CHAPTER III

Data and Methodology

3.1 Data

The samples are the firms in G7 nations provided by Reuters. Then, select only the prime stock market of each country and choose the firms that rated by S&P domestic Issuer Credit Rating as the sample. The prime stocks exchanges are selected because this study is expanded into 7 countries, then the data need to be compact and efficient. The advantages of using prime stock exchange are as follow. Firstly, the numbers of rating agencies giving the rate to the firms, firms listed in the stock exchange are rated by more than one rating agency. Next, the stock exchange will have various types of firm which will include a vast industries type in this research.

The data of firms' credit rating and firm name are retrieved from Reuter's database and accounting data are retrieved from DataStream's database. The risk free rate used to calculate probability of default is 3 month T-bill from each country. After excludes the firm that missing, the samples then includes the firms from Toronto stock exchange 127 firms, Frankfurt stock exchange 58 firms, Euronext Paris 83 firms, Milan stock exchange 34 firms, Tokyo stock exchange 273 firms, London Stock exchange 91 firms, and S&P 500 index 405 firms. Total firms are 1,071 firms; 10 years time series data cover the period of 1997 to 2006 which contains rating are 6,991 firm-years. Then, the accounting data and the variables that are missing value are cut and net observations are 6,070 firm years.

3.2 Research Hypotheses

To conduct the empirical objective, the following hypotheses will empirically examine:

Hypothesis 1: In G7 nations, credit ratings are a material consideration in managers' capital structure decision as in Kisgen (2006).

Under this hypothesis, if firms concern in their rating, they will be less likely to issue debt securities if its rating have potential to change both upgrades and downgrades.

Hypothesis 2: Probability of default is useful determinant in explaining the change in firms' capital structure.

Since probability of default has an effect on credit rating and credit rating has an effect on firms' capital structure, then probability of default must have an effect on capital structure too. Firms with high probability of default will be more likely to issue less/no debt.

3.3 Methodology

This thesis investigate the behavior of credit rating effect on firms' capital structure and the use of probability of default in determine the firms' capital structure in G7 nations.

3.3.1 The effect of credit rating on firms' capital structure in G7 nations

In First step, I will test the significance of credit rating affects on the G7 nations. Testing this is to investigate the affect of credit rating on firms' capital structure in the G7 nations. The following section I will explain about testing of an affect of credit rating on firms' capital structure follow Kisgen (2006). The data used will be firms' financial statement of listed firms with its credit ratings from these countries. Note that the rating/credit rating mentioned in this paper is the firms' rating.

To test the effect of credit rating on firms' capital structure, as Kisgen (2006) he do assume the characteristic of firms that have potential to change in rating. Firms whose have potential to change in their rating are firms that have its rating with plus or minus sign called "Board rating test". In other word, within the broad rating of B, both B+ and B- firms are defined to be near a rating change and firm that are B are not. For example, Rating B+ will be upgraded to rating BB- while rating B-will be downgraded to rating CCC+. In the real world, there is more kind of rating change. Firm in the middle of broad rating must concern about changing to plus or minus category. Then concern only rating change between broad ratings might underestimate the true effect. For example, a strong B- firm may not be near a downgrade within B broad rating and a weak B+ may not be near an upgrade or strong B and weak B either changes to B+ or B- respectively.

The second measure allows for testing of credit rating effects at all rating changes. Testing in this level is called "Micro rating test" which will observe the change within each broad ratings. In Kisgen (2006) he divide particular rate in each broad rating into three levels by using credit scoring to classify which level firms are in. For example, firms that have B rate will be classified into three levels, high, middle, and low, by using credit scoring. Firms that ranked in high and low level will be assumed to be firms that are likely to change in their ratings (High or Low Test or HOL Test).

Two levels of test Kisgen (2006) designed are called "Board Rating test" or "Plus or Minus Tests" and "Micro Rating test" or "High or Low Tests" which will be discussed in next section including the calculation of each countries credit scoring to classify the level of firms in "Micro Rating Tests".

3.3.1.1 Plus or Minus Tests

In this section, I will evaluate a change in broad rating using POM Tests. Kisgen (2006) implies that firms with plus or minus rating will issue less debt relative to equity than firms that are in the middle. The following three regressions are used to test this hypothesis:

$$NetDIss_{it} = \alpha + \beta_0 CR_{POM} + \phi K_{it} + \varepsilon_{it} \quad (1)$$

$$NetDIss_{it} = \alpha + \beta_1 CR_{Plus} + \beta_2 CR_{Minus} + \phi K_{it} + \varepsilon_{it} \quad (2)$$

$$NetDIss_{it} = \alpha + \beta_3 CR_{POM} + \varepsilon_{it} \quad (3)$$

Where

$NetDIss_{it}$ = net debt issuing for firm i at time t $(\Delta D_{i,t}-\Delta E_{i,t})/A_{i,t}$.

CR_{Plus} = dummy variable (equal to 1) for firms that have a plus credit rating at the beginning of the period.

CR_{Minus} = dummy variable for firms that have a minus credit rating at the beginning of the period.

CR_{POM} = $CR_{Plus} + CR_{Minus}$ = dummy variable for firms that have a minus or plus credit rating at the beginning of the period.

K_{it} = set of control variables, including leverage: $D_{i,t-1}/(D_{i,t-1}+E_{i,t-1})$, profitability: $EBITDA_{i,t-1}/A_{i,t-1}$, and size: $\ln(Sales_{i,t-1})$.

These equations test whether a firm's net issuance of debt and equity for a particular year is affected by how near that firm is to change their credit rating at the end of the previous period.

Assumption is that firms that nearly change in credit rating are more likely to issue less debt, both to boosts up to the higher rating and prevent from rating down grade, than firms in the middle. So the negative relationship between credit rating

dummy and net debt issuing is expected. Thus, the null hypothesis is $H_0 : \beta_i \geq 0$ while $H_1 : \beta_i < 0$, i=0, 1, 2, 3. Then the null hypothesis is expected to be rejected which implies the negative relationship of change in rating and debt issuance. Only consider the rating change from one board rating to another is not enough, the change within board rating must also be considered. Kisgen (2006) design what he calls "Micro Rating".

3.3.1.2 High or Low Tests

In this section, I will evaluate the concern for a potential change in rating of any kind. This test will deeply focus on the classes of each rate within particular board rating which Kisgen (2006) called "Micro Rating". Firms will be assigned the number computed by using credit scoring and classify what level firms are in. The firms which are in the high and Low level are assumed to be the firms that are more likely to change in their rating than those in the middle level. To compute credit score, the following regression is used. All three independent variables are the variables that thought to be able to predict credit score. Note that the variable NI/A is used instead of variable EBITDA/A due to the data missing of EBITDA that corrected from DataStream.

$$CreditScore = \beta_1 Log(A) + \beta_2 \frac{NI}{A} + \beta_3 \frac{Debt}{TotalCap} \qquad (4)$$

The dependent variable is now assigned the number 1for a rating D, up to 22 for rating AAA. Then the regression is run using Order Probit Model and got the coefficient of each independent variable. Next, these coefficients and independent variables are used to calculate credit score for each firm. After getting credit score for each firm, the firms is assigned its credit score and classified by rate. Each rate is divided into 3 levels and assigned letter H for high, M for middle, and L for low. Then

the dummy number is assigned. For example, within micro rating B+, firms with credit score that place them in the high and low level within B+ are given a value of 1 for dummy variable CR_{HOL} and firms with credit scores that place them in the middle level are assigned a 0 for dummy variable.

The following regressions will be used to evaluate the micro rating change. As same as broad rating test the different is the dummy variables:

$$NetDIss_{it} = \alpha + \beta_0 CR_{HOL} + \phi K_{it} + \varepsilon_{it} \quad (5)$$

$$NetDIss_{it} = \alpha + \beta_1 CR_{High} + \beta_2 CR_{Low} + \phi K_{it} + \varepsilon_{it} \quad (6)$$

$$NetDIss_{it} = \alpha + \beta_3 CR_{HOL} + \varepsilon_{it} \quad (7)$$

Where

$NetDIss_{it}$ = net debt issuing for firm i at time t $(\Delta D_{i,t}-\Delta E_{i,t})/A_{i,t}$.

CR_{High} = dummy variable for firms that are in the high level of their micro rating with regard to their credit score at the beginning of the period.

CR_{Low} = dummy variable for firms that are in the low level of their micro rating with regard to their credit score at the beginning of the period.

CR_{HOL} = $CR_{High} + CR_{Low}$ = dummy variable for firms that are in high or low level with regard to their credit score at the beginning of the period.

K_{it} = set of control variables, including leverage: $D_{i,t-1}/(D_{i,t-1}+E_{i,t-1})$, profitability: $EBITDA_{i,t-1}/A_{i,t-1}$, and size: $\ln(Sales_{i,t-1})$.

These equations test whether a firm's net issuance of debt and equity for a particular year is affected by how near that firm is to change their credit rating at micro level at the end of the previous period.

Assumption is that firms that nearly change in micro rating (high and low level) are more likely to issue less debt, both to boosts up to the higher rating and

prevent from rating down grade, than firms in the middle. Then, negative relationship between the credit rating dummy and net debt issuing is expected. Then the null hypothesis is $H_0 : \beta_i \geq 0$ while $H_1 : \beta_i < 0$, i=0, 1, 2, 3. Then the null hypothesis is expected to be rejected which implies the negative relationship of change in micro rating and debt issuance.

3.3.2 The use of Probability of Default as determinant of the Firms' Capital Structure

In this step, I will test the Probability of default (PD) affect on firms capital structure by calculate each firms' PD and use same regression as in previous section to test my hypothesis. I use PD instead of firms' credit rating to determine capital structure change in believe that PD can affect the firms' capital structure which is able to be used as a determinant of capital structure, base on the logic that PD have an effect on firms' rating and firms' rating have an affect on the change in capital structure. Moreover, I believe that PD will be the easier tool in investigating the change in capital structure than credit rating is. There are 2 benefits of using PD over credit rating. Firstly, since PD is calculated from stock price which always change. It makes PD become more dynamic than credit rating. Secondly, we can calculate PD by ourselves using Merton's model which stock prices are used as input. These create the independence from rating agencies. So, replacing PD in this purpose will make the observation on capital structure behavior become more convenient and easier. In this section, the hypothesis is that PD can be used to determine firms' capital structure change. To test this hypothesis, Net Debt Issuing ($NetDIss_{it}$) from previous section will also be used as the proxy of change in firms' capital structure. PD, the explanatory variable, will be calculated using Merton's model, the structural form (using historical stock price) and will be run with $NetDIss_{it}$, the dependent variable.

The following section will discuss about the PD calculation and the test of PD on firms' capital structure.

3.3.2.1 Probability of Default Calculation

The Probability of Default of each company will be calculated by implying Black-Scholes Model.

$$C = SN(d1) - Ke^{-rT}N(d2)$$

To apply this manager of the company will be looked as call option holder, underlying asset (usually Stock (S)) is now the firm value (Value (V)) and exercise price (K) is now firms' debt level (D), manager will exercise the option when the underlying asset is greater than the exercise price. In this place, if Value > Debt, manager will pay debt, but if Value < Debt manager will default (mean that the option will be exercise when S>K (V>D)).

$$E = VN(d1) - De^{-rT}N(d2)$$

$$\sigma_E = \frac{V}{E}N(d1)\sigma_V$$

How to calculate PD? PD is the probability that S<K (not exercise the option) or V<D (manager will not pay debt). We know that N(d2) is the probability that option will be In the Money, $\Pr ob(S \geq K)$, then probability that option will be Out of the Money, $\Pr ob(S < K)$, can be calculated as 1-N(d2) or N(-d2).

Then the probability of default can be observed back out the parameter V and σ_V by using Excel. Then we can find N(d2), the probability of In the Money and calculate the firms' PD, 1-N(d2).

3.3.2.2 Running probability of default with Net debt issuing

The regression below will be used in finding the relationship between the probability of default and net debt issuance (capital structure change) by expect that the probability of default in period t-1 will have an effect on the capital structure in the period t.

$$NetDIss_{it} = \alpha + \beta_0 PD_{i,t-1} + \phi K_{i,t} + \varepsilon_{it} \quad (8)$$

$$NetDIss_{it} = \alpha + \beta_1 PD_{i,t-1} + \varepsilon_{it} \quad (9)$$

Where

$NetDIss_{it}$ = net debt issuing for firm i at time t (Δ Di,t- Δ Ei,t)/Ai,t.

$PD_{i,t-1}$ = Probability of default for firm i at time t-1

K_{it} = set of control variables, including leverage: $D_{i,t-1}/(D_{i,t-1}+E_{i,t-1})$, profitability: $EBITDA_{i,t-1}/A_{i,t-1}$, and size: $\ln(Sales_{i,t-1})$.

The series of $NetDIss_{it}$ and PD_{t-1} will be run using OLS upon the regression above for every firms in 7 nations from the data. Assumption is that firms that face the situation of high PD in previous period will be more likely to reduce its debt. The negative relationship also be expected here. Then the null hypothesis is $H_0 : \beta_i \geq 0$ while $H_1 : \beta_i < 0$, i=0, 1. Then the null hypothesis is expected to be rejected which implies the negative relationship of probability of default and debt issuance. PD is expected to be superior to credit rating as capital structure's determinant.

If the result came out as expected, probability of default can provide; the more dynamic in observing the capital structure change since credit rating is rarely change. The independence from the rating agencies and reduce bias from the agencies since the probability of default can be self calculating using stock price which should reflect all information about the firms in the market such G7 countries. Moreover, probability

of default can be more convenient and powerful tool in investigating the change in capital structure.

3.3.3 Incorporating Credit Rating and Probability of Default into Capital Structure Theories

In this section, testing credit rating and probability of default on the capital structure theories, Pecking Order, Trade-off, and Market Timing theory will be discussed. Objective of this section is to test the explanatory power between credit rating dummy and probability of default variables with capital structure variables. Testing credit rating and PD on capital structure theories is testing the synchronization of new theories to traditional one.

3.3.3.1 Pecking Order Test

The test for pecking order asserts that to the extent that a firm has a deficit in funds (DEF) beyond what can be met by internally generates funds; the deficit will be made up through an issuance of debt instead of equity. Then, DEF is defined as capital expenditures, dividend payments, the net increase in working capital, and the current portion of long-term debt less operating cash flows. In this study, net increase in working capital and current portion of long-term debt are deleted because of unavailability of data from DataStream database. To determine whether credit rating affect and PD affect on firms' capital structure are persist in the context of pecking order test, Kisgen (2006) adapt the following regression from the work of Shyum-Sunder and Myers (1999):

$$\frac{\Delta LTD_{it}}{A_{it}} = a + b\frac{DEF_{it}}{A_{it}} + c\frac{(TLTD - LTD_{it})}{A_{it}} + dMTBV_{i,t-1} + eCR_{POM} + fCR_{HOL} + gPD_{i,t-1} + \varepsilon_{it} \quad (10)$$

Where

ΔLTD_{it} = Change in long-term debt for firm i at time t

A_{it} = Total asset of firm i at time t

DEF_{it} = Deficit of firm i at time t

$TLTD$ = Target long-term debt of firm i at time t

LTD_{it} = Long-term debt of firm i at time t

$MTBV_{i,t-1}$ = Market to book ratio of firm i at time t-1

CR_{POM} = $CR_{Plus} + CR_{Minus}$ = dummy variable for firms that have a minus or plus credit rating at the beginning of the period.

CR_{HOL} = $CR_{High} + CR_{Low}$ = dummy variable for firms that are in high or low level with regard to their credit score at the beginning of the period.

$PD_{i,t-1}$ = Probability of default for firm i at time t-1

Upon Pecking order theory "b" must close to 1, in other word, when firm run out of fund, deficit, firm will find other source of financing and borrowing is that source which is the step of financing upon the pecking order theory, and "a" is close to 0. CR_{POM} and CR_{HOL} are the dummy variable for the firm that have credit rating plus or minus within broad rating, and the firm that have ranked by credit score in high and low level of its micro rating. PD_{t-1} is the probability of default of previous period. If the pecking order theory is correct and above three variables are not matter, the e, f, and g coefficients should be equal to 0. If above three variables are work, it implies that the e, f, and g will be less than 0 implies negative relationship to the debt issuing.

3.3.3.2 Trade-off Theory Test

Trade-off theory implies that there should be no change in leverage from year to year, regardless of whether the firms are near the change in rating, except to move back to the target leverage.

Refer to equation10; TLTD is the firm's target long-term debt level. It is calculated from the historical average of debt to total capital ratio, Tarrart (1977). To derive the target debt level for particular year, the average debt ratio are taken for each firm sample period and multiply that average by the firm's beginning total capital of each year. The trade-off theory states that "c" will stay between 0 and 1. In other word, if target debt level is higher than the real debt level, which will get positive result, firms need to issue more debt in order to move it real debt level to the target debt level. This implies positive relationship with debt issuing. While credit rating and PD imply that firms near an upgrade or a down grade and firms face the situation of high PD respectively, may be less willing to increase their debt level , even if they are below their target debt levels. Thus, credit rating and PD imply that "e", "f", and "g" will have negative value.

3.3.3.3 Testing on Market Timing Theory

The change in market stock price can leads to the different decision of securities issuing. Based on the market timing theory, the securities issuing will time the market, Baker and Wurgler (2002), thus, the increase in price lead to the issue of equity security to time the market. Since the market stock price is used in the process of probability of default calculation, then market timing theory is also needed to be examined.

The market timing theory claims that the equity security will have the positive relationship with the firm's market stock price. Based on the equation10, firm's

market stock price will have the negative relationship with the debt security issuing. In other word, if the market timing theory is exist, the negative relationship between $MTBV_{i,t-1}$ and $\frac{\Delta LTD_{it}}{A_{it}}$ is expected and "d" will stay between -1 and 0.