15 January 2015 – <u>Addendum 6 to the CRI Technical Report (Version: 2014, Update 1)</u>

This document updates the Technical Report (Version: 2014, Update 1) and details (1) Replacement of interest rates, (2) CRI coverage expansion, (3) Revision to the missing value treatment for PD calculation, and (4) Adjustment for Lithuania due to its entrance to Eurozone. These changes have been implemented for probabilities of default (PDs) and Actuarial Spreads (AS) since 12 January 2015.

<u>I. Replacement of interest rates</u>

(1) 1-year interest rate, Cyprus

In June 2014, Cyprus tapped the international capital markets after three years of absence through a heavily oversubscribed bond issuance. Henceforth, we use the *Bloomberg 1-year Republic of Cyprus Rate* as a replacement for the 1-year risk-free rate for Cyprus in the DTD computation. As this interest rate is only available since 17 July 2014, we continue to use the *Reuters 13-week Cyprus Treasury Bill Rate* for earlier periods.

(2) 1-year interest rate, Hungary

As of the January 2015 calibration, we use the *Reuters Hungary Central Bank Base Rate* as a replacement for the 1-year risk-free rate in the DTD computation for all data points starting from 15 October 1990. This is the announcement rate by the Monetary Council of the National Bank of Hungary at its monetary policy meetings.

(3) 1-year interest rate, Ireland

As of the January 2015 calibration, we use the *Bloomberg 12-month Dublin Interbank Offered Rate* as a replacement for the 1-year risk-free rate in the DTD computation for all data points starting from 10 April 1991.

(4) 3-month and 1-year interest rates, Netherlands

We used to take *3-month Amsterdam Interbank Offer Rate* and *1-year Amsterdam Interbank Offer Rate* for Netherlands. In July 2014, the ICE Benchmark Administration introduced a new commercial structure for access to all LIBOR data, which delayed the publication of both the 3-month and 1-year interest rates in Netherlands. We have thus replaced them with the more relevant *3-month*

Netherlands Interbank Rate and *1-year Netherlands Interbank Rate* respectively, starting from the January 2015 calibration for all data points since 2 January 1979.

(5) 1-year interest rate, Nigeria

As of the January 2015 calibration, we use the *Bloomberg 12-month Nigeria Interbank Treasury Bill Fixing Rate* as a replacement for the 1-year risk-free rate for Nigeria in the DTD computation. The new risk-free rate is based on market bids for Nigerian Treasury Bills. As this interest rate is only available since 7 August 2007, we continue to use the *Bloomberg 3-month Nigeria Interbank Offered Rate* for earlier periods.

(6) 3-month and 1-year interest rates, Venezuela

Large changes in interest rates and inconsistencies in available data of the *Reuters Venezuela Overnight Rate* have prompted the change in interest rates for Venezuela. As of the January 2015 calibration, we use the *Reuters 90-day Venezuela Deposit Rate* and the *Reuters Savings Deposit Rate* as a replacement for the 3-month and 1-year risk-free rate respectively. As the *Reuters 90-day Venezuela Deposit Rate* is only available since 10 January 1997 and the *Reuters Savings Deposit Rate* is only available since 3 January 2000, we continue to use the *Reuters Venezuela Overnight Rate* for earlier periods.

(7) 1-year interest rate, Slovakia

The National Bank of Slovakia stopped reporting the 1-year interbank rate and our data provider, Reuters, ceased updating the *Reuters 1-year Slovak Republic Interbank Rate* on 31 December 2008. We have thus used the *Reuters 2-week Slovak Repo Tender Limit Rate* as a replacement in the DTD computation, which is the key monetary instrument of the central bank, as a replacement for the risk-free rate for Slovakia from 1 January 2009.

(8) 1-year interest rate, South Africa

As of the January 2015 calibration, the *Reuters 1-year South African Prime Overdraft Rate* is used as a replacement for the 1-year risk-free rate in the DTD computation for all data points starting from 2 January 1950.

II. CRI coverage expansion

With stock exchanges of Bosnia and Herzegovina, Montenegro, Serbia, and Tunisia added into the PD system, the CRI coverage has been extended to 116 economies since the January 2015 calibration.

Changes to grouping of monthly calibration

Typically, small economies do not have enough defaults, and calibrations of these individual economies are not statistically meaningful. In order to ensure that there are enough defaults for calibration, different economies under the CRI coverage are categorized into groups according to similarities in their stage of economic development and geographic locations. Within these groups, the economies are combined and calibrated together.

Based on this approach, Bosnia and Herzegovina, Montenegro and Serbia are added to the calibration group of Europe (in addition to Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK and Ukraine), while Tunisia is added to the calibration group of emerging economies (in addition to Argentina, Bahrain, Bangladesh, Brazil, Chile, Colombia, Egypt, Indonesia, Jamaica, Jordan, Kazakhstan, Kuwait, Malaysia, Mexico, Morocco, Nigeria, Oman, Pakistan, Peru, Philippines, Saudi Arabia, South Africa, Sri Lanka, Thailand, United Arab Emirates, Venezuela and Vietnam).

Description and summary statistics

When adding new countries to the CRI coverage, several benchmark indexes are carefully selected. The details are listed in the table below.

Economy	Bosnia and Herzegovina	Montenegro	Serbia	Tunisia
ISO Code	BA	ME	RS	TN
Calibration Group	Europe	Europe	Europe	Emerging
Stock Exchange (Period Used)	SASX-10 (2012-01-12 - 2014-10-15)	Montenegro Stock Exchange 20 (2012-01-12 – 2014-10-30)	BELEXline Index (2012-01-12 - Present)	Tunis SE TUNINDEX (2012-01-12 - Present)
Short Term Interest Rate (Period Used)	Set as zeros due to delayed/irregular publish of the index	Set as zeros due to delayed/irregular publish of the index	National Bank of Serbia BELIBOR 3M Rate (2012-01-12 - Present)	TU POLICY RATES: TMM (1988-01-15 - Present)
Interest Rate Name (Period Used)	BP REAL INTEREST RATE NADJ (1998-01-01 - Present)	Treasury Bill Rate - 182-Day (2004-07-16 - Present)	Serbia Treasury Bill Auction Results 12 Months Average Accepted Yield (2012-01-17 - Present)	TU BCT KEY INTEREST RATE (2000-01-15 - Present)

Table 1: ISO Code, stock index and interest rates

The next tables provide further information on the input variables included in the RMI PD model, the number of active companies, defaults and other exits.

	Min	25%	Median	75%	Max	Mean	StdDev	#Observation
DTD Level	-1.50	1.45	2.62	4.78	25.65	3.67	3.64	3058
DTD Trend	-8.06	-0.52	-0.07	0.26	7.73	-0.10	1.27	3058
Cash/TA Level	0.00	0.01	0.02	0.07	0.78	0.07	0.12	5842
Cash/TA Trend	-0.46	0.00	0.00	0.00	0.37	0.00	0.04	5842
NI/TA Level	-0.07	0.00	0.00	0.00	0.08	0.00	0.01	6391
NI/TA Trend	-0.19	0.00	0.00	0.00	0.18	0.00	0.01	6391
Size Level	-6.04	-0.64	0.76	2.45	7.65	0.94	2.17	24306
Size Trend	-2.02	-0.02	0.00	0.02	2.11	0.01	0.19	24306
M/B	0.15	0.43	0.71	1.03	16.86	0.85	0.90	5149
Sigma	0.03	0.11	0.16	0.21	0.73	0.17	0.08	2853

Table 2: Bosnia and Herzegovina – Summary statistics of input variables (based on data from 2006 to 2014)

		Defaults		Others	
	Active	#	%	#	%
2006	303	0	0	164	35.12%
2007	249	0	0	347	58.22%
2008	193	0	0	378	66.20%
2009	171	0	0	594	77.65%
2010	463	0	0	739	61.48%
2011	148	0	0	983	86.91%
2012	140	0	0	922	86.82%
2013	130	0	0	919	87.61%
2014	562	0	0	485	46.32%

Table 3: Bosnia and Herzegovina – Number of defaults and other exits from 2006 to 2014

	Min	25%	Median	75%	Max	Mean	StdDev	#Observation
DTD Level	-0.28	1.39	2.18	3.10	7.96	2.51	1.66	755
DTD Trend	-3.61	-0.38	-0.02	0.24	4.94	0.01	0.82	755
Cash/TA Level	0.00	0.00	0.01	0.08	0.45	0.06	0.09	2028
Cash/TA Trend	-0.23	0.00	0.00	0.00	0.24	0.00	0.03	2028
NI/TA Level	-0.06	0.00	0.00	0.00	0.03	0.00	0.01	2099
NI/TA Trend	-0.05	0.00	0.00	0.00	0.06	0.00	0.00	2099
Size Level	-6.74	-2.83	-1.23	0.45	5.42	-1.20	2.34	6946
Size Trend	-2.02	-0.04	0.00	0.04	2.11	-0.02	0.35	6946
M/B	0.15	0.33	0.48	0.83	21.42	0.73	1.35	1794
Sigma	0.05	0.12	0.18	0.24	0.73	0.20	0.11	640

Table 4: Montenegro – Summary statistics of input variables (based on data from 2004 to 2014)

		Defaults		Others	
	Active	**#**	**%**	**#**	**%**
2004	42	0	0	68	61.82%
2005	77	0	0	60	43.80%
2006	100	0	0	85	45.95%
2007	130	0	0	102	43.97%
2008	74	0	0	154	67.54%
2009	73	0	0	95	56.55%
2010	84	0	0	65	43.62%
2011	56	0	0	220	79.71%
2012	34	0	0	221	86.67%
2013	218	0	0	59	21.30%
2014	226	0	0	176	43.78%

Table 5: Montenegro – Number of defaults and other exits from 2004 to 2014

	Min	25%	Median	75%	Max	Mean	StdDev	#Observation
DTD Level	-2.64	0.47	1.83	3.44	22.90	2.29	2.83	2129
DTD Trend	-8.06	-0.43	-0.02	0.25	4.75	-0.13	0.95	2129
Cash/TA Level	0.00	0.04	0.13	0.27	0.91	0.18	0.17	9535
Cash/TA Trend	-0.46	0.00	0.00	0.00	0.47	0.00	0.06	9535
NI/TA Level	-0.12	0.00	0.00	0.01	0.08	0.00	0.01	10796
NI/TA Trend	-0.13	0.00	0.00	0.00	0.06	0.00	0.00	10796
Size Level	-6.74	-0.34	1.03	2.47	7.92	1.05	2.10	27798
Size Trend	-2.02	-0.07	0.00	0.06	2.11	0.01	0.24	27798
M/B	0.15	0.65	0.85	1.13	21.42	1.01	0.88	8715
Sigma	0.01	0.13	0.20	0.27	0.72	0.20	0.09	4602

Table 6: Serbia – Summary statistics of input variables (based on data from 2005 to 2014)

		Defaults		Others	
	Active	#	%	#	%
2005	190	0	0	77	28.84%
2006	335	0	0	392	53.92%
2007	395	0	0	955	70.74%
2008	315	0	0	652	67.43%
2009	315	0	0	459	59.30%
2010	1280	0	0	452	26.10%
2011	226	0	0	1282	85.01%
2012	256	0	0	235	47.86%
2013	164	0	0	395	70.66%
2014	239	2	0.48%	173	41.79%

Table 7: Serbia – Number of defaults and other exits from 2005 to 2014

	Min	25%	Median	75%	Max	Mean	StdDev	#Observation
DTD Level	-1.69	2.02	3.44	5.67	17.78	4.10	2.94	6291
DTD Trend	-7.52	-0.58	-0.04	0.53	7.59	-0.02	1.27	6291
Cash/TA Level	0.00	0.03	0.07	0.13	0.70	0.10	0.11	7275
Cash/TA Trend	-0.22	-0.01	0.00	0.01	0.19	0.00	0.03	7275
NI/TA Level	-0.04	0.00	0.00	0.00	0.02	0.00	0.01	7538
NI/TA Trend	-0.03	0.00	0.00	0.00	0.03	0.00	0.00	7538
Size Level	-3.42	-0.94	0.06	1.13	3.11	0.12	1.26	8490
Size Trend	-1.79	-0.11	-0.03	0.06	1.93	-0.01	0.20	8490
M/B	0.19	0.96	1.07	1.41	8.34	1.35	0.75	7104
Sigma	0.01	0.06	0.07	0.09	0.52	0.08	0.04	7012

Table 8: Tunisia – Summary statistics of input variables (based on data from 1999 to 2014)

		Defaults		Others	
	Active	**#**	**%**	**#**	**%**
1999	33	0	0	1	2.94%
2000	36	0	0	2	5.26%
2001	40	0	0	3	6.98%
2002	41	0	0	2	4.65%
2003	42	0	0	1	2.33%
2004	39	0	0	4	9.30%
2005	45	0	0	3	6.25%
2006	48	0	0	1	2.04%
2007	49	0	0	4	7.55%
2008	49	0	0	4	7.55%
2009	51	0	0	1	1.92%
2010	54	0	0	2	3.57%
2011	56	0	0	0	0.00%
2012	57	0	0	0	0.00%
2013	66	0	0	0	0.00%
2014	76	0	0	0	0.00%

Table 9: Tunisia – Number of defaults and other exits from 1999 to 2014

III. **Revision to the missing value treatment for PD calculation**

As of the February 2013 calibration, we had used the criteria to start the missing value treatment only six months after the IPO of a company to ensure that PDs in the beginning of a company's history are more reflective of the true creditworthiness of that individual company, as documented in Section III. 1 in Technical Report (Version: 2014, Update 1). This treatment was based on an observation that "In the initial phase of a company – up until 6 months after IPO – it can be expected that the company's data availability and quality is relatively low".

The DTD level and trend are crucial to the PD prediction. Replacing the missing DTD levels and trends with a sector median sometimes results in extreme spikes and falls in the company's PD. Therefore, a protection scheme has already been implemented to identify the PD irregularities through comparison to the previous PD values and thus undo the sector replacements. However, if a sector median replacement occurs at the beginning of a company's history, there are no previous PD values to compare to, so the protection scheme does not take effect.

It is possible that the DTD level and trend are not able to be calculated even after 6 months from its IPO due to the delay of the financial statement. For example, Google's IPO took place in Aug 2004. However, its financial statement was only available from 31 Dec 2004. Since the DTD at a certain time spot can only be calculated with at least 50 days of valid observations in the past one year, its value is finite only starting from March 2005 and thus both the DTD level and trend in the 7th month after IPO are missing. In this case, the sector replacement would be implemented if the old logic was used; however, this treatment does not make sense since it occurs at the beginning of history, as discussed above.

Therefore, since the January 2015 calibration, we have revised our criteria to start the missing value treatment only after the month with both finite DTD level and trend.

IV. Adjustment for Lithuania due to its entrance to Eurozone

Lithuania joined the Eurozone on 1 January 2015. Therefore, we started to apply the current treatment of benchmark interest rate for Eurozone economies to Lithuania. As of the January 2015 calibration, the benchmark interest rate in Lithuania is entered as zero before joining the Eurozone and set to be Germany's 3-month Bubill rate thereafter. Also, the benchmark interest rate coefficient of Lithuania is changed to be the same as that of other Eurozone economies.