Appendix B - Tables and Supplementary Figures

**Table B.1 - List events and results of the survey**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Event** | | | **Mean** | | **Stand. Dev.** |
| 2007 | Summer 2007: 1st phase of the financial turmoil. | | | 1.793 | | 0.726 |
| September 2007: bank run of Northern Rock. | | | 1.828 | | 0.539 |
| 2008 | March 2008: Bear Stearns bailout. | | | 1.897 | | 0.673 |
| First semester of 2008: banking crisis in Ireland/Iceland. | | | 1.897 | | 0.489 |
| September 2008: Lehman Brothers default. | | | 2.828 | | 0.384 |
| September 2008/ March 2009: bail-out of AIG, Fortis, Fannie Mae and Freddie Mac. Bank rescues in USA and UK. | | | 2.552 | | 0.686 |
| 2009 | October 2009: beginning of the concern over public finances in Greece. | | | 1.700 | | 0.702 |
| November 2009: Dubai default. | | | 1.393 | | 0.567 |
| 2010 | April/May 2010: Greece applies for Financial Support Mechanism. | | | 2.533 | | 0.507 |
| November/December 2010: Ireland seeks financial support. | | | 2.500 | | 0.509 |
| 2011 | April 2011: Portugal requests activation of aid mechanism. | | | 2.033 | | 0.556 |
| August 2011: stock markets fall due to fears of the European sovereign debt crisis spreading to Spain and Italy, as well as concerns about the slow economic growth of the United States and fear of its credit rating being downgraded. | | | 2.967 | | 0.183 |
| October/November/December 2011: concern about public finances most directly targeted on Italy and Spain; Spain and Italy are hit by a wave of rating downgrades by the three main rating agencies; increase of haircuts on Italian bonds by CC&G and LCH. | | | 3.000 | | 0.000 |
| 2012 | March 2012: agreement on the restructuring of the Greek public debt, followed by the exercise of the CDS on Greek government securities. | | | 1.800 | | 0.664 |
| June/July 2012: conditions in sovereign debt markets worsened again; Spain requests financial assistance to recapitalize banking sector and Cyprus requests financial support. | | | 2.500 | | 0.509 |
| 2013 | February 2013: Italian elections. | | | 1.800 | | 0.610 |
| March 2013: introduction of Financial Transaction Tax on Italian stock market. | | | 1.200 | | 0.407 |
| March 2013: Cyprus bailout deal averts default. Cyprus agreed to the outlines of an international bailout, paving the way for 10 billion euros of emergency loans and eliminating the threat of default. | | | 1.633 | | 0.615 |
| July 2013: end-of-half-year tensions on Italian financial markets and uncertainty about central counterparties’ risk management policies. | | | 2.000 | | 0.707 |
| August 2013: introduction of the concentration risk framework by LCH-Clearnet (additional margin on Italian government bonds). | | | 1.655 | | 0.614 |
| September 2013: elections in Germany. | | | 1.133 | | 0.346 |
| November 2013: Spain decided to exit its bank bailout without seeking a precautionary credit line in reserve. | | | 1.033 | | 0.183 |
|  |  |  |  | |

This table presents the list of events that we have identified. Thirty financial experts were asked to evaluate the level of “liquidity” stress that these events caused to the Italian financial markets on a scale of 1 to 3. The last two columns of the table present the average value and the standard deviation of the experts’ answers. An event is identified as a liquidity crisis if the average level of stress is above the mean of the stress scale (2.5).

**Table B.2. Probit regression results**

|  |
| --- |
| Dependent variable: BINARY\_INDEX |
| Method: ML - binary probit (quadratic hill climbing) |
| Sample: 1/03/2005 12/30/2013 |
| Included observations: 2264 |
| Convergence achieved after 4 iterations |
| Covariance matrix computed using second derivatives |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|
| C | -3.0859 | 0.1147 | -26.8949 | 0.0000 |
| SLRI | 7.5191 | 0.2866 | 26.2372 | 0.0000 |
| McFadden R-squared | 0.6689 | Mean dependent variable | | 0.2465 |
| S.D. dependent variable | 0.4310 | Standard error of regression | | 0.2398 |
| Akaike info criterion | 0.3715 | Sum of the squared residuals | | 130.0339 |
| Schwarz criterion | 0.3766 | Log likelihood | | -418.5871 |
| Hannan-Quinn criterion | 0.3734 | Deviance |  | 837.1738 |
| Restricted deviance | 2528.5241 | Restricted log likelihood | | -1264.2601 |
| LR statistic | 1691.3511 | Average log likelihood | | -0.1849 |
| Prob(LR statistic) | 0 |  |  |  |
|  |  |  |  |  |
| Obs with Dep=0 | 1706 | Total obs |  | 2264 |
| Obs with Dep=1 | 558 |  |  |  |
|  |  |  |  |  |

This table presents the results of the following probit regression:

Where Φ is the cumulative distribution function of the standard normal distribution, *yi* is the binary index derived from the survey and *xi* comprises the constant and *SLRIi*, the systemic liquidity risk indicator. Estimations based on daily data from January 2005 to December 2013.

**Table B.3. Probit regression results: expectation-prediction evaluation for binary specification and goodness of fit**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **Expectation-Prediction Evaluation for Binary Specification** | | | |
| *(Success cutoff: C = 0.5)* | | | |
|  | Estimated equation | | |
|  | Dep=0 | Dep=1 | Total |
|  |  |  |  |
| P(Dep=1)<=C | 1,611 | 91 | 1,702 |
| P(Dep=1)>C | 95 | 467 | 562 |
| Total | 1,706 | 558 | 2,264 |
| Correct | 1,611 | 467 | 2,078 |
| % Correct | 94.43 | 83.69 | 91.78 |
| % Incorrect | 5.57 | 16.31 | 8.22 |
| **Goodness-of-Fit Evaluation for Binary Specification** | | | |
|  |  | Statistic | Prob. Chi-Sq |
| Hosmer-Lemeshow (H-L) Test | | 31.1034 | 0.0001 |
| Andrews Test | | 1053.7231 | 0 |

This table presents the results of the evaluation for the binary specification, where the dependant variable (Dep) is the binary index derived from the survey. Estimations based on daily data from January 2005 to December 2013.

**Table B.4. Comparing different specifications of Markov-switching autoregressive models for the systemic liquidity risk indicator (SLRI)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| **α (st)** | **β (st)** | **σ (st)** | **Log-likelihood** | **AIC** | **RCM** |
| variable | variable | variable | 904.2412 | -3.83009 | 10.68886 |
| variable | constant | variable | 904.0182 | -3.83341 | 10.89849 |
| variable | constant | constant | 790.2494 | -3.35149 | 15.66012 |
| constant | variable | variable | 903.3075 | -3.83037 | 10.80872 |
| constant | constant | variable | 899.9527 | -3.82031 | 11.64375 |
|  |  |  |  |  |  |

We estimate several variants of a first-order autoregressive Markov-switching model for our indicator (*xt*), with two states (*st*):

The RCM is the regime classification measure in its refined version of Baele (2005) as defined in the following equation:

where *K* is the number of regimes, *T* is the number of observations, and *pj,t*is the smoothed probability of being in regime *j=1,….,K* at time t.

RCM lies between 0 and 100 where lower values are associated with better regime classification. We report in green the chosen specification, which is an autoregressive process of order one (AR(1)) in which the intercept (α(st)), the slope coefficient (β(st)) and the residual variance (σ(st)) are allowed to switch across both the regimes. Estimations based on weekly averages of daily data from January 2005 to December 2013.

**Table B.5. Parameter estimates of the Markov switching autoregressive process of order one with two regimes for the systemic liquidity risk indicator (SLRI)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
| **α (1)** | 0.0107 | 0.0061 | 1.968 | 0.049 |
| **α (2)** | 0.0023 | 0.0013 | 2.029 | 0.038 |
| **β (1)** | 0.9704 | 0.0153 | 63.418 | 0.000 |
| **β (2)** | 0.9587 | 0.0096 | 100.311 | 0.000 |
| **σ (1)** | -2.8721 | 0.0448 | -64.096 | 0.000 |
| **σ (2)** | -4.2929 | 0.0702 | -61.193 | 0.000 |
| **P(1,1)** | 3.7945 | 0.5127 | 7.401 | 0.000 |
| **P(2,1)** | -3.4052 | 0.5276 | -6.454 | 0.000 |
|  |  |  |  |  |

The table presents the results of the Markov-switching autoregressive model of order one for our indicator (*xt*), with two states (*st*):

where the intercept (α(st)), the slope coefficient (β(st)) and the residual variance (σ(st)) are allowed to switch across both the regimes. P(1,1) and P(2,1) are the transition matrix parameters. Estimations based on weekly averages of daily data from January 2005 to December 2013.

**Table B.6. Transition matrix probabilities of the Markov switching autoregressive process of order one with two regimes for the systemic liquidity risk indicator (SLRI)**

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | Regime 1,t | Regime 2,t |
| Regime 1,t+1 | 0.9780 | 0.0321 |
| Regime 2,t+1 | 0.0220 | 0.9679 |
|  |  |  |

Estimations based on weekly averages of daily data from January 2005 to December 2013.

**Table B.7. Probit regressions results and goodness of fit test using different specifications for the cross-correlations**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | **BEKK GARCH** | | **DCC GARCH** | | **EWMA** | |
|  | Constant | SLRI | Constant | SLRI | Constant | SLRI |
| Coefficient | -3.08591 | 7.51913 | -5.37683 | 11.15839 | -2.18148 | 5.92890 |
| Std. Error | 0.11474 | 0.28658 | 0.22530 | 0.48978 | 0.07329 | 0.24043 |
| z-Statistic | -26.89486 | 26.23720 | -23.86523 | 22.78224 | -29.76467 | 24.65954 |
| Prob. | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| *McFadden R-squared* | *0.668908* | | *0.661553* | | *0.406476* | |
|  | Hosmer-Lemeshow (H-L) Test | Andrews Test | Hosmer-Lemeshow (H-L) Test | Andrews Test | Hosmer-Lemeshow (H-L) Test | Andrews Test |
| Statistic | 31.1034 | 1053.7231 | 6.1475 | 541.9716 | 102.5871 | 732.3819 |
| *Prob. Chi-Square* | 0.0001 | 0.0000 | 0.6307 | 0.0000 | 0.0000 | 0.0000 |
|  |  |  |  |  |  |  |

This table presents the results of the following probit regression:

where Φ is the cumulative distribution function of the standard normal distribution, *yi* is the binary index derived from the survey and *xi* comprises the constant and the systemic liquidity risk indicator (*SLRI*) calculated using different specifications of the cross-correlations: BEKK, DCC and EWMA. Estimations based on daily data from January 2005 to December 2013.

**Figure B.1**

**Comparing the systemic liquidity risk indicator in the Italian financial markets with the composite indicator of systemic stress (CISS) in the euro-area financial system**

(*weekly data*)



This figure compares the systemic liquidity risk indicator in the Italian financial markets with the Composite Indicator of Systemic Stress (CISS) in the euro area financial system (Hollò et al., 2012). When compared with the CISS, the systemic liquidity risk indicator in the Italian financial markets presents some differences: i) it is focused on the Italian financial market, ii) it is intended to capture the liquidity risk, iii) it does not consider measures of the banking sector separately and focuses on indicators of financial markets, without using "fundamental" measures such as price-to-book value, iv) it uses a different method for the estimation of correlations between sub-indices (GARCH BEKK vs exponentially-weighted moving averages, EWMA); v) it is calculated on daily data while the CISS is based on weekly data.

Despite the differences just described, the two indicators show quite a similar trend.