Assessment tools of stress conditions in the Romanian money market

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Outlines

1. General framework – Why are interbank money markets important?
2. How to assess stress conditions faced by interbank money market.
3. How important is risk appetite in leveling stress conditions?
4. Conclusions.

1. General framework

- Interbank money market represents an essential vehicle for financial institutions funding.
- In the unsecured money markets, lending transactions are uncollateralised, thus the lending investors are exposed to counterparty risk.
- For this reason the information asymmetries are very important in interbank money market developments.
- The outbreak of the global financial crisis caused a rise in the level of uncertainty regarding the solvency and liquidity of money market participants.
- Therefore, an increase of stress conditions was felt in interbank money markets.

1. Why are money markets important?

The importance of money markets stems from several facts:

- Asset pricing perspective - money market rates are used as benchmarks for lending activities or pricing process for fixed income transactions.
- Financial stability perspective - liquidity level from money markets may cause leverage cycles.
- Monetary policy perspective - money markets affect the efficiency of monetary innovations' transmission mechanism.
- Real economy perspective - developments from money markets have a major impact on households and non-financial corporations funding conditions.

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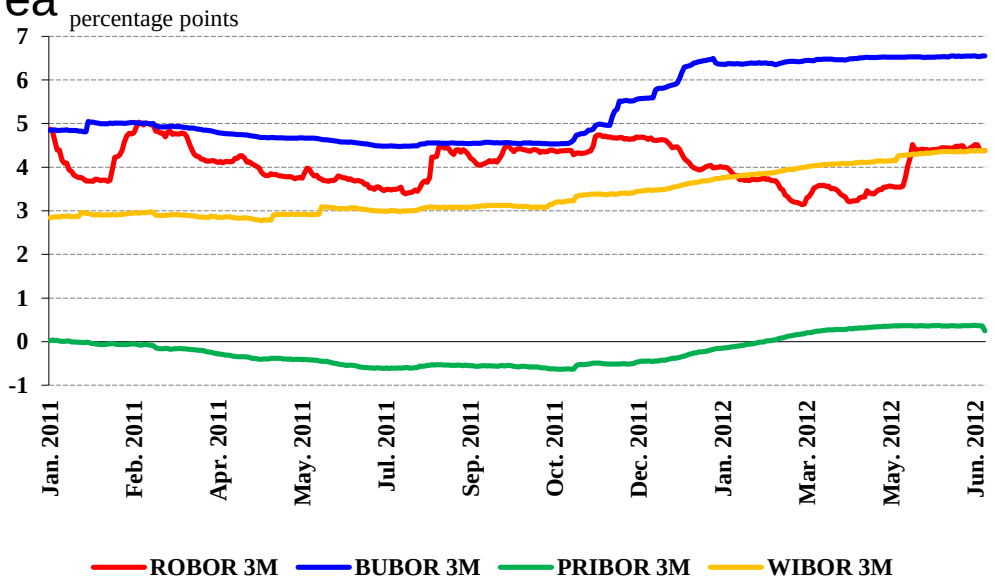
2. How to assess stress conditions faced by interbank money market

- After the start of the global financial and economic crisis, the Romanian interbank money market showed an alternation of the stressful and less stressful periods regarding funding conditions.
- But similar developments were also recorded by other countries from Central and Eastern Europe (CEE) such as Czech Republic, Hungary and Poland.
- Financing pressures in the interbank money market stem from two major factors: liquidity risk and counterparty risk.
- In order to examine stress conditions in regional interbank money markets, the spreads between 3-month daily rates in Romania (ROBOR), the Czech Republic (PRIBOR), Poland (WIBOR) and Hungary (BUBOR) and the euro-area rate (EURIBOR) were considered.

2. How to assess stress conditions faced by interbank money market

- In the Convergence Report, European Commission resorted also to the spread between benchmark 3M rates and 3M EURIBOR in order to look at developments from CEE money markets.
- Spread between 3M money market rates in the region and 3M EURIBOR in the euro area



Source:Bloomberg, NBR calculations

2. How to assess stress conditions faced by interbank money market

- The first method used to assess the level of stress conditions relative to financing activity on interbank money markets is based on a Markov Switching Model.
- Current model is based on Hamilton (1991) approach for Data Generating Process (DGP):

$$(1) i_t - \mu_{S_t} = \sum_{i=1}^{T} \phi_i \left(i_{t-i} - \mu_{S_{t-i}} \right) + \varepsilon_t$$

where i_t is the interest rates spread, μ_{S_t} denotes its average for a certain state recorded at the moment *t* in time, *T* is the number of lags, ϕ_i is the auto-regression coefficient and $\varepsilon_t \sim N(0, \sigma^2)$.

- Therefore, in current analysis the interest rate is supposed to hover around an average growth rate.

2. How to assess stress conditions faced by interbank money market

- Using a Markov style model, the interest rate spread dynamics is allowed to transit among three regimes: increasing, decreasing or staying around the previous day's level of the interest rate spread.
- A high level of probability to shift to a regime with a rising interest-rate spread is indicative of a pick-up in stress conditions on the interbank money market.
- The probability of transition from one regime to another at any moment in time is done via a filtering procedure of the Maximum Likelihood Estimation method as:

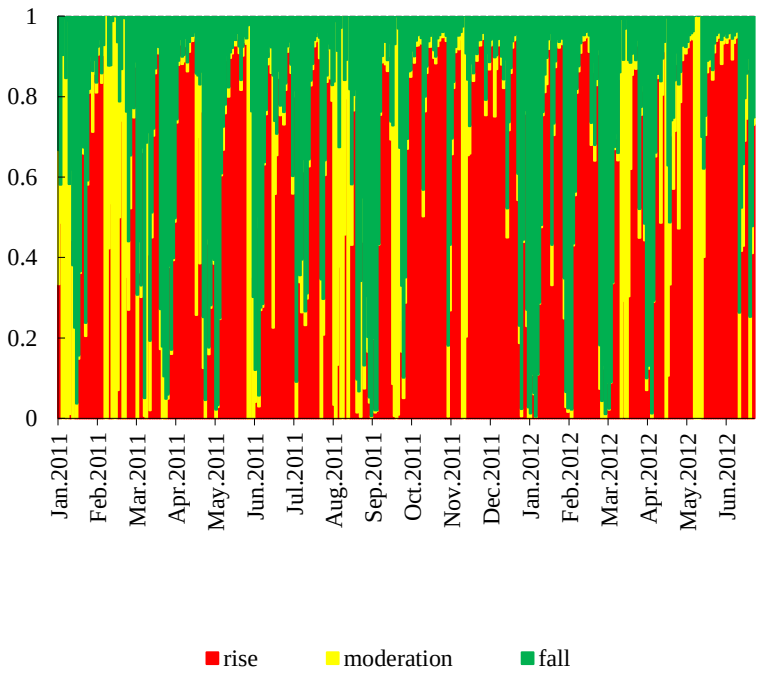
$$(2) P(S_t = j|\mathcal{F}_t) = \frac{f(i_t|S_t = j, \mathcal{F}_{t-1}) * P(S_t = j|\mathcal{F}_{t-1})}{\sum_{j=0}^{1} f(i_t|S_t = j, \mathcal{F}_{t-1}) * P(S_t = j|\mathcal{F}_{t-1})}$$

where $\mathcal{F}_t$ denotes a filtration and $f(\cdot \mid \cdot)$ is a conditional distribution.

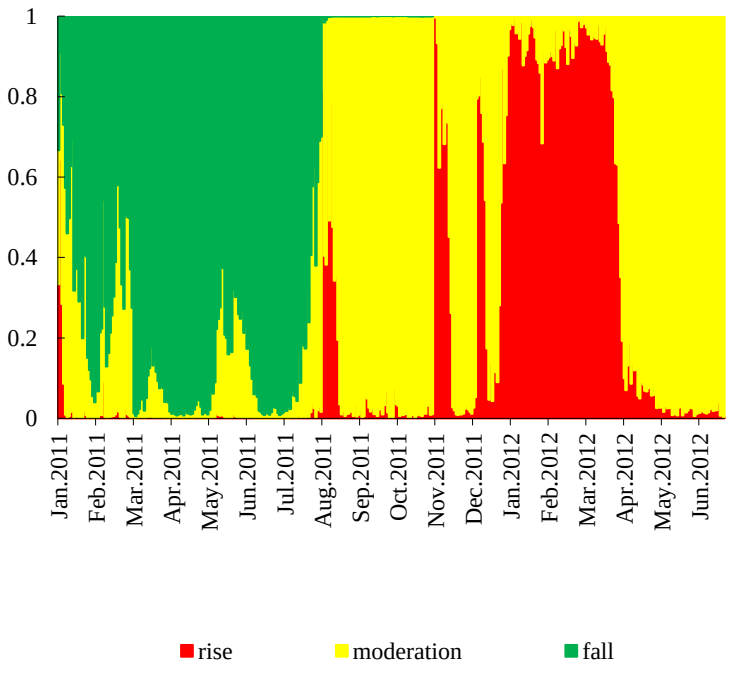
2. How to assess stress conditions faced by interbank money market

- Evolution of transition probabilities between stress regimes in the interbank money markets from Romania and Czech Republic :

ROBOR 3M



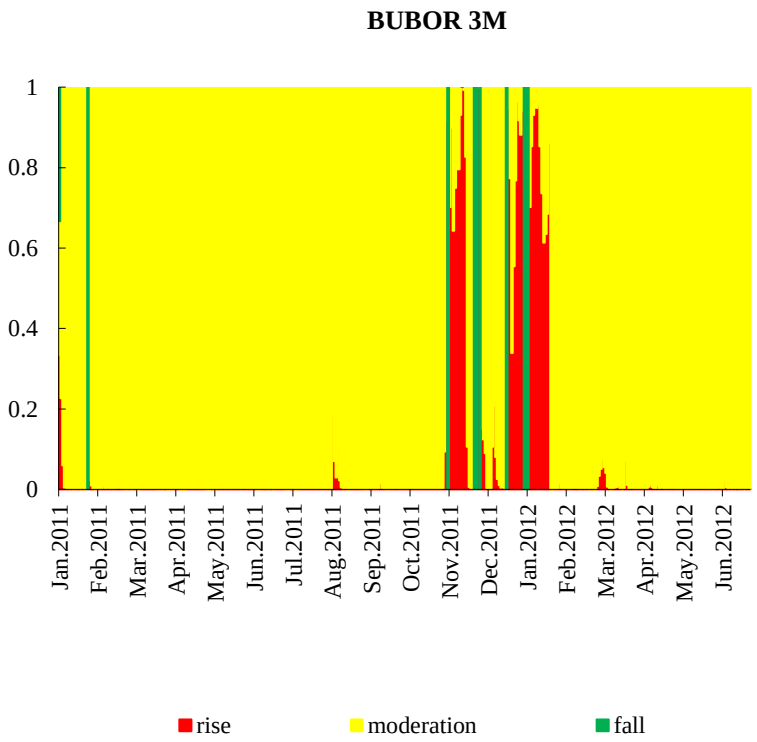
PRIBOR 3M

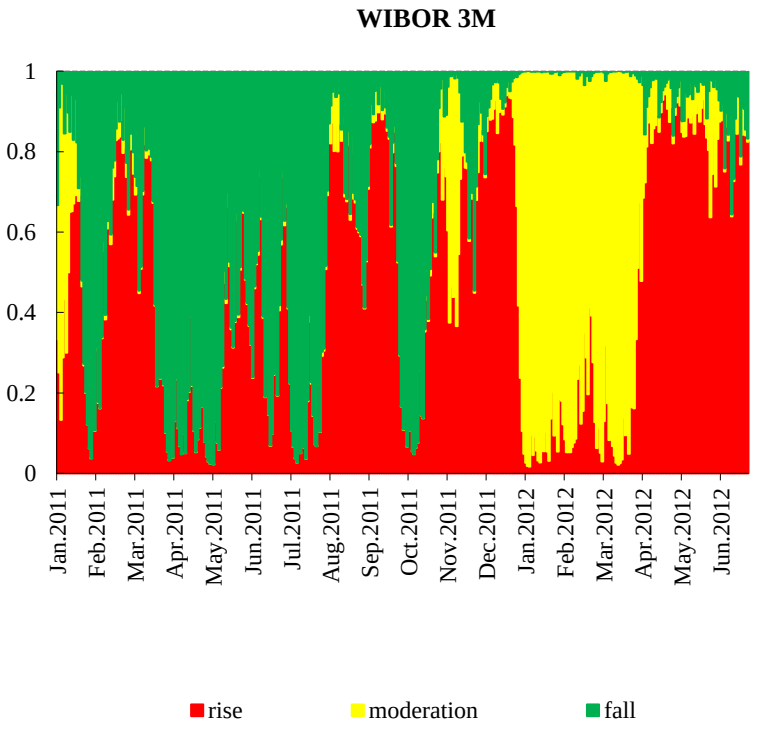


Source:Bloomberg, NBR calculations

2. How to assess stress conditions faced by interbank money market

- Evolution of transition probabilities between stress regimes in the interbank money markets from Hungary and Poland:





Source:Bloomberg, NBR calculations

2. How to assess stress conditions faced by interbank money market

- Owing to high volatility of 3M ROBOR, periods with strong pressures on funding conditions were frequently alternated with the periods when stress stood at moderate or low levels.
- Persistence of stress conditions was shorter for the ROBOR-EURIBOR spread than for the spread between PRIBOR (Czech Republic), or WIBOR (Poland), and the EURIBOR rate:

	Expected duration for each regime (time periods)			
Level of stress conditions	Romania	Hungary	Czech Republic	Poland
High	**7.35**	5.87	26.60	29.45
Moderate	**5.22**	83.73	55.00	42.17
Low	**3.79**	1.48	137.68	26.73

*

2. How to assess stress conditions faced by interbank money market

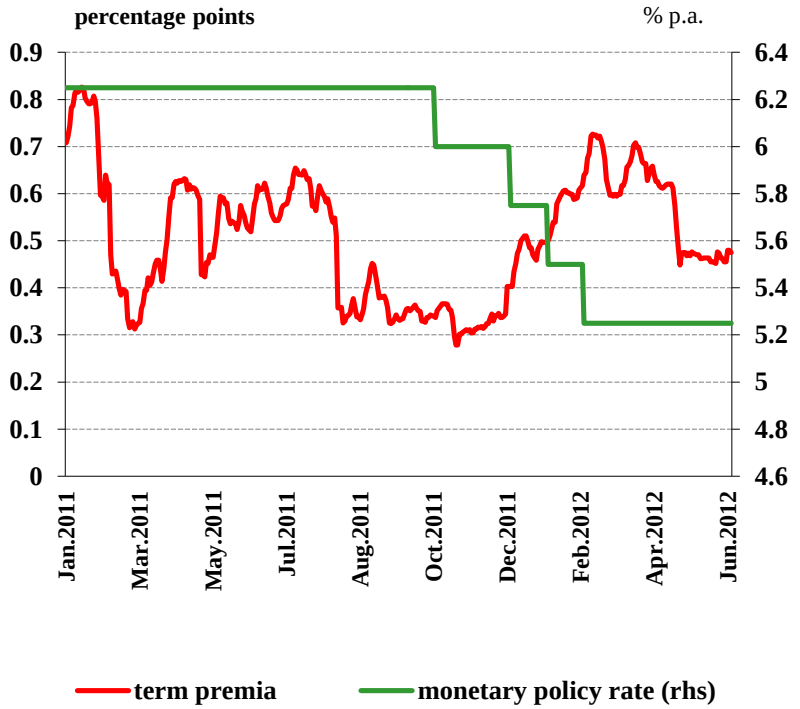
- The second method used to examine stress conditions in the interbank money market is based on the calculation of *term premia.*
- Term premia concept denotes the premium that investors charge for the assumed risk and represents the difference between the forward rate and the expected change in the short-term interbank money market rate.
- To calculate the term premia, an affine continuous-time model based on geometric Brownian motion of the following form was used:

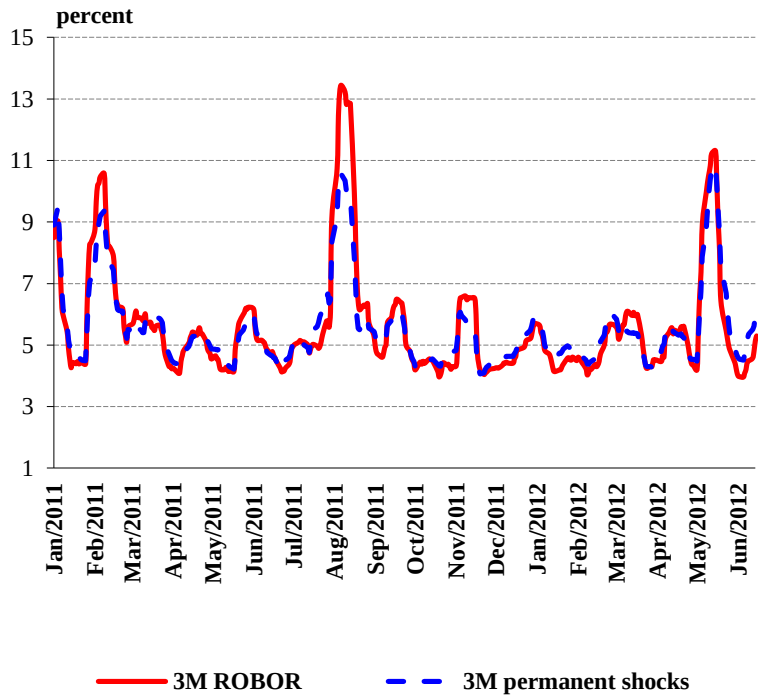
$$(3) dr(t) = [f_T(t,t) - \lambda(t)\sigma(t,t)]d(t) + \sigma(t,t)dZ(t)$$

where $dr(t)$ is the expected change in short-term rate (1M ROBOR), $f_T(t,t)$ is the slope of forward curve, $\sigma(t,t)$ is the model diffusion and $\lambda(t)\sigma(t,t)$ denotes the term-premia. The model was estimated via GMM method using moment conditions formulated by Mahdavi (2011).

2. How to assess stress conditions faced by interbank money market

- Evolution of term premia related to investors' expectations and conditional volatility for the 3M ROBOR rate:





Source:NBR, NBR calculations

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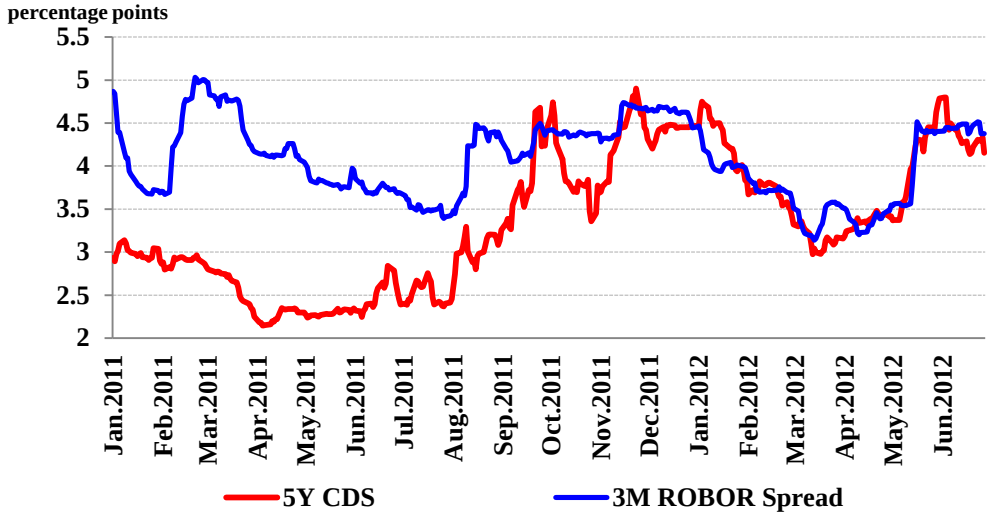
3. How important is risk appetite in leveling stress conditions?

- To assess how investors' risk appetite affects stress conditions from Romanian interbank money market it has been used two approaches in order to confer robustness to final conclusion.
- To account for investors' risk premium in response to sovereign risk, there are used quotes for sovereign 5Y CDS spread, while for money markets is used the same 3M ROBOR Spread.



Source:Bloomberg, NBR calculations

3. How important is risk appetite in leveling stress conditions?

- At the first glance, the relationship between 5Y CDS and 3M ROBOR Spread was analysed through the Granger Causality approach.

Granger Causality Test						
Number of lags	**2 lags**		**4 lags**		**12 lags**	
Null: No causality	F-stat	P-value	F-stat	P-value	F-stat	P-value
CDS $\xrightarrow{Granger\ Cause}$ Spread	6.88	0.00	3.93	0.00	1.66	0.08
Spread $\xrightarrow{Granger\ Cause}$ CDS	0.50	0.61	0.50	0.74	0.42	0.96

- Estimated results showed that 5Y CDS exhibits influence (in a Granger sense) on the 3M ROBOR Spread evolution that decreases for higher lags, but no causality from 3M ROBOR Spread to 5Y CDS at any lags.
- The first approach is an empirical method and its steps will be described in the following lines:

3. How important is risk appetite in leveling stress conditions?

1) Taking the stress probabilities (p_t) provided by Markov Switching Model, it was constructed an indicator function to flag only the stress moments from:

$$(3) 1_P(p_t) \begin{cases} 1, p_t \geq p_{tr} = 0.8 \\ 0, p_t < p_{tr} = 0.8 \end{cases}$$

where p_{tr} is the transition probability related to stress regime.

2) In order to determine the relation between stress periods flagged through an indicator function (expressed as a binomial series) and the 5Y CDS dynamics (a numerical series) I estimated a LOGIT model via Maximum Likelihood method:

$$(4) E(P \mid \text{CDS}) = \frac{e^{(\hat{\beta} * \text{CDS})}}{1 + e^{(\hat{\beta} * \text{CDS})}} = 39.91\%$$

Estimated parameters were statistically significant, showing that 5Y CDS evolution has predictive power for stress conditions in money market.

3. How important is risk appetite in leveling stress conditions?

2) The slope value ($\hat{\beta}$ = 0.4394) indicates a positive relation between risk aversion and the probability of stress regime *P*, which equals 39.91 % for a median value of around 3.265 % recoded by 5Y CDS.

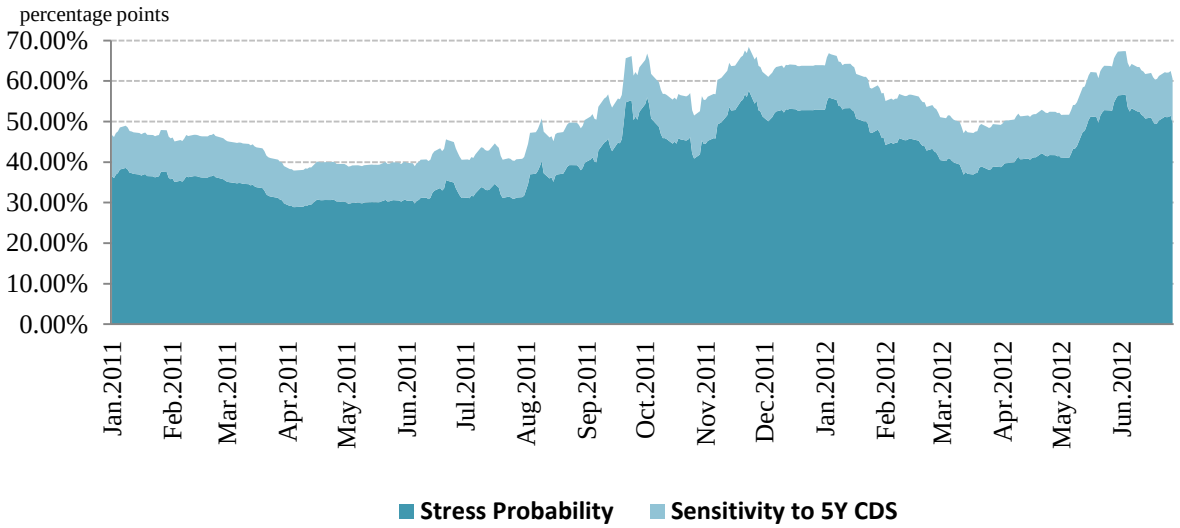
3) The last step was to determine the sensitivity of stress probability to a unit change in 5Y CDS that takes the form:

$$(5)\ \frac{\partial E(P \mid \mathrm{CDS})}{\partial \mathrm{CDS}_t} = \frac{e^{(\hat{\beta} * \mathrm{CDS})}}{1 + e^{(\hat{\beta} * \mathrm{CDS})^2}} \hat{\beta}_t = 10.54\%$$

For the 3.265 % median value of 5Y CDS, the sensitivity of stress probability *P* to 1 unit change (one standard deviation) in 5Y CDS is around 10.54 %.

3. How important is risk appetite in leveling stress conditions?

5) Evolution of stress probability and of its sensitivity to a unit change in 5Y CDS:



Source:Bloomberg, NBR calculations

Assessing the model performance:

- on 03/13/2012, 5YCDS=3.10% and $E(P \mid \mathrm{CDS}) + \frac{\partial E(P \mid \mathrm{CDS})}{\partial \mathrm{CDS}_t}$ = 48.60%

- on 06/29/2012, 5YCDS=4.15% and the proportion of stress periods was around 46.83%.

3. How important is risk appetite in leveling stress conditions?

- The second approach used to assess the impact of risk premium on Romanian interbank money market is based on the structural relationship between the sovereign 5Y CDS and the 3M ROBOR-EURIBOR spread.
- In the following lines I will step into the method's assumptions:

1) The form of the Structural Vector-Autoregressive(SVAR) model used:

$$(7)\begin{bmatrix} C_t \\ S_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{1,11} & a_{1,12} \\ a_{1,21} & a_{2,22} \end{bmatrix}\begin{bmatrix} C_{t-1} \\ S_{t-1} \end{bmatrix} + \begin{bmatrix} a_{2,11} & a_{2,12} \\ a_{2,21} & a_{2,22} \end{bmatrix}\begin{bmatrix} C_{t-2} \\ S_{t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

where C_t and S_t denote the evolutions of 5Y CDS, respectively of interest rates spread, while $\varepsilon_{1,2t}$ are the exogenous shocks that affect the system.

2) Based on both studies of Zhang regarding the CDS stylised facts in terms of informational efficiency and the recent empirical observations, here is considered that underlined variables follow *random walk* processes (data in levels expressed as weekly averages are used).

3. How important is risk appetite in leveling stress conditions?

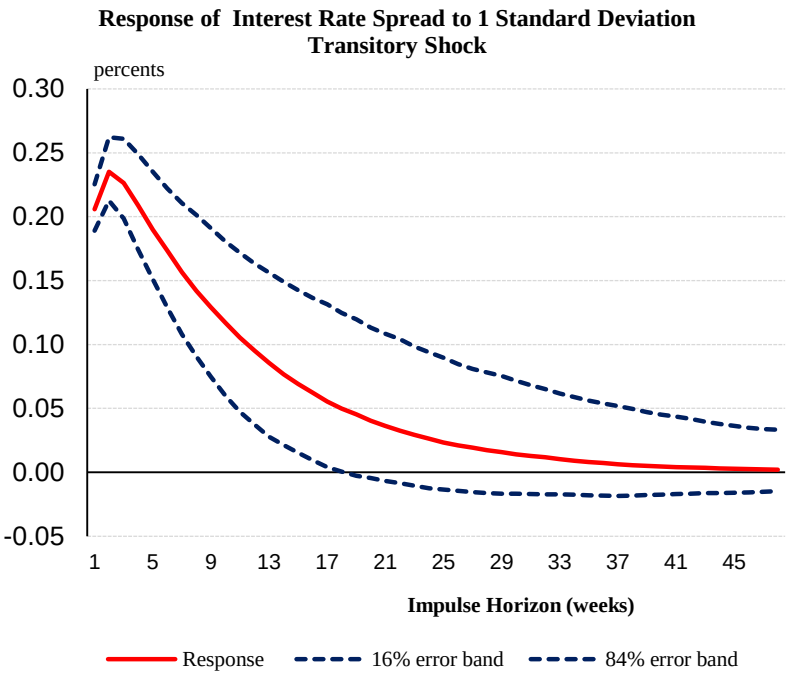
3) Considering previous assumption, I referred to the approach used by the specialists from Federal Reserve of Minnesota (*Minnesota approach*) pioneered by Litterman (1979) that uses a Bayesian econometrics framework to incorporate prior beliefs.

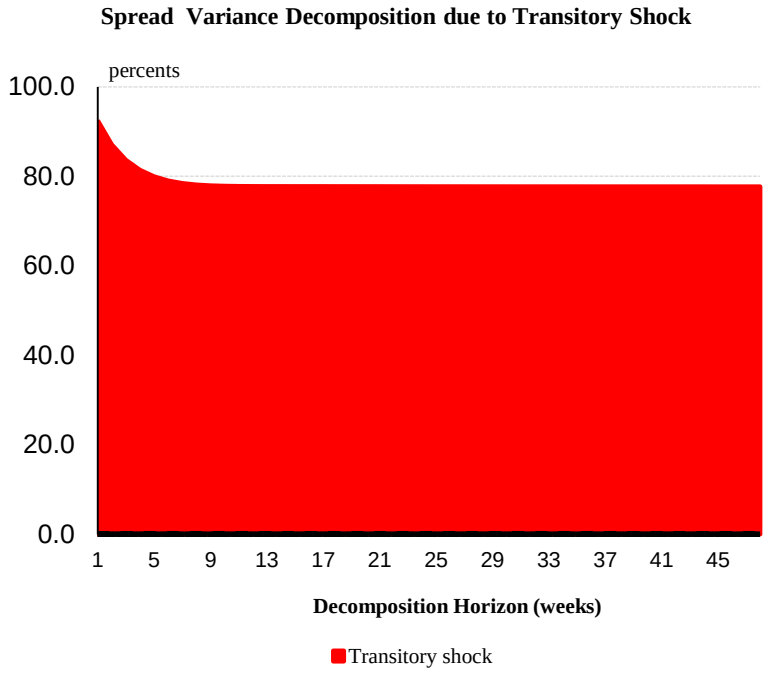
4) Considering results from previous analysis, it was considered that CDS evolution is explained only by the investors' expectations regarding sovereign fundamentals and outlooks that are expressed in terms of risk premium, while the spread evolution is explained by both the fundamentals developments (permanent shock) and an idiosyncratic risk appetite (transitory shock). In the spirit of Cochrane (1994) work, this framework is implemented using a Cholesky procedure, where $S_{1,2t}$ are the structural shocks:

$$(8)\ \begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\end{bmatrix} = \begin{bmatrix}\Sigma_{11} & 0\\ \Sigma_{12} & \Sigma_{22}\end{bmatrix}\begin{bmatrix}s_t^{permanent}\\ s_t^{transitory}\end{bmatrix}$$

3. How important is risk appetite in leveling stress conditions?

- The impact of transitory (risk appetite) shock on spread movements is around 0.23%; estimated transitory shock accounts for 77.7% of the spread variance.





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4. Conclusions

- Stress conditions in the Romanian interbank market followed mainly transitory paths and eased starting with January 2012 following the monetary policy rate cuts.
- Instead, beginning with February 2012, the term premium widened, even though the monetary policy rate was subject to successive cuts; the explanation for this could be related to the economic uncertainties.
- Sovereign 5Y CDS quotes showed a significant predictive power for stress conditions in Romanian interbank money market.
- Risk appetite developments pose an impact of around 0.23 % on the spread between 3M ROBOR and EURIBOR rates.

Thank you!