economy

- ***Time frame analyzed***: November 2009 (the starting month of the period generically known as the sovereign debt crisis in the eurozone, Greece was the trigger) - March 2015 (the last month for which data series were available)

3. Econometric research methodology

3.2. The GVAR model

- **<u>Building the model - similar approaches</u>:**

Favero and Missale (2011) and, more recently, Favero (2013) modeled sovereign spreads across eurozone using a GVAR methodology. Each spread dynamics is determined by three factors:

a) forecasts for the dynamics of fiscal fundamentals (debt-to-GDP, fiscal balance-to-GDP) of each country compared to Germany: $E_t(b_i - b_{GER})$, $E_t(d_i - d_{GER})$

b) a global risk aversion variable (a US corporate spread between Baa and Aaa-rated bonds): $(Baa_t - Aaa_t)$

c) weakly exogenous, foreign-type variables, that reflect the joint influence on a sovereign spread of all the other countries spreads, modeled as weighted averages, with weights based on a „fiscal distance” between countries

3. Econometric research methodology

3.2. The GVAR model

- **<u>Building the model - similar approaches</u>:**

Favero and Missale (2011) approach to construct the weakly exogenous foreign variables:

$$\left(Y_t^i - Y_t^{GER}\right)^* = \sum_{j \neq i} w_{ij,t} \left(Y_t^j - Y_t^{GER}\right)$$

$$w_{ij,t} = \frac{w_{ij,t}^*}{\sum_{j \neq i} w_{ij,t}^*} \qquad\qquad w_{ij,t}^* = \frac{1}{dist_{ij,t}}$$

$$dist_{ij,t} = 0.5 * E_t\left(\left|b_i - b_j\right|\right)/60 + 0.5 * E_t\left(\left|d_i - d_j\right|\right)/3$$

- The two terms of the “fiscal distance” are based on 2-year ahead DG-ECFIN forecasts
- Each term is rescaled for comparability purposes with the respective reference values of 60 percent of GDP and 3 percent of GDP, specified in the Maastricht criteria.

3. Econometric research methodology

3.2. The GVAR model

- <u>**Building the model – our approach**</u>**:**

i. ***fiscal fundamentals forecasts compared to Germany*** are ***ignored***, as Favero and Missale (2011) find an insignificant influence for each

ii. ***analysis*** is ***extended to*** the ***CDS segment*** of the sovereign financial markets

iii. ***analysis*** is ***extended geographically***, to ***all EU sovereign markets***: first, Luxembourg, Cyprus, Malta, Latvia, Estonia and Croatia are excluded for various comparability-related reasons; the remaining 21 countries are then aggregated in four regions, based on the relative weight of each country's average value of marketable sovereign debt for the 2008-2010 time period: *Eurocore*, *Europeriphery*, *CEE* and *Noneuro*

3. Econometric research methodology
3.2. The GVAR model

- **<u>Building the model – our approach</u>:**

IV. instead of using the US corporate spread as the risk aversion global variable, a ***Dominant Unit*** in the sense defined by Chudik & Pesaran (2013), is employed in our GVAR model to ***capture global effects*** of the three market-based variables mentioned above (VIX, 3M EURIBOR-EONIA, 10-year German CDS)

V. a ***new measure of distance*** is defined, a ***„macro distance”*** which includes in its formula the DG-ECFIN forecasts for current account balance-to-GDP ratio and for GDP growth, in addition to the two measures used in computing the original „fiscal distance”:

$$dist_{ij,t} = 0.25 * \frac{E_t(|b_i - b_j|)}{E_t(|b_{EU}|)} + 0.25 * \frac{E_t(|d_i - d_j|)}{E_t(|d_{EU}|)} + 0.25 * \frac{E_t(|g_i - g_j|)}{E_t(|g_{EU}|)} + 0.25 * \frac{E_t(|ca_i - ca_j|)}{E_t(|ca_{EU}|)}$$

3. Econometric research methodology

3.2. The GVAR model

- **<u>Building the model – The "macro distance"</u>:**

a. If Beirne & Fratzscher (2013) or Heinz & Sun (2014) allow for the four fundamental factors to directly impact spreads, we are only letting the respective ***factors*** to ***influence spreads indirectly***, with a ***time-varying influence***

b. The ***terms*** are ***rescaled*** for comparability reasons ***with*** averages of the 2-year ahead period of DG-ECFIN forecasts for the ***respective values across entire EU***.

c. ***Limitations*** in the formula used, related to the denominator of each fraction, ***can be overcome***, by conveniently using other variables of choice for rescaling.

d. Given the rather narrow approach we initially took in writing this paper, which is that of a bond portfolio manager required to rebalance at each year end, the „macro distances" and the associated ***weight matrices*** were ***built annualy***, ***based only*** on ***Autumn forecast reports***, even though the frequency of DG-ECFIN forecast reports is three times per year.

3. Econometric research methodology

3.2. The GVAR model

- **<u>Building the model – The “macro distance”</u>:**

e. The mathematically correct ***formula of distance*** in a four-dimensional Euclidean space is:

$$\|i-j\| = \sqrt{\left[\frac{E_t(b_i-b_j)}{E_t(b_{EU})}\right]^2+\left[\frac{E_t(d_i-d_j)}{E_t(d_{EU})}\right]^2+\left[\frac{E_t(g_i-g_j)}{E_t(g_{EU})}\right]^2+\left[\frac{E_t(ca_i-ca_j)}{E_t(ca_{EU})}\right]^2}$$

However, the formula we use instead, based on the arithmetic average, verifies the ***conditions of a metric space***:

$dist_{ij} = 0$ if and only if *i=j* (identity of indiscernibles)

$dist_{ij} = dist_{ji}$ for any *i* and *j* (symmetry)

$dist_{ij} + dist_{jk} \geq dist_{ik}$ for any *i*, *j* and *k* (triangle inequality)

3. Econometric research methodology

3.2. The GVAR model

- **<u>GVAR methodology - the theory behind the empirical study</u>:**

- Assume one of the units of the GVAR model is known to be dominant in the sense defined by Chudik and Pesaran (2013) and further assume the Dominant Unit follows a VAR process:

$$\omega_t = \upsilon_0 + \upsilon_1 t + \sum_{k=1}^{p_\omega} \Gamma_k \omega_{t-k} + \eta_t \qquad (1)$$

- Then, if $p_\omega = q_i$, the general form of an individual VARX* model for a country i in a GVAR model with N countries and time-varying weights can be written as:

$$x_{it} = a_{i0} + a_{i1} t + \sum_{j=1}^{p_i} \Phi_{ij} x_{i,t-j} + \sum_{k=0}^{q_i} \Lambda_{ik} x^*_{i,t-k} + \sum_{k=0}^{q_i} \Psi_{ik} \omega_{t-k} + u_{it} \qquad (2)$$

$x^*_{i,t} = \sum_{l=1}^{N} w_{il,t} x_{l,t} = w_{i,t} x_t$ are weakly exogenous foreign-type variables

3. Econometric research methodology

3.2. The GVAR model

- **<u>GVAR methodology - the theory behind the empirical study</u>:**

- Allow for a cross-country weak contemporaneous correlations among idiosyncratic shocks:

$$E\left(u_{it}u'_{lt'}\right) = \begin{cases} \Sigma_{il}, t = t' \\ 0, t \neq t' \end{cases}$$

- Smith and Galesi (2014): for purposes of specification of VARX* models, treat the global variables in the Dominant Unit as foreign, weakly exogenous

- Model the Dominant Unit to allow only lagged feed-backs from the rest of the GVAR model, as contemporaneous values are not weakly exogenous for the parameters we want to estimate

- Given the reduced size of our sample, we can safely employ this procedure and obtain satisfactory results, but for large samples ($N \rightarrow \infty$), the inclusion of lagged values is redundant, because of high correlation

3. Econometric research methodology

3.2. The GVAR model

- **<u>Solving a GVAR model in the presence of a Dominant Unit (DU):</u>**

- Write (1) in its VEC form: $\Delta\omega_t = c + \delta \widetilde{ECM}_{t-1} + \sum_{j=1}^{\hat{p}-1} \Gamma_j \Delta\omega_{t-j} + \sum_{j=1}^{\hat{q}-1} \Theta_j \Delta\widetilde{x_{t-j}} + \eta_t$ (3)

where $\widetilde{x_t} = \widetilde{W} x_t$ is the set of global feed-back variables for the DU

- Estimate with OLS and use AIC or SBC to obtain:

$$\omega_t = \upsilon_0 + \upsilon_1 t + \sum_{k=1}^{\hat{p}} \Gamma_k \omega_{t-k} + \sum_{k=1}^{\hat{q}} \Upsilon_k \widetilde{W_k} x_{t-k} + \eta_t \qquad (4)$$

where we used the notation $\widetilde{x_{t-k}} = \widetilde{W_k} x_{t-k}$

- Assume, without a loss of generality, that $p_i = q_i$ and that weight matrices are fixed, rather than time-varying

3. Econometric research methodology
3.2. The GVAR model

- **<u>Solving a GVAR model in the presence of a Dominant Unit (DU):</u>**
- Write (2) in reduced form: $G_{i0} z_{it} = a_{i0} + a_{i1} t + \sum_{j=1}^{p_i} \mathrm{G}_{ij} z_{i,t-j} + \sum_{k=0}^{q_i} \Psi_{ik}\, \omega_{t-k} + u_{it}$ (5)

where: $z_{it} = \left(x_{it}', x_{it}^{*\prime}\right)'$, $x_t = \left(x_{1,t}', x_{2,t}', \ldots, x_{N,t}'\right)'$, $G_{i0} = \left(I_{k_i}, -\Lambda_{i0}\right)$, $G_{ij} = \left(\Phi_{ij}, \Lambda_{ij}\right)$

- Use the identity $z_{it} = W_i x_t$, where W_i are link matrices, to write further:

$$G_{i0} W_i x_t = a_{i0} + a_{i1} t + \sum_{j=1}^{p_i} \mathrm{G}_{ij} W_i x_{t-j} + \sum_{k=0}^{q_i} \Psi_{ik}\, \omega_{t-k} + u_{it} \qquad (6)$$

- Use: $\mathrm{G}_j = \begin{pmatrix} \mathrm{G}_{0j} W_0 \\ \mathrm{G}_{1j} W_1 \\ \vdots \\ \mathrm{G}_{Nj} W_N \end{pmatrix}$ $\Psi_k = \begin{pmatrix} \Psi_{0k} \\ \Psi_{1k} \\ \vdots \\ \Psi_{Nk} \end{pmatrix}$ $\mathrm{a}_0 = \begin{pmatrix} \mathrm{a}_{00} \\ \mathrm{a}_{10} \\ \vdots \\ \mathrm{a}_{N0} \end{pmatrix}$ $\mathrm{a}_1 = \begin{pmatrix} \mathrm{a}_{01} \\ \mathrm{a}_{11} \\ \vdots \\ \mathrm{a}_{N1} \end{pmatrix}$ $\mathrm{u}_t = \begin{pmatrix} \mathrm{u}_{0t} \\ \mathrm{u}_{1t} \\ \vdots \\ \mathrm{u}_{Nt} \end{pmatrix}$

3. Econometric research methodology
3.2. The GVAR model

- **<u>Solving a GVAR model in the presence of a Dominant Unit (DU):</u>**

- Replace in (6) to obtain: $G_0 x_t = a_0 + a_1 t + \sum_{j=1}^{p} \mathrm{G}_j x_{t-j} + \sum_{k=0}^{q} \Psi_k \omega_{t-k} + u_t$ (7)

- Write (4) and (7) in matrix form: $H_0 y_t = h_0 + h_1 t + \sum_{j=1}^{p} \mathrm{H}_j y_{t-j} + \varepsilon_t$ (8)

where: $y_t = (x_t', \omega_t{}')'$, $H_0 = \begin{bmatrix} G_0 & -\Psi_0 \\ 0_{mxm_\omega} & \mathrm{I}_{m_\omega} \end{bmatrix}$, $H_j = \begin{bmatrix} G_j & \Psi_j \\ \Upsilon_j \widetilde{W_j} & \Gamma_j \end{bmatrix}$, $h_0 = \begin{bmatrix} a_0 \\ \upsilon_0 \end{bmatrix}$, $h_1 = \begin{bmatrix} a_1 \\ \upsilon_1 \end{bmatrix}$, $\varepsilon_t = \begin{bmatrix} u_t \\ \eta_t \end{bmatrix}$

- The solution of the GVAR model is: $y_t = b_0 + b_1 t + \sum_{j=1}^{p} B_j y_{t-j} + H_0^{-1} \varepsilon_t$ (9)

where $b_j = H_0^{-1} h_j$ for $j = \overline{0,1}$ and $B_j = H_0^{-1} \mathrm{H}_j$ for $j = \overline{1,p}$

- The order of the process described by is given, in the general case, by $max(p, q, \tilde{p}, \tilde{q})$
- No deterministic time trends in our particular case

3. Econometric research methodology
3.2. The GVAR model

- **The data and properties of the series:**

- 65 monthly data points for each of the series, for a time span between November 2009 and March 2015

- ***Data sources***: Eurostat, Reuters, author's computations

BOND YIELD SPREAD	bsprd
CDS DIFFERENTIAL 5Y USD	cddif
VIX (in logarithm)	vix
EURIBOR EONIA SPREAD	eesp
GERMANY CDS 10Y EUR	gecd

- ***Unit root testing*** using the Weighted Symmetric Dickey Fuller (WS-ADF) test of Park and Fuller, the lag order for the test is chosen based on AIC

- 82 out of the 86 variables in the model are **I(1)**, bsprd for Denmark and cddif for Austria and Czech Republic are **I(0),** bsprd for Lithuania is **I(1)** but in this particular case, we used the simple ADF test

3. Econometric research methodology
3.2. The GVAR model

- **<u>The data and properties of the series:</u>**

- The DG-ECFIN Autumn forecasts published between 2008 and 2014 were used to calculate "macro distances", derive "flows" between countries and construct the time-varying weight matrices for each of the years 2009-2015; these matrices are shown in Tables 3.8 - 3.14 from Appendix

- The data sources for the 2008-2010 sovereign marketable debt values (in USD), used to aggregate countries in regions and to construct the feed-back variables in the Dominant Unit model, were the OECD site for OECD members and Central Bank sites for Bulgaria, Lithuania and Romania

- Assume 2008-2010 average is representative for the time span studied

3. Econometric research methodology

3.3. Model estimation

- **<u>Lag order choice criteria and individual model specification:</u>**

- Akaike Information Criterion (AIC) was used and, due to small data sample, a maximum allowed lag order of 2 was imposed for the domestic variables

- The individual VARX* models were estimated in their error-correcting form, VECMX*, using the Johansen reduced-rank procedure

- As economic theory does not mention anything about the existence of trends in the data series analyzed, we opted for restricted intercepts and no trend coefficients in estimating the VECMX* models.

Lag orders

VARX*(p,q)	**p**	**q**
AUSTRIA	1	1
BELGIUM	1	1
FINLAND	2	1
FRANCE	2	1
NETHERLANDS	2	1
SLOVAKIA	1	1
SLOVENIA	2	1
GREECE	1	1
IRELAND	2	1
ITALY	1	1
PORTUGAL	2	1
SPAIN	1	1
BULGARIA	2	1
CZECH REP	2	1
HUNGARY	2	1
LITHUANIA	2	1
POLAND	1	1
ROMANIA	2	1
DENMARK	2	1
GREAT BRITAIN	2	1
SWEDEN	2	1

3. Econometric research methodology

3.3. Model estimation

- **<u>Lag order choice criteria and individual model specification:</u>**

- The cointegration ranks were derived based on the results of ***„trace" statistic***, since this test is more flexible with regard to the assumption of normality of residuals and more robust in small samples than the „maximum eigenvalue" statistic

- ***16 cointegrating vectors*** found in our particular model

- The models for which no cointegrating vectors were found, including that of the Dominant Unit, were estimated in differences

Cointegrating rank order

Country	#
AUSTRIA	1
BELGIUM	1
FINLAND	0
FRANCE	0
NETHERLANDS	0
SLOVAKIA	0
SLOVENIA	0
GREECE	0
IRELAND	1
ITALY	1
PORTUGAL	2
SPAIN	2
BULGARIA	1
CZECH REP	1
HUNGARY	1
LITHUANIA	1
POLAND	1
ROMANIA	1
DENMARK	1
GREAT BRITAIN	0
SWEDEN	1

3. Econometric research methodology

3.3. Model estimation

- **<u>Lag order choice criteria and individual model specification:</u>**

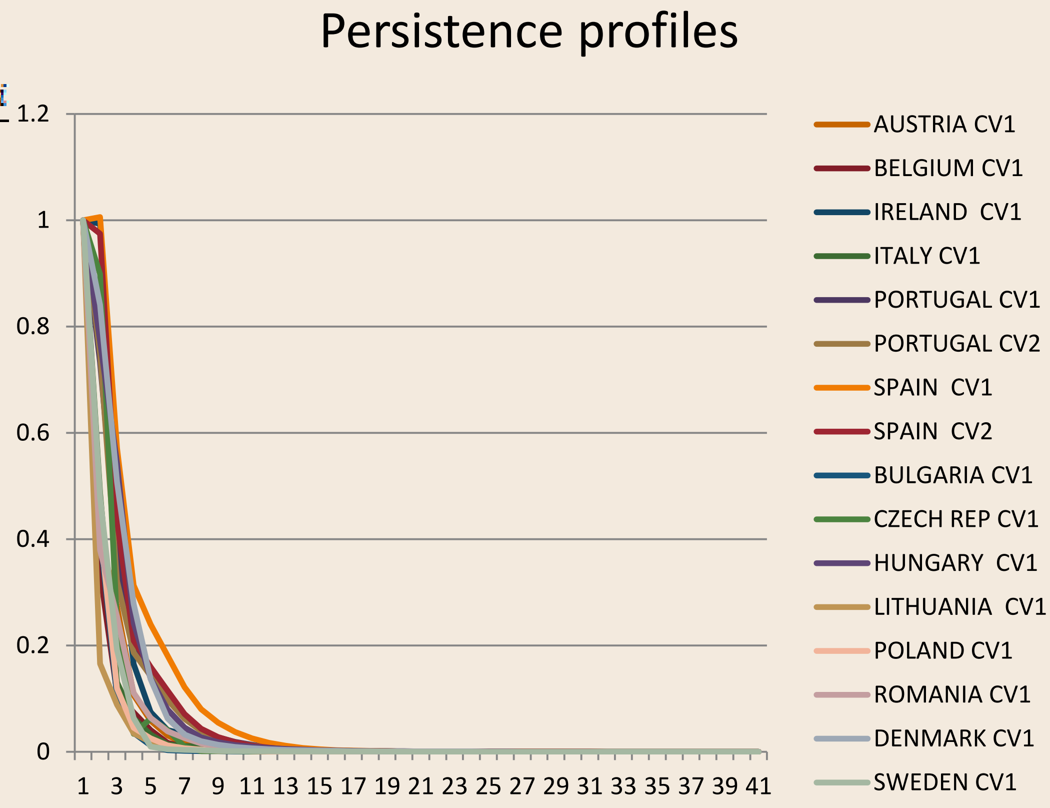
- Persistence profiles for the cointegrating vectors , with respect to a system-wide shock over *n* periods:

$$PP(\beta'_{ji} z_{it}; \varepsilon_t, n) = \frac{\beta'_{ji} W_i A^n \Sigma_\varepsilon A^{n\prime} W_i' \beta_{ji}}{\beta'_{ji} W_i \Sigma_\varepsilon W_i' \beta_{ji}}$$

- β_{ji}' is the j-th cointegration relation for country i
- $\sum_\varepsilon$ is the covariance matrix of innovations

- ***"True cointegration relations"***

- ***Convergence to equilibrium***



3. Econometric research methodology

3.3. Model estimation

- **Validity conditions for the GVAR model estimation:**

- Use the F-test to verify the joint hypothesis that $\rho_{ij,n} = 0$ in the regression:

$$\Delta x^{*}_{it,n} = c_{in} + \sum_{j=1}^{r_i} \rho_{ij,n}\, \widetilde{ECM}_{ij,t-1} + \sum_{s=1}^{p_i^*} \phi'_{is,n}\, \Delta x_{i,t-s} + \sum_{s=1}^{q_i^*} \psi'_{is,n}\, \Delta \widetilde{x^{*}_{i,t-s}} + \eta_{it,n}$$

- The ***weak exogeneity*** assumption is ***rejected*** at the 5% significance level ***for only 2 out of 70 variables***:

Country	F test	Fcrit_0.05	bsprds	cddifs	vix	eesp	gecd
AUSTRIA	F(1,46)	4.051749	0.327642	0.221886	0.009952	4.990578	0.039053
BELGIUM	F(1,46)	4.051749	0.332819	0.00789	2.79625	2.26087	0.01459
IRELAND	F(1,48)	4.042652	0.032648	0.137254	0.749263	0.194114	0.916528
ITALY	F(1,51)	4.030393	0.797545	1.644623	0.02931	1.093233	1.319711
PORTUGAL	F(2,47)	3.195056	0.937926	1.224339	0.765248	0.361238	3.305369
SPAIN	F(2,47)	3.195056	0.986615	0.259128	0.238591	0.247861	1.369699
BULGARIA	F(1,51)	4.030393	2.877581	3.726679	1.122018	0.827858	0.070931
CZECH REP	F(1,51)	4.030393	0.017007	0.047221	0.002558	2.607302	0.012851
HUNGARY	F(1,51)	4.030393	0.052103	0.435179	2.385719	0.084002	0.759016
LITHUANIA	F(1,51)	4.030393	0.367554	0.11506	0.277822	3.354231	0.004949
POLAND	F(1,51)	4.030393	1.696154	2.466914	0.192658	0.724684	1.360132
ROMANIA	F(1,51)	4.030393	1.819641	0.832598	1.244142	1.066241	2.011691
DENMARK	F(1,48)	4.042652	0.929068	1.025675	0.396165	0.00673	0.198471
SWEDEN	F(1,51)	4.030393	1.24499	0.709039	0.382494	0.020541	0.135176

3. Econometric research methodology

3.3. Model estimation

- <u>**Validity conditions for the GVAR model estimation – Pesaran et al (2004):**</u>

1. The ***global model*** is ***dynamically stable***:

- write (9) as GVAR(1) $\mathbf{Y_t} = \mathbf{BY_{t-1}} + \mathbf{E_t}$ and verify that eigenvalues of **B** lie on or inside the unit circle
- 28 out of the 132 eigenvalues are unitary

2. The ***weights*** are ***„granular”***: $\sum_{l=1}^{N} w_{il,t}^2 \to 0$ as $N \to \infty$

- confirm by checking weight matrices, the largest weight approximately 0.361

3. The ***idiosyncratic shocks*** are ***weakly correlated*** across countries:

- $\frac{\sum_{l=1}^{N} cov(u_{im,t}, u_{lp,t})}{N} = 0$ as $N \to \infty$
- average pairwise cross-section correlations are reported in Table 3.20
- the magnitude of the strongest correlation is -0.1679

3. Econometric research methodology

3.3. Model estimation

- **<u>Contemporaneous effects of foreign variables on their domestic counterparts:</u>**

- in general, ***Europeriphery countries*** are the ***most sensitive*** to shocks coming from outside their borders
- overshooting in the sovereign CDS markets of Ireland and Portugal and in the sovereign bond markets of Italy and Spain
- the bond spreads of Greece, Ireland and Portugal have reduced sensitivities, perhaps due to small size of these particular bond markets as compared to Italy and Spain
- ***in the non-euro CEE region***, ***Czech Republic and Poland*** variables ***show resilience*** – better macro fundamentals compared to peers
- ***Denmark, Sweden and Great Britain*** appear ***isolated*** from shocks coming from the rest of EU

- **Impact elasticities**

Country	bsprd	cddif
AUSTRIA	0.280412	0.101548
BELGIUM	0.602065	0.278599
FINLAND	0.016115	-0.03496
FRANCE	0.273565	0.308834
NETHERLANDS	0.110514	0.304495
SLOVAKIA	0.615558	0.39033
SLOVENIA	0.103103	0.934207
GREECE	0.191042	
IRELAND	0.167228	2.411699
ITALY	1.225027	1.117325
PORTUGAL	0.110135	2.037768
SPAIN	1.000955	0.97937
BULGARIA	0.534096	1.151272
CZECH REP	0.144413	0.093859
HUNGARY	0.4669	2.112425
LITHUANIA	0.570434	0.508389
POLAND	0.22495	0.259146
ROMANIA	0.757481	0.4163
DENMARK	-0.01193	0.181073
GREAT BRITAIN	0.020906	0.049341
SWEDEN	-0.0579	-0.00567

3. Econometric research methodology
3.4. Dynamic Analysis

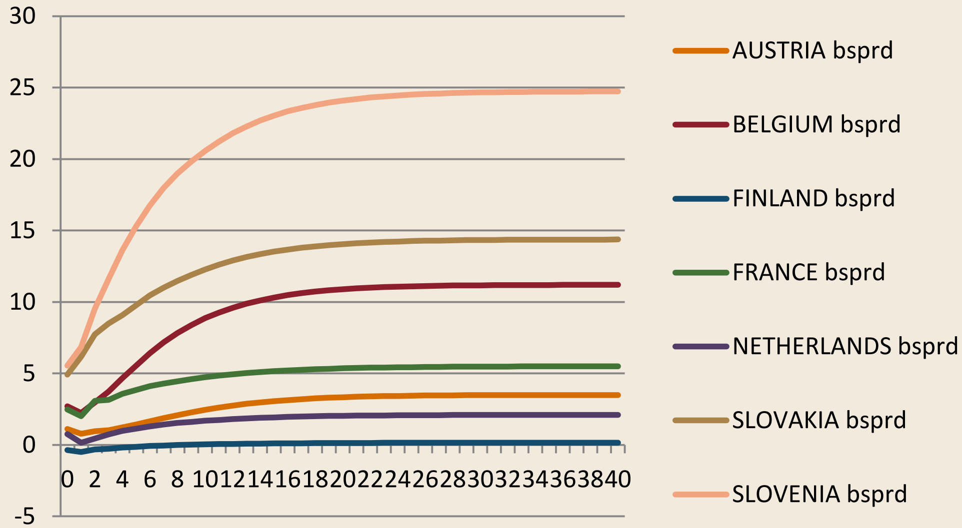
General observations:

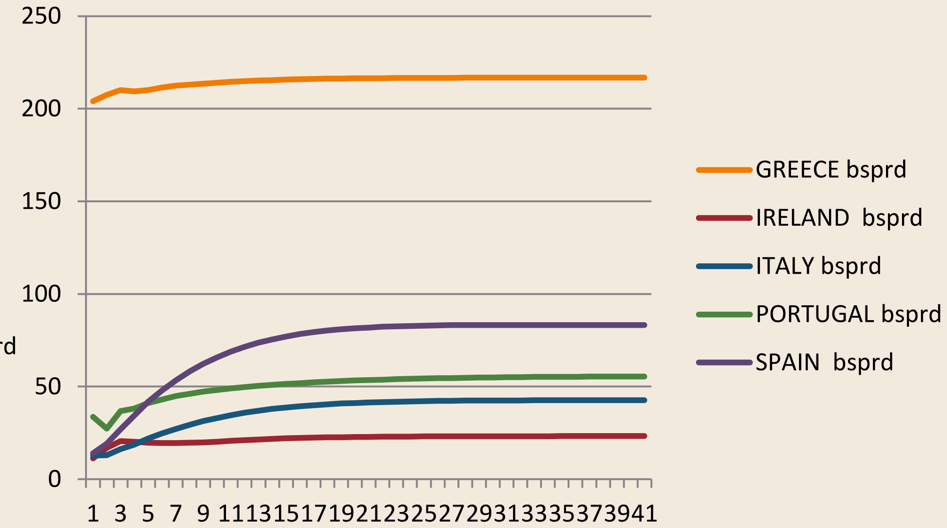
- Generalized Impulse Response Functions (***GIRFs***) and Generalized Forecast Error Variance Decomposition (***GFEVDs***): Galesi and Sgherri (2009), Sun et al. (2013)
- no „a priori” assumptions with regard to the ordering of the countries (units) in the model; no imposed restrictions backed by economic theory
- GIRFs cannot provide insights on the causality among variables, but are useful for the study of linkages and propagation of shocks across the sovereign markets
- given the existence of contemporaneous correlations among error terms, GFEVDs do not give proportions (they do not sum to one)
- nevertheless, GFEVDs uncover transmission channels through which spillovers are geographically propagated

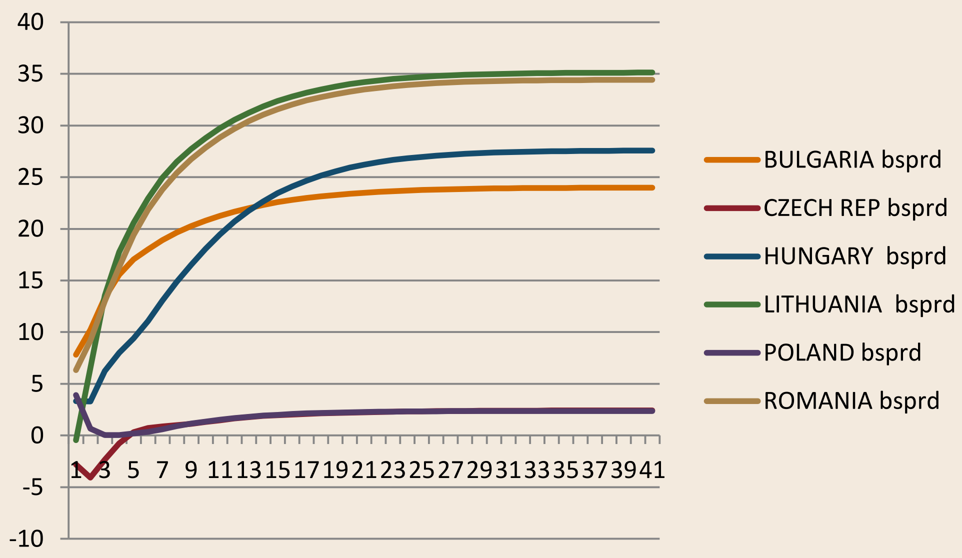
3. Econometric research methodology

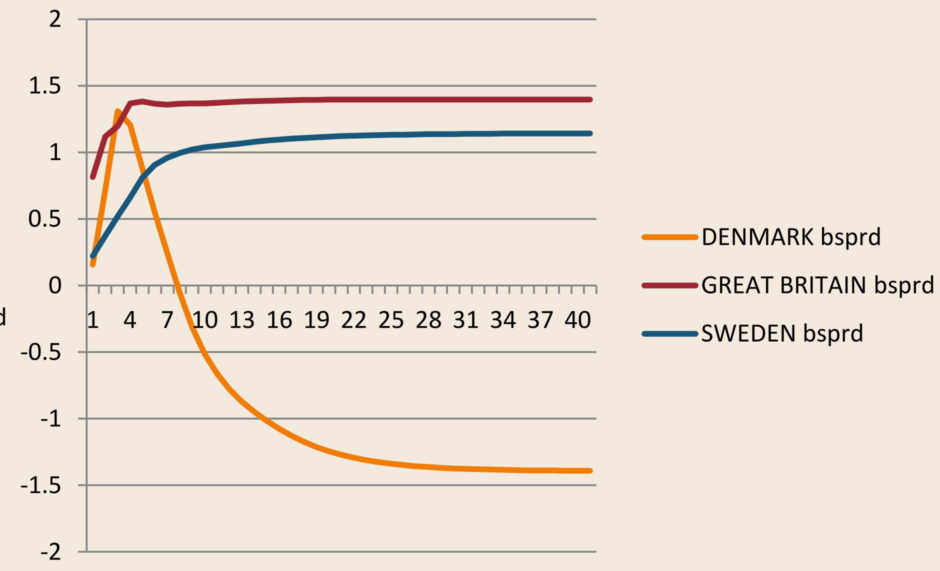
3.4. Dynamic Analysis

- **<u>One standard error positive shock to Greece sovereign bond spread (GIRFs):</u>**









3. Econometric research methodology

3.4. Dynamic Analysis

- **One standard error positive shock to Greece sovereign bond spread (GIRFs):**

- with the exceptions of Finland, Lithuania and Czech Republic, ***all EU sovereign bond spreads increase instantaneously***

- post-impact, spreads for these three countries increase also

- at a regional level, the ***largest instantaneous increases*** are seen ***in the Europeriphery***, with values between 11% for Ireland and 34% for Portugal

- sovereign spread increases for *Eurocore* countries are much smaller

- ***increases for the Noneuro group*** countries are ***insignificant***

- for *CEE* countries, the spread increases are between 4% for Poland and 7.83% for Bulgaria

3. Econometric research methodology
3.4. Dynamic Analysis

- <u>**One standard error positive shock to Greece sovereign bond spread (GFEVDs):**</u>

Region	Market segment	0	1	2	3	4	5
cee	**bsprd**	0.02496	0.024771	0.024555	0.024579	0.02463	0.024672
	cddif	0.064459	0.063751	0.065192	0.066247	0.066635	0.066821
	total	0.089419	0.088522	0.089747	0.090826	0.091264	0.091493
core	**bsprd**	0.012307	0.011253	0.010534	0.010239	0.010141	0.010068
	cddif	0.03091	0.02917	0.027765	0.027178	0.026955	0.026812
	total	0.043217	0.040422	0.0383	0.037417	0.037096	0.03688
noneuro	**bsprd**	0.007974	0.008591	0.008504	0.008254	0.00812	0.0081
	cddif	0.035786	0.035999	0.036101	0.035913	0.035689	0.035523
	total	0.04376	0.04459	0.044605	0.044167	0.043809	0.043623
periphery	**bsprd**	0.125342	0.124478	0.12417	0.124293	0.124424	0.124483
	cddif	0.019638	0.019074	0.018086	0.017491	0.017301	0.017218
	total	0.14498	0.143553	0.142256	0.141784	0.141725	0.141701

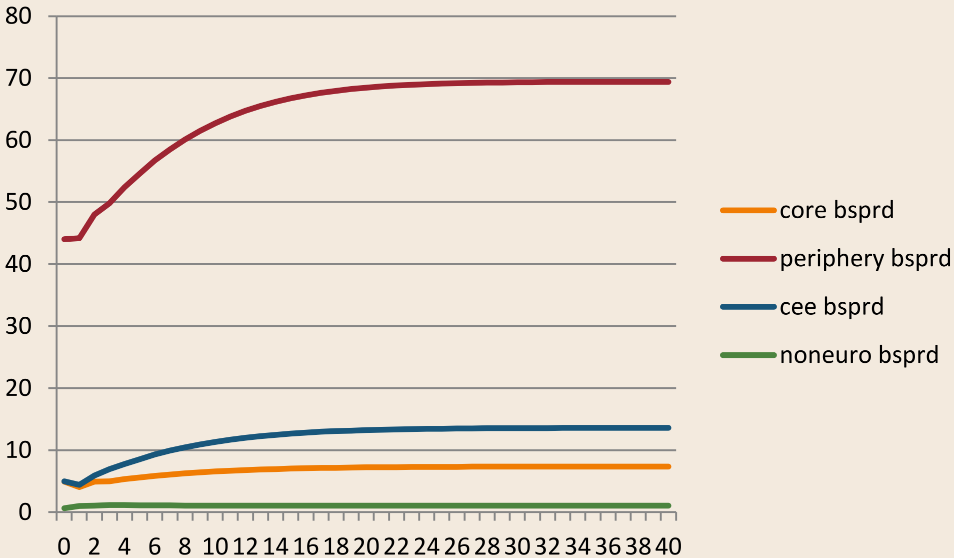
- ***Europeriphery explains most of the forecast error variance***, contributing for 14%; *CEE* region contributes for 9%, while *Eurocore* and *Noneuro* for only 4% each

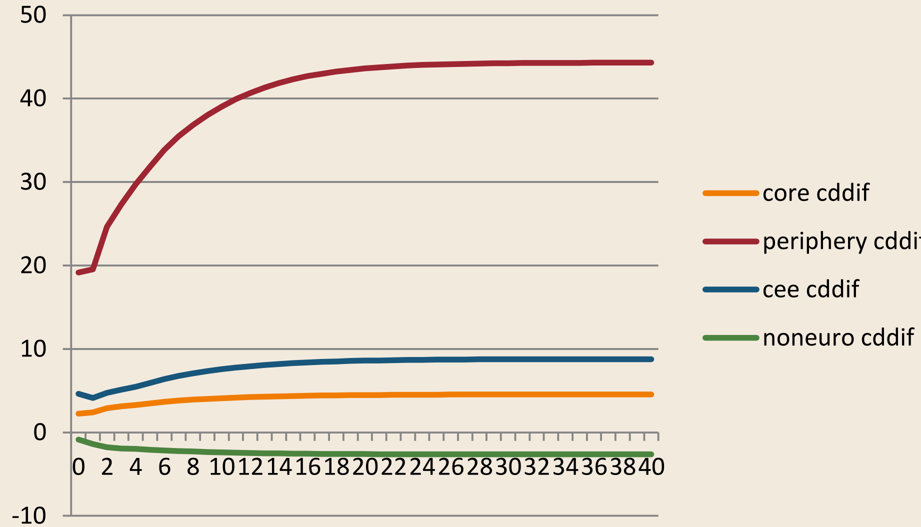
- across almost all EU regions, the CDS markets were the main channel of contagion ; in the *Europeriphery*, the bond markets took the leading role

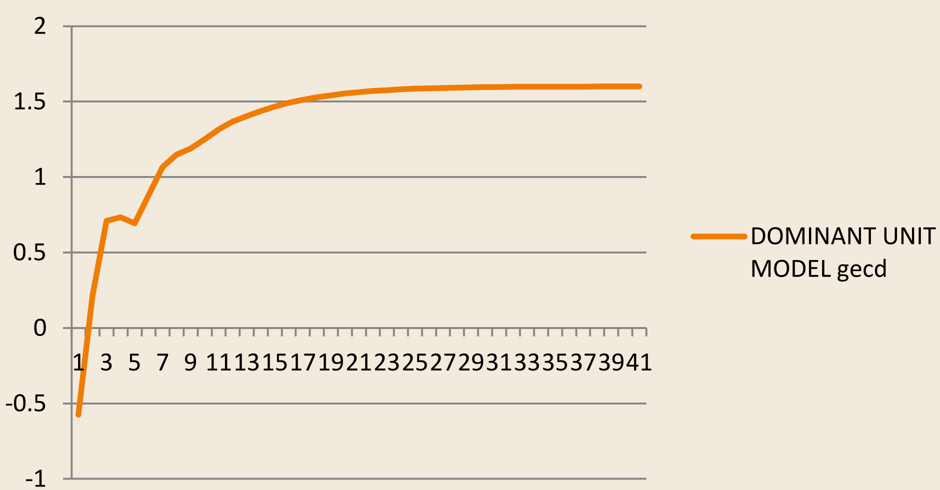
3. Econometric research methodology

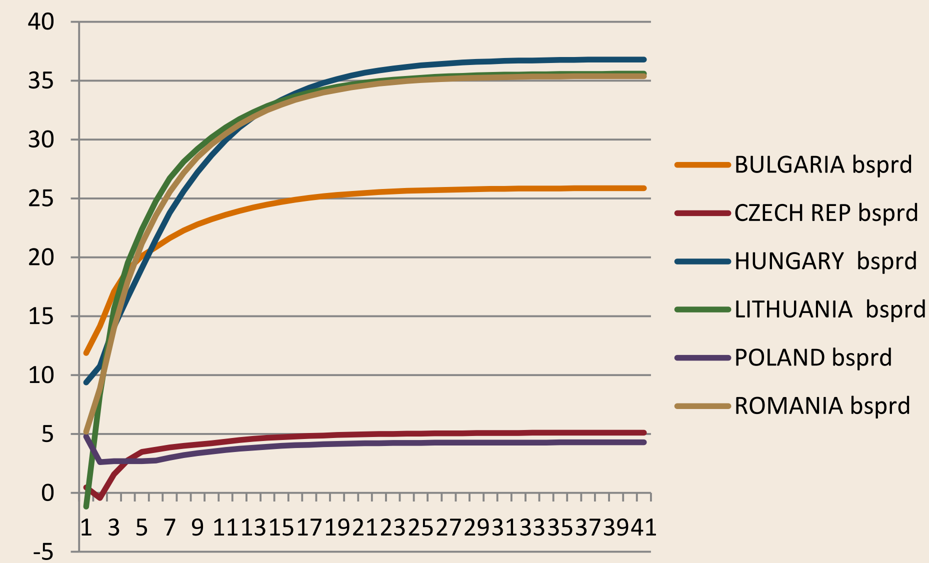
3.4. Dynamic Analysis

- <u>**One standard error positive shock to *Europeriphery* sovereign spreads (GIRFs):**</u>









3. Econometric research methodology

3.4. Dynamic Analysis

- <u>**One standard error positive shock to *Europeriphery* sovereign spreads (GIRFs):**</u>

- ***magnitude of responses*** is ***largest for Europeriphery*** sovereign markets and ***smallest for Noneuro region***, with responses from *Eurocore* and *CEE* in between

- across each region, the ***percentage change*** is ***greater for sovereign bond spreads than for sovereign CDS differentials***; possible explanations:

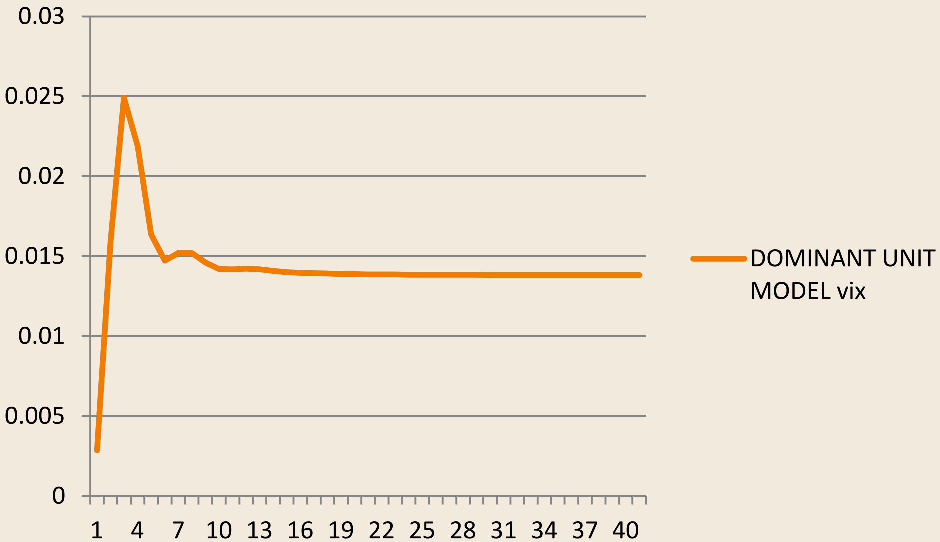
1. special „safe haven" status of benchmark German Bunds, aggressive buying during „flight to safety" periods drives their yields down, increasing bond spreads
2. increased quotes for benchmark German sovereign CDSs, confirmed by behavior of 10-year German CDS in the DU, narrow CDS differentials

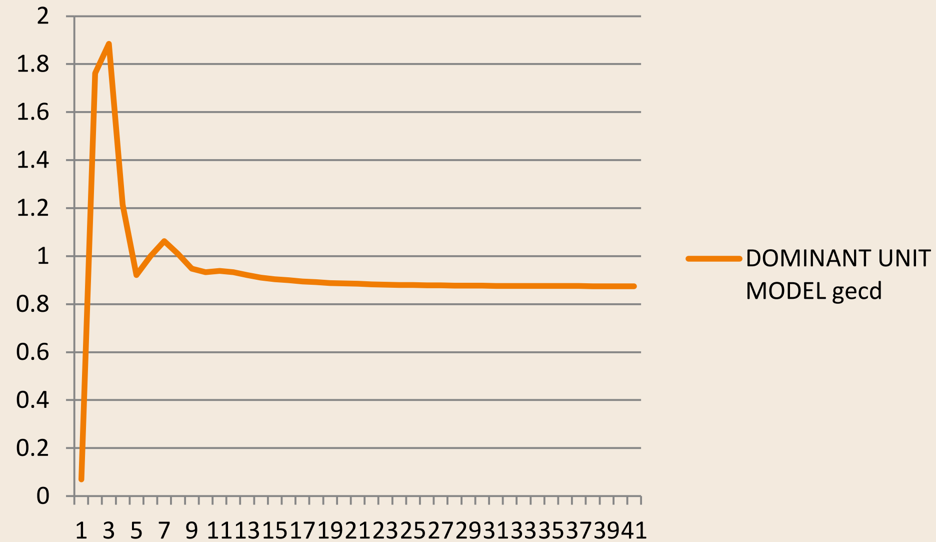
- among **CEE countries**, the magnitude of spread increases is larger for Bulgaria, Hungary, Romania and Lithuania than for ***Poland and Czech Republic***
- these two have ***better macro fundamentals***, ***experience less pain***

3. Econometric research methodology

3.4. Dynamic Analysis

- <u>**One standard error positive shock to *Europeriphery* CDS differentials (GIRFs):**</u>





- ***effects of the shock on*** the ***global variables*** from the Dominant Unit (DU)

- VIX and the 10-year German CDS face increases post-impact

- possibility that ***troubles in the periphery of the eurozone spread into*** an ***outright generalized risk aversion***

3. Econometric research methodology

3.4. Dynamic Analysis

- **One standard error positive shock to *Europeriphery* sovereign spreads (GFEVDs):**

Region	0	1	2	3	4	5
cee	0.12138	0.112934	0.114037	0.117731	0.122541	0.127022
core	0.107195	0.097434	0.090865	0.084784	0.077727	0.07103
noneuro	0.045263	0.038351	0.035322	0.032548	0.030658	0.029503
periphery	0.154165	0.154536	0.147105	0.141495	0.135761	0.130849

- **One standard error positive shock to *Europeriphery* CDS differentials (GFEVDs):**

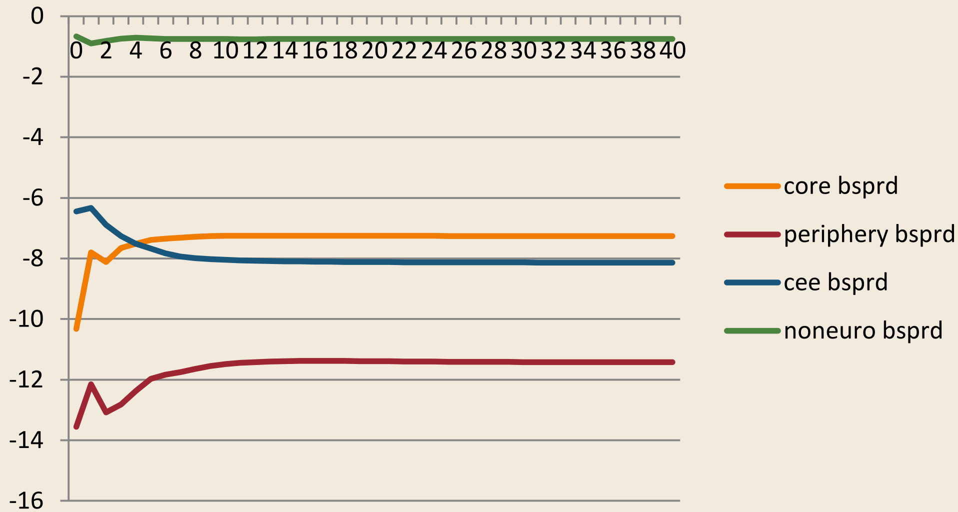
Region	0	1	2	3	4	5
cee	0.093767	0.093685	0.097124	0.101814	0.107733	0.113574
core	0.267076	0.253654	0.221157	0.195834	0.173417	0.154328
noneuro	0.023693	0.014269	0.011477	0.010123	0.009584	0.009536
periphery	0.243977	0.258257	0.229127	0.207144	0.187637	0.171886

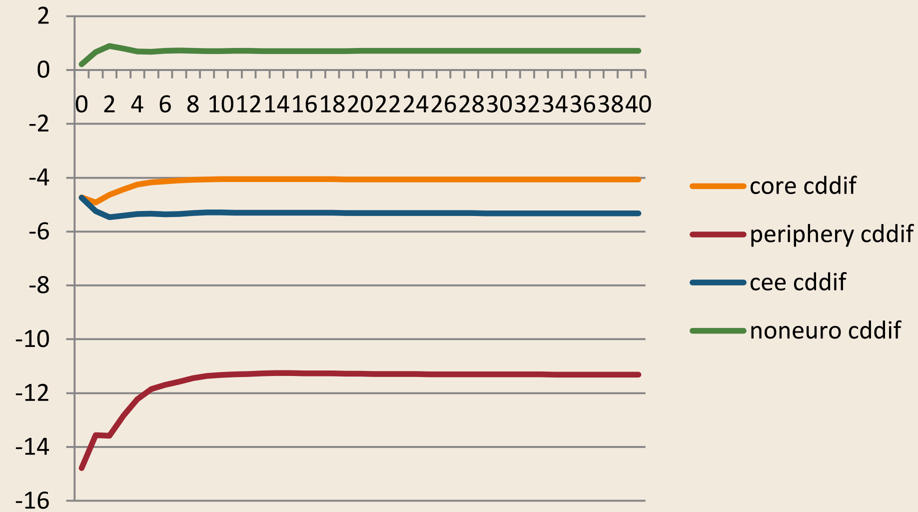
- in ***both cases***, the post-impact ***contribution of Europeriphery*** is the ***greatest*** and the ***contribution of*** the ***Noneuro*** region is the ***smallest***
- ***CEE*** has a ***larger contribution*** than *Eurocore* in explaining the forecast error variance of the historical shock ***in the bond markets***, ***but in the CDS markets***, the ***Eurocore contribution*** is ***more important***

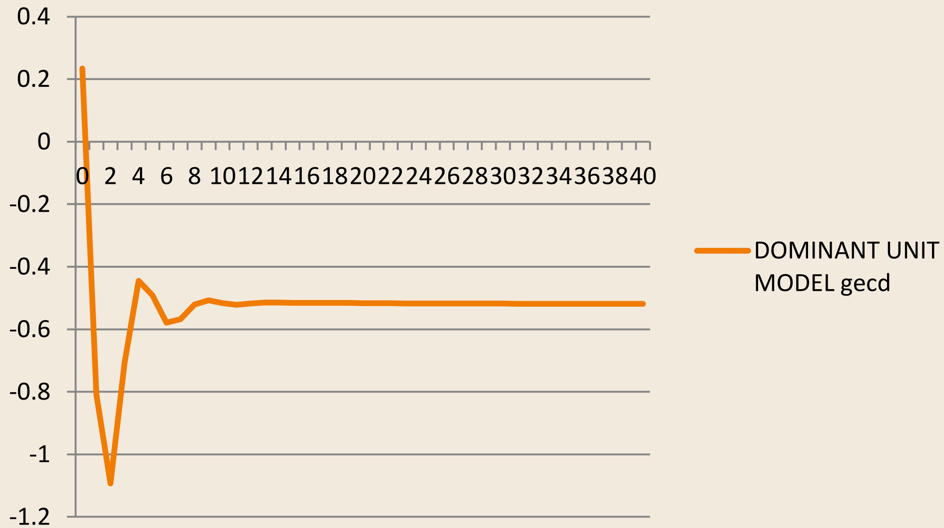
3. Econometric research methodology

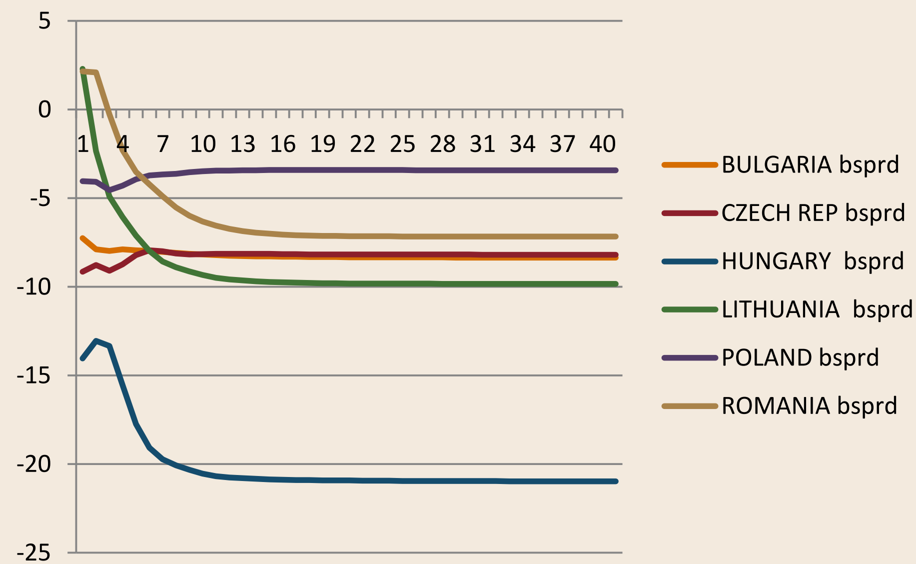
3.4. Dynamic Analysis

- **<u>One standard error negative shock to *Eurocore* sovereign spreads (GIRFs):</u>**









3. Econometric research methodology

3.4. Dynamic Analysis

- <u>**One standard error negative shock to *Eurocore* sovereign spreads (GIRFs):**</u>

- assume generalized decrease in *Eurocore* sovereign bond spreads as a ***direct consequence of the recent Public Sector Purchase Program (PSPP) of ECB***

- ***study effects of*** this ***policy measure*** and its ***transmission across the entire EU***

- post-impact, ***sovereign spre***ads and ***CDS differentials fall across all regions***

- as expected, ***Europeriphery benefitting the most***, followed by Eurocore

- ***spillover effects in CEE markets*** also, but ***no significant influence for Noneuro*** sovereigns

- ***decrease in*** the quotes for the ***German CDSs*** in the DU, ***reduced risk in euroarea***

3. Econometric research methodology

3.4. Dynamic Analysis

- <u>One standard error negative shock to *Eurocore* sovereign spreads (GFEVDs):</u>

Region	Market segment	0	1	2	3	4	5
cee	**bsprd**	0.083185	0.082076	0.080496	0.079912	0.07948	0.079145
	cddif	0.086109	0.07571	0.072877	0.071595	0.07162	0.071956
	total	0.169294	0.157786	0.153373	0.151507	0.1511	0.151101
core	**bsprd**	0.498337	0.475431	0.444098	0.422873	0.40304	0.386319
	cddif	0.238002	0.235097	0.222706	0.214126	0.204382	0.195411
	total	0.736339	0.710529	0.666805	0.636999	0.607423	0.58173
noneuro	**bsprd**	0.00606	0.005189	0.00452	0.004066	0.003873	0.003899
	cddif	0.006349	0.004584	0.004195	0.003726	0.003447	0.003213
	total	0.012408	0.009773	0.008715	0.007792	0.00732	0.007111
periphery	**bsprd**	0.081116	0.08799	0.085857	0.084512	0.082449	0.080789
	cddif	0.029947	0.035378	0.034378	0.033939	0.032584	0.031345
	total	0.111062	0.123368	0.120235	0.11845	0.115033	0.112134

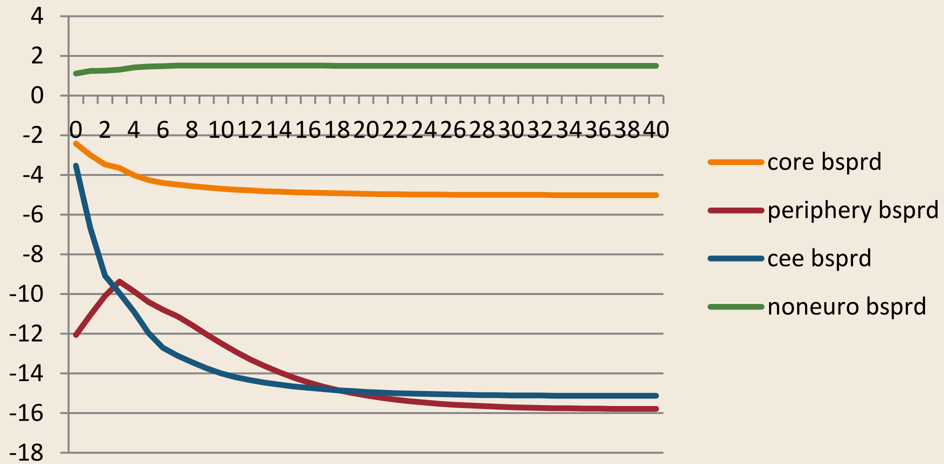
- ***Eurocore*** is the ***main channel of propagation*** for this shock, contributing for 73% of the variance of the shock at impact
- More than ***two thirds*** of this regional contribution is ***explained by the sovereign bond spread***, the rest by the CDS differential

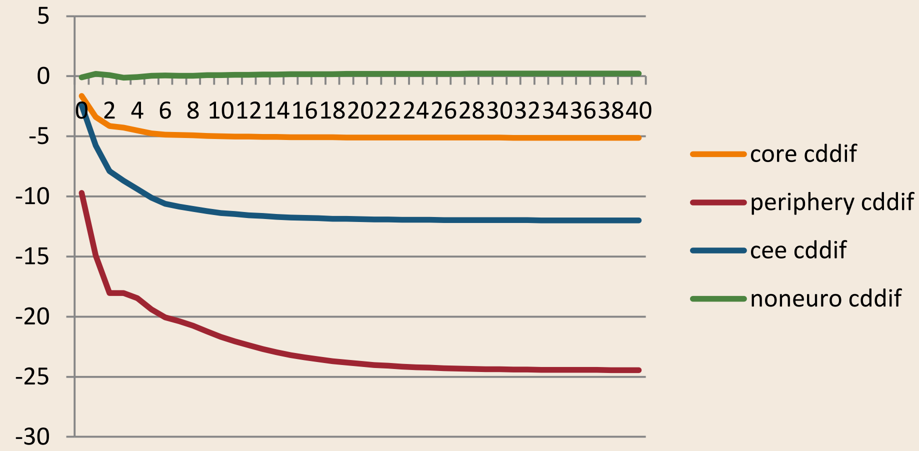
- ***contribution of CEE region*** is ***more important than*** that of ***Europeriphery region***

3. Econometric research methodology

3.4. Dynamic Analysis

- **<u>One standard error negative shock to EURIBOR-EONIA spread (GIRFs):</u>**





- narrowing of the EURIBOR-EONIA spread used as a ***market proxy for liquidity-driven operations*** conducted ***by ECB*** in 2011-2012 (eg. LTRO, OMT)

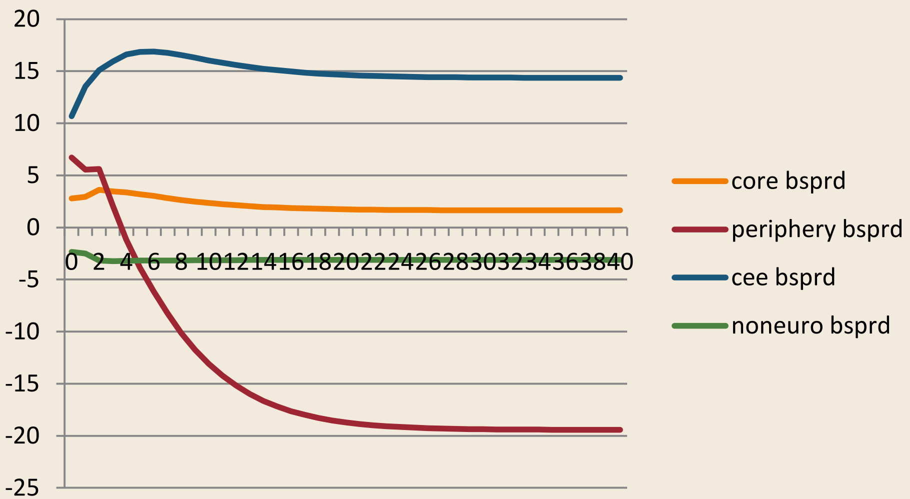
- ***Europeriphery*** seems to have ***benefited the most*** from the massive liquidity interventions of ECB, -12% contemporaneous change in sovereign bond spreads

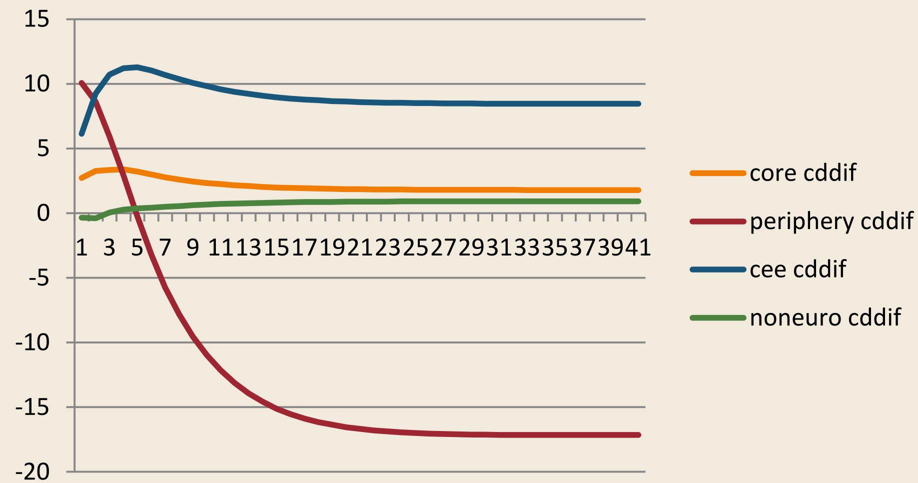
- decrease in sovereign bond spreads is of a larger magnitude for the *CEE* region than for *Eurocore*; ***CEE countries might actually have benefited more than Eurocore countries*** from ECB interventions

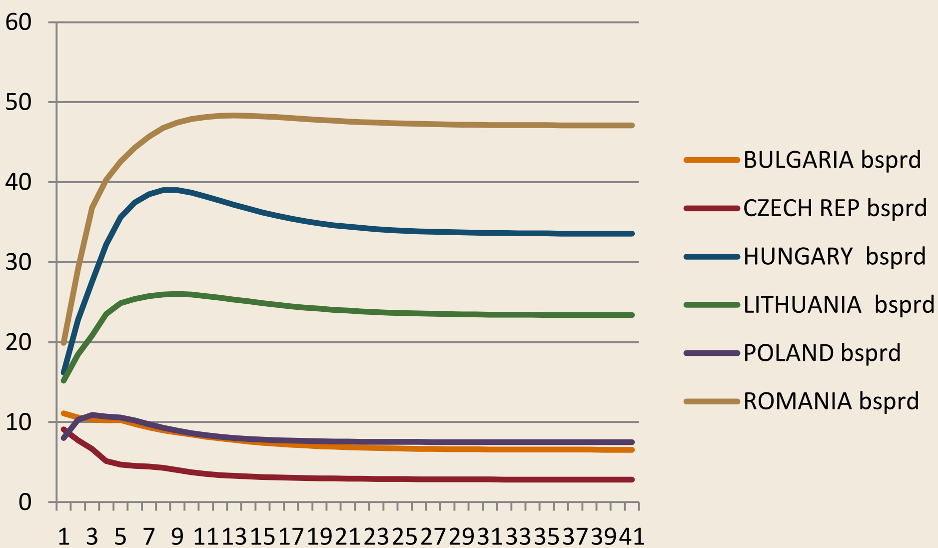
3. Econometric research methodology

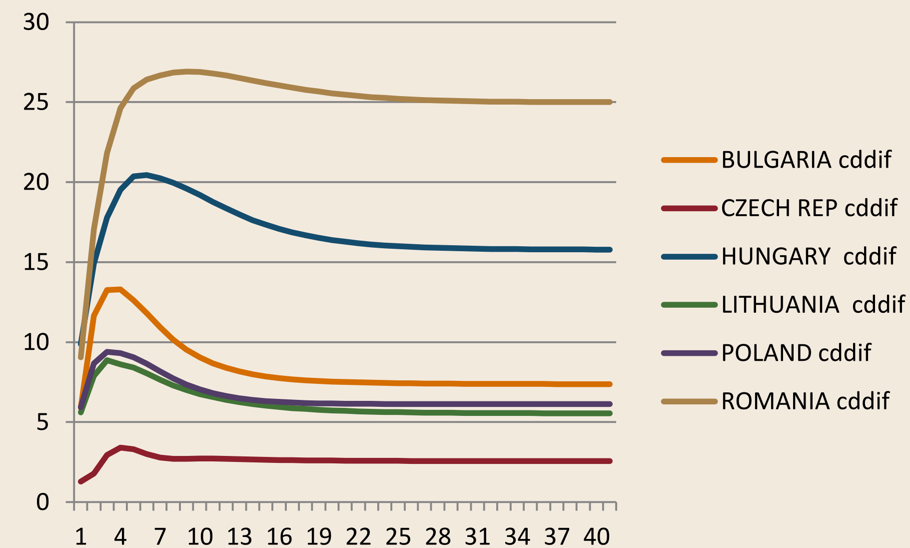
3.4. Dynamic Analysis

- **One standard error positive shock to VIX (GIRFs):**









3. Econometric research methodology

3.4. Dynamic Analysis

- <u>**One standard error positive shock to VIX (GIRFs):**</u>

- ***sovereign bond spreads most affected*** by an increase in the global risk aversion are those ***in the CEE region***

- breaking the analysis by CEE country, ***Romania and Hungary*** experience ***the largest increases*** in both variables, ***Czech Republic*** is ***least affected*** among its *CEE* peers

- relatively ***higher country risk of Romania and Hungary compared to*** that of ***Poland or Czech Republic*** weighs during „flight to safety” periods

- some contradictory results for Europeriphery; starting with period 4 post-impact, variables decline relative to their base values

- ***caution***: ***VIX analysis*** may be ***more appropriate for higher-frequency data*** (e.g. daily)

3. Econometric research methodology

3.4. Dynamic Analysis

- <u>**One standard error positive shock to 10-year EUR German CDS (GIRFs):**</u>

- analyze the influence of a ***fundamental shock in the „engine" of the eurozone***, as is sometimes named Germany

- use as ***market proxy*** a positive innovation in the 10-year German CDS, the global variable from the Dominant Unit (DU)

- ***increase in VIX*** following the simulated shock, increase in global risk aversion more likely, ***„flight to quality" mode*** triggered

- ***result: buy safe assets - German Bunds!***; decreased Bund yields; wider spreads

4. Concluding remarks

1. Sovereign financial markets of ***Europeriphery more sensitive to shocks coming from the rest of the EU***; ***CDS markets***, in particular, ***more prone to overshooting*** than sovereign bond markets.

2. ***Spillover*** effects ***from Greece across the entire EU***; ***Europeriphery*** region ***contributes the most to the propagation*** of shocks; the ***main channel of contagion is the CDS market***, with the ***exception of Europeriphery, where the bond market takes the leading role***.

3. ***Stronger influence on bond spreads than on CDS differentials across the entire EU from regional positive shocks to Europeriphery sovereign spreads***; possible explanation: ***different behavior of benchmarks used*** in each case (Bunds are bid and their yields fall, widening spreads, while German CDSs are bid also but their quotes rise, narrowing differentials).

4. Sovereign spreads for ***Poland*** and ***Czech Republic*** the ***least affected among their CEE peers*** by shocks coming from *Europeriphery*; possible explanation: ***better macro fundamentals***.

4. Concluding remarks

5. ***transmission of shocks*** originating ***in Europeriphery***: *Eurocore* seems to contribute more then *CEE* to propagation of shocks coming from CDS markets, but ***CEE contribution*** is ***relatively stronger to propagation of shocks coming from the sovereign bond markets***.

6. ***Europeriphery troubles*** (regional increase in sovereign CDS differentials) might ***influence global risk aversion*** (***increase in VIX***).

7. Consider a ***narrowing of EURIBOR-EONIA*** spread as a satisfactory market proxy for ***measures undertaken by ECB to provide liquidity to the markets in 2011-2012*** and remark the ***effectiveness*** of such measure, as sovereign spreads and CDS differentials decrease across all EU regions, with the exception of *Noneuro*.

8. Assume the ***recent ECB quantitative easing programme (PSPP)*** narrows the *Eurocore* spreads first and conclude that this shock have ***positive effects not only on Europeriphery spreads*** but there are ***„spillover" effects on CEE*** countries as well.

4. Concluding remarks

9. An ***increase in global risk aversion***, as proxied by a positive shock in VIX, has the ***largest contemporaneous effect on CEE countries*** if we are talking about ***sovereign bond spreads*** and ***on Europeriphery countries*** in the case of ***CDS differentials***.

10. A fundamental negative shock in the economy of the Germany, for which a good market proxy would be an ***increase in the spread of the 10-year EUR-denominated German sovereign CDS*** determines widening of sovereign spreads across all EU regions and ***might*** also ***determine an increase in the global risk aversion*** as it determines an increase in VIX post-impact.

11. ***Denmark***, ***Sweden*** and ***Great Britain isolated from shocks coming from eurozone***; extremely low values for all these countries' GIRFs post-impact; countribution to the transmission of shocks across the EU insignificant.

References

- [1] Afonso, A. and A.C. Ramos Felix (2013). „Contagion in EU sovereign yield spreads”. ISEG Economics Working Paper No. 04, November 2013 (pp. 1-42)
- [2] Afonso, A., M. Arghyrou and A. Kontonikas (2012). „The determinants of sovereign bond yield spreads in the EMU”. ISEG Economics Working Paper No. 36, October 2012 (pp. 1-39).
- [3] Ait-Sahalia, Y., R.J.A. Laeven and L. Pelizzon (2014). „Mutual excitation in eurozone sovereign CDS”. Journal of Econometrics, 183(2), 151-167.
- [4] Ang, A. and F.A. Longstaff (2011). „Systemic sovereign credit risk: Lessons from the US and Europe”. Journal of Monetary Economics, 60(5), 493-510.
- [5] Arghyrou, M. and A. Kontonikas (2011). „The EMU sovereign debt crisis: fundamentals, expectations and contagion”. DG-ECFIN Economic Papers No. 436, February 2011 (pp. 1-45).
- [6] Badaoui, S., L. Cathcart and L. El-Jahel (2013). „Do sovereign credit default swaps represent a clear measure of sovereign default risk? A factor model approach”. Journal of Banking and Finance, 37, 2392-2407.
- [7] Bai, J., C. Julliard and K. Yuan (2012). „Eurozone sovereign bond crisis: liquidity or fundamental contagion”. Paper presented at the 11th International Conference on Credit Risk Evaluation, Venice, Italy.

References

- [8] Barrios, S., P. Iversen, M. Lewandowska and R. Setzer (2009). „Determinants of intra-euro area government bond spreads during the financial crisis”. DG-ECFIN Economic Papers No. 388, November 2009 (pp. 1-26).
- [9] Beirne, J. and M. Fratzscher (2013). „The pricing of sovereign risk and contagion during the european sovereign debt crisis”. ECB Working Paper Series No. 1625, December 2013 (pp. 1-39).
- [10] Caceres, C., V. Guzzo and M. Segoviano (2010). „Sovereign spreads: global risk aversion, contagion or fundamentals?” IMF Working Paper 10/120, May 2010 (pp. 1-29).
- [11] Calice, G., J. Chen and J. Williams (2011). „Liquidity spillovers in sovereign bonds and CDS markets: An analysis of the Eurozone sovereign debt crisis”. Journal of Economic Behavior and Organization, 85, 122-143.
- [12] Chudik, A. and M.H. Pesaran (2013). „Econometric analysis of high dimensional VARs featuring a Dominant Unit”. Econometric Reviews, 32, 592-649.
- [13] (2014). „Theory and practice of GVAR modeling”. Federal Reserve Bank of Dallas. Globalization and Monetary Policy Institute Working Paper No. 180, May 2014 (pp. 1-54).
- [14] Cimadomo, J., P. Claeys and M. Poplawsky-Ribeiro (2014). „How do financial institutions forecast sovereign spreads?” ECB Working Paper Series No. 1750, December 2014 (pp. 1-42).

References

- [15] Claeys, P. and B. Vasicek (2012). „Measuring sovereign bond spillover in Europe and the impact of rating news”. CNB Working Paper Series No. 7, September 2012 (pp. 1-49).
- [16] Codogno, L., C. Favero and A. Missale (2003). „Yield spreads on EMU government bonds”. Economic Policy, 114, 503-532.
- [17] Corzo, M.T., J. Gomez and L. Lazcano (2012). „The co-movement of sovereign credit default swaps and bonds, and stock markets in Europe”. Working Paper, February 2012.
- [18] Csonto, B. and I. Ivaschenko (2013). „Determinants of sovereign bond spreads in emerging markets: local fundamentals and global factors vs. ever-changing misalignments”. IMF Working Paper 13/164, July 2013 (pp. 1-41).
- [19] D’Agostino, A. and M. Ehrmann (2013). „The pricing of G-7 sovereign bond spreads: The times, they are a-changin”. ECB Working Paper Series No. 1520, March 2013 (pp. 1-48).
- [20] Dees, S., F. di Mauro, M. H. Pesaran and L.V. Smith (2005). „Exploring the international linkages of the euro area - A Global VAR analysis”. ECB Working Paper Series No. 568, December 2005 (pp. 1-61).
- [21] De Grauwe, P. and Y. Ji (2013). „Self-fulfilling crises in the Eurozone: an empirical test”. Journal of International Money and Finance, 34, 15-36.
- [22] (2014). „Disappearing government bond spreads in the eurozone – Back to normal?” CEPS Working Paper No. 396, May 2014 (pp.1-10).

References

- [23] De Haan, L., J. Hessel and J.W. van den End (2013). „Are European sovereign bonds fairly priced? The role of modeling uncertainty". DNB Working Paper No. 399, November 2013 (pp. 1-53).
- [24] De Socio, A. „The interbank market after the financial turmoil: squeezing liquidity in a <lemons market> or asking liquidity <on tap>". Banca D'Italia Working Papers No. 819, September 2011 (pp. 1-40).
- [25] Dewachter, H., L. Iania, M. Lyrio and M. de Sola Perea (2014). „A macro financial analysis of the euro area sovereign bond market". NBB Working Paper No. 259, June 2014 (pp. 1-38).
- [26] Di Cesare, A., G. Grande, M. Manna and M. Taboga (2012). „Recent estimates of sovereign risk premia for euro-area countries". Banca D'Italia Occasional Papers No. 128, September 2012 (pp. 1-39).
- [27] Favero, C.A. (2013). „Modelling and forecasting government bond spreads in the euro area: a GVAR model". Journal of Econometrics, 177(2), 343-356.
- [28] Favero, C. and A. Missale (2011). „Sovereign spreads in the Euro area. Which prospects for a Eurobond?" CEPR Discussion Paper No. 8637, presented at the 54th Economic Policy Panel Meeting, Warsaw, Poland.
- [29] Fontana, A. and M. Scheicher (2010). „An analysis of Euro area sovereign CDS and their relation with government bonds". ECB Working Paper Series No. 1271, December 2010 (pp. 1-47).
- [30] Galesi, A. and S. Sgherri (2009). „Regional financial spillovers across Europe: a Global VAR analysis". IMF Working Paper 09/23, February 2009 (pp. 1-32).

References

- [31] Giordano, L., N. Linciano and P. Soccorso (2012). „The determinants of government yield spreads in the euro area”. CONSOB Working Papers No. 71, October 2012 (pp. 1-41).
- [32] Giordano, R., M. Pericoli and P. Tommasino (2013). „Pure or wake-up-call contagion? Another look at the EMU sovereign debt crisis”. International Finance 16(2), 131-160.
- [33] Gross, M. and C. Kok (2013). „Measuring contagion potential among sovereigns and banks using a mixed-cross-section GVAR”. ECB Working Paper Series No. 1570, August 2013 (pp. 1-49).
- [34] Gyntelberg, J., P. Hordhal, K. Ters and Jorg Urban (2013). „Intraday dynamics of euro area sovereign CDS and bonds”. BIS Working Papers No. 423, September 2013 (pp. 1-82).
- [35] Haugh, D., P. Ollivaud and D. Turner (2009). „What drives sovereign risk premiums?: An analysis of recent evidence from the euro area”. OECD Economics Department Working Papers No. 718, OECD Publishing, July 2009 (pp. 1-22).
- [36] Heinz, F.F. and Y. Sun (2014). „Sovereign CDS spreads in Europe - the role of global risk aversion, economic fundamentals, liquidity, and spillovers”. IMF Working Paper 14/17, January 2014 (pp. 1-76).
- [37] Hordahl, P. and O. Tristani (2013). „Macro factors and sovereign bond spreads: a quadratic no-arbitrage model”. Paper presented at HKIMR Seminar, August 2013, Hong Kong, China.

References

- [38] Kalotychou, E., E. Remolona and E. Wu (2014). „What makes systemic risk systemic? Contagion and spillovers in the international sovereign debt market”. HKIMR Working Paper No. 07, April 2014 (pp. 1-28).
- [39] Matei, I. and A. Cheptea (2012). „Sovereign bond spread drivers in the EU market in the aftermath of the global financial crisis”, in B.H Baltagi et al. (Ed.), Essays in honor of Jerry Hausman (Advances in econometrics, volume 29), Emerald Group Publishing Limited (pp. 327-352).
- [40] Monfort, A. and J.P. Renne (2014). „Decomposing euro-area sovereign spreads: credit and liquidity risks”. Oxford Journals. Review of Finance, 18(6), 2103-2151.
- [41] Nickel, C. and I. Vansteenkiste (2013). „The international spillover of fiscal spending on financial variables”, in F. di Mauro and P.H. Pesaran (Ed.), The GVAR Handbook: Structure and application of a macro model of the global economy for policy analysis. Oxford: Oxford University Press.
- [42] O’Kane, D. (2012). „The link between Eurozone sovereign debt and CDS prices”. Bankers, Markets and Investors, 117, 29-39.
- [43] Palladini, G. and R. Portes (2011). „Sovereign CDS and bond pricing dynamics in the Euro-area”. NBER Working Paper Series No. 17586, November 2011 (pp. 1-34).
- [44] Papavassiliou, V.G. (2014). „Financial contagion during the european sovereign debt crisis: a selective literature review”. ELIAMEP Crisis Observatory Research Paper No. 11, June 2014 (pp. 1-20).
- [45] Pesaran, M.H., T. Schuermann and L.V. Smith (2008). „Forecasting economic and financial variables with Global VARs”. Federal Reserve Bank of New York Staff Reports No. 317, February 2008 (pp. 1-42).

References

- [46] Pesaran, M.H., T. Schuermann and S.M. Weiner (2004). „Modeling regional interdependencies using a global error-correcting macroeconometric model". Journal of Business and Economic Statistics, 22, 129-162.
- [47] Rojas-Suarez, L. (2015). „Emerging market macroeconomic resilience to external shocks: today versus pre-global crisis". Center for Global Development essay, February 2015 (pp. 1-21)
- [48] Schwarz, K. (2014). „Mind the gap: disentangling credit and liquidity in risk spreads". Working Paper, May 2014.
- [49] Smith, A.V. and A. Galesi (2014). „GVAR Toolbox 2.0", https://sites.google.com/site/gvarmodelling/gvar-toolbox.
- [50] Sun, Y., F.F. Heinz and G. Ho (2013). „Cross-country linkages in Europe: A Global VAR analysis". IMF Working Paper 13/194, September 2013 (pp. 1-73).
- [51] Thornton, D.L. (2009). „What the LIBOR-OIS spread says". Economic synopses No. 24. Federal Reserve Bank of St. Louis, May 2009 (pp. 1-2).
- [52] ***, Global Financial Stability Report (2013, April). Chapter 2: „A new look at the role of sovereign credit default swaps" (pp. 57-92). IMF World Economic and Financial Surveys.

Thank you!

Questions & Answers