CHAPTER IV

Results

The empirical results in this chapter are separated into two main parts. First is the outcome of the static and the hazard rate models which are used in predicting the issuer ratings change and the out-of-sample accuracy of the entire models considered and the second is the results of the standard of rating agency when assigning the issuer ratings.

4.1 Predicting Issuer Ratings Change

4.1.1 Model Estimates

Table 3 reports binary logit regression results of firms which have investment rates for various alternative specifications. Panel A displays results for upgrade estimated by static model, Panel B presents results for upgrade estimated by hazard rate model, Panel C shows outcomes for downgrade estimated by static model, and Panel D demonstrates outcomes for downgrade estimated by hazard rate model.

In Panel A, parameter estimates of Altman's model are insignificant except Age. It is 0.0148. By using this model, the probability of upgrades is only depended on the number of years that each firm was rated. The Blume model indicates that TD/TA and Beta are negatively significant. TD/TA is negative at -2.5067. It can be interpreted as for a given level of total assets, a firm with more total debt in its capital structure will tend to receive a lower credit rating. Also, according to systematic risk, the higher value of Beta will receive higher probability of upgrades. Beta on this model is -0.6984. The Campbell model shows that the market-driven variables which include Dif-Ret, Rel-Size, MB, and Price are significant. The magnitudes of parameters are 3.6043, 0.6203, 0.0037, and 0.8280, respectively. This model indicates that variables which are relative to the market are influential with the probability of upgrades. The Shumway specifies that the TA/TL is negatively significant at -1.4144. Dif-Ret has a positive relation with upgrade. The magnitude of the parameter, 3.3285, is closed to that estimated be the Campbell model. However, there are no significant variables estimated by Zmijewski.

The Altman model in Panel B shows that there are no significant variables while the Blume model indicates that the TD/TA and Beta are negatively significant like this model estimated in Panel A. They are -2.4831 and -0.9702, respectively. The market-driven variables estimated by Campbell are all significant except Sigma. The signs of these significant variables are consistent with the estimations in Panel A. The value of TL/TA estimated by Shumway is -0.8184. It has a negatively relation with upgrade. Dif-Ret is 2.6666, it is closed to that estimated be the Campbell model, 2.6868. This confirms that the result is not due to an interaction with other variables that are highly correlated. The Sigma is -0.4587 and significant at 99% confidence level. Also, the TL/TA estimated by Zmijewski is -1.0278 and significant at 95% confidence level.

The static downgrade estimated by Altman demonstrates that the WC/TA and EBIT/TA have negative effects on downgrade. They are -2.1280, and -5.2837, respectively, and strongly significant at 99% level. The magnitude of the Age is 0.0155. This relation should be negative because firms which were rated for a long time should have higher probability to upgrade. Nonetheless, it is possible for positive relation if those firms face financial problems. Therefore, this variable can be treated as a controlling variable. The Beta and SE estimated by Blume are 0.3552, and 26.0638, respectively. The high value of SE indicates that a firm with high idiosyncratic risk will have high probabilities of downgrade. The signs on NI/MTA, TL/MTA, and Sigma estimated by Campbell match the expectation. They are -5.4388, 0.5244, and 2.7935, respectively. The Shumway model points out that NI/TA is -4.9898 and TL/TA is 1.1908 while these parameters estimated by the Zmijewski model are -5.9797, and 1.3728, respectively. In addition, the values of Dif-Ret and Sigma are -0.5703, and 2.6787, respectively. The signs on all of them also match the expectation.

The results in Panel D show that the signs on WC/TA and EBIT/TA estimated by Altman match the expectation. They are -2.3955, and -4.3253, respectively. They have negative effects on downgrade. Additionally, the Beta, 0.2280, and SE, 36.4856, estimated be the Blume model indicates that they have positive effects on downgrade, especially, the SE. The Campbell model specifies that NI/MTA, -5.9059, and MB, -0.0019, have negative effects on downgrade. Sigma, 2.2230, is significant at 99% confidence level. The Campbell's results are consistent with the Shumway's results. The NI/TA estimated by Shumway is -3.2294, TL/TA is 0.9182, and Sigma is 2.3452. The magnitude of Sigma estimated by Shumway is closed to that estimated by Campbell. Also, all variables estimated by Zmijewski are significant and have correct expected signs. NI/TA is -4.4337, TL/TA is 0.9481, and CA/CL is -0.2589.

Moreover, the model estimations of non-investment rates are displayed in Table 4. Panel A shows the results estimated by static model for upgrade. The Altman model does not provide any significant values of various variables while the Blume model indicates a negative value of SE, -41.5441. This value is very high and significant. It indicates that firms with high idiosyncratic risks will have lower probability to upgrade. The Campbell model indicates that NI/MTA, 2.3110, and CA/MTA, 1.3324 are significant at 90% confidence level. They have positive effects on upgrade. TL/MTA, -4.6000, and Price, 2.4732, are significant at 90% confidence level. They all match the expected signs. Also, the only one significant value of the Zmijewski model is CA/CL, 0.9380.

Panel B displays the results estimated by hazard rate model for upgrade of non-investment rates. The EBIT/TA, 4.0210, estimated by Altman and OPTMAR, 0.0330, LTD/TA, -3.4647, and TD/TA, -4.9305, estimated by Blume have correct expected signs. The two market variables estimated by the Campbell model, Dif-Ret, and Rel-Size match the expected signs but two market variables, MB, and Price do not. They are -0.2409, and -1.1200, respectively. The magnitude of Dif-Ret estimated by Shumway, 2.2147, is closed to that estimated by Campbell, 2.1291. Also, the Zmijewski model provides the only one significant value of NI/TA, 4.7598.

The results of downgrade estimated by static model for non-investment rates are displayed in Panel C. The Blume, Campbell, and Zmijewski models do not provide any significant values if specific variables. However, the Altman model shows that WC/TA, -2.3809 and Age, 0.1312, are significant at 95% confidence level. Also, the Shumway model indicates that TL/TA, 1.8080, is significant at 90% confidence level. Panel D displays results for downgrade estimated by hazard rate model on non-investment firms. WC/TA, EBIT/TA, and Age estimated by Altman are -1.9400, -3.0471, and 0.1463, respectively. Unlike Panel C, the Blume and Zmijewski models provide some significant values. The OPTMAR, -0.0230, and Beta, 0.6211, estimated by Blume and NI/TA, -2.3459, and TL/TA, 1.5794, estimated by Zmijewski are all significant. The value of TL/TA, 1.9548, estimated by the Shumway model is also significant at 95% confidence level. However, the Campbell model does not provide any significant values of any variables. From these results, it is obvious that the five sets of explanatory variables can be used better for investment firms than for non-investment firms since most of them are significant for investment firms but insignificant for non-investment firms.

4.1.2 Testing for Discriminative Power

To investigate the relative predicting performances of static and hazard rate models, the data in the out-of-sample periods from 2005 through 2007 are used. The ROC curves for both models are plotted to access the predicting accuracy. Figure 1 displays the ROC curves of firms which have investment rating upgrades, and Figure 2 shows the downgrades. The non-investment rating upgrades are showed in Figure 3, and the downgrades are in Figure 4.

In this part of the paper I also analyze the calculation of confidence intervals for the areas under the curves, AUC. This sample of the database contains 1571 observations for investment ratings which have 218 upgrades and 100 downgrades. Also, the sample for non-investment ratings has 527 observations which have 59 upgrades and 209 downgrades.

The results are summarized in Table 5 and 6. Panel A of Table 5 presents the AUC for the upgrades and Panel B presents for the downgrades of investment ratings. They report that all five models which apply hazard rate techniques have more areas than those which apply static techniques. Starting with upgrades, the area on the Altman's model estimated by static technique is 0.541 while by hazard rate technique is 0.572. The curve of hazard is quite above the static curve, but both of them are near the random model curve, which its area is 0.500. The next model is from Campbell, its static technique area is 0.577, and hazard is 0.651. It is easier to look at the curves of this model because the hazard curve is obviously above the static curve. Next, the static area on Zmijewski is 0.620, and the hazard area is 0.636. The Blume's model provides better large areas, its static technique presents at 0.631, and hazard is 0.646.

The greatest model for upgrade is the Shumway's model. Its estimated area of hazard is 0.681, and of static is 0.655. The static and hazard curves of last three models are quite overlap if looking at the figure. Additionally, for downgrades, on average, the areas of five models are less than upgrades. They are roughly around 0.5 through 0.6. The static and hazard curves of Altman and Blume are near the random model curve. It indicates that these two models are not good enough to predict the downgrades. Moreover, some parts of the static curve of Campbell and both static and hazard curves of Zmijewski are below the random model. It points out that these models are worse than the random model. However, like the upgrades, the greatest model for downgrades is the Shumway's model, and its static area is 0.551, and hazard is 0.596. These curves are good because it is apparent that hazard curve is above static curve, and both to them are above the random model.

Panel A of Table 6 represents the upgrades and Panel B represents the downgrades of non-investment ratings. Unlike Table 5, the best model for the upgrade in this table is the Campbell's model. Its area estimated by hazard rate model is 0.653. Both static and hazard curves are above the random model. The static curve of Altman is close with the random model at the low values of cut-off points while the hazard curve is close with the random model at the high values of cut-off points. Some parts of the static curve of Blume is below the random model at the low values of cut-off points. Also, both static and hazard curves of Zmijewski are greatly close with the random model, it consists with the AUC of them that their AUC are 0.505, and 0.511, respectively. Additionally, for downgrades, performances on five models provide areas larger than 0.6, except the Blume's model. Its static area is 0.533, and hazard is 0.587, as you can see from the Blume figures, some parts of them are below the random model. Besides, the both curves of Altman are close with each other, and both of them are above the random model. Like the Altman, the Zmijewski curves are close with each other, but both of them are steeper than the Altman. As well, the best for downgrades is the Campbell's model. Its area is 0.722. Their curves are very steeper. Therefore, for overall results, the interpretation of these results is the performances of hazard rate model are better than the performances of static models.

4.1.3 Comparison of AUC for two Different Rating Models

In this part of the paper I apply the test on the differences of the area below the ROC curve of two rating models. I carry out pairwise comparisons of our five rating models Altman, Blume, Campbell, Shumway, and Zmijewski on the total validation sample from 2005 - 2007. The results are displayed in Table 7. Panel A and Panel B represent the difference of AUC for the upgrades and the downgrades of investment ratings, respectively. Panel C and Panel D represent the difference of AUC for the upgrades and the downgrades of non-investment ratings, respectively. The rating models static and hazard for upgrades of investment ratings estimated by the Altman's and Shumway's model are not different while the Blume's, Campbell's, and Zmijewski's models are different at the p-value at 0.006, 0.026, and 0.079, respectively. From Panel B, the results show that the static and hazard of the Altman, Blume, and Zmijewski models are not different. However, the Campbell and Shumway models are different with high significant, unlike the results from Panel C, upgrades of non-investment ratings, all of models are not different. Nevertheless, from Panel D, all of models are different except the Altman's model. In this panel, especially, the p-value of the test of Blume and Shumway indicates the difference with high significant. From the inconclusive of the results, I cannot conclude that static and hazard models are significantly different.

Moreover, Table 8 displays model estimates of ratings change of whole samples. Table 9 and Figure 5 display the testing rating accuracy by ROC curves and the differences areas below the curves. The results suggest that the best models of both up- and downgrades are Shumway models. They provide larger areas below the curves. For upgrades, it provides area at 0.649, and for downgrades, it provides 0.587. However, hazard rate on Shumway model is not significantly different from static model for upgrades while they are significantly different for downgrades at the p-value 0.012. Also, both static and hazard models for upgrades are significantly different on the Blume and Campbell models at 95%, and 99% level, respectively, and insignificant, otherwise, while both static and hazard models for downgrades are significantly different on all models except the Zmijewski.

4.2 Measuring Standard of Rating Agency

4.2.1 Model Estimates

Estimation of the parameters of the ordered logit model for the data covering the years 2000 through 2007 are displayed in Table 10. It shows the five estimated models which include Altman, Blume, Campbell, Shumway, and Zmijewski. Additionally, the time dummies and economic factors are added into each model. The economic factors, EMPLOY, PROD, OUTPUT, and GDP, are used to consider business cycle with credit ratings. The estimated coefficient of the Altman's model WC/TA value is 0.9761, EBIT/TA is 6.1870, ME/TL is 0.0236, and Age is 0.0617. They all match expected signs and are significant at 99% confidence level. The higher value of these variables will increase the probability to improve in credit ratings. Besides, this model indicates that the economic factors affect credit ratings supported from this estimates. PROD value is 0.0394, GDP is 0.1036, and, especially, OUTPUT value is 18.7841. However, EMPLOY is insignificant in this model.

The next estimation is the Blume's model. There are only two significant variables in this model. They are LTD/TA, -2.8131, and SE,-106.4633. The estimated coefficient on SE is very high and strongly significant at 99% confidence level. This interpretation on this value is that firms with high idiosyncratic risks will have lower probabilities to improve in their ratings. Also, all economic factors in this model are significant. The values of estimated coefficients on EMPLOY, PROD, OUTPUT, and GDP are 0.0104, 0.0457, 11.3694, and 0.0983, respectively. Like the Altman's model, the OUTPUT of this model is high and strongly significant.

The estimated covariates of the next model, Campbell, on Dif-Ret, Rel-Size, Sigma, and Price are 0.6545, 0.4178, -2.4569, and 0.6585, respectively. These results obviously show that they all are market-driven variables while NI/MTA, TL/MTA, and CA/MTA which are accounting variables are insignificant. Surprisingly, these accounting variables on the Shumway's model which use book value of total assets are significant. NI/TA value is 5.1012, and TL/TA is -1.0387. Like the Campbell's model, market-driven variables in this model match expected signs and strongly significant. The estimated coefficient on Dif-Ret is 0.5512, Rel-Size is 0.6775, and Sigma is -1.9823. Additionally, economic factors of both model match expectations, especially, the values on OUTPUT of both models are highly significant. The estimated by Campbell is 41.4848, and by Shumway is 38.5669. GDP estimated values on both model also are closed, they are 0.0168, and 0.0169, respectively. The last model is from Zmijewski, its estimated coefficients values on NI/TA is 7.1600, TL/TA is -1.7945, and CA/CL is -0.1357. All economic variables are strongly significant except EMPLOY. The highest affect is on OUTPUT, 14.7783, is like other models. All these estimations indicate that credit ratings are not only depended on accounting variables, which reflect firms risks themselves, but also on economic cycles, which reflect economic activities and trends on their countries.

4.2.2 Results of Measuring Rating Standard

According to the estimated results in Table 10, the time dummies increase over time, these coefficient values are plotted and displayed in Figure 6. The values of time dummies are measurements of standard of rating agency in each year. If the coefficient values increase year by year, it is consistent with the application of more lenient standards in assigning ratings. The figure shows the five models estimates. Firstly, the Altman's model, the year 2001 dummy value is -2.2537, and its value gradually increases to -1.4712 in year 2002. Its value then slowly increases to -1.2320 in year 2005, and suddenly increases to -0.4761 in year 2006. Like the Altman's model, the Blume's model provides increasing time dummies which reach -1.6040 in 2005, and after that it steadily increases to -0.6588 in year 2006. Also, the Campbell's and Shumway's lines are so close while the Zmijewski's line looks like the other lines that steadily increases in year 2006.

For overall, all five models provide upward movements in time dummies lines. These upwards in the values of the coefficients are consistent with the application of increasingly more lenient standards over time in assigning ratings, but they provides no direct evidence of the economic importance of these statistical results. One way to ascertain the economic significance of this change is to compare the rating that the logit model would predict for a particular year using the firm characteristics for that year with thee rating that the logit model would predict for an earlier or later year but using the same firm characteristics. In short, keep the data the same, but vary the year of the rating standard.

Table 11 reports effect of changing rating standards on predicting ratings based on the ordered logit model. This table contains five panels, each panel employed different sets of explanatory variables which includes Altman, Blume, Campbell, Shumway, and Zmijewski. The samples used in this part are listed and rated 217 firms which existed during 2000 through 2007. As an illustration, the panel A, Altman, is used for an example. Considering the based year 2000, one year later is 2001 which has received lower predicted ratings at 72.35%. The next four years later of 2000 has downgraded 67.74%, and seven years later is 59.91%. Also, in the based year 2007, 59.91% has received higher predicted ratings in one year earlier, 58.99% in two years earlier, and 44.24% in seven years earlier. If a substantial portion of companies have received lower percentages by using n years later or earlier comparing with based year, the standard of agency will be softer. From the overall results of five models, some comparing years have higher percentages but some have lower percentages. However, the trend changed of up- and downgraded is decreased. Obviously, if the far years are compared, the clearer results are verified. Therefore, from the five sets of firm characteristics, it can conclude that the S&P agency applies the lenient standard in assign ratings.

4.3 Robustness check

4.3.1 Comparison between Static and Hazard Rate Models

This part examines the performances of forecasting ratings change by static and hazard rate models which use a new set of explanatory variables. I find that the best explanatory variables for forecasting are NI/TA, TL/TA, Dif-Ret, Rel-Size, SE, CA/CL, and TD/TA. The estimated coefficients of both static and hazard and both up- and downgrades of investment ratings are displayed in Table 12. Also, Figure 7 presents the comparison of ROC curves between static and hazard rate models. In upgrades, the area below the curve of static is 0.643 and hazard is 0.682. The difference of two models is 0.0389 and they are significantly different at 10% level. Additionally, in downgrades, the area below the static curve is 0.646 and hazard is 0.682. The difference of area under both two curves is 0.0360 and they also are significantly different at 1% level. These results are consist with Table 5 and 6 which indicate that hazard rate models provide better performances on forecasting ratings change than static models.

4.3.2 Results of Measuring Rating Standard of Investment Ratings

I do robustness test to confirm that standard of rating agency are lenient by re-estimating the ordered logit model only on investment rated firms. Table 13 displays this estimation. All accounting variables of the Altman's model are significant while the Blume's variables are significant only on the estimated of LTD/TA and SE. The insignificant accounting variables of Campbell are TL/MTA and MB, but TL/TA of Shumway is significant, and all accounting variables of Zmijewski are significant. Surprisingly, even though most economic factors on five models are significant, GDP is not. However, these results on investment ratings are consistent with the results on whole samples which GDP on whole samples are significant but not strongly. Nevertheless, the overall results in this table are like as in Table 10 in measuring standard of rating agency. Figure 8 presents the plot of coefficient of time dummies estimated in Table 13. It indicates that S&P agency are lenient when assigning ratings demonstrates by the upward movements of five models estimations.

This study also rechecks the rating standard by using US data. The samples used are from S&P500 which contain 433 firms. The variables used are market capitalization (MKT), beta which is estimated from the market model (Beta), total debt to total assets (TD/TA), long-term debt to total assets (LTD/TA), net income after taxes plus interest to interest (TIE), returns on assets (ROA), and probability of default (PD). Table 14 shows the model estimates by the ordered logit model. All estimated parameters match expected signs except total debt to total assets. The estimated values on market capitalization and returns on assets are 0.9846, and 4.6257, respectively. The higher values on these variables indicate the higher probabilities of firms to improve their ratings. The values on Beta and long-term debt to total assets are -0.7809, and -7.2210, respectively. It can interpret as the higher values on these variables lead firms to have the lower upgrade probabilities. Moreover, the estimated coefficients on time dummies indicate the standards of the agency. The plots of these time dummies are displayed in Figure 9. The line sharply increases to -0.7958 at year 2001, and drops down through year 2003, and rises up after that. Table 15 displays the number of percentages of up- and downgrades of each year. This table is consistent with the results on G6 that the rating agency applies more lenient standards when assigning ratings.