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Capital Structure and Default Risk: Evidence from Korean Stock Market*

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Abstract

This study analyzes the effect of the capital structure of Korean manufacturing firms on default risk based on Moody's KMV option pricing model where the probability of default is obtained by measuring the distance to default as a covariant in logit model developed by Merton (1974). Based on the panel data of manufacturing firms, this study achieves its primary objective, using a fixed effect regression model and examines the effect of a firm's capital structure on default risk amongst publicly listed firms on Korea exchange during 2005-2016. Empirical results obtained suggest that the rise in short-term debt to assets leads to increase the risk of default whereas the increase in long-term debt to assets leads to decrease the default risk. The benefits of short-term debt financing over a short-term period fade out in the presence of information asymmetry. However, long-term debt financing overcomes the information asymmetry and enjoys the paybacks of tax advantage associated with long-term debt. Additionally, size, tangibility and interest coverage ratio are also the important determinants of default risk. Findings support the trade-off theory of capital structure and recommend the optimal use of long-term debt in a firm's capital structure.

Keywords: Capital Structure, Default Risk, Korean Stock Market, Merton's Model, Moody's KMV.

JEL Classification Code: G32, G33, G39.

1. Introduction

Capital structure is one of the important decisions in corporate finance and it deals with a choice between different ways of financing available to corporate firms. A balance between benefits and costs of debt financing emerge as a theory called the trade-off theory (Myers, 1984). Jensen and Meckling (1976) suggested that the probability of default or bankruptcy has an important role in the trade-off theory of capital structure. Moreover, they stated that firms following the trade-off theory choose capital structure by trading off the costs of debt (financial distress and bankruptcy) with the benefits of debt (tax shield advantage). However, the use of debt financing creates agency issues between shareholders and management and between debt holders and shareholders.

Present study directly tests the trade-off theory of capital structure, using an expected default frequency (EDF) as the measure of the default risk in an empirical analysis of manufacturing firms listed on Korea exchange. Based on data analysis from 2005-2016, this study not only identifies the strong bonding between the capital structure of the Korean manufacturing firms and their default risk but also tries to minimize the literature gap. The recent study of Gul, Cho, and Wang (2018) claimed the role of rollover risk in increasing the default risk for Korean firms, but it did not analyze the effect of overall capital structure's measures on default risk. Following the model of Merton (1974), the present study is the first to analyze the effect of capital structure on the EDF of Korean manufacturing firms, aiming at providing the findings in the great interest of future policymakers and academic researchers.

There are several empirical and theoretical studies regarding the corporate capital structure. However, considering the importance of the manufacturing sector in the economy of Korea, not enough empirical studies have been conducted to analyze the different possible determinants of corporate default, using the option pricing model which is an important part of the financial theory. Using the panel data from 1985-2002 for Korean manufacturing firms, Kim, Heshmati, and Aoun (2006)

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developed a model for the dynamic capital structure and results indicated that higher optimum leverage is found in chaebol firms and these firms adjust their capital structure quicker than non-chaebol firms. Moreover, they found that a firm's leverage is associated with factors such as size, profitability, growth opportunity, and financial crisis, but not with the factor of chaebol- affiliation. Kim, Kim, and Youn (2017), with analysis on the family-owned Korean firms from 2002-2012, argued that family ownership put negative effect on the firm's value, which resulted from the presence of agency problems from controlling family shareholders.

This study divides debt into short-term debt and long-term debt, and findings are also analyzed separately for these two categories of debt financing. Short-term debt leads to increase the probability of default due to the presence of information asymmetry and firm thus does not realize the benefits of debt financing over a short-term period. However, long-term debt financing overcomes the information asymmetry and enjoys the benefits of tax advantage associated with long-term debt. Thus, higher use of long-term debt financing decreases EDF. Further, it is found that the firm's size, tangibility, and interest coverage ratio are also important factors which further increase EDF.

The remainder of the present study consists of four more sections as follows. Section 2 presents literature and develops the hypotheses of this study. It discusses the measures of capital structure, a measure of default risk and control variables. Section 3 for research methodology, contains information regarding the data collection, sample, and measurement of variables. An empirical analysis is conducted in Section 4. Descriptive statistics, correlation analysis, and fixed effect regression models are employed to analyze the data. Finally, Section 5 concludes the findings and also provides suggestions for further research.

2. Literature Review

Previous literature analyzing the determinants of corporate default can be divided into two strands. First employs a statistically reduced form of models and basically employed for the prediction of bankruptcy. The second strand of literature follows a structural approach of deriving the default probability based on the eminent work of Merton (1974), which is employed in this study.

2.1. Default Risk

Merton (1974) constructed EDF by using a structural model approach. Many studies in past, used credit ratings to analyze the default risk, which accounts for the relative measure of default risk at some fixed number of discrete levels. But, EDF is a prediction of default, observed statistically over course of the credit cycle. Therefore, EDF is considered a more appropriate measure of default than credit ratings (Wang, Chiu, & Pena, 2017; Hovakimian, Kayhan, & Titman, 2012). Wang et al. (2017) claimed that EDF also predicts the likelihood of a firm's default in near future rather only in past. They further suggested that in the process of computing EDF, the Moody's KMV estimates the distance to default by computing the volatility for the firm's underlying assets, using an iterative method such as volatility of equity returns and structural model formulas. This study uses an estimation of asset return volatility for controlling an asset risk while examining leverage and beta (risk) in the cross-sectional units.

2.2. Capital Structure

Capital structure means an arrangement through which a firm finances its assets by employing the combination of debt, equity or hybrid securities (Saad, 2010). Based on the previous studies of Dasilas and Papasyriopoulos (2015) and Mateev, Poutziouris, and Ivanov (2013), this study employs long-term debt to assets (LTDA) and short-term debt to assets (STDA) as the measures of capital structure.

2.3. Capital Structure and Default Risk

Default probability, which is measured by EDF and credit ratings has a central role in static trade-off theory of a firm's capital structure. Firms having higher financial distress and motivation for higher debt level are expected to have a higher probability of bankruptcy (Hovakimian et al., 2012), and higher leverage level is associated with higher default probability (Bonaccorsi di Patti, D'Ignazio, Gallo, & Micucci, 2015). In Merton's structural model, the default risk is derived from a combination of the firm's assets volatility and its capital structure. There are higher chances that the firm's value will decrease below the default point (liabilities) when it contains more leverage; as higher leverage leads to a more volatile value of the firm. However, a higher default risk does not necessarily lead to higher systematic risk. For instance, corporate debt yield contains expected loss and expected gain component. The expected loss is directly associated to default risk, whereas the expected return is connected to the non-diversifiable risk (Merton, 1974). Hamada (1972) found that covariance between the market risks or beta mechanically should rise with an increase in leverage level. However, there is also a possibility that firms with higher leverage show low business or asset risk.

Kisgen (2006) argued that the firm adjusts its capital structure according to its different credit ratings (a measure of default risk). Kisgen (2009) claimed that managers arrange capital structure's behaviors to set the minimum level of credit ratings, so that firm more likely decreases its debt in accordance with the lower rating level. Bosch and Steffen (2011) argued that if the firm is not rated high, no capital will be delivered by the non-bank investors and firm will more rely on equity shares. Kisgen and Strahan (2010) implied that the firm's cost of debt is affected by rating based rules on investments in bonds. The study of Molina (2005) claimed that while considering the capital structure decisions, credit ratings are important assessments of forecasting firm's default risk. The findings of Graham and Harvey (2001) suggested that while issuing debt, credit ratings rank higher than any other factor in the traditional model of capital structure. Based on this literature, the following hypothesis is developed:

H1: There is a positive relationship between LTDA and EDF.

McCann and Calder (2012), on the other hand, with the probability of default from credit register data of Irish small and medium enterprises (SMEs), suggested that a firm is expected to default if it has debt due in 90 days. According to the study of Schwarcz and Schwarcz (2014), short-term debt financing brings less interest rate risk as compared to long-term debt financing. They further argued that short-term debt financing is an easy way of judging the borrower's ability to pay long-term debt financing. However, short-term debt also possesses a higher probability of rollover risk. Rollover risk is that part of the long-term debt, which is due at the end of year 't-1', and is settled in the year 't' (Wang et al., 2017). Gopalan, Song, and Yerramilli (2014) claimed that rollover risk arises when there is an existing debt payable and subsequent liquidity needs are unmet and firm rely on short-term debt by constantly rolling over expiring debt liabilities, which is itself a factor of greater risk of default. Considering the previous literature provided above, the following hypothesis is developed:

H2: There is a positive relationship between STDA and EDF.

2.4. Control Variables

2.4.1. Cash and Default Risk

It is commonly believed that firms with enough cash holdings (CASH) are safe and have fewer credit spreads (Acharya, Davydenko, & Strebulaev, 2012). In other words, there will be a lower probability of default and credit spread for the cash-rich firms, when other things are being kept constant. Other studies such as Anderson and Sundaresan (1996) and Ross (2005) found the similar findings that even with fundamentally sound business, any temporary decline in cash flows leaves the firms out of necessary cash required for servicing the debt. Thus, insufficient liquidity in the presence of short-term obligations may result in default even when there is no economic distress.

2.4.2. Tangibility and Default Risk

Dasilas and Papasyriopoulos (2015) argued that the firm's tangibility has a positive correlation with its debt, and tangible assets (TANG) can reduce the bankruptcy cost and credit risk. TANG possesses a positive correlation with leverage and it can mitigate the problems of information asymmetry (Degryse, Goeij, & Kappert, 2012). Other studies such as Korteweg (2010) and Céspedes, González, and Molina (2010) also argued that TANG positively correlate with leverage. Jong, Kabir, and Nguyen (2007) found that firm with a high fraction of TANG mitigates lender's risk with TANG used as collateral. Therefore, a high fraction of TANG is associated with high leverage. Mateev et al. (2013) pointed out that firm's tangibility behaves differently with either short-term debt or long-term debt. Long-term debt is positively correlated with tangibility, while there is a negative relationship between the tangibility of the firm and short-term assets.

2.4.3. Size and Default Risk

Dasilas and Papasyriopoulos (2015) argued that a firm's size (SIZE) is an inverse proxy for earning's volatility and bankruptcy. Trade-off theory predicts that there is a positive correlation between leverage and SIZE (Fama & French, 2002), and thus there is the possibility of a higher probability of default, due to higher debt financing. On the other hand, Degryse et al. (2012) claimed that large size firms are more diversified and their earnings are less volatile, therefore bankruptcy cost is compensated by less volatile earnings.

Firm size positively correlates with leverage, since large companies get reliable and high-quality information, which thus results in lower cost of debt (Lee & Son, 2015; Palacín-Sánchez, Ramírez-Herrera, & di Pietro, 2013). Other researchers such as Céspedes et al. (2010) also found similar findings, claiming that a SIZE is negatively associated with default risk and asset volatility. George and Hwang (2010) reported that firm size derives the default risk premium in equity returns. More diversified and large-sized firms face a lower level of default risk (Frank & Goyal,

2009). With an analysis of Iranian firms from 2006-2012, Salehi, Rostami, and Salmanian (2013) claimed that the capital structure of the firm varies according to a firm's life cycle stage.

According to Harris and Raviv (1991), large size firms and firms having a significant level of TANG possessed less financial distress and thus are more likely to get long-term debt financing. On the contrary, firms with less TANG and growth opportunities prefer avoiding debt financing due to the high cost of financial distress. Moreover, firms with higher TANG and larger SIZE are more likely to be rated high and such firms get access to the long-term debt due to their ability to maintain low information asymmetry and less cost of financial bankruptcy.

2.4.4. Interest Coverage Ratio and Default Risk

Wang et al. (2017) examined the effect of rollover risk on the risk of default, using a comprehensive database of U.S. industrial firms from 1986-2013, and found that interest coverage ratio (INTCOV) has a positive correlation with default risk. However, by the study on the relationship of rollover risk with default risk for manufacturing firms listed on Korea exchange from 2005-2016, Gul et al. (2018) claimed that there is a negative relationship between INTCOV and default risk.

3. Research Methodology

3.1. Variables

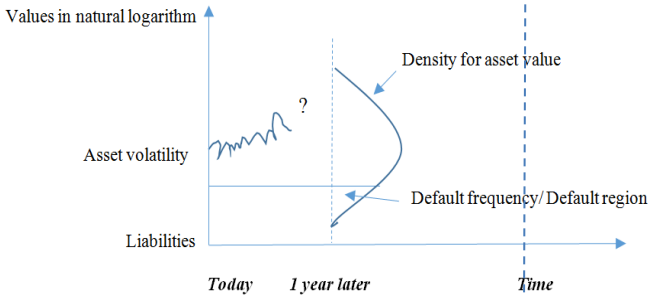
3.1.1. Default Risk

Based on Merton (1974), the present study uses an expected default frequency (EDF) to represent default risk. Many of the previous studies employed EDF to analyze default risk of non-financial firms (Gul et al., 2018; Wang et al., 2017; Hovakimian et al., 2012; Löeffler & Posch, 2011). In this study, a well-known Moody's KMV approach is adopted to measure EDF, using the mathematical equation (1) given below:

$$EDF= \quad N\left(-\left(\frac{log\left(\frac{V}{B}\right)+\left(\mu-\sigma^2{}_v/2\right)T}{\sigma_v\sqrt{T}}\right)\right) \tag{1}$$

where N (.) is cumulative normal function; V is the firm's total value; B is a book or face value of total liabilities; σ_v is a change or volatility in firm's daily asset's return for each year of 12 years' sample period; μ is an estimate for expected long-run firm's asset return and is computed by taking the mean value of log returns of V; T is a forecast horizon and in this case it is equal to 1 year; EDF is a one-year default frequency.

In Figure 1, firms reach to default region when their value of assets falls below the value of liabilities. By following the steps given by Löeffler and Posch (2011), EDF can be computed using the accounting data obtained from financial statements.



Source: Löeffler & Posch (2011)

Figure 1: Expected Default Frequency

The geometric Brownian motion for asset's values is assumed as the equation (2) given below:

$$dV = \mu V dt + \sigma_v V dz \tag{2}$$

where V and dV are the value of firm and changes in the value of the firm, respectively; μ and σ_v are the continuously compounded return of V and volatility of firm's value, respectively; dz represents Wiener process (standard Brownian motion). The market value of equity can be related to the total value of the firm in the following way:

$$V_E = VN(d_1) - Be^{-rT}N(d_2) \tag{3}$$

$$d_1 = \frac{ln\left(\frac{V}{B}\right)+(r+\sigma^2{}_v/2)T}{\sigma_{v\sqrt{T}}},$$

$$d_2 = d_1 - \sigma_v\sqrt{T}$$

where V_E represents the market equity; r is the risk-free interest rate; B represents a book or face value of liabilities (value of debt); N(.) is the cumulative standard normal distribution.

Furthermore, V_E is market capitalization or the product of outstanding shares and the current market price of the stock for 1-year. B is debt taken as the sum of current liabilities and half of the long-term liabilities. Remaining variables are the value of the firm (V) and the volatility of a firm's value(σ_v). The volatility of firm's value(σ_v) is estimated as the annual

standard deviation of asset's return and for this purpose, daily data is used over a 1-year period about the summation of the face value of debt and market value of equity over the past year. The drift (μ) is computed by taking the mean of log returns of the firm's value (V). With all above inputs, EDF is computed using equation (1).

3.1.2. Capital Structure

According to the previous literature such as Dasilas and Papasyriopoulos (2015), Mateev et al. (2013), Palacín-Sánchez et al. (2013) and Degryse et al. (2012), this study uses two measures of capital structure; STDA and LTDA. STDA is short-term debt which is the sum of current liabilities for one-year obtained from the balance sheet, and is taken as the ratio to total assets. LTDA is the long-term debt which is the sum of non- current liabilities for one-year given in the firm's balance sheet, and is taken as the ratio to total assets.

3.1.3. Control Variables

In order to further strengthen the empirical model, more characteristics of the firms such as its CASH, TANG, SIZE, and INTCOV are also included as the control variables. CASH includes all cash and cash equivalents and is measured as the ratio of cash and cash equivalents to total assets. TANG is representing all tangible assets such as plant, property, machinery, and equipment and is taken as a ratio to total assets of the firm (Dasilas & Papasyriopoulos, 2015; Palacín-Sánchez et al., 2013; Mateev et al., 2013). Natural log of total assets (millions KRW) of the firm is taken as a proxy for SIZE (Gul et al., 2018; Wang et al., 2017; Dasilas & Papasyriopoulos, 2015). INTCOV is given as the ratio of operating income after depreciation to the total interest expenses (Gul et al., 2018; Wang et al., 2017; Gopalan et al., 2014).

3.2. Sample and Data Collection

Targeted firms are manufacturing firms listed on Korea exchange. All accounting based information is obtained from the balance sheets and income statements. For this purpose, Data Analysis, Retrieval and Transfer System (DART) for the Repository of Korea's Corporate Fillings are used. DART carries the accounting information of Korean firms, listed on stock exchange from 2005-2016. Therefore, this study conducts analysis for 12 years, starting from 2005 and ending in 2016. On the DART database, there are 455 manufacturing firms, listed on Korea exchange from 2005-2016 and based on a random sampling method, 50 firms are chosen for analysis. Thus the sample size is more than 10% of the total population of manufacturing firms present on DART database from 2005-2016. It is also considered that chosen firm should not have total debt less than 5% of its total assets. Yahoo Finance's website is used to obtain the data on share prices.

4. Research Analysis

4.1. Descriptive Statistics

The descriptive statistics are presented for default risk, capital structure's measures, and control variables in Table 1. Recall that 50 firms from the manufacturing sector are examined over 12 years, leading to 409 data points, based on a common sample for all variables.

Table 1: Descriptive Statistics

Sample: 2005-2016							
	EDF	**STDA**	**LTDA**	**CASH**	**TANG**	**SIZE**	**INTCOV**
Mean	0.256	0.260	0.158	0.178	0.290	3.373	1.991
Median	0.223	0.263	0.162	0.183	0.300	3.378	1.626
Maximum	1.000	0.572	0.411	0.299	0.645	3.500	5.717
Minimum	0.000	0.071	0.013	0.103	0.001	3.230	0.008
Std. Dev.	0.214	0.101	0.080	0.025	0.124	0.056	1.430
Skewness	0.915	0.347	0.226	-0.512	-0.312	-0.526	0.972
Kurtosis	3.700	2.539	2.383	4.050	2.587	3.187	3.114
Observations	409	409	409	409	409	409	409

According to Merton's model (Moody's KMV approach), EDF value lies between 0 and 1; 1 being high default risk and 0 being low or no default risk. The mean for EDF in Table 1 is 0.256, indicating that Korean firm's default risk is relatively low and it can be easily inferred that Korean firms listed on Korea stock exchange lie in the safer zone in terms of default risk, which is consistent with the studies such as Wang et al. (2017) and Gul et al. (2018). The median of EDF is 0.223, indicating that half of the data set for EDF is below the average EDF of overall EDF's distribution. In other words, half of the firms in a sample have EDF below the average EDF of 50 manufacturing firms, included in the sample. The maximum of EDF in overall sample is 1 and the minimum is 0. The mean of STDA and LTDA is 26.0% and 15.8%, respectively. Therefore, it is seen that Korean firms rely more on equity financing than on debt financing and a major portion of debt financing consists of short-term debt. Moreover, the median of STDA and LTDA is 26.3% and 16.2%, respectively. Thus, it is inferred that half of the firms in a sample of 50 firms have short and long-term debt above the average STDA and LTDA.

Table 2: Correlation Matrix

Covariance analysis: Ordinary
Sample: 2005-2016
Included observations: 600
Pairwise samples (Pairwise missing deletion)

Correlation Probability	EDF	STDA	LTDA	CASH	TANG	SIZE	INTCOV
EDF	1.000						

STDA	0.261***	1.000					
	0.000	----					
LTDA	-0.152***	0.196***	1.000				
	0.000	0.000	----				
CASH	-0.034	0.010	0.005	1.000			
	0.441	0.813	0.903	----			
TANG	-0.017	0.127***	0.269***	-0.040	1.000		
	0.702	0.004	0.000	0.376	----		
SIZE	-0.323***	0.037	0.073	0.106**	-0.161***	1.000	
	0.000	0.403	0.101	0.017	0.000	----	
INTCOV	-0.027	-0.324***	-0.423***	0.106**	-0.255***	-0.018	1.000
	0.553	0.000	0.000	0.023	0.000	0.703	----

Note: ***, **, and * represent the statistical significance at 1, 5 and 10% levels, respectively.

While looking at the other characteristics of sample firms, it is seen that on average, 17.8% of total assets are cash and cash equivalents and 29.0% of total assets are tangible assets such as property, plant, and equipment. SIZE is the natural log of total assets and an average of SIZE's distribution is 3.373. The mean of INTCOV is 1.991 which is a good figure for any manufacturing firm, to pay its due interest payments on the debt taken. Thus, Korean manufacturing firms have a reasonable capacity to pay off their interest payments. Furthermore, half of the data set for CASH, TANG and SIZE is above the respective mean values, as indicated by their corresponding medians 18.3%, 30.0% and 3.378, respectively. However, the median of INTCOV (1.626) on the other hand shows that half of the data set is below the average INTCOV (1.991). Skewness of EDF (0.915) and INTCOV (0.972) shows that EDF and INTCOV are positively skewed distributions.

4.2. Correlation Analysis

Table 2 shows the correlation matrix for one to one relationship among all given variables such as EDF, STDA, LTDA, CASH, TANG, SIZE, and INTCOV. In Table 2, the capital structure's measures (STDA and LTDA) are found to be statistically highly correlated with EDF. Correlation between EDF and STDA is 0.261 and is statistically significant at 1% level. Thus an increase in STDA tends to increase EDF and vice versa. On the other hand, LTDA is found to be negatively correlated with EDF (-0.152) and is statistically highly significant at 1% level. Therefore, an increase in LTDA will lead to decrease in EDF. SIZE is also found to be a highly considerable factor while dealing with the default risk of a firm.

Correlation between SIZE and EDF is negative (-0.323), and is statistically highly significant at 1% level. By diversifying or increasing the SIZE that is total assets of the firm, the default risk ultimately decreases significantly. Other control variables such as CASH, TANG and INTCOV are also negatively correlated with EDF, but these correlations are not only weak but also statistically insignificant.

4.3. Regression Analysis

4.3.1. LTDA and EDF

This study employs a panel data analysis method adopted by previous studies (Dasilas & Papasyriopoulos, 2015; Psillaki & Daskalakis, 2009) and analyzes the contribution of both of capital structure's measures by conducting a separate regression analysis for each, along with specific control group variables. Default risk's dependency on capital structure is analyzed with the fixed effect regression model as given below:

$$EDF_{i,\,t-1} = \alpha + \beta\,(\text{Capital Structure}_{\,i,\,t-1}) + \gamma X_{i,\,t-1} + \text{Firm FE} + \varepsilon_{it} \quad (4)$$

where $EDF_{i, t-1}$ is expected default frequency for the firm 'i' in the year '$_{t-1}$'; Capital structure $_{i, t-1}$ consists of $STDA_{i, t-1}$ and $LTDA_{i, t-1}$; the firm's characteristics $X_{i, t-1}$ ($CASH_{i, t-1}$ is the cash to assets for the firm 'i' in the year '$_{t-1}$'; $SIZE_{i, t-1}$ is the natural log of total assets for the firm 'i' in the year '$_{t-1}$'; $TANG_{i, t-1}$ is the tangible assets to total assets for the firm 'i' in the year '$_{t-1}$'; $INTCOV_{i, t-1}$ is the interest coverage ratio for the firm 'i' in the year '$_{t-1}$') in the model above are controlled variables. Moreover, an empirical model above includes the firm's fixed effects (Firm FE) for the purpose of controlling any unobservable factors affecting EDF_{t-1} across sample firms.

The first regression model to test the H1 is given as follows:

$$EDF_{i, t-1} = \alpha + \beta\ (LTDA_{i, t-1}) + \gamma X_{i, t-1} + \text{Firm FE} + \varepsilon_{it} \qquad (4.1)$$

Table 3: Regression results of (4.1)

Dependent Variable: EDF_{t-1}				
Method: Panel Least Squares				
Sample(adjusted): 2006-2016				
Periods included:11				
Cross-Sections included:47				
Total Panel(unbalanced) observations:409				
Variable	**Coefficient**	**Std.Error**	**t-Statistics**	**Prob.**
C	-3.6717*	2.0302	-1.8086	0.0714
$LTDA_{t-1}$	-0.4584***	0.1671	-2.7431	0.0064
$CASH_{t-1}$	-0.3231	0.4239	-0.7623	0.4464
$TANG_{t-1}$	0.2364*	0.1364	1.7331	0.0840
$SIZE_{t-1}$	1.1741*	0.6058	1.9383	0.0534
$INTCOV_{t-1}$	0.0146	0.0098	1.4859	0.1382
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.5530	Mean dependent var		0.2563
Adjusted R-squared	0.4891	S.D. dependent var		0.2136
S.E. of regression	0.1527	Akaike info criterion		-0.8026
Sum squared resid	8.3226	Schwarz criterion		-0.2923
Log-likelihood	216.1276	Hannan- Quinn criter.		-0.6007
F-statistic	8.6591***	Durbin- Watson stat		1.4649
Prob (F-statistic)	0.0000			

Note: ***, **, and * represent the statistical significance at 1, 5 and 10% levels, respectively.

The results presented in Table 3 show that the estimated coefficient of $LTDA_{t-1}$ has a negative effect on EDF_{t-1} and is statistically different from zero, which rejects the H1 with 1% level of statistical significance. This result is consistent with the findings of Hovakimian et al. (2012). Currently, Korean firms listed at Korea exchange are heavily relying on equity financing, but if they shift their capital structure towards long-term debt financing, there will be a significant decline in EDF_{t-1}. It is seen that for one unit rise in $LTDA_{t-1}$, there will be a 0.4584 units decrease in EDF_{t-1}. Use of short-term debt financing can increase the EDF_{t-1}, whereas higher use of long-term debt financing ($LTDA_{t-1}$), brings EDF_{t-1} down to the reasonable level.

Merton (1977) and Gruber and Warner (1977) found similar findings and they argued that interest paid on long-term debt is a tax-deductible expense. Therefore, an increase in long-term debt financing decreases the taxable income. Further, bankruptcy cost does exist when there is a higher use of long-term debt financing, but it is reasonably small relative to tax saving advantage, associated with long-term debt. The theory of agency cost argues that debt financing is one of the mechanisms to alleviate agency problems and to improve the firm's performance, and as a result of an improved firm's performance, default probability mitigates (Vijayakumaran, 2015). Therefore, for Korean firms, it is claimed that the trade-off theory of capital structure is a more attractive choice.

Further results presented in Table 3 suggest that investment in more $TANG_{t-1}$ and enlarged $SIZE_{t-1}$ lead to increase EDF_{t-1}. One unit rise in $TANG_{t-1}$ leads to 0.2364 units increase in EDF_{t-1}. This effect is statistically weak and is significant at the 10% level. Moreover, a one-unit increase in a firm's total $SIZE_{t-1}$ brings the 1.1741 units to increase in EDF_{t-1} and this finding is statistically significant at 5 % level. In other words, if a firm does not manage its long-term debt financing properly, then every unit rise in $SIZE_{t-1}$ and $TANG_{t-1}$ of the firm, bring an increase in EDF_{t-1} of Korean firms.

As indicated by R^2, this model captures the 55.30% variation in the dependent variable EDF_{t-1} and Adjusted R^2 is 48.91%. The F statistics further support the overall strength of this statistical model and it is statistically significant at 1% level. Data is also free from the issue of autocorrelation as Durbin Watson's value is 1.4649. Similarly, standardized residual's plot given in Figure 2 is free from any specific trend and it follows a clear normal distribution.

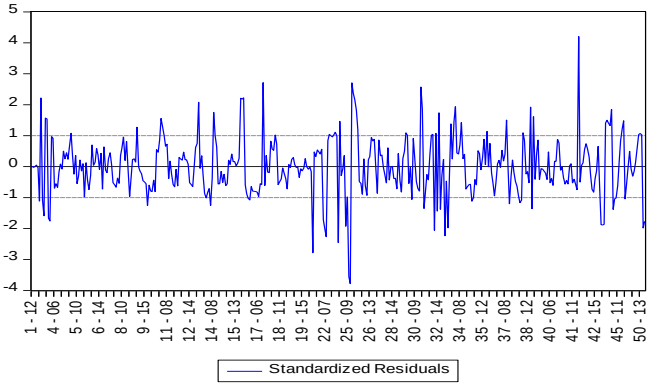


Figure 2: Residuals

4.3.2. STDA and EDF

The second regression model to test the H2 is given as follows:

$$EDF_{i,\,t-1} = \alpha + \beta\,(STDA_{i,\,t-1}) + \gamma X_{i,\,t-1} + \text{Firm FE} + \varepsilon_{it} \qquad (4.2)$$

Table 4: Regression results of (4.2)

Dependent Variable: EDF_{t-1}				
Method: Panel Least Squares				
Sample(adjusted): 2006-2016				
Periods included:11				
Cross-Sections included:47				
Total Panel(unbalanced) observations:425				
Variable	Coefficient	Std.Error	t-Statistics	Prob.
C	-4.0512**	1.6963	-2.3883	0.0174
$STDA_{t-1}$	1.0729***	0.1459	7.3541	0.0000
$CASH_{t-1}$	-0.6143	0.4004	-1.5342	0.1258
$TANG_{t-1}$	0.2146	0.1308	1.6412	0.1016
$SIZE_{t-1}$	1.1960**	0.5021	2.3819	0.0177
$INTCOV_{t-1}$	0.0229**	0.0092	2.4980	0.0129
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.5593	Mean dependent var	0.2585	
Adjusted R-squared	0.4990	S.D. dependent var	0.2133	
S.E. of regression	0.1510	Akaike info criterion	-0.8293	
Sum squared resid	8.5011	Schwarz criterion	-0.3335	
Log-likelihood	228.2286	Hannan- Quinn criter	-0.6334	
F-statistic	9.2810***	Durbin- Watson stat	1.5405	
Prob (F-statistic)	0.0000			

Note: ***, **, and * represent the statistical significance at 1, 5 and 10% level, respectively.

The results presented in Table 4 show that the estimated coefficient of $STDA_{t-1}$ has a positive effect on EDF_{t-1} and is statistically different from zero, which accepts the H2 with 1% level of statistical significance. In other words, every one-unit increase in $STDA_{t-1}$ causes the 1.0729 units to rise in EDF_{t-1}. Thus, $STDA_{t-1}$ puts a large statistical effect besides having the economic effect on the default risk of Korean manufacturing firms.

This finding is consistent with studies such as Forte and Pena (2011), Krishnamurthy (2010) and Brunnermeier (2009). Krishnamurthy (2010) and Brunnermeier (2009) proved that short-term debt like commercial papers and overnight repos and other loans played an important role in the default of Bear Stearns and Lehman Brothers. Short term loans, commercial papers or repo contracts, require to be rolled over and failing to do so brings out the risk of default. Similarly, Forte and Pena(2011) gave the theoretical implication of their findings that short-term debt maturing in a short period of time, leads to increasing the default risk.

Out of all control variables, $SIZE_{t-1}$ and $INTCOV_{t-1}$ are found to be positively correlated with EDF_{t-1}. For a one-unit increase in $SIZE_{t-1}$ of the firm, there is 1.1960 units increase in EDF_{t-1} with 5% level of statistical significance. This empirical result is not consistent with Degryse et al. (2012), and the negative effect of $SIZE_{t-1}$ is observable in the situations where larger size leads to the loss of control over management and an inefficient hierarchy which ultimately makes the firm inefficient (Williamson, 1967). Therefore, the potential increase in the size of the firm indirectly becomes one of the causes of default.

However, in the present study, this finding is also quite understandable in the sense that when a firm grows in size, it also opts to have more debt in its capital structure (Palacín-Sánchez et al., 2013; Fama & French, 2002). Here, as presented in descriptive statistics in Table 1, sample firms are more inclined towards short-term debt financing which ultimately increases the risk of default due to lack of debt benefits and the presence of information asymmetry. Leland and Toft (1996) also confirmed that short-term financing does not enjoy the significant benefits of debt such as tax debt shield advantage.

Every unit rise in $INTCOV_{t-1}$ contributes 0.0229 units rise in EDF_{t-1} and this positive effect is statistically significant at 5% level. The possible explanation for such a trend is that high use of short-term debt financing and its higher interest coverage (ability to pay off interest payment) is a good indication in the short run only. But, in the longer run, higher ability to pay off short-term debt financing cannot be the best indicator of higher ability to pay off long-term debts as well. Therefore, even when $INTCOV_{t-1}$ increases, firms still face an increasing trend in default risk.

The F statistics suggests that overall model is fitted well, as indicated by its statistical significance at 1% level. Furthermore, the model's coefficient of determination (R^2) is 0.5593, indicating that 55.93% variation in EDF_{t-1} is captured by the explanatory variables of this study. R^2 after adjustments reached 49.90%. Durbin Watson statistics is 1.5405 and is supporting the absence of autocorrelation problem. The standardized residuals graph shown in Figure 3 suggests that there is no specific trend and regression residuals follow a normal distribution.

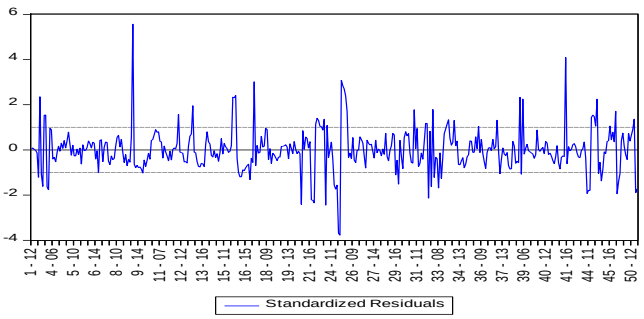


Figure 3: Residuals

5. Conclusion

There is an extensive literature dealing with the determinants of corporate default. However, not a significant number of studies measured default risk using the structural model of Merton (1974) based on Moody's KMV approach. To mitigate the literature gap, this study employs EDF which is a continuous and absolute measure of default. EDF changes over time, as the credit cycle progresses and is considered a more appropriate measure of default risk.

Using fixed effect regression model, this study explores the effect of capital structure's measures (STDA and LTDA) on EDF for Korean manufacturing firms publicly listed on Korea exchange from 2005-2016. Statistically, results support the notion that STDA and LTDA both have a significant impact on Korean firm's default risk. For instance, higher use of STDA leads to increase the default risk whereas higher use of LTDA decreases the default risk.

Furthermore, the importance of SIZE and INTCOV is also noticeable in regression analysis, where SIZE and INTCOV intervene and results in further increasing the possibility of default. In other words, in the presence of larger SIZE and INTCOV, STDA affects EDF positively. Similarly, SIZE and TANG further increase the effect of LTDA on EDF. Therefore, large SIZE firms with more of TANG are expected to use higher LTDA, and LTDA brings substantial benefits of tax debt shield advantage to the targeted firms and ultimately causes the significant decline in EDF.

This study also provides the policy implications for the managers of the firm to make better plans for the mix of debt to equity capital and use the optimum capital structure. Specifically, considering the effects of short-term debt and long-term debt on the probability of default, it is highly suggested to add the optimum level of long-term debt in the capital structure, while lowering the level of short-term debt. However, there is also a need to conduct further research in the area of the capital structure and default risk in Korea, as not the significant number of studies have explored all the possible empirical factors. The potential extension of this work would be to investigate the relationship of capital structure and EDF in cross-sector both financial and non-financial sectors and cross-country analysis. Moreover, capital structure and default risk of small and medium-size firms along with the partnership form of business remained underexplored in Korea and can be considered for future analysis. Similarly, the effect can be analyzed with market-based measures of capital structure and more control variables including the broad macroeconomic factors.

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