

Bank Credit Risk Rating Process: Is There a Change With the 2007-09 Crisis?

Emna Damak¹

¹ Ecole Supérieure des Sciences Economiques et Commerciales, Université de Tunis, Tunisie

Correspondence: Emna Damak, Enseignante universitaire à l'Ecole Supérieure des Sciences Economiques et Commerciales, Université de Tunis, Unité de Recherche DEFI, 4 Rue Abou Zakaria El Hafsi, Montfleury 1089, Tunis, Tunisie. Tel: 216-98-589-240.

Received: June 6, 2021

Accepted: July 10, 2021

Online Published: July 16, 2021

doi:10.5430/ijfr.v12n5p41

URL: <https://doi.org/10.5430/ijfr.v12n5p41>

Abstract

The purpose of this article is to study empirically the bank credit risk rating (BCRR) process over time using 89 banks from 27 EMENA countries rated by S&P's simultaneously before and after 2007-09 crises. We made this comparison based on the CAMELS model with a proposed 'S' to BCRR. We use "ordered logit" regression for the rating classes and we complete our analysis by "linear multiple" regression for the rating grades. The results show that the rating changes in 2012 are mainly a methodology revision consequence of the entire rating process changes, including the weight of components, the important factors and the relevant variables in order to take into account some of the lessons learned from this global crisis. They also show a consistence between the BCRR's revealed and practiced methodologies revised by the credit rating agencies (CRAs).

Keywords: bank credit risk rating, credit rating agencies, camels model, determinants, financial crisis, too-big-to-fail

1. Introduction

The subprime crisis has prompted credit rating agencies to review their practices by revising their rating criteria and models and improving the transparency of the revealed methodologies of the BCRR (IMF, 2010; Packer & Tarashev, 2011). These reviews have attracted the attention of capital market players and restored their confidence in the CRAs.

The revealed methodologies are the set of qualitative and quantitative criteria, grouped into factors and key analytical factors, developed by agencies in their publications (Gaillard, 2008). And the practiced methodologies are all of these criteria integrated and applied in the rating process.

The study of the evolution of BCRR's revealed methodologies based on the specific publications of the world's most renowned CRAs: S&P's, Moody's and FitchRatings (Damak & Chichti, 2017) have shown that, first, they have not been fundamentally disrupted since they are based on the same components (intrinsic credit quality or internal factors, environmental support or external factors), factors (qualitative, quantitative) and information (public, private). Second, they underwent modest but remarkable changes between the periods before and after the subprime crisis (Packer & Tarashev, 2011) which allowed for a more explicit examination of environmental support and improved coherence between the three CRAs. Finally, the revealed methodologies have become more transparent, but more complex. But this work was limited to describing the evolution over time and space of the methodologies revealed before and after the Asian and the subprime crisis without a thorough econometric study to detect the methodologies practiced.

A theoretical study followed by empirical validation was conducted by Damak (2018). The author attempted to adopt the famous CAMELS (Note 1) model by proposing an adjusted 'S' to the BCRR and using simple indicators based on quantifiable information available to the public from their financial statements. This adjusted model explicitly incorporates the two components of the BCRR: the intrinsic quality of the credit that generates the 'Stand-alone' ratings and the environmental support that generates the 'Support' ratings. And these two components combined give the 'all-in' ratings on the universal scale of long-term ratings. The work empirically validated the adjusted model but did not address the comparison over time.

In light of this finding, assuming that the BCRR are consistent with the micro and macro-economic theoretical foundations and that the CAMEL'S model with a proposed 'S' well explains the 'all-in' ratings, we try, in the context of

this study, to answer the following question: Is there a difference between the BCRR process before and after the subprime crisis?

Our objective of this work is to complete the perspective of changes in the time of the BCRR criteria through the study of methodologies practiced by comparing the rating processes before and after this crisis. Our contribution lies in the use of the CAMEL'S model with an adjusted 'S' for BCRR. Previous research on time comparison was limited to the use of certain variables without referring to a 'tailor-made' model. Through this BCRR-adapted model, we will conduct an empirical study to detect any structural changes in the influence of components, factors or variables on grades to assess the extent to which revisions to methodologies practiced have led to changes in the BCRR process.

Using the ratings of S&P's, the agency that made the most significant changes to its revealed methodology, the results showed evidence at two levels. On the one hand, the changes in the 2012 ratings are mainly the result of revisions to the entire rating process, including the weight of the components, important factors and relevant variables to take into account some of the lessons learned from this global crisis. On the other hand, there is a coherence between the methodologies revealed and those practiced by the BCRR which could strengthen the restoration of the confidence of the capital market players in the CRAs.

The rest of this paper is structured as a follow-up: in the second section, we will present a selection of theoretical and empirical studies on the time comparison of BCRR. In the third section, we will present the conceptual framework and our research hypotheses. In the fourth section, we will outline the methodological aspects necessary to test the validity and robustness of our hypotheses. In the fifth section, we will analyze the results of the comparison over time. And in the sixth section, we will finish this work with a conclusion.

2. The Literature Review

Table 1. Selected studies on the comparison of BCRR before/after crisis

Authors/ year	Subject/Sample/Period/Methods of analysis	Main results
Packer & Tarashev (2011)	Comparison of the revealed methodologies of the BCRR of S&P's, Moody's and FitchRatings using the ratings of 70 major banks in 10 countries for the period between mid-2007 and April 2011.	<ul style="list-style-type: none"> The authors find with the onset of the crisis, the CRAs undertake revisions to their rating criteria and models to consider some of the lessons learned from this crisis.
Van Laere et al. (2012)	Analyze what specific dynamics contribute to the split of bank 'all-in' ratings by Moody's and S&P's from 2000 to 2011 of more than 505 rated banks in 40 countries using heteroscedastic-ordered probit (stepwise forward-backward).	<ul style="list-style-type: none"> The two rating agencies changed their models in response to the crisis. S&P's has implemented stricter bank rating standards than Moody's.
Salvador et al. (2014)	Study the impact of the subprime crisis on 'all-in' and 'stand-alone' ratings by Moody's and FitchRatings and 'all-in' of S&P's from 2000 to 2009 of 44 Spanish banks (2379 quarterly observations) using ordered-probit with variable effect variable.	<ul style="list-style-type: none"> With the crisis, rating agencies have changed their criteria. On average, the observed reduction in the ratings of Spanish banks is explained in large majority by worsening of bank solvency, but also by the hardening of the evaluation criteria adopted by the agencies.
D'Apice et al. (2016)	Investigation of the relationship between a bank's rating and its business model with 'all-in' rating of S&P's, Moody's and FitchRatings of 241 listed banks from 39 countries from 2006 to 2009 using a traditional business index as a proxy business model.	<ul style="list-style-type: none"> The relationship between a bank's rating and its business model changed through the crisis. Banks with higher values of the business index had similar ratings to other banks until 2007 and better rating performance through 2008–09.
Damak	Comparison of the revealed methodologies of	<ul style="list-style-type: none"> After the subprime crisis, the CRAs have

& Chichti (2017)	the BCRR of S&P's, Moody's and FitchRatings before the Asian crisis, between the two financial crisis and after the sub-prime crisis.	undertaken restructuring and refinement in BCRR revealed methodologies and S&P's proposed the most important revision.
Salvador et al. (2018)	Analysis of the adjustment of the 'all-in' ratings of S&P's, Moody's and FitchRatings of 475 banks from 24 countries (USA, Japan and 22 European countries) during the period of 2004 to 2013 using a specific methodology.	<ul style="list-style-type: none"> • With the crisis, there was a generalized fall in BCRR. Theirs falls in the USA and European countries due to a hardening of rating policies are the highest for Fitch and the lowest for Moody's and those due to the worsening of the bank asset situation are the highest for Moody's and the lowest for S&P's.
Chodnicka- Jaworska (2018)	Analysis of S&P's, Moody's and FitchRatings behaviors over time with the 'all-in' ratings during the prosperity and economic downturns by taking account the financial indicators with quarterly reports from 1998–2016 for 643 banks from 44 European countries by using of panel-ordered probit models.	<ul style="list-style-type: none"> • At the time of the crisis, the rating assigned by FitchRatings and Moody's for banks is lower than during the prosperity of the banking sector. Moreover, S&P's ratings are insensitive to the analyzed changes.
Salvador et al. (2020)	Analyze the bank rating migrations before and since the onset of the financial crisis in Europe and the United States from 2000 to 2016 with taking into account the 'all-in' ratings of S&P's, Moody's and FitchRatings of 1,441 banks using the granger causality test, based on an ordered probit model.	<ul style="list-style-type: none"> • Since the onset of the global financial crisis, the interdependence between the downgrades and upgrades issued by pairs of agencies increased significantly. The agencies adopted more conservative behavior. Indeed, they are more likely to conduct subsequent downgrades than upgrades.

Source: This table is the author's construction.

The scientific literature that we are going to present focuses on the comparison over time of the BCRR methodologies. The period considered is mainly before and after the subprime crisis (Packer & Tarashev, 2011; Van Laere, Vantieghe, & Baesens, 2012; Salvador, Pastor, & De Guevara, 2014; D'Apice, Ferri, & Lacitignola, 2016; Salvador, De Guevara, & Pastor, 2018). Damak & Chichti (2017) did a comparison before the Asian crisis, between the two financial crises and after the subprime crisis. The investigation of those researches showed that the comparison over time was made from two points of view. On the one hand, the comparison related to the revealed methodologies based on the specific publications of the three most world-renowned agencies (Packer & Tarashev, 2011; Damak & Chichti, 2017) show that they have not been fundamentally changed. But they have had evolutionary structures from one period to another that have allowed the consideration of environmental support in a more explicit way. They have become refined and better formalized in such a way that they reduce the share of subjectivity in the awarding of the grade. These studies were made without an in-depth econometric study.

And in the other hand, the comparison over time based on econometric studies related to the determinants of their practiced methodologies, to the investigation of the relationship between a bank's rating and its business model and/or to the analyze of 'all-in' rating adjustments and migrations and of the CRAs behaviors (Van Laere et al., 2012; Salvador et al., 2014, 2018, 2020; D'Apice et al., 2016; Chodnicka-Jaworska, 2018). They show a structural change in the rating models and behaviors and/or that the rating decline might have been caused partially by the worsening asset position and partially by the tightening of rating policies.

But none of these works addressed the issue of the evolution of the process of BCRR at the time before and after the 2007-09 financial crisis by referring to a famous model revisited to take into account the peculiarities of the BCRR. Table 1 summarizes a selection of these works with their main results.

3. Conceptual Framework and Research Hypothesis

3.1 Camels Model With a Proposed 'S' for the BCRR

The comparison over time of the BCRR's revealed methodologies (Damak & Chichti, 2017) shows that they are based on the same components, factors and information. Then we will use, for both periods, the famous CAMELS model. This model is generally accepted in its composite and component form as, expressed by Derviz and Podpiera in 2008, an important monitoring instrument and research topic for those interested in the behavior of banks for academic or applied purposes. But to achieve our goal, we chose an adaptation of this model to the BCRR that explains and reconstructs well the 'all-in' ratings proposed by Damak (2018). It consists of using the CAMELS model with BCRR specific 'S' with simple indicators drawn from publicly available quantifiable information. This 'tailor-made' model considers the two components of the BCRR: intrinsic credit quality as measured by the first five factors and environmental support as measured by the last 'S' factor which encompasses four variables.

Rating 'all-in' = f (component 1, component 2) = f (Intrinsic credit quality, Environment supports)

Rating 'all-in' = f (CAMEL, Supports) = f (CAMEL'S) =

f (Capital, Assets, Management, Earnings, Liquidity, Supports) =

f (Capital, Assets, Management, Earnings, Liquidity, Sovereign rating, Size, Origin of capital, Activity of the bank)

3.2 Hypotheses of Research

The IMF report (2010) supported by the statements of the CRAs (S&P's, 2011b; FitchRatings, 2011; Moody's, 2012) indicate that they have undertaken an update of their rating criteria and models and a review of the ratings issued. These revisions led to adjustments to the ratings of banks around the world in 2012, taking into account the new criteria. The studies analysing the specific documents published by the three main CRAs confirm their revisions of the revealed methodologies that have led to downgrades in the ratings of financial institutions, particularly European and American.

Packer and Tarashev (2011) also point out that CRAs have increased the transparency of BCRR, in particular the role of formal support, and have placed greater emphasis on the external support that banks receive from economic authorities. In addition, Damak and Chichti (2017) showed that after this crisis, S&P's is the agency that proposed the most important revisions and adjustments to its revealed methodology. And with the restructuring and refinement done, Moody's and FitchRatings stepped in to adjust the importance of assessing environmental support and some analytical elements. These results are largely consistent with the conclusions of empirical studies (Van Laere et al., 2012; D'Apice et al., 2016; Salvador et al., 2014, 2018). Van Laere et al. (2012) in addressing the evolution of BCRR determinants induced by the revision of the methodology showed that Moody's and S&P's had changed their rating model in response to the 2007-09 crisis. Salvador et al. (2014, 2018) also found that as a result of these revisions, CRAs have had a structural change in the influence that each component or factor has on ratings and consequently a change in the determinants of BCRR and point out that this influence does not occur equally across all agencies. All those results suggest the following main hypothesis:

MH: The 'all-in' rating process has changed following the revision of the methodology in response to the 2007-09 financial crises.

To test our main hypothesis, we are looking for any structural change in the influence that components or factors or variables have on the ratings with the using CAMELS model with 'S' adjusted to BCRR. To become more pragmatic, our main hypothesis can be broken down into three sub-hypotheses and his confirmation needs the cumulated confirmations of the three.

SH1: The component weights in the allocation of 'all-in' ratings has changed between 2002 and 2012.

SH2: The important factors in the allocation of 'all-in' ratings have changed between 2002 and 2012.

SH3: The relevant variables to the allocation of 'all-in' ratings changed between 2002 and 2012.

4. Methodological Aspects

4.1 The Explanatory Variables

The explanatory variables selected to represent each factor are presented in Table 2. They are extract from the work of Damak (2018): 10 variables of the CAMEL model for 'intrinsic credit quality' component and 4 variables for 'environmental support' component. All variables of CAMEL factors are three-year averages that precede the rating year (Note 2). This approach, called 'Through-The-Cycle' (as opposed to the 'Point-In-Time'), neutralizes the impact of the business cycle on ratings, in order to obtain indicators less dependent on the characteristics of the business

issuers' financial statements (Amato & Furfine, 2004; Godlewski, 2004; Alejandro & Analia, 2008). The source of our data is the 'S&P Capital IQ' database in 2012 (Note 3).

4.2 The Variables to Explain

Given that previous studies have shown that S&P's is the agency that has carried out the most important revisions to its revealed methodology, we will conduct our empirical comparative study using S&P's 'all-in' ratings collected from its website. To capture all the information on the 'all-in' rating process of each period, we chose to conduct the study on rating grades and classes by making numerical conversions (see Table 2).

4.3 The Control Variable

We will introduce the variable "rating year 'RY'" as a control variable in regressions that consider the both periods at the same time (see Table 2).

4.4 Sample Characteristics

We will conduct our comparison over time on the 89 banks rated simultaneously in 2002 and 2012 from 27 countries of Europe, Middle East and North Africa (EMENA) (see Table 3). We chose the 2002 ratings to be quite far from the beginning of the relaxation of the ratings detected by Gray, Mirkovic, & Ragunathan (2006) and Cheng and Neamtiu (2009) and those of July 2012 (the date of the end of the revision of all notes) to take into account all changes made during the revision of the methodology by agencies in response to the 2007-09 financial crisis. Indeed, the years surrounding 2007-09 are characterized by turbulence in the financial environment worldwide. Depr̄s (2011) pointed out that after relaxing their criteria in the year leading up to the crisis, the CRAs tightened it, which led to a general decline in ratings and a worsening of the economic situation following a significant tightening in the conditions of access to capital markets. Other studies that have analyzed the influence of the economic cycle on the behavior of ratings, including Amato and Furfine (2004) and Van Laere and Baesens (2011), have found that agencies are procyclical, characterized by a relaxation of rating criteria during periods of economic expansion and a tightening of these criteria during recession.

4.5 Analytical Methods

After univariate (Note 4) and bivariate (Note 5) descriptive analyses, we will use "ordered logit 'OLOGIT'" regression (Scott & Freese, 2006) for the numerical value of the rating classes (decreasing scale of 5 to 1). In order to capture as many relevant variables as possible, we will complete our analysis with a multiple linear regression (according to the method of the ordinary least squares 'OLS') of the numerical value of the rating grades (decreasing scale of 17 to 1) (Note 6).

To test the validity of our hypotheses, we will do this in three steps. In the first one, we will, run the regressions of the following three equations from (1) to (3) for the two periods with the rating year 'RY' control variable and for each period alone.

$$\text{Rating 'all-in'}_{it} = f(\text{CAMEL'S}) = f(A_{it-1} + B_{it}) + \varepsilon_{1it} \quad (1)$$

$$\text{Rating 'all-in'}_{it} = f(\text{CAMEL}) = f(A_{it-1}) + \varepsilon_{2it} \quad (2)$$

$$\text{Rating 'all-in'}_{it} = f(\text{Supports}) = f(B_{it}) + \varepsilon_{3it} \quad (3)$$

Where, Rating 'all-in' $_{it}$ is the vector of 'all-in' rating class or grade of the bank i in the period t ($t=2002$ or/and 2012).

A_{it-1} is the matrix of 10 quantifiable variables (see Table 2) for the assessment of the intrinsic credit quality of the bank i . They are three-year averages preceding the period t ($t=2002$ or/and 2012).

B_{it} is the matrix of 4 quantifiable variables (see Table 2) for the evaluation of the environment supports of the bank i in the period t ($t=2002$ or/and 2012).

ε_{pit} are the vectors of the residues of the p^{th} equation ($p=1,2,3$). The error term represents the part of the specification error and captures all of the private information that are formed by the confidential information held by CRAs about the bank i in the period t ($t=2002$ or/and 2012) and the interpretation of the expert group in charge of the folder.

In the second step, we will compare the signification thresholds of the RY coefficients and the explanatory powers of OLS and OLOGIT regressions of the 'all-in' rating equations (from 1 to 3) of 2002 versus 2012.

In the third and last step, we will compare the important factors, the relevant variables and signification thresholds of some coefficients in 'all-in' rating regressions of 2002 versus 2012.

The explanatory powers of the OLS and OLOGIT regressions are measured respectively by 'adjusted R2' and 'Pseudo R2'. The explanatory powers of the equation (1) regressions provide information on the quality of the CAMELS

model with adjusted 'S' specification. High explanatory power indicates good specification. The weight of component 1 in the attribution of the 'all-in' rating can be measured by the importance of the explanatory powers of the equation (2) regressions and the difference between the explanatory powers of the regressions of equations (1) and (3). And that of component 2 can be measured by the importance of the explanatory powers of the equation (3) regressions and the difference between the explanatory powers of the regressions of equations (1) and (2). A factor is qualified as important when at least one of the variables that measure it is relevant. A variable is qualified as relevant when its regression coefficient is significant at the thresholds of 1% or 5% or 10% or 15%.

For each regression, we will proceed to diagnose the multi-collinearity with the «Variance Inflation Factor 'VIF'» (Note 7) and diagnose the model stability with «Bootstrap Inclusion Fractions 'BIF'» (Note 8) advocated by Nunez E., Steyerberg & Nunez J. (2011). For diagnosing of heteroskedasticity in 'all-in' rating regressions measured by grades, we use the «Breusch-Pagan» test (Note 9).

Given that the number of observations in our sample is not important for taking a sub-sample, we will test the robustness of our hypotheses by using the bootstrapping approach (Royston & Sauerbrei, 2009) with 1000 replications for regressions of the equations (from 1 to 3).

Table 2. Variable definitions

<i>Components 'A-B'/'CAMEL, Supports' FACTORS/ Ratios and definitions</i>			
EXPLANATORY VARIABLES			
A - The quantifiable explanatory variables in the intrinsic credit quality (CAMEL)			
		Expected sign	Expected sign
<i>CAPITAL (C)</i>			<i>EARNINGS (E)</i>
CPAO/TAA = Common shareholders equity % Total adjusted assets	+		ROA = Net income % Total adjusted assets
RTier1 = Tier 1 capital ratio	+		ROE = Net income % Equity ordinary tangible means
<i>ASSETS (A)</i>			<i>LIQUIDITY (L)</i>
CON/PMC = Net 'charge offs' % Average customer loans	+		TPN/TAA = Total Net loans % Total adjusted assets
ANP/EC = Non-performing assets % Total credits	-		TD/TAA = Total deposits % Total adjusted assets
MANAGEMENT (M)			
CE/TAA= Operating expenses % Total adjusted assets	-		
PHI/PNB = Operating non-interest income % Operating income	+		
B - The quantifiable explanatory variables in the environment support (Supports)			
		Expected sign	Expected sign
RS SP = sovereign rating of the country of establishment of the bank on the date of rating of S&P's.	+		OC = Dummy variable for public banks or semi 1 and 0 for private banks
LnTAA = Total adjusted assets from last 12-31 preceding the year of rating (natural Log).	+		ACT = Dummy variable 1 for universal banks or having three activities and more, and 0 elsewhere

CONTROL VARIABLE

	Expected sign
RY= Dummy variable for Rating Year : 0 for 2002 and 1 for 2012	-

VARIABLES TO EXPLAIN

	Correspondence between the LT 'all-in' rating scale and the numerical values assigned to each grade and class of rating
VNGSP= Numeric value of 'all-in' rating grade of S&P's in July 2002 and/or 2012.	Investment Grade: AAA=17, AA+=16, AA=15, ..., BBB+=10, BBB=9, BBB-=8; Speculative Grade: BB+=7, BB=6, BB-=5, B+=4, B=3, B-=2 and CCC/CC/C=1
VNCSP1-5= Numeric value of 'all-in' rating class of S&P's in July 2002 and/or 2012.	Investment Grade Classes: AAA/AA=5, A=4, BBB=3; Speculative Grade Classes: BB=2 and B/CCC/CC/C=1

Source: This variable definition table is extract from Damak (2018) after a small adjustment by the author of the variables to explain and of control to adapt it to the needs of the study.

Table 3. S&P's sovereign ratings and number of banks by country

Country	Sovereign rating		N° of Banks rated simult. in 2002-2012	Country	Sovereign rating		N° of Banks rated simult. in 2002-2012
	2002	2012			2002	2012	
1 Austria	AAA	AA+	1	15 Sweden	AA+	AAA	4
2 Belgium	AA+	AA	2	16 G-Britain	AAA	AAA	3
3 Denmark	AAA	AAA	2	17 Croatia	BBB-	BBB-	1
4 France	AAA	AA	7	18 R-Czech	A-	AA-	2
5 Germany	AAA	AAA	5	19 Hungary	A-	BB+	3
6 Greece	A	CCC/CC/C	3	20 Poland	BBB+	A-	4
7 Ireland	AAA	BBB+	3	21 Russia	B/B+/BB-/BB	BBB	2
8 Italy	AA	BBB+	10	22 Slovakia	BBB-	A	1
9 Liechtenst.	AAA	AAA	1	23 Turkey	B-	BB	4
10 Luxemb.	AAA	AAA	1	24 Egypt	BB+	B	2
11 Netherl.	AAA	AAA	9	15 Lebanon	B-	B	1
12 Portugal	AA	BB	1	26 Morocco	BB	BBB-	1
13 Spain	AA+	BBB+	2	27 Tunisia	BBB	BB	4
14 Switzerl.	AAA	AAA	10	N° of banks			89

Source: This table is the author's construction from the collected data.

5. Analysis of Results

5.1 Univariate and Bivariate Descriptive Analyses

The sample distributions of 89 banks rated simultaneously in 2002 and 2012 distinguishing the five classes of the 'all-in' rating and the year of rating are presented in Table 4. We see an upward adjustment in the frequencies of the 'all-in' ratings (to the lower category). Of the 89 banks rated simultaneously in the two periods, 7.89% (79.77-71.91) saw their ratings moved from the investment category to speculative. The frequencies of the highest AAA/AA rating classes alone had the frequencies of the AAA/AA rating classes alone had decreases of 13.48% (32.58-19.10). For the BBB and BB classes, they increased from respectively 14.61% and 12.36% in 2002 to 20.22% in 2012. With these decreases in 'all-in' ratings, we also observe the maintenance of the same frequencies for classes B/CCC/CC/C (7.87%) which may be a first indication that S&P's has made a revision and not a tightening of the BCRR methodology.

Table 4. Descriptive statistics by class and rating year

Year of rating	2002					2012				
Category of rating	Investment		Speculative			Investment		Speculative		
S&P's class of rating	AAA/AA	A	BBB	BB	B/CCC/CC/C	AAA/AA	A	BBB	BB	B/CCC/CC/C
Numerical value assigned	5	4	3	2	1	5	4	3	2	1
Sample distributions (89 banks (observations) rated simultaneously in 2002 and 2012)										
Frequency	29	29	13	11	7	17	29	18	18	7
Frequency in %	32,58	32,58	14,61	12,36	7,87	19,10	32,58	20,22	20,22	7,87
Frequency cumulative in %	32,58	65,16	79,77	92,13	100,00	19,10	51,68	71,91	92,12	100,00
Frequency by category of rating in %	79,77		20,23			71,91		28,09		

Source: Author' calculation.

The descriptive statistics for the set of continuous and dummy variables (defined in Table 2) for the same sample show that as expected and in both periods, the decrease in RSSP is perfectly consistent with lower rating classes (qualified as bad risk). Also, the decrease in RN/CPOTM (from 15.34 to -7.24) in 2002 and the increase in ANP/EC (from 1.27 to 11.06) and TD/TAA (from 53.06 to 84.18) in 2012 lead to bad risk rating classes. The influence of the other variables on the 'all-in' rating is not clear. The comparisons of the averages of the variables to explain shows that the 'all-in' rating averages (grades and classes) for this sample of 89 banks are respectively A- and A in 2002 and BBB+ and BBB in 2012 (the corresponding grade and class numerical values by year are respectively 11 and 3,70 for 2002 and 10 and 3,35 for 2012). This shows reductions in average ratings of S&P's between the two periods. Theirs student tests are significant at the 1% threshold.

Observed with greater accuracy, the transition matrix presented in Table 5 shows an adjustment of the top-down ratings with a high probability of being located in the lower classes. Of the 89 banks, 39 experienced a reduction in the rating (above the main diagonal). The remaining 50/89 banks have had their ratings increased or maintained. The increases affected 18 banks, 2 of which saw their ratings increase by 2 classes (from BB to A). It is further an indication that the methodology has been revised, not just a tightening of BCRR criteria or a deterioration of solvency caused by the 2007-09 crisis.

Table 5. 'All-in' rating class transition matrix

	<i>t=2012</i>	<i>AAA/AA</i>	<i>A</i>	<i>BBB</i>	<i>BB</i>	<i>B/CCC/CC/C</i>	
<i>t-1=2002</i>	<i>VNC</i>	5	4	3	2	1	
<i>AAA/AA</i>	5	11	13	3	2	0	29
<i>A</i>	4	6	11	9	3	0	29
<i>BBB</i>	3	0	3	4	3	3	13
<i>BB</i>	2	0	2	1	5	3	11
<i>B/CCC/CC/C</i>	1	0	0	1	5	1	7
		17	29	18	18	7	89

Source: Author's construction

In summary, the results of the preliminary analysis show that with the revision of the BCRR methodology in response to the 2007-09 financial crisis, there has been an adjustment in the 'all-in' ratings of S&P's, whose meaning, size and intensity differ from one bank to another.

5.2 Multivariate Analysis

The results of the regressions of the equations from (1) to (3) by OLS and OLOGIT with the sample of 89 banks rated simultaneously in 2002 and 2012 by the 'all-in' ratings of S&P's for both measures (grades and classes) are presented in tables from 6 to 8 and summarizes in Table 9. The regressions of the three equations with the control variable "Rating Year 'RY'" as a dummy variable (0 for 2002 ratings and 1 for 2012 ratings) and samples from both periods (89x2=178 observations) with the grades (column 1) then with the classes (column 2) in tables from 6 to 8 show three results. Firstly, the coefficients with the negative signs of this variable are significant (at the thresholds respectively 10% and 1%) in the two regressions of the equations (1) and (2) but not significant in the equation (3). This result confirms once again the downward trend in the ratings between 2002 and 2012.

Secondly, the high meaning thresholds of the RY coefficients in the regressions of the equation (2) can provide information on the remarkable decrease in the weight of the first component 'Intrinsic credit quality' represented by CAMEL factors. This change is also manifested, on one hand, by the decreases in the explanatory powers of the regressions of the equation (2) measured by adjusted R2 or Pseudo R2 (respectively from 66.42% and 35.30% in 2002 to 44.85% and 24.37% in 2012). On the other hand, it appears in the negative variations of regression explanatory powers of equations (1) versus (3) (Table 9, columns 3&6) for 2002 and 2012 (for grade regressions -0.0158 and for class regressions -0.0085).

Thirdly, the absence of signification of the RY variable coefficients in the regressions of the equation (3) may inform the lack of a remarkable change in the weight of the second component 'Environment supports' represented by the 'S' factor. It is coherent with the shy decreases in the explanatory powers of the regressions of the equation (3) measured by adjusted R2 or Pseudo R2 (respectively from 85.59% and 59.55% in 2002 to 80.39% and 51.28% in 2012). But the differences of regression explanatory powers of equations (1) versus (2) for 2002 and 2012 (Table 9, columns 3&6) show a positive variation (for grade regressions +0.1479 and for class regressions +0.0181). They inform us about the increase of the second component weight to the detriment to the first component in the allocation of 'all-in' ratings in 2012. This is coherent with the evolution of S&P's revealed methodology investigated by Damak & Chichti (2017). These results are sufficient to confirm the first SH1 sub-hypothesis which states that "The component weights in the allocation of 'all-in' ratings have changed between 2002 and 2012."

The equation (1) regressions (Table 6) made with the 'all-in' ratings of S&P's in 2002 (columns 3 and 4) and 2012 (columns 5 and 6) suggest that the factors of the relevant variables are not, quite, the same in both periods. With regression explanatory powers measured by adjusted R2 or Pseudo R2 exceeding 81.59% and 57.24% respectively, and in general, coefficients estimated with the expected signs, the factors: Management and Supports are important in all the regressions of the two periods. The factors: capital adequacy and profitability are important in at least one regression in both periods. Asset quality is important only in the 2002 regressions. The Liquidity factor does not appear to be important in the allocation of the rating for both periods with this sample. So, the spectrum of important factors in the regressions in the 'all-in' rating of S&P's en 2002 is wider than those of 2012. This indicates a change in the rating process.

Specifically, in 2002, S&P's classed the banks on the basis of *Asset quality* (measured by CON/PMC) and *quality of Management* (measured by CE/TAA) in addition to the factor *Supports* (measured by RSSP, LnTAA and OC). And to specify the grade in the class, it is also based on other CAMEL elements : *Capital* (measured by CPAO/TAA and RTier1) and *Profitability* (measured by ROA). And for 2012, S&P's classes the banks based on *Management quality* (measured by CE/TAA) and factor *Supports* (measured by RSSP and OC). And to specify the grade in the class, it is also based on *Profitability* (measured by ROA) and the *Support* variable 'bank size' (measured by LnTAA).

Table 6. The results of equation (1) estimates

Rating Year	2002-2012		2002		2012	
Regression	OLS	OLOGIT	OLS	OLOGIT	OLS	OLOGIT
Variable to explain	VNGSP	VNCSP15	VNGSP	VNCSP15	VNGSP	VNCSP15
Column	1	2	3	4	5	6
	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)
Constant	-1.9036 (0.245)		0.2934 (0.889)		-2.7066 (0.350)	
A-Intrinsic credit quality (CAMEL)						
Capital						
CPAO/TAA	0.0023 (0.940)	0.0200 (0.713)	-0.0761** (0.085)	-0.0702 (0.446)	0.0999* (0.150)	0.1467* (0.123)
RTier1	0.0291** (0.064)	0.0182 (0.470)	0.0294** (0.076)	0.0462 (0.365)	0.0035 (0.929)	-0.0150 (0.776)
Assets						
CON/PMC	0.2469 (0.178)	0.3977 (0.168)	0.3868** (0.068)	1.0127*** (0.033)	0.1227 (0.728)	0.1303 (0.779)
ANP/EC	-0.0359** (0.092)	-0.0353 (0.262)	-0.0362* (0.113)	-0.0498 (0.271)	-0.0481 (0.304)	-0.0768 (0.247)
Management						
CE/TAA	-0.1354*** (0.028)	-0.2542*** (0.016)	-0.2036**** (0.010)	-0.4309*** (0.032)	-0.2256* (0.116)	-0.3584** (0.065)
PHI/PNB	0.0028 (0.406)	0.0046 (0.347)	-0.0074 (0.359)	-0.0042 (0.856)	0.0045 (0.266)	0.0057 (0.286)
Earnings						
ROA	0.4489**** (0.004)	0.6690*** (0.018)	0.8417**** (0.001)	0.8040* (0.131)	0.4094* (0.120)	0.6395 (0.157)
ROE	0.0003 (0.243)	0.0007 (0.244)	-0.0201* (0.106)	-0.0020 (0.939)	0.0003 (0.338)	0.0007 (0.339)
Liquidity						
TPN/TAA	-0.0002 (0.981)	-0.0043 (0.645)	-0.0070 (0.459)	-0.0264 (0.190)	0.0036 (0.753)	0.0060 (0.678)
TD/TAA	0.0061	0.0046	-0.0047	-0.0127	0.0104	0.0064

	(0.370)	(0.644)	(0.617)	(0.494)	(0.374)	(0.685)
B-Environment Supports ('S')						
<i>RS SP</i>	0.6917****	1.0909****	0.6492****	1.5219****	0.6953****	0.9931****
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>LnTAA</i>	0.2905****	0.3711***	0.3602****	0.5884***	0.2772*	0.2480
	(0.004)	(0.015)	(0.005)	(0.026)	(0.118)	(0.278)
<i>OC</i>	1.5367****	1.4361****	1.6802****	1.5004***	1.2087****	0.9154*
	(0.000)	(0.001)	(0.000)	(0.046)	(0.006)	(0.119)
<i>ACT</i>	-0.1831	-0.0964	-0.1858	-0.7222	-0.2636	0.1905
	(0.474)	(0.798)	(0.586)	(0.237)	(0.545)	(0.736)
Control variable						
<i>RY</i>	-0.5801**	-0.8575**				
	(0.068)	(0.066)				
N ° of observation	178	178	89	89	89	89
<i>Diagnostics of the explanatory power</i>						
R2	0.8649		0.9022		0.8452	
R2 Adj	0.8523		0.8837		0.8159	
Prob> chi2		0.0000		0.0000		0.0000
Pseudo R2		0.5844		0.6636		0.5724
<i>Diagnostics of multi-collinearity¹</i>						
VIF Moyen	1.65	1.65	2.25	2.25	1.76	1.76
VIF Max	2.43	2.43	4.61	4.61	2.60	2.60
<i>Diagnostics of model stability²</i>						
% BIF min (Vi) 1000 rép.	45.30% (AN)	46.30% (AN)	34.20% (ANP/EC)	34.20% (ROA)	31.80% (CPAO/TAA)	38.60% (CPAO/TAA)
% BIF max (Vi) 1000 rép.	100.00% (RSSP)	100.00% (RSSP)	100.00% (RSSP)	100.00% (RSSP)	100.00% (RSSP)	100.00% (RSSP)
<i>Diagnostics of heteroskedasticity³</i>						
Breusch-Pagan						
chi2(1)	4.48		0.72		7.26	
Prob > chi2	0.0343		0.3974		0.0071	
**** Significance at 1%, *** Significance at 5%, ** Significance at 10%, * Significance at 15%						

Source: Author' calculation

Notes: 1-By calculating the Variance Inflation Factor (VIF). 2-By using the "Bootstrap Inclusion Fractions 'BIF'" test with 1000 replications. The model is even more stable that the BIF minimum is high. The % BIF min. (Vi) 1000 rep. is the percentage of minimum 'BIF' of the significant variable (vi) with 1000 replications. The % BIF max (Vi) 1000 rep. is the percentage of maximum 'BIF' of the significant variable (vi) with 1000 replications. 3- High Chi2 and low "p-value" indicate the presence of heteroskedasticity.

Variable definitions. See Table 2.

Table 7. The results of equation (2) estimates

Rating Year	2002-2012		2002		2012	
Regression	OLS	OLOGIT	OLS	OLOGIT	OLS	OLOGIT
Variable explain	to VNGSP	VNCSP15	VNGSP	VNCSP15	VNGSP	VNCSP15
Column	1	2	3	4	5	6
	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)	Coef. (P-values)
Constant	16.6310**** (0.000)		18.5048**** (0.000)		14.0364**** (0.000)	
A-Intrinsic credit quality (CAMEL)						
Capital						
<i>CPAO/TAA</i>	-0.1727**** (0.001)	-0.1186**** (0.008)	-0.3325**** (0.000)	-0.2753**** (0.000)	0.0921 (0.416)	0.1047 (0.166)
<i>RTier1</i>	0.0427* (0.117)	0.0447* (0.112)	0.0243 (0.378)	0.0286 (0.404)	0.0472 (0.479)	0.0001 (0.998)
Assets						
<i>CON/PMC</i>	0.5272** (0.096)	0.3523** (0.069)	0.5164* (0.139)	0.4165** (0.095)	0.5649 (0.337)	0.1926 (0.610)
<i>ANP/EC</i>	-0.1477**** (0.000)	-0.0960**** (0.000)	-0.1060**** (0.004)	-0.0749**** (0.016)	-0.2433**** (0.002)	-0.2254**** (0.000)
Management						
<i>CE/TAA</i>	-0.6307**** (0.000)	-0.4610**** (0.000)	-0.6354**** (0.000)	-0.5347**** (0.000)	-0.8367**** (0.000)	-0.6350**** (0.000)
<i>PHI/PNB</i>	0.0146*** (0.012)	0.0092*** (0.027)	0.0140 (0.295)	0.0153 (0.294)	0.0126** (0.073)	0.0080** (0.088)
Earnings						
<i>ROA</i>	0.9869**** (0.000)	0.6661**** (0.002)	1.8056**** (0.001)	1.3515**** (0.001)	0.6047 (0.167)	0.2370 (0.427)
<i>ROE</i>	-0.0004 (0.347)	-0.0003 (0.569)	-0.0291 (0.160)	-0.0164 (0.395)	-0.0004 (0.459)	-0.0005 (0.450)
Liquidity						
<i>TPN/TAA</i>	0.0159* (0.148)	0.0113 (0.157)	0.0141 (0.333)	0.0051 (0.719)	0.0248 (0.173)	0.0164* (0.141)
<i>TD/TAA</i>	-0.0372**** (0.000)	-0.0247**** (0.003)	-0.0515**** (0.000)	-0.0466**** (0.001)	-0.0463**** (0.012)	-0.0258**** (0.037)
Control variable						
<i>RY</i>	-2.2536**** (0.000)	-1.7683**** (0.000)				
N° of observation	178	178	89	89	89	89
<i>Diagnostics of the explanatory power</i>						
R2	0.5653		0.7024		0.5112	
R2 Adj	0.5365		0.6642		0.4485	

Prob> chi2	0.0000		0.0000		0.0000	
Pseudo R2	0.2573		0.3530		0.2437	
<i>Diagnostics of multi-colinearity¹</i>						
VIF Moyen	1.43	1.43	1.90	1.90	1.57	1.57
VIF Max	2.13	2.13	3.70	3.70	2.31	2.31
<i>Diagnostics of model stability²</i>						
% BIF min (Vi) 1000 rép.	36.00% (TPN/TAA)	46.10% (RTier1)	26.40% (CON/PMC)	29.30% (CON/PMC)	55.70% (PHI/PNB)	40.60% (TPN/TAA)
% BIF max (Vi) 1000 rép.	100.00% (CE/TAA)	100.00% (CE/TAA)	99.90% (CE/TAA)	99.70% (CE/TAA)	95.20% (CE/TAA)	96.40% (CE/TAA)
<i>Diagnostics of heteroskedasticity³</i>						
Breusch-Pagan						
chi2(1)	1.37		0.30		0.01	
Prob > chi2	0.2418		0.5867		0.9381	

**** Significance at 1%, *** Significance at 5%, ** Significance at 10%, * Significance at 15%

Source: Author' calculation.

Notes. 1-By calculating the Variance Inflation Factor (VIF). 2-By using the "Bootstrap Inclusion Fractions 'BIF'" test with 1000 replications. The model is even more stable that the BIF minimum is high. The % BIF min. (Vi) 1000 rep. is the percentage of minimum 'BIF' of the significant variable (Vi) with 1000 replications. The % BIF max (Vi) 1000 rep. is the percentage of maximum 'BIF' of the significant variable (Vi) with 1000 replications. 3-High Chi2 and low "p-value" indicate the presence of heteroskedasticity.

Variable definitions. See Table 2.

Table 8. The results of equation (3) estimates

Rating Year	2002-2012		2002		2012	
Regression	OLS	OLOGIT	OLS	OLOGIT	OLS	OLOGIT
Variable to explain	VNGSP	VNCSP15	VNGSP	VNCSP15	VNGSP	VNCSP15
Column	1	2	3	4	5	6
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
	(P-values)	(P-values)	(P-values)	(P-values)	(P-values)	(P-values)
Constant	-1.6755*** (0.046)		-2.8588**** (0.007)		-0.2588 (0.857)	
B- Environment Supports ('S')						
<i>RS SP</i>	0.7679**** (0.000)	1.0433**** (0.000)	0.7979**** (0.000)	1.3815**** (0.000)	0.7416**** (0.000)	0.9174**** (0.000)
<i>LnTAA</i>	0.1729** (0.051)	0.2278** (0.054)	0.2485*** (0.033)	0.4210** (0.028)	0.05526 (0.687)	0.0020 (0.990)
<i>OC</i>	1.4905**** (0.000)	1.2795**** (0.001)	1.5798**** (0.000)	1.5515**** (0.009)	1.3340**** (0.002)	1.0286*** (0.045)
<i>ACT</i>	-0.0568 (0.831)	-0.0118 (0.973)	-0.0745 (0.832)	-0.3722 (0.487)	0.0377 (0.926)	0.4018 (0.415)
Control variable						
<i>RY</i>	-0.1909	-0.2866				

	(0.486)	(0.424)				
N ° of observation	178	178	89	89	89	89
<i>Diagnosis of the explanatory power</i>						
R2	0.8373		0.8624		0.8128	
R2 Adj	0.8325		0.8559		0.8039	
Prob> chi2		0.0000		0.0000		0.0000
Pseudo R2		0.5413		0.5955		0.5128
<i>Diagnosis of multi-collinearity¹</i>						
VIF Moyen	1.18	1.18	1.19	1.19	1.15	1.15
VIF Max	1.39	1.39	1.37	1.37	1.29	1.29
<i>Diagnosis of model stability²</i>						
% BIF min (Vi) 1000 rép. (LnTAA)	48.50%	48.00%	60.80%	61.80%	89.40%	51.50%
% BIF max (Vi) 1000 rép. (RSSP)	100%	100%	100%	100%	100%	100%
<i>Diagnosis of heteroskedasticity³</i>						
Breusch-Pagan						
chi2(1)	5.67		0.46		7.43	
Prob > chi2	0.0173		0.4983		0.0064	
**** Significance at 1%, *** Significance at 5%, ** Significance at 10%, * Significance at 15%.						

Source: Author' calculation.

Notes: 1-By calculating the Variance Inflation Factor (VIF). 2-By using the "Bootstrap Inclusion Fractions 'BIF'" test with 1000 replications. The model is even more stable that the BIF minimum is high. The % BIF min. (Vi) 1000 rep. is the percentage of minimum 'BIF' of the significant variable (Vi) with 1000 replications. The % BIF max (Vi) 1000 rep. is the percentage of maximum 'BIF' of the significant variable (Vi) with 1000 replications. 3-High Chi2 and low "p-value" indicate the presence of heteroskedasticity.

Variable definitions. See Table 2.

So it appears that the change has affected both some important factors and the variables that measure them. In fact, to class the banks, S&P's is based on four factors measured by six variables in 2002 while in 2012 on three factors measured by four variables. And to specify the grade in the class, it is based on five factors measured by ten variables in 2002 while in 2012 on four factors measured by six variables. These results are sufficient to confirm the second *SH2* sub-hypothesis which states that "*The important factors in the allocation of 'all-in' ratings have changed between 2002 and 2012*". With the consolidation of several indices, the confirmation of the *SH3* sub-hypothesis became evident. Moreover, additional details on the change in the relevance of some variables have caught our attention. On the one hand, the variable *RTier1* did not appear relevant until 2002 (Table 6, columns 3&5). This result can be explained by the decrease in the relevancy of this ratio known as the "Cooke ratio" in the regulation of banks in favor of the new solvency ratio known as Basel II "McDonough ratio" in the Basel II agreements.

On the other hand, the variable 'bank size' (measured by LnTAA) in 2012 appears less or irrelevant (significant coefficient but at a threshold of 15% (Table 6, column 5) or not significant (Table 6, column 6) and (Table 8, columns 5&6)). This result can be explained by the diminishing importance of the famous "too-big-to-fail" principle of considering the limits of environmental supports following the bankruptcy of Lehman Brothers among others. These additional details in the results further consolidate the *SH3* sub-hypothesis which states that "*The relevant variables to the allocation of 'all-in' ratings changed between 2002 and 2012.*"

So it appears that the changes have affected the entire rating process, including the weight of the components, the important factors and the relevant variables. We have also detected several indications that S&P's has made a revision and not only a tightening of BCRR criteria. The deterioration of bank solvency caused by the crisis is partly a possible explanation for the decrease in the average level of ratings between 2002 and 2012 given their procyclical

character detected by some studies such as Amato and Furfine, 2004 and Salvador et al., 2018. But also, with the cumulation of the three sub-hypotheses, we cannot reject our main hypothesis *MH* which states that "The 'all-in' rating process has changed as a result of the revision of the methodology in response to the 2007-09 financial crisis."

Table 9. The regression explanatory power summary of the equations from (1) to (3)

Regression	OLS			OLOGIT		
Variable to explain	VNGSP			VNCSP15		
Explanatory power	R2 Adj			Pseudo R2		
Rating Year	2002	2012	Variation	2002	2012	Variation
Column	1	2	3	4	5	6
Equation (1)	0.8837	0.8159	-0.0678	0.6636	0.5724	-0.0912
Equation (2)	0.6642	0.4485	-0.2157	0.3530	0.2437	-0.1093
Equation (3)	0.8559	0.8039	-0.0520	0.5955	0.5128	-0.0827
Explanatory power comparaisons						
Eq. (1) – Eq. (2)	0.2195	0.3674	+0.1479	0.3106	0.3287	+0.0181
Eq. (1) – Eq. (3)	0.0278	0.0120	-0.0158	0.0681	0.0596	-0.0085

Source. Author' calculation.

Equation (1): Rating 'all-in' = f(CAMEL, Supports);

Equation (2): Rating 'all-in' = f(CAMEL);

Equation (3): Rating 'all-in'= f(Supports)= f(RS, LnTAA, OC, ACT)

5.3 Robustness Check

The bootstrapping approach results (Note 10) will be commented versus tables from 6 to 8. Given the loss of the overall meaning of nearly the whole class regressions, we will comment only grade regressions. On one hand, the control variable RY coefficients keep their same meaning thresholds in the regressions of the three equations from (1) to (3) (respectively tables from 6 to 8). On the other hand, the support variables: RSSP, LnTAA and OC for the two periods (Table 6, columns: 3&5) and the variables of Management and Profitability factors measured respectively by CE/TAA and ROA in 2002 (Table 6, column: 3) don't lose their relevancies with this approach. Those results, although based only on grade regression results, do not prevent consolidation of our sub-hypotheses and our main hypothesis.

6. Conclusion

We have been empirically studying whether the BCRR process of S&P's has changed with the 2007-09 crisis. We found evidence that the rating changes in 2012 are not only a consequence of the deterioration in bank solvency or the tightening of rating criteria. But they are mainly due to methodological revisions to the entire rating process, including the weight of components, important factors and relevant variables to reflect some of the lessons learned from this global crisis. The weight of the second 'environmental supports' component increased at the expense of the first 'intrinsic credit quality' component, which led to decreases in the importance of CAMEL factors. This explains the decrease in the spectrum of important factors in the 2012 regressions compared to those of 2002. Some variables such as the size of the bank and the Basel I solvency ratio became less and irrelevant respectively in the allocation of all-in ratings after the 2007-09 crisis. These results also show a consistency between the revealed and practiced methodologies of the S&P's BCRR that can improve the restoration of confidence of capital market players in the CRAs.

At the end of this work, we can say that although we have tried to contribute to the existing literature, this research work cannot hide the existence of certain limits. Indeed, we compared the BCRR process over time using the CAMELS model with a 'S' proposed to BCRR. And, we restricted our sample to the EMENA banks. The use of other model with sample from other region could be the subject of later study. This work can be complemented, also,

by a comparison of the BCRR process between the agencies and bank groups. But only time can confirm whether this revised methodology will be able to predict the next crisis.

References

- Alejandro, P., & Analía, R. (2008). The rating agencies' through-the-cycle methodology: an application to sovereign ratings. *MPRA Paper 10458*, University Library of Munich, Germany.
- Amato, J. D., & Furfine, C. H. (2004). Are credit ratings procyclical?. *Journal of Banking & Finance*, 28, 2641-2677. <https://doi.org/10.1016/j.jbankfin.2004.06.005>
- Bissoondoyal-Bheenick, E., & Treepongkaruna, S. (2011). An analysis of the determinants of bank ratings: comparison across ratings agencies. *Australian Journal of Management*, 36(3). <https://doi.org/10.1177/0312896211426676>
- Cheng, M., & Neamtiu, M. (2009). An empirical analysis of changes in credit rating properties: Timeliness, accuracy and volatility. *Journal of Accounting and Economics*, 47(1-2), 108-130. <https://doi.org/10.1016/j.jacceco.2008.11.001>
- Chodnicka-Jaworska, P. (2018). Significance of financial indicators and banks' credit ratings during crisis. *Acta Universitatis Lodzianensis, Folia Oeconomica*, 1(333), 167-183. <https://doi.org/10.18778/0208-6018.333.11>
- D'Apice, V., Ferri, G., & Lacitignola, P. (2016). Rating performance and bank business models: is there a change with the 2007-2009 crisis?. *Italian Economic Journal*, 2, 385-420. <https://doi.org/10.1007/s40797-016-0036-9>
- Damak, E. (2018). Camels model with a proposed 's' for the bank credit risk rating. *International Journal of Economics and Finance*, 10(9). <https://doi.org/10.5539/ijef.v10n9p69>
- Damak, E., & Chichti, J. (2017). L'évolution des méthodologies révélées de la notation du risque du crédit bancaire. *Banque & Stratégie*, 356. Retrieved from <http://www.revue-banque.fr/banque-investissement-marches-gestion-actifs/article/evolution-desmethodologies-revelees->
- Deprès, M. (2011). *Mayo El comportamiento de los ratings crediticios a lo largo del ciclo*. Informe de Estabilidad Financiera del Banco de España.
- Derviz, A., & Podpiera, J. (2008). Predicting bank camels and s&p's ratings: the case of the Czech Republic. *Emerging Markets Finance & Trade*, 44(1), 117-130. <https://doi.org/10.2753/REE1540-496X440107>
- FitchRatings. (2011). Global financial institutions rating criteria. *Master Criteria*, August 16.
- Gaillard, N. (2008). Les méthodologies de notation souveraine. *Thèse de Doctorat*, Institut d'Etudes Politiques de Paris, Janvier.
- Godlewski, C. J. (2004). Influence des facteurs institutionnels sur l'excès de risque et les ratings de banques dans les pays émergents. *Revue Bancaire et Financière*, 450-460. Retrieved from https://www.researchgate.net/publication/46477563_L
- Gray, S., Mirkovic, A., & Rangunathan, V. (2006). The determinants of credit ratings: Australian evidence. *Australian Journal of Management*, 31(2), 333-354. <https://doi.org/10.1177/031289620603100208>
- International Monetary Fund. (2010). The uses and abuses of sovereign credit ratings. *Global financial Stability Report*.
- Moody's Investors Service. (2012). Incorporation of joint-default analysis into moody's bank ratings: global methodology. *Rating Methodology*.
- Nunez, E., Steyerberg, W. E., & Nunez, J. (2011). Regression modeling strategies. *Sociedad Espanola de Cardiologia*. Published by Elsevier Espana. <https://doi.org/10.1016/j.rec.2011.01.017>
- Packer, F., & Tarashev, N. (2011, June). Rating methodologies for banks. *BIS Quarterly Review*.
- Royston, P., & Sauerbrei, W. (2009). Bootstrap assessment of the stability of multivariable models. *The Stata Journal*, 9(4), 547-570. Retrieved from http://ageconsearch.umn.edu/bitstream/143012/2/sjart_st0177.pdf
- Salvador, C., De Guevara, J. F., & Pastor, J. M. (2018). The adjustment of bank ratings in the financial crisis: International evidence. *The North American Journal of Economics and Finance*, 44, 289-313. <https://doi.org/10.1016/j.najef.2018.01.001>
- Salvador, C., García, L. T., & Ramos-Herrera, M. C. (2020). Bank rating migrations before and since the onset of the financial crisis. *Spanish Journal of Finance and Accounting*. <https://doi.org/10.1080/02102412.2020.1805953>

- Salvador, C., Pastor, J. M., & De Guevara, J. F. (2014). Impact of the subprime crisis on bank ratings: The effect of the hardening of rating policies and worsening of solvency. *Journal of Financial Stability*, 11, 13-31. <https://doi.org/10.1016/j.jfs.2013.10.005>
- Scott, L. J., & Freese, J. (2006). *Regression models for categorical dependent variables using stata*. Texas, College Station: Stata Press.
- Standard & Poor's. (2011a). Bank spreadsheet data definitions. *Criteria Financial Institutions Banks*, 5.
- Standard & Poor's. (2011b). Banks: Rating Methodology and Assumptions. *Criteria Financial Institutions Banks*, 9.
- Van Laere, E., & Baesens, B. (2011). Analyzing bank ratings: key determinants and procyclicality. *24th Australasian Finance & Banking Conference*, Sydney, 14-16 December. <https://doi.org/10.2139/ssrn.1905443>
- Van Laere, E., Vantiegheem, J., & Baesens, B. (2012). The difference between Moody's and S&P's bank ratings: is discretion in the rating process causing a split?. *RMI Working Paper*, (12/05). Retrieved from <http://citeseerx.ist.psu.edu/view doc/download?>

Notes

- Note 1. CAMELS is the acronyms of Capital, Assets, Management, Earnings, Liquidity and Sensitivity to market risk.
- Note 2. The averages of the financial ratios of N-3, N-2 and N-1 are used as independent variables to explain the N-year ratings.
- Note 3. S&P's (2011a) states that it makes analytical adjustments to the amounts reported in the financial statements and regulatory filings of the rated entities. These adjustments, under the S&P's termes, are made to generate measures that are more meaningful reflections of the economic reality of financial risks and to level the ratio differences and facilitate comparison between institutions and periods, which improves the analytical relevance and consistency of the financial ratios used in the credit analysis.
- Note 4. We calculated the means, standard deviations, minimums, and maximums of the variables by year of rating. But we have not carried over the corresponding tables.
- Note 5. We calculated the correlations between the variables using the Pearson coefficient for CAMEL variables (Pearson coefficients less than 72.20%), Khi-2 test for dummy variables (OC and ACT) and analysis of variance (ANOVA) for mixed variables. We also compared the means or proportions of the variables by year of rating using Student's test. But we have not carried over the corresponding tables.
- Note 6. Bissoondoyal-Bheenick and Treepongkaruna (2011) found that the studies on grades and classes give different results. We used the stata 12 for all our data treatments.
- Note 7. The VIF measure the multi-collinearity between the explanatory variables. $VIF=1/(1-R^2_i)$ with R^2_i is the coefficient of determination of the regression of the variable i with the other explanatory variables. A VIF superior to five indicates a strong multi-collinearity.
- Note 8. The BIF is a way of assessing the degree of stability of the model that occurs when the selected predictors are sensitive to a small change in data (Royston & Sauerbrei, 2009). A variable, which is weakly correlated with others and significant in the complete model must be selected in half of the bootstrap (BIF greater than or equal to 50%) samples and with the 'p-values' lower, the BIF increases to 100%.
- Note 9. High Chi2 and low "p-value" indicate the presence of heteroskedasticity.
- Note 10. We don't report the tables of Bootstrapping regressions.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).