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Does Capital Structure React Similarly to Probable and Real Credit Rating Changes?

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Abstract: This study examines whether the effects of probable and real credit rating changes on capital structure decision making are similar. Tests are investigated for 292 American firms listed on the S&P 500 index from 2007-2010. The results show that the both effects are significant in the capital structure decision making. However, capital structure reactions to probable and real credit rating changes aren't similar. While capital structure reactions are similar for real and probable downgrades to the speculative grade, capital structure reactions aren't similar for real and probable upgrades to the investment grade. Firms close to an upgrade/downgrade will issue less debt relative to equity to either avoid a downgrade or to increase the chances of an upgrade. Firms receiving a downgrade will reduce their debt issuance in the following year in order to reach again the investment grade. However, once the investment grade reached, firms will increase again their debt issues without fear of being downgraded again.

Key words: Real and probable credit ratings changes, capital structure behavior, investment grade, speculative grade, debt

INTRODUCTION

Capital structure decisions constitute one of the most important financial decisions. A considerable debate has occurred in the academic literature around the factors influencing capital structure decision making. Graham and Harvey (2001) argue that credit ratings are the second highest concern for firms when determining their capital structure. They add that credit rating rank higher than many factors suggested by traditional capital structure theories such as profitability, interest tax shield, firm size.

This study contributes to the theoretical and empirical capital structure decisions frameworks by examining the effects of probable and real credit rating changes on capital structure behavior for American firms listed in the S&P 500 index. The effects of both probable and real credit rating changes on capital structure decisions have not been investigated in the same study in the capital structure literature to date. The previous studies have analyzed the effects of probable credit ratings on capital structure decisions making for American firms (Kisgen, 2006) and in the Korean context (Shin *et al*., 2012). On the other hand, Kisgen (2009) has studied the effects of real credit rating changes on capital structure decisions.

This study argues that both probable and real credit rating changes are significant for capital structure decisions, given discrete costs (benefits) associated to different credit rating levels. We empirically examine whether capital structure reacts similarly to probable and real credit rating changes. While previous studies (Kisgen, 2006; Shin *et al*., 2012) have used two different measures to approximate probable credit rating changes (changes in broad ratings defined as rating levels including plus or minus notch ratings and changes in ratings grades defined as ratings that are on the border lines between the investment and speculative grades BBB-/Baa3 and BB+/Ba1) in this study, we have used only probable and real changes in rating grades. Our choice is due to the fact that regulations are almost specific to the credit ratings changes between investment and speculative grades. The both results are statistically significant. While firms near a probable rating change (an upgrade or a downgrade) will issue less net debt relative to net equity as a percentage of total assets, firms really receiving a rating change will issue less net debt following a downgrade but will issue more net debt following an upgrade.

Literature review and hypothesis development

Relevant literature

Credit rating-capital structure hypothesis: Kisgen (2006) have developed the credit rating and capital structure

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hypothesis which suggests that credit ratings affect firm's capital structure behavior. The credit rating and capital structure hypothesis states that:

- Credit ratings are a material consideration in managers' capital structure decisions due to the discrete costs (benefits) associated with different rating levels
- Concern for the impact of credit rating changes affects directly capital structure decisions with firms near a rating change issuing less net debt relative to net equity than firms not near a rating change (Kisgen, 2006)

Kisgen (2006) attributed these discrete costs to several reasons: the regulatory effects on investments, the information content of ratings, the firm's third party relationships, the utility-maximizing managers' concern for their reputation and the rating triggers.

Several regulations relating to financial institutions and other intermediaries investments are directly tied to credit rating. Cantor and Packer (1994) argue that financial regulators have made increasing use of credit ratings in their decision making. For example, since 1936, banks were restricted from owning bonds belonging to the speculation grade. Regulations generally do not focus on changes in broad ratings; AA+ and AA- firms are treated similarly from the regulatory perspective. Kisgen (2006) argues that the best way to test empirically the effects of regulations will be to focus on changes in rating grades (from the investment to the speculative grade or the opposite).

Credit ratings may also provide information on the firm quality beyond other publicly available information (Kisgen, 2006). Boot *et al.* (2006) argue that rating agencies are accelerating the dissemination of information to financial markets. Ratings may also allow firms to be pooled with firms in the same rating category. That is all firms within the same ratings group would be assessed similar default probabilities.

Credit ratings may affect the firm's third party relationships (employees, suppliers and customers), incur direct costs by limiting a firm's access to financial markets and firm's business operations.

Utility-maximizing managers' concern for their reputation may also induce discrete costs related to credit rating changes. Managers target a level of debt that increases the chance of an upgrade whatever the optimal debt level. Higher credit ratings may lead to higher reputation which affects managers' compensation, job security and other work opportunities.

Credit rating changes may also affect bond covenants directly tied to firms' credit ratings. Rating triggers may impose discrete costs due to bond covenants. Larger changes in credit ratings can cause a change in firm's coupon rate or a forced repurchase of bonds. Kisgen (2006) suggests that rating triggers' effect is more significant around the rating grade changes.

Credit rating in the context of traditional capital structure theories: Kisgen (2006) states that the Credit Rating-Capital Structure (CR-CS) hypothesis complements the capital structure theories. CR-CS hypothesis explains deviations of firm leverage from the debt level implied by the pecking order (Myers and Majluf, 1984) and trade-off theories (Myers, 1984) with the discrete costs resulting from a potential credit rating change.

The pecking order theory argues that firms will prefer to fund projects first with internal funds, then with debt and finally with equity only if necessary (Frank and Goyal, 2003; Myers, 2001; Chang, 1999).

If credit rating-capital structure hypothesis and pecking order effects are material, managers will face a tradeoff between the discrete costs associated with a potential credit rating change and the costs of issuing equity. The credit rating considerations may outweigh the implications of the pecking order theory for firms that are near a rating change. That is firms that are near an upgrade will choose to issue equity instead of debt to benefit from a higher rating and firms that are near a downgrade may avoid issuing debt to prevent the costs resulting from a downgrade (Kisgen, 2006).

The tradeoff theory implies that a firm will balance the value of interest tax shields and other benefits of debt against the costs of bankruptcy and other costs of debt to determine an optimal level of leverage for the firm (Fama and French, 2002). If the rating-dependent cost (benefit) is material, managers will balance that cost (benefit) against the traditional costs and benefits implied by the tradeoff theory. The tradeoff theory may outweigh the credit rating considerations in certain cases while in other cases; the capital structure behavior will differ from that implied by the tradeoff theory due to discrete costs associated with credit rating changes (Kisgen, 2006).

Hypothesis development: Total credit ratings (AAA~D, according to S&P and Aaa~D, according to moody) can be divided into investment grade (AAA~BBB-, according to S&P and Aaa~Baa3, according to Moody) and speculative grade (BB+~D, according to S&P and Ba1~D, according to moody) and so BBB-/Baa3 and BB+/Ba1 are on the border lines between the investment and speculative grades. Shin *et al.* (2012) argue that regulations are specific to the credit ratings changes between investment and speculative grades, so their effects should be greatest around these changes.

To examine the effects of probable credit rating changes on capital structure, the proximity to a grade rating change (investment or speculative grades) can be defined as ratings located on the border of the investment grade (BBB- or BBB~BBB-; according to S&P and Baa3 or Baa2~Baa3 according to moody) or on the border of the speculative grade (BB+ or BB~BB+; according to S&P and Ba1 or Ba2~Ba1; according to moody) at year (t-1). It is assumed that the proximity to a grade rating change has a greater effect on capital structure behavior than the proximity to a broad rating change (defined as ratings levels including a plus or minus notch within a broad rating). The credit rating and capital structure hypothesis implies that firms close to a grade rating upgrade or downgrade will issue less debt relative to equity to either avoid a downgrade or increase the chances of an upgrade. So, research hypothesis is as below:

- H_1: firms whose ratings are on the border of the investment grade (BBB- or BBB~ BBB-; according to S&P and Baa3 or Baa2~Baa3; according to moody) or on the border of the speculative grade (BB+ or BB~BB+; according to S&P and Ba1 or Ba2~Ba1; according to moody) will issue less debt relative to equity than other firms

To examine the effects of real credit rating changes on capital structure, we use real rating upgrade from the speculative to the investment grade and real rating downgrade from the investment to the speculative grade in the year preceding the capital structure reaction. Moreover, speculative grade firms would be more concerned with rating effects than investment grade firms. Therefore, firms that have received a downgrade to the speculative grade are more concerned with capital structure behavior in the next year than firms upgraded to the investment grade (Kisgen, 2009). Firms downgraded to the speculative grade will issue next year less debt relative to equity to reach again the investment grade. However, once the investment grade reached, firms will not change their debt issuance next year. So, research hypothesis is as below:

- H_2: firms downgraded to the speculative grade will issue next year less debt than equity while firms upgraded to the investment grade will not change their debt issuance

MATERIALS AND METHODS

Sample selection: The sample is constructed of the S&P 500 index American firms with a credit rating from moody during the period 2007-2010, according to the criterion as follows: firms in financial industries are excluded due to special regulations; firms having their first rating after 2010 are excluded and non American firms are also excluded due to the non inclusion of sovereign ratings in our model. Our final sample is constructed of 292 firms.

Model and variables: In this study, we test if capital structure reacts similarly to probable (regression 1) and real (regression 2) credit rating changes. The following two regressions test these hypotheses:

$$\text{Net debt issuance}_{it} = \beta_0+\beta_1 CR^{IOS}_{i,\,t-1}+\beta_2 MB_{i,\,t-1}+\beta_3 TANG_{i,\,t-1}+\beta_4 PROF_{i,\,t-1}+\beta_5 DEPRE_{i,\,t-1}+\beta_6 SIZE_{i,\,t-1}+\beta_7 LEV_{i,\,t-1}+\varepsilon_{i,\,t} \quad (1)$$

$$\text{Net debt issuance}_{it} = \phi_0+\phi_1 Inv/Spe_{i,\,t-1}+\phi_2 Spe/Inv_{i,\,t-1}+\phi_3 MB_{i,\,t-1}+\phi_4 TANG_{i,\,t-1}+\phi_5 PROF_{i,\,t-1}+\phi_6 DEPRE_{i,\,t-1}+\phi_7 SIZE_{i,\,t-1}+\phi_8 LEV_{i,\,t}+\varepsilon_{i,\,t} \quad (2)$$

In order to estimate regressions 1 and 2, we operate statistical tests such as the Lagrange multiplier test and the Hausman test that allow us to apply fixed effect models.

The dependent variable is the net debt issue ratio (net debt issuance$_{it}$) which is measured as [(year t debt change-year t equity change)/(year t total assets)]. Year t debt change is measured as (year t long term debt-year t-1 long term debt) and year t equity change is measured as (year t book value of shareholders' equity-year t-1 book value of shareholders' equity).

The explanatory variables are three rating dummies: the proximity to investment or speculative grade rating dummy ($CR^{IOS}_{i,\,t-1}$), the degradation to the speculative grade rating dummy ($Inv/Spe_{i,\,t-1}$) and the upgrade to the investment grade rating dummy ($Spe/Inv_{i,\,t-1}$). $CR^{IOS}_{i,\,t-1}$ takes the value 1 if the firm rating is located on the border of the investment grade (BBB- or BBB~BBB-; according to S&P and Baa3 or Baa2~Baa3; according to moody) or on the border of the speculative grade (BB+ or BB~BB+; according to S&P and Ba1 orBa2~Ba1; according to moody) at year (t-1) and 0 otherwise. $Inv/Spe_{i,\,t-1}$ takes the value 1 if the firm rating degrades to the speculative grade (generally from Baa3 to Ba1 or Ba2 according to Moody) at year (t-1) and 0 otherwise. $Spe/Inv_{i,\,t-1}$ takes the value 1 if the firm rating upgrades to the investment grade (generally from Ba1 or Ba2 to Baa3 according to moody) at year (t-1) and 0 otherwise. While $CR^{IOS}_{i,\,t-1}$ is a proxy variable for the proximity to a rating change and is

expected to have a negative effect on the net debt issue ratio, $Inv/Spe_{i, t-1}$ is a proxy for real rating change (downgrade) and is expected to have negative effect on the net debt issue ratio and $Spe/Inv_{i, t-1}$ is a proxy for real rating change (upgrade) and is expected to have no significant effect on the net debt issue ratio.

The control variables are a standard set of leverage determinants such as the market to book ratio ($Mb_{i, t-1}$), tangibility ratio ($TANG_{i, t-1}$), profitability ratio ($PROF_{i, t-1}$), depreciation cost ratio ($DEPRE_{i, t-1}$), firm size ($SIZE_{i, t-1}$) and leverage ratio ($LEV_{i, t-1}$). Market to book ratio ($Mb_{i, t-1}$) is a proxy for the growth opportunities measured as [(year t-1 market capitalization of equity+year t-1 total liabilities)/(year t-1 total assets)]. Firms with higher growth opportunities need more equity financing than debt issuance to avoid wealth transfer from shareholders to creditors (Huang and Song, 2006; Booth *et al*., 2001; Padron *et al*., 2005). Tangibility ratio ($TANG_{i, t-1}$) is measured as [(year t-1 tangible assets+year t-1 inventory assets)/(year t-1 total assets)]. Tangible assets can be used as collateral to reduce debt agency costs. High proportion of tangible assets is associated with high debt levels justified by ease recovery of tangible assets for creditors (Frank and Goyal, 2007). Profitability ratio ($PROF_{i, t-1}$) is measured as [(year t-1EBITDA)/(year t-1 total assets)] and is expected to have a negative effect on the net debt issue ratio. High profitability strengthens the company financial autonomy and allows him to reduce its debts (Titman and Wessels, 1988; Friend and Lang, 1988; Rajan and Zingales, 1995; Huang and Song, 2006). Depreciation cost ratio ($DEPRE_{i, t-1}$) as a proxy for non-debt tax shield is measured as [(year t-1 depreciation expenses)/(year t-1 total assets)] (Chen, 2004). Firms with higher depreciation expenses are less likely to issue debt for tax shield purpose (Fitriya *et al*., 2013). Firm size ($SIZE_{i, t-1}$) is measured as (year t-1 total assets). Larger firms tend to have higher leverage as they have more diversification opportunities, more cash flow stability and low probability of bankruptcy (Gonzalez and Gonzalez, 2012; Padron *et al*., 2005). And leverage ratio ($LEV_{i, t-1}$) is measured as [(year t-1total liabilities)/(year t-1 market capitalization of equity+year t-1 total liabilities)]. High leveraged firms tend to have a negative effect on the net debt issue ratio (Shin *et al*., 2012; Faulkender and Petersen, 2006; Nguyen *et al*., 2008).

RESULTS AND DISCUSSION

Descriptive statistics: The descriptive statistics of the dependent variable (net debt $issuance_{it}$), the explanatory variables (the rating dummies) and the control variables (the leverage determinants) are shown in Table 1-3. The sample contains 1168 firm-years for the regression 1 and 876 firm-years for the regression 2. Table 1 shows statistics for the net debt issuance within the sample. Firms issue more debts than equities for the years 2007 and 2008 and more equities than debts for the years 2009 and 2010. Table 2 shows statistics for the rating dummies. On average for the 4 years (2007-2010); 41.5% of the observations are close to a change in rating grade ($CR^{IOS}_{i, t-1}$). Real change in rating grades represents small percentages. While upgrades to investment grade ($Spe/Inv_{i, t-1}$), varying between 1.03 and 1.72%, represent an average of 1.49%; downgrades to speculative grade; having an average of 1.14%; realize their greatest percentage between 2006 and 2007 (2.41%) and low percentages for the following 2 years (2008 and 2009); 0.34 and 0.68%, respectively. Table 3 shows statistics for the leverage determinants variables. The average debts represents 42.59% of the firm total debts and equities.

Transformations are necessary for certain variables in order to correct the skewed distributions. The log transformation is operated to the market to book ratio and the size variable and the square root to the tangibility, depreciation and leverage ratios.

Multivariate results: This study examines empirically the effects of probable and real credit rating changes on capital structure for the American S&P 500 firms, controlling for the market to book ratio, tangibility ratio, depreciation ratio, profitability ratio, firm size and lagged leverage ratio using panel data for multivariate regression models (regression 1 and 2). Table 4 shows the results for regression models 1 and 2.

The results in regression 1 show that the proximity to a change in rating grade (CR^{IOS}) have a negative and significant effect on the net debt issue ratio at the 1% level. That is firms whose ratings are on the border of the investment grade (BBB- or BBB0~BBB-; according to S&P and Baa3 or Baa2~Baa3; according to moody) or on the border of the speculative grade (BB+ or BB0~BB+;

Table 1: Descriptive statistics of the net debt issuance

Variables	Years	N	Mean	Median	SD	Minimum	Maximum
Net debt $issuance_{it}$	2007	288	0.0095324	-0.0144079	0.1298415	-0.3844172	0.5876347
	2008	287	0.0495010	0.0358602	0.1192990	-0.3058603	0.5549146
	2009	289	-0.0285207	-0.0280180	0.0891695	-0.6041474	0.5221581
	2010	288	-0.0279587	-0.0279999	0.0840289	-0.4910046	0.4232647
	Panel	1152	0.0005708	-0.0119286	0.1119085	-0.6041474	0.5876347

according to S&P and Ba1 or Ba2~Ba1; according to moody) at time (t-1)will issue next year 1.67% less debt than equity. These results imply that firms close to an upgrade to the investment grade or to a downgrade to the speculative grade will issue less debt relative to equity to either avoid a downgrade or to increase the chances of an upgrade, consistent with Kisgen (2006) and Shin *et al.* (2012).

Among the control variables, market to book ratio has an insignificant effect on the net debt issue. Firm size has a negative and significant effect on the net debt issue ratio at the 10% level, consistent with the result by Wald (1999) for German companies that large firms with less information asymmetry prefer to issue less debt than equity. Tangibility ratio has a negative and significant effect on the net debt issue ratio at the 5% level, consistent with the prediction of the pecking order theory and the results by Huang and Song (2006) and Frank and Goyal (2007). Profitability ratio has a negative and significant effect on the net debt issue ratio at the 1% level, consistent with the prediction of the pecking order theory and the results by Huang and Song (2006) and Booth *et al.* (2001). Depreciation cost ratio has a positive and significant effect on the net debt issue ratio at the 1% level, consistent with the results by Graham (2006) that firms with higher depreciation expenses as non-debt tax shield are less likely to issue debt which contradicts the substitution between tax and non-tax shield purposes. And leverage ratio has a positive and significant effect on the net debt issue ratio at the 1% level which contradicts the results by Shin *et al.* (2012) that higher leveraged firms issue less debt than equity.

Table 2: Descriptive statistics of rating dummies

		G1 (CR^{IOS} takes the value 0)		G2 (CR^{IOS} takes the value 1)	
Variables	Years	Effectifs	Percentage	Effectifs	Percentage
CR^{IOS}	2006	156	59.770	105	40.230
	2007	163	60.820	105	39.180
	2008	161	57.500	119	42.500
	2009	164	56.165	128	43.835
	Panel	644	58.492	457	41.508
		G1 (Spe/Inv takes the value 0)		G2 (Spe/Inv takes the value 1)	
Variables	Years	Effectifs	Percentage	Effectifs	Percentage
Spe/Inv	2006/2007	288	98.97	3	1.03
	2007/2008	285	98.28	5	1.72
	2008/2009	287	98.29	5	1.71
	Panel	860	98.51	13	1.49
		G1 (Inv/Spe takes the value 0)		G2 (Inv/Spe takes the value 1)	
Variables	Years	Effectifs	Percentage	Effectifs	Percentage
Inv/Spe	2006/2007	284	97.59	7	2.41
	2007/2008	290	99.66	1	0.34
	2008/2009	290	99.32	2	0.68
	Panel	864	98.86	10	1.14

Table 3: Descriptive statistics of leverage determinants variables

Variables	Years	N	Mean	Median	SD	Minimum	Maximum
MB	2006	289	2.021712	1.781321	0.9147267	0.3787264	6.545253
	2007	289	1.92668	1.632683	0.8856891	0.4291949	5.361063
	2008	291	1.551364	1.314237	0.6533955	0.5433745	4.239057
	2009	289	1.745324	1.496369	0.7648	0.8532582	5.673587
	Panel	1158	1.810821	1.536202	0.8298265	0.3787264	6.545253
Prof	2006	286	0.1611014	0.1480823	0.0774925	-0.0745755	0.5793421
	2007	287	0.1567644	0.1516962	0.086779	-0.3039511	0.5499346
	2008	291	0.1352119	0.1461363	0.1341375	-0.8830124	0.6316468
	2009	284	0.1335819	0.128157	0.0876014	-0.2489136	0.6872815
	Panel	1148	0.1466474	0.1439724	0.0998279	-0.8830124	0.6872815
Size	2006	289	9.44482	9.317417	1.076179	6.385496	13.45488
	2007	289	9.527623	9.399861	1.064158	6.446954	13.58652
	2008	291	9.526595	9.424161	1.045061	6.389463	13.58957
	2009	289	9.577683	9.459361	1.034313	6.497945	13.56948
	Panel	1158	9.519193	9.400167	1.054743	6.385496	13.58957
Lev	2006	289	0.3890909	0.3660939	0.2288168	0	1.747157
	2007	289	0.4106572	0.390034	0.2227603	0	1.781784
	2008	291	0.4677649	0.4386252	0.294275	0	3.338341
	2009	286	0.4360441	0.4109737	0.2398839	0.0027219	1.804252
	Panel	1155	0.4259354	0.3998927	0.2495779	0	3.338341
Tang	2006	274	0.4403481	0.4300839	0.233778	0.0165947	0.9405049
	2007	278	0.4434573	0.4275743	0.2358849	0.0216372	0.9385468
	2008	282	0.4481698	0.4211548	0.2387108	0.0286716	0.9463073
	2009	265	0.4324577	0.3983993	0.2408836	0.0234129	0.9316164
	Panel	1099	0.441239	0.4209225	0.2370491	0.0165947	0.9463073
Depre	2006	257	0.0396169	0.353458	0.0231292	0	0.2649049
	2007	271	0.407124	0.0366061	0.0275282	0.0060229	0.3566421
	2008	227	0.0431858	0.0379668	0.034205	0.0043636	0.4067102
	2009	196	0.0438318	0.0377331	0.0342291	0.005397	0.3879833
	Panel	951	0.0416496	0.0370785	0.0296862	0	0.4067102

The results in regression 2 show that real credit rating changes have significant effect on the net debt issue ratio (Inv/Spe, Spe/inv). Firms downgraded to the speculative grade at time (t-1) will issue next year (1.94%) less debt than equity. That is firms will reduce their debt issuance in the year following the downgrade in order to reach again the investment grade. However, firms upgraded to the investment grade at time (t-1) will issue next year (11.27%) more debt than equity. That is once the investment grade reached following an upgrade, firms will increase again their debt issues without fear of being downgraded again. This result contradicts the research by Kisgen (2009) showing that capital structure doesn't reacts to real upgrades to the investment grade.

Among the control variables, we have found the same results of regression 1 except for two variables. The market to book ratio has a positive and significant effect on the debt net issue ratio at the 1% level. That is firms with strong growth opportunities issue more debt than equity which is consistent with the prediction of the pecking order theory. Firm size has a non-significant effect on the net debt issue ratio which confirms the results by Huang and Song (2006) and Padron *et al.* (2005).

CONCLUSION

This study analyses empirically the reaction of capital structure to probable (regression 1) and real (regression 2) credit rating changes. Firms are categorized such as near a rating grade change if their ratings are on the border of the investment and speculative grades (BBB-/Baa3 and BB+/Ba1).

The main results of this study can be summarized as follows. On the one hand, firms whose ratings are on the border of the investment grade or on the border of the speculative grade at time (t-1) will issue next year (1.67%) less debt than equity. These results imply that firms close to an upgrade to the investment grade or to a downgrade to the speculative grade will issue less debt relative to equity to either avoid a downgrade or to increase the chances of an upgrade. On the other hand, firms downgraded to the speculative grade at time (t-1) will issue next year (1.94%) less debt than equity and firms upgraded to the investment grade at time (t-1) will issue next year (11.27%) more debt than equity. That is firms will reduce their debt issuance in the year following the downgrade in order to reach again the investment grade. However, once the investment grade reached following an upgrade, firms will increase again their debt issues without fear of being downgraded again.

These findings suggest that capital structure reactions to probable and real credit rating changes aren't similar. While capital structure reactions are similar for real and probable downgrades to the speculative grade, capital structure reactions aren't similar for real and probable upgrades to the investment grade. This result outlines the effect of managerial discretion in decisions affecting capital structure. The hope of reaching the investment grade leads managers to lower their debt issues. However, once the investment grade reached, the managers will increase again their debt issues.

This study contributes to correctly understanding the capital structure decisions. Managers, whoare concerned by reaching a target rating will use their managerial discretion that translates into real capital structure decisions. Rating agencies would benefit from including managerial discretion as part of the credit rating framework.

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