The Costs of Financial Distress; Evidence from Credit Default Swaps

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Abstract

This study utilizes a newly available data, Credit Default Swap (CDS) spreads, to revisit the calculation of the NPV of financial distress costs. The results show that the cost of financial distress estimated here is on average more than what previous studies have estimated. This new measure of the cost of financial distress is further verified by analyzing the variables often attributed to the financial distress. The risk-adjusted probability of default using Almeida and Philippon (2007) is 0.23% where the conditional probability of default using the CDS spreads is 1.42%. This large difference translates to a much larger average cost of financial distress of 30% compared to the risk-adjusted cost of financial distress of 7.42%, using CDS premiums and credit spreads, respectively.

Introduction

Trade-off theory of capital structure state that the mix of capital in a firm is determined by the trade-off between the benefits of debt and the costs of debt. One of the major costs of debt is the cost of financial distress which can be direct or indirect. Consequently, there were some attempts to estimate the bankruptcy or financial distress costs (Warner (1977), Altman (1984), Weiss (1990), Opler and Titman (1994), Andrade and Kaplan (1998), Almeida and Philippon (2007)) and the consensus is that the direct costs of financial distress such as administrative and legal costs associated with the bankruptcy process are relatively small. For example Warner (1977) and Weiss (1990) estimate the direct cost of distress is 3%-5% of the value of the distress firms. On the other hand, the indirect costs of distress, such as loss of market share (Opler and Titman (1994)) and inefficient sale of assets (Shleifer and Vishny(1992)) can be very significant. For example Altman (1984) estimate these costs to be 11%-17% firm value three years before the bankruptcy. Andrade and Kaplan (1998) show similar results to Altman (1984) and estimate the cost of financial distress to be 10%-23% of pre-distress firm value for a sample of firms involved

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in high leverage buyouts. However, estimating the indirect costs of financial distress is a challenging task because these are not as easy as direct costs to quantify.

Almeida and Philippon (2007) develop a framework to quantify the Net Present Value (NPV) of financial distress costs using the risk-neutral probabilities of default rather than historical default rates. They find that the distress costs derived from the historical default rates significantly underestimate the average value of distress costs. In other words, Almeida and Philippon (2007)'s measure could explain, at least partially, the conservative leverage ratios of the US firms despite the existence of sizeable tax benefits of debt as suggested by Graham (2000).

There is an extensive literature (Elton et al. (2001), Chen et al. (2007), Huang and Huang (2003), Eom et al. (2004), Huang and Huang (2012)) about the role of default risk in explaining yield spreads such as those used in Almeida and Philippon (2007). These papers point out a need for a better measure of default likelihood for any study that involves this measure. Recent literature (Longstaff, Mithal, and Neis (2005), Blanco et al. (2005), Ericsson et al. (2009)) has provided a new and a "cleaner" measure of default: Credit Default Swap (CDS) premium. Single name credit default swap is the most popular credit derivative and it serves as an insurance against worsening of creditworthiness of a bond issuer. These contracts enable firms to exchange their credit risk and have become an essential tool in credit risk management. Furthermore, as far as the speed with which new information is impounded into prices is concerned, Blanco et al. (2005) find that CDS market leads bond market. They argue that price discovery process occurs in CDS market and that CDS premiums are superior to credit spreads in reflecting new information. In other words, CDS spreads adjust to credit risk changes more quickly and accurately, which makes CDS market the best place for trading credit risk.

Hence, the main goal of this study is to test whether using the newly available CDS data provides more insight for the calculation of financial distress. In doing so, we first derives the conditional probability of default from the CDS spreads and the recovery rates of each bond. Next step is to estimate the present value of financial distress using the Almeida and Philippon (2007) framework with conditional probability of default instead of their risk-adjusted probability of defaults. This substitution of probability measures, provides a unique opportunity to check whether the CDS spread data can provide more insight into the financial distress costs measurements. The estimates of this study suggest that the conditional probability of default and consequently the NPV of financial distress derived from CDS spreads are considerably larger than the risk-adjusted probability of default and cost of financial distress of Almeida and Philippon (2007). Consider, for example a firm with a bond rated BB. The risk-adjusted probability of default for a BB rated firm is 0.31%, whereas, the conditional probability of default derived from the CDS spread is 1.61%. This large difference between the risk-adjusted and conditional probability of default translates into a substantial difference in the NPVs of financial distress costs. For example, the NPV of the risk adjusted cost of financial distress for a BB rated bond is 8.79% of the pre-distress firm value, however, this value is 35.04% when the conditional probability of default derived from CDS is used.

The results of this study are in line with the findings of Almeida and Philippon (2007). However, given the evidence and the literature that the CDS spreads are cleaner measure of default, one can argue that the NPV of the financial distress, derived from the CDS spreads represent financial distress in a better way. Since the new measure of financial distress are even larger than the risk-adjusted NPV of distress costs of Almedia and Philippon (2007), it suggest that the marginal distress costs can be even larger than the marginal tax benefits of debt as estimated by Graham (2000).

To further evaluate the soundness of this new measure of the financial distress and compare it with risk-adjusted cost of financial distress of Almeida and Philippon (2007) a model of the costs of financial distress is developed with dependent variables that according to literature have some predicting power for financial distress. Among these factors, Leverage (+), Profitability (-), Tobin's Q (-), bond illiquidity (+), Asset Volatility (+), Unemployment (+), Term spread (-), and S&P500 return (-) are all significant and have the expected signs. Moreover, the R-squared of the complete model with the CDS derived NPV of financial distress as dependent variable, 0.2115, is larger than that of Almedia and Philippon (2007), 0.1652. These results show that these variables are successful in explaining the default in both models of financial distress and the new measure of distress cost offers new insight for capital structure behaviors of firms.

The rest of the paper proceeds as follows. Section I, presents the framework of Almeida and Philippon (2007) used in this study. Section II, explains why CDS spread is a better measure of default risk and how to derive the NPV of financial distress costs using CDS spreads. Section III, develops a model of financial distress by explaining the methodology and the data used in this study. Section IV, presents the empirical results of this study and finally section V concludes.

I. The Risk Adjusted Cost of Financial Distress

This section illustrates the process of calculating the NPV of financial distress. This study will follow Almeida and Philippon (2007) framework for this task which provides an opportunity to compare and contrast their risk-adjusted cost of financial distress and the NPV of costs of financial distress derived from CDS spreads.

Almedia and Philippon (2007) start their calculation of the value of financial distress cost by finding the default component of each bond and use this value to calculate the risk-adjusted (risk-neutral) probability of default. However, the credit risk literature suggests that spread between the corporate bonds and treasury bonds of the same maturity cannot be completely attributed to default losses, since it is also influenced by liquidity and tax concerns. Therefore, following Chen et al. (2009), they assumed that the component of the yield spread that is not given by default can be achieved by using the spreads between AAA rated corporate bonds and their treasury counterparts. Hence Almedia and Philippon use the following formula to calculate the default component:

$$(Default\ Component)_i^t = (Spread)_i^t - 0.51\%$$

Where 0.51% is the historical average AAA corporate bond spread over treasuries. This study use the same historical average for reproducing their results. In the next step, Almedia and Philippon estimate the risk-adjusted probability of default (*q*) by dividing the default component by the product of the one plus bond's yield *(1+y)* and its loss given defaults. Next, they use *q* to find the risk adjusted probability of surviving beyond year *t* evaluated at date 0:

$$\left(1 - Q_{0,t}\right) = \prod_{s=1}^{t} (1 - q_{0,s})$$

This means that the $Q_{0,t}$ is the cumulative risk adjusted probability of default before or during year *t*. Hence, the probability that default happens exactly at *t* is $(1- Q_{0,t-1})q_{0,t}$. Next, they introduced the formula to calculate the NPV of financial distress:

$$\Phi_0 = \phi \sum_{t\geq 1} B_{0,t}\ (1 - \ Q_{0,t-1})q_{0,t}$$

Where $B_{0,t}$ is the time price of a riskless zero coupon bond paying one dollar at date t and □ is the deadweight loss given distress which they assume to be constant. The goal of this study is to show that the NPV of financial distress derived from the CDS spreads is superior to the above measure. The following section provided the motivation on why this study used CDS spreads to measure corporate probability of defaults.

II. The NPV of the Cost of Financial Distress Derived from CDS Spreads

Chen et al. (2004) state that there is a debate about the role of default risk in explaining yield spreads because Treasuries are more liquid than corporate bonds and part of the spread should reflect the liquidity premium. Also, Elton et al. (2001) argue that Treasuries have tax advantage over corporate bonds because they are not subject to state and local taxes. Consequently, one cannot attribute the entire yield spread to default risk.

These characteristics of corporate bonds have led to different attempts by researchers to estimate the default component of corporate bonds using various methods. Some used structural models of credit risk inspired by Merton (1974) in which debt is assumed to be a contingent claim on the assets of the firm. This model makes simplifying assumptions of log change in market value of firm's assets follows a geometric Brownian motion, default occurring only at the maturity, flat term structure of interest rate, costless bankruptcy, and simple capital structure comprised of equity and non-callable zero-coupon (discount) bond. Several researchers extended Merton's (1974) model by relaxing its assumptions. However, although Merton's model is sophisticated and popular in empirical research, it also has been widely criticized for its inability to explain credit spreads and default rates simultaneously. Huang and Huang (2012) referred to this phenomenon as "credit spread puzzle". In the view of structural models of credit risk, credit spreads should only reflect the probability of default and the loss given default. However, current evidence in empirical studies indicates that structural models have difficulty predicting accurately the level and changes of corporate bond spreads. Most of these studies find Merton type models biased for their under prediction of credit spreads.

Huang and Huang (2003) use a calibration approach and find that the default component predicted by many structural models is relatively small. Eom et al. (2004) test the predictions of five structural models: Merton (1974), Geske (1977), Longstaff and Schwartz (1995), Leland and Toft (1996), Collin-Dufresne and Goldstein (2001). They find that while the first two models on average under predict credit spreads, the other three tend to over predict spreads. As Eom et al. (2004) argue the newer models tend to overestimate credit spreads of firms with high leverage or volatility leading to large spread predictions, while they underestimate spreads for safer firms. However, when Huang and Huang (2012) calibrated each of these models to be consistent with historical default and recovery rates, they all generate similar credit spreads that are well below historical averages.

As shown in these papers, the credit spreads are many times larger than the spreads implied by the probability of default and loss given default. The credit spread puzzle refers to this significant gap between credit spreads and expected losses and the puzzle does not necessarily imply that structural models underestimate yield spread. From the empirical point of view, Huang and Huang (2012) state that the stylized fact about the structural models, whether they underestimate or overestimate credit spreads, is that they are unable to explain credit spreads and default rate simultaneously. The literature on structural models of credit risk highlights the fact that Merton type models are misspecified, in a sense that they are missing a credit risk factor and more complex models are needed. Collin-Dufresne, Goldstein and Martin (2001) document the impact of a missing factor on credit spread.

Overall, the discussion above points out the need for a better measure of default likelihood. Recent literature has provided a new and a “cleaner” measure of default: Credit Default Swap (CDS). Single name credit default swap is the most popular credit derivative and it serves as an insurance against worsening of creditworthiness of a bond issuer (reference entity). CDS contracts enable firms to exchange their credit risk and have become an essential tool in credit risk management. Due to increased interest in credit risk management, CDS market has experienced tremendous growth and liquidity over the past decade. According to the June 2006 survey by the International Swaps and Derivatives Association (ISDA) the notional amount grew from $40 billion in 1996 to $26,000 billion in June 2006 and to $57.3 trillion in June 2008. In particular, these instruments allow firms to short credit risk at a known fee, CDS premium or spread, by buying credit protection. CDS spread is defined as the annual payment, expressed as a percent of the notional value of the contract. The protection buyer pays this spread periodically to the protection seller who bears the credit risk of the reference entity for a given term. If the reference entity defaults then protection seller has to buy the reference issue at its par value from the protection buyer. Thus, CDS spread can be interpreted as a “direct” and “clean” measure of credit risk of the underlying reference; the higher the default risk (hence probability of default) the higher the spread. The contract expires at its maturity date if the reference entity does not default. Maturity of CDS contracts is negotiable since they are over-the-counter contracts. Maturity could range from a few months to 10 years or more. However, according to Hull et al. (2004), five years is the most common maturity and most liquid CDS contract, therefore, it is widely accepted that these 5 year CDS contract convey the most accurate pricing information.

Arora et al. (2012) provide evidence that the price of counter party risk is infinitesimal and has no economic significance. In particular, they show that an increase in the protection seller’s credit spreads of 645 basis points, on average, translates into only one basis point decline in CDS premium the dealer charges for selling credit protection. Ericsson et al. (2009) use CDS data and study the relationship between default risk factors as postulated by structural models and CDS premia in the spirit of Collin-Dufresne, Goldstein and Martin (2001). While they report these variables to possess significant economical and statistical explanatory power, a significant amount of CDS premium variation remains unexplained. Moreover, unlike Collin-Dufresne, Goldstein and Martin (2001), their principal component analysis of residuals reports limited evidence for the existence of a common factor. This result indicates that structural models fit CDS data better, at least partially. In other words, CDS spreads are less noisy relative to yield spreads in reflecting credit risk, and thus are “cleaner” measures of default risk, which further justifies using CDS spreads in this study. Furthermore, as far as the speed with which new information is impounded into prices is concerned, Blanco et al. (2005) find that CDS market leads bond market. They argue that price discovery process occurs in CDS market and that CDS premiums lead credit spreads in reflecting new information. They argue CDS premiums adjust to credit risk changes more quickly and accurately making CDS market the most convenient location for the trading of credit risk.

From the liquidity point of view there are a few reasons that CDS spreads are superior to yield spreads. First, credit default swaps are contracts, not securities. Securities are in fixed supply whereas; the notional amount of credit default swaps can be arbitrarily large. This means that a different type of supply and demand forces affect credit default swaps and the forces that impact corporate bond market are less influential in CDS market. Second, Unlike Treasuries or some popular stock, there are no "on-the-run" or "special" CDS contracts. Third, CDS contracts are less prone to be "squeezed" as they can always be created. Finally, CDS contracts are viewed as insurance contracts, and most of the participants in this market tend to keep their insurance until maturity. They do not liquidate their position earlier. Even if they do, they simply enter into a new swap contract but would take the opposite direction rather than trying to sell the current position.

Given that there is no tax advantage in the CDS market such as the one exists for Treasuries and municipal bonds over corporate bonds and given the reasons that the liquidity issues are irrelevant for CDS contracts, this study argues that instead of deducting a 0.51% from the yield spreads, as Almeida and Philippon (2007) do to account for illiquidity and tax disadvantage of corporate bonds, CDS spread is used to calculate the NPV of the cost of financial distress.

Having CDS spreads and the recovery rates for each bond we can use the following formula for CDS spreads,

$$S = (1 - \rho)h$$

And by rearranging we get the hazard rate or the conditional probability of default,

$$h = \frac{S}{(1 - \rho)}$$

This conditional probability of default will replace the probability of default at t is $(1- Q_{0,t-1})q_{0,t}$ that Almeida and Philippon use. In other words, one can calculate the NPV of the cost of financial distress using the following formula:

$$\Phi_0 = \phi \sum_{t \geq 1} B_{0,t} \, h_t$$

This formula will give us an opportunity to compare the NPV of the cost of financial distress derived from two different methods.

[Insert Table I]

Panel A of Table I presents the risk-adjusted (risk-neutral) probability of default, q, estimated using Almeida and Philippon (2007) framework and the conditional probability of default derived from CDS spreads, h. It can be seen from the table that conditional probability of default derived from CDS spreads is substantially larger than the risk-adjusted probability of default. For example, in the case of a firm with BB rated bonds, the risk-adjusted probability of default is 0.31% where, the conditions probability of default is 1.61% which is almost five times larger. The average risk-adjusted probability of default in the sample is 0.23% whereas, the average conditional probability of default is 1.42%. The probabilities of default would change in the time of the crisis. Panel B of the Table I presents this difference in time of crisis, in time before and after the crisis. For instance, for the same firm with BB rated bonds, both measures of the probability of default almost doubled during the crisis.

This large difference between the risk-adjusted (q) and conditional probabilities of default (h) translates into a substantial difference in the NPVs of financial distress costs. The first column of panel A in Table II presents the estimates of the risk-adjusted costs of financial distress following the Almeida and Philippon (2007) methodology. They used the whole universe of corporate bonds to find the risk-adjusted cost of financial distress, whereas, in this table, only the corporate bonds which are the underlying instruments in the CDS market are used. Using this subsample will allow us to compare and contrast risk-adjusted and CDS-derived costs of financial distress. Almeida and Philippon (2007) estimates suggest that risk-adjusted probabilities of default and consequently, the risk-adjusted NPV of financial distress cost, are considerably larger than historical default probabilities and the non-risk-adjusted NPV of financial distress cost. Almeida and Philippon (2007) explain that the most important capital structure implication of their results is that the marginal risk-adjusted distress costs can be of the same magnitude as the marginal tax benefits of debt computed by Graham (2000). In other words, their large estimates of financial distress costs may help explain why many US firms appear to be under-levered as suggested by Graham (2000).

[Insert Table II]

The second column of panel A in Table II shows estimates of the NPV of financial distress costs derived from the new CDS spreads data, using the framework of Almeida and Philippon (2007). As it can be seen from the table, these estimates are almost three times larger for investment grade bonds. For example in case of a AA rated bond, the risk-adjusted cost of financial distress is 2.72% of the pre-distress firm value, whereas the cost of financial distress using the CDS spreads is 10.46% of the pre-distress firm value. The difference is even larger for corporate bonds of lower quality. For example, in case of high yield bonds such as a B rated bond, the risk-adjusted cost of financial distress is 18.94% of the pre-distress firm value, whereas the cost of financial distress using the CDS spreads is 97.41% of the pre-distress firm value an almost five times difference. Surprisingly, the cost of financial distress for some of the high yield bonds are more than the pre-distress value of the firm. For example, the NPV of cost of financial distress using the CDS spread for a CC rated bond is 118.31% which is 18.31% more than the total value of the firm. The average risk-adjusted cost of financial distress in the sample is 7.42% of the pre-distress firm value, whereas, the average CDS derived cost of distress is 30% of the pre-distress firm value.

Panel B of Table II reports both the risk adjusted and CDS-derived costs of financial distress for the time of crisis and the time before and after the crisis. It is obvious to see that the costs of financial distress has increased across the board during the time of crisis. For example the risk adjusted cost of financial distress has almost doubled for AA bonds from 2.45% in time of no crisis to 4.48% during the crisis whereas, the CDS derived cost of financial distress has increased from 10.14% to 12.53%. One thing that needs to be noticed is that in most cases, especially for investment grade bonds, the risk-adjusted cost of financial distress during crisis has increased more than the CDS-derived cost of financial distress which can be a confirmation of Blanco et al. (2005) argument that CDS market leads bond market and price discovery process occurs in CDS market and that CDS premiums lead credit spreads in reflecting new information.

The results presented in Table II further confirms Almeida and Philippon (2007)'s argument that US corporations, on average, are not under-levered as suggested by Graham (2000). Since the new measure is larger than that of Almeida and Philippon (2007), one can argue that the marginal distress costs can more than offset the marginal tax benefits of debt as estimated by Graham (2000).

III. A Model of financial distress cost

A. Methodology and Hypothesis Development

In this section, I propose a model in which financial distress cost is explained by a battery of factors influencing a firm's distress costs. This study utilizes a newly available data of credit default swaps to estimate the costs of financial distress using an existing framework (Almeida and Philippon (2007)). The motivation behind this endeavor is that, based on the credit risk literature, the CDS spreads are better and cleaner measures of default risk and the distress cost derived from CDS spreads should shed more light on the understanding of financial distress costs. Hence, testing the following hypothesis will be the focus of this study:

H_0: Can the NPV of financial distress derived from CDS spreads explain whether US firms irrationally choose to leave some tax benefits of debt in capital structure unexploited.

Then, the following linear relationship between the NPV of financial distress cost and proxies for expected cost of financial distress will be examined:

$$\boldsymbol{NPV\_Distress_{it}} = \beta_0 + \beta_1 \boldsymbol{Lev_{it-1}} + \beta_2 \boldsymbol{Prof_{it-1}} + \beta_3 \boldsymbol{Tang_{it-1}}$$

$$+ \beta_4 \boldsymbol{Intang_{it-1}} + \beta_5 \boldsymbol{Size_{it-1}} + \beta_6 \boldsymbol{Cash_{it-1}} + \beta_7 \boldsymbol{Q_{it-1}}$$

$$+ \beta_8 \boldsymbol{Illiq_{it-1}} + \beta_9 \boldsymbol{Vol_{it-1}} + \beta_{10} \boldsymbol{Uemp_{it-1}} + \beta_{11} \boldsymbol{TermSpread_{it-1}} + \beta_{12} \boldsymbol{S\&P500_{it-1}} + \varepsilon_{it}$$

Where $\boldsymbol{NPV\_Distress_{it}}$ is my proxy for financial distress costs estimated in the previous section at time *t* for firm *i*. The rest of the factors are lagged one year so that they are in the information set at time t. $\boldsymbol{Lev_{it-1}}$ represents leverage of a firm calculated as the ratio of total debt over market value of the assets of the firm. Based on trade-off theory one would expect to see a positive sign for this variable. In other words, the higher the leverage, the higher will be dead weight cost of bankruptcy. $\boldsymbol{Prof._{it-1}}$ is a measure of profitability is the ratio of operating income before depreciation over assets. According to static trade-off theory, profitable firms face lower expected costs of financial distress. $\boldsymbol{Q_{it-1}}$ represents Tobin's q, which is the ratio of the firm's market value to its replacement costs of its assets. Replacement costs approximately show the selling value of the assets of the firm and are positively correlated with the liquidation value of the assets. Lang et al. (1996) find a strong positive relationship between Tobin's q and all proxies for firm's growth. Hence, Tobin's q used as a measure of growth of the firm. A significant Tobin's q coefficient supports the need to control for investment opportunities when evaluating the costs of financial distress.

$\boldsymbol{Tang._{it-1}}$ and $\boldsymbol{Intang._{it-1}}$ are the ratios of the tangible and intangible assets to total assets of a firm. According to Frank and Goyal (2009) tangible assets (i.e. property, plant, and equipment) are easier for outsiders to value than intangibles, therefore one would expect to see a negative sign for $\boldsymbol{Tang._{it-1}}$. In other words, $\boldsymbol{Tang._{it-1}}$ would be a measure of collateral value. Another measure of collateral value introduced by Titman and Wessels (1988) is ***Intang.***$_{it-1}$ and they show that it is negatively related to collateral value, and hence, it should be positively related to the cost of financial distress. ***Size***$_{it-1}$ is the log of sales and it is a proxy for firm size. Large and more diversified firms, face lower default risk. Furthermore, mature firms with good reputation in debt markets face lower debt related agency costs. Therefore, the prediction of trade-off theory is that larger older and larger firms would have more debt. On the other hand, Rajan and Zingales (1995) state that size can be used as a measure for inverse of the probability of financial distress, which is based on the assumption that relies on the negative correlation of between size and cash flow volatility. Given this argument, a negative sign for the size coefficient would confirm that mature and older firms are able to handle the financial distress more easily; therefore, they would have a lower cost of financial distress.

Vol$_{it-1}$ is the 30-day implied volatility from OptionMetrics. It can be argued that firms with high asset volatility would have higher financial distress costs due to higher uncertainty. ***Illiq.***$_{it-1}$ is Amihud's illiquidity measure for corporate bonds and it is expected that the more illiquid the bond, the higher would be the cost of financial distress for the firm. Here, I want to test the hypothesis that as liquidity of the secondary bond market deteriorates the NPV of the financial distress costs increases. ***Cash***$_{it-1}$ is cash and marketable securities, and they increase the liquidity and solvency of a firm, therefore, one would expect to see a significant negative sign for this variable. Finally, ***Uemp.***$_{it-1}$ is the rate of unemployment. Almeida and Philippon (2007) state that financial distress is more likely to happen in bad times and one of the macroeconomic variables that can proxy a bad time is a high unemployment rate. Therefore, one would expect to see a significant and positive sign for this proxy of financial distress. ***Term Spread***$_{it-1}$ is the difference between the 10-year and 2-year Treasuries and ***S&P500***$_{it-1}$ is the return on the S&P500 index.

B. Data

In this section, the data that is used to develop the variables are introduced. The dependent variables in the regression are the risk-adjusted and CDS-derived NPVs of financial distress cost. In order to get the risk-adjusted cost of financial distress, the data from Trade Reporting and Compliance Engine (TRACE) used which offers daily transaction data on corporate bonds from July 1st 2002. TRACE intra-day price and yield of each bond are used to calculate the trade weighted average for each bond in each month to obtain monthly yields. Next, the monthly TRACE data is merged with Mergent FISD to get the bond characteristics information such as ratings and time to maturity. At this point only the data for plain vanilla bonds are retained. Then, credit spread which is the difference between the monthly yield of a particular bond issue with a known maturity and the monthly constant maturity Treasury rates of the same maturity is calculated. The data for the monthly constant maturity Treasury rates are collected from Federal Reserve Economic Data provided by the Federal Reserve Bank of Saint Louis, FRED. The data on Treasuries are interpolated to get the Treasury rate for all maturities.

CDS spread quotes on 5 year contracts which according to Hull et al. (2004) convey the most accurate pricing information are obtained from Markit database. Markit CDS data is not transaction data; neither is it real time quoted prices, but it is a post-trade mid-point quote that is determined by aggregating valuation information. The range of CDS data start from January 2nd 2002 until 31st November 2013.

As a stylized fact about the corporate bond market, we know that the corporate bonds are not as liquid as commons stocks, therefore, the measures of liquidity should be adjusted for the corporate bonds. Here, the Friewald et al. (2012) version of Amihud (2002) illiquidity measure is used which is a common measure of illiquidity for equities. In the case of volatility, from a theoretical point of view, a firm's future volatility can be inferred from implied volatilities of its traded options (Collin-Dufresne et al. (2001)). Therefore, in this study is used 30 day implied volatility obtained from OptionMetrics.

Compustat quarterly database is used to get each firm's accounting data for the period from July 1st 2002 to November 31st 2013. The data are quarterly and are converted to 2009 dollars using the GDP deflator. However, monthly observation are needed to calculate the estimates of leverage ratio, assets, sales, Tobin's q, cash and equivalent securities, tangible, and intangible assets, we had to interpolate the monthly data and then merge the outcome with the bond and CDS data. Financial and utility firms are excluded. Also excluded are firms with missing book value of assets.

The dataset spans from July 2002 till November 2013 and the data management resulted in a panel dataset with 59223 monthly observations, for 1455 different bonds of 397 firms. Table III provides a summary statistics of the panel. In my sample the average firm has a risk-adjusted NPV of the costs financial distress of about 7% of the pre-distress firm value, where this value for the NPV of the costs financial distress derived from the CDS data is 30% of the pre-distress firm value.

[Insert Table III]

The average profitability ratio in the sample is 3.6%. Tangible assets comprise about 30% of the total assets of the average firm, where, intangible assets are about 22% of the total assets of a firm. The average 30-day implied volatility of a firm in the sample is 30% and the average Amihud's scaled illiquidity is 19%. The average unemployment rate in this period is 7.1% and the average Tobin's q is 3.11.

IV. Empirical Results

In this section, estimation results of the proposed model of the financial distress costs are presented.

[Insert Table IV]

Table IV reports the estimation results of the financial distress costs models. In panel A, the dependent variable is the NPV of financial distress costs derived from CDS spreads and in panel B the dependent variable is the risk-adjusted NPV of financial distress derived from the Almeida and Philippon (2007) framework. In model I of both panels, we regress the two estimates of financial distress costs on the first group of variables which are mostly suggested by the capital structure literature. We run a similar regression for second group of variables which are mostly suggested by the structural models literature in model II. Finally, in model III all the variables are included in the regression. A comparison of the results in panels A and B should give us enough evidence to test the hypothesis.

Leverage is positive and significant in all models except model III of panel B in which all variables are regressed against the risk-adjusted cost of financial distress of Almeida and Phillipon (2007). Overall, the results show that the higher the leverage of the firm, the higher will be the cost of financial distress. Profitability is negative and significant across all models, suggesting that the cost of financial distress is lower for firms with high level of profitability. The same is true for Tobin's Q. The existence of a negative and significance coefficient for Tobin's Q shows that good investment opportunities mitigates the financial distress costs borne by firms. Intangibility of assets as suggested by Titman and Wessels (1988) is negatively related to collateral value and hence it should be positively related to the costs of financial distress.

However, the results of all models suggest that this variable is negatively significant, which suggest that the higher the level of intangible assets, the lower would be the cost of financial distress. This can be evidence that any type of valuable asset such as intangible asset would reduce the cost of financial distress.

The rest of the variables in the first group of variables are not significant. Even though the signs of tangibility, cash and marketable securities, and size are consistent with the theory, their coefficients are not significant in any of the models.

The results from the second group of variables which are suggested by the credit risk literature to have an effect on the costs of financial stress are presented in models II and III. The modified Amihud's illiquidity measure for bonds which is the price impact of trading on bonds is positive and significant in all models. This shows that the companies with illiquid bonds will have higher costs of financial distress. Also influential in the costs of financial distress, is the asset volatility which has a positive and significant sign in all models. This shows that more volatile firms will have higher costs of financial distress. Das et al. (2006) point out that asset volatility moves with the business cycle. According to structural models, asset volatility is one of the primary inputs in determining default probabilities. The unemployment rate is also positive and significant across the board. This is an indication that the higher unemployment rate can explain the costs of financial distress. This is in line with the results of Almeida and Philippon (2007) that states financial distress is more likely to happen in bad times and high unemployment rate is one of the macroeconomic indicators of bad times. On the other hand, the return of the S&P500 index is an indication of the overall performance of economy, which is negative and significant in all models. This means that in good times, when the return of the S&P500 is high, the costs of financial distress are lower. The term spread of interest rates is also negatively significant.

Collin-Dufresne, Goldstein and Martin (2001) state that this variable is central to structural models framework. Also the expectations hypothesis of term structure argues that positively sloped term structure is an indication that future short term rates are going to be higher, which also means that the assets are going to grow at a higher rate in the future, hence, the cost of bankruptcy are expected to be lower in the future.

Overall, the results of panels A and B of Table V are very similar. However, the R-squared measures of these models suggest that one model is superior to the other. The R-square of the model I in panel A is 0.2730, whereas in panel B it drops to 0.1589. Also, the R-square of the complete model III in panel A is 0.2115, and it drops to 0.1652 in panel B. Furthermore, one can see that the sensitivities of these variables to the NPV of financial distress cost derived from CDS spreads are much larger than the sensitivities on the risk-adjusted financial distress cost.

V. Conclusion

The indirect costs of financial distress are hard to quantify and Almeida and Philippon (2007)'s risk-adjusted cost of financial distress measure is one of the most recent and sophisticated efforts to quantify indirect costs of financial distress. They state that financial distress is more probable in bad times and they estimate NPV of distress costs using the risk neutral default probabilities derived from corporate bond spreads. They show that the NPV of financial distress costs are much larger than what historical measures show. Their results lead to the conclusion that marginal distress costs can be as large as the marginal tax benefits of debt as shown in Graham (2000). They argue that this is an explanation for the underleverage puzzle of US firms.

This study attempts use a newly available data on CDS spreads to estimate a new measure of the present value of the distress cost using the Almedia and Philippon (2007) framework. Instead of using the corporate bond spreads to derive the probability of default, this study uses the CDS spreads and their corresponding recovery rates to find the conditional probability of default. Use of this measure is motivated by a rich literature that argues CDS spread is a cleaner measures of default. Next, the analysis of this model illustrate that the NPV of financial distress that is derived from the CDS spreads are larger than the measure of Almedia and Philippon.

In the next step, we developed a model of financial distress cost to test the effectiveness of the common proxies of financial distress in explaining the new measure of NPV of financial distress that is derived from the CDS spreads. The regression results show that most of the variables that are supposed to explain the cost of financial distress have significant coefficients. Also, the R-square of the model with the dependent variable, NPV of financial distress that is derived from the CDS spreads, is significantly larger than the other model that has the risk-adjusted cost of financial distress as its dependent variable.

Overall, the results of this study provides further support for Almeida and Philippon (2007) argument that explains the conservative use of debt. The magnitude of the new measures are in general larger than those of Almeida and Philippon (2007) which according to our hypothesis can bring new insight to the underleverage puzzle.

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Table I

Risk-Adjusted Vs. Conditional Probability of Default

Panel a of this table reports a replication of the Almeida and Philippon (2007) risk-adjusted probability of default as well as the conditional probability of default derived from CDS spreads, expressed as a percentages. Panel B reports the values for these two types of probability of default before/after and during the recent financial crisis

Panel A

Credit Rating	Risk-Adjusted Probability of Default	Conditional Probability of Default Using CDS
AA	0.05%	0.32%
A+	0.12%	0.46%
A	0.11%	0.48%
A-	0.16%	0.63%
BB	0.31%	1.61%
B+	0.48%	4.35%
B	0.54%	5.53%
B-	0.57%	6.69%
CC	0.57%	7.48%
C	0.85%	14.96%
Not Rated	0.20%	1.11%
In Default	0.67%	26.95%
Mean	0.23%	1.42%

Panel B

Credit Rating	Before and After Crisis		During Crisis	
	Risk-Adjusted Probability of Default	Conditional Probability of Default Using CDS	Risk-Adjusted Probability of Default	Conditional Probability of Default Using CDS
AA	0.03%	0.28%	0.20%	0.64%
A+	0.07%	0.39%	0.24%	0.67%
A	0.08%	0.45%	0.25%	0.66%
A-	0.14%	0.60%	0.31%	0.83%
BB	0.27%	1.42%	0.47%	2.31%
B+	0.42%	3.67%	0.63%	6.21%
B	0.52%	4.94%	0.65%	8.55%
B-	0.52%	5.23%	0.67%	9.59%
CC	0.52%	5.80%	0.72%	12.65%
C	0.85%	8.36%	0.85%	15.37%
Not Rated	0.17%	1.01%	0.34%	1.52%
In Default			0.67%	26.95%

Table II

Risk-Adjusted Vs. CDS-Derived Cost of Financial Distress

Panel a of this table reports a replication of the Almeida and Philippon (2007) NPV of risk-adjusted cost of financial distress as well as NPV of cost of financial distress using CDS spreads, expressed as a percentage of predisterss firm value. The first column of panel A, uses the risk neutral probabilities of default to derive the NPV of cost of financial whereas in the second column I used the conditional probability of default derived from CDS spreads and their respective recovery rates. Almeida and Philippon (2007) use a fixed value of loss given default, but here the reported values of loss given default for each bond is uses. As in Almeida and Philippon (2007), I also assume recovery of Treasury and a recovery rate of 0.41. Panel B reports the values for these two types of NPV of cost of financial distress before and after and during the recent financial crisis

Panel A

Credit Rating	Risk-Adjusted Cost of Financial Distress	NPV of Cost of Financial Distress Using CDS Spreads
AA	2.72%	10.46%
A+	4.29%	12.84%
A	4.49%	15.08%
A-	5.32%	17.79%
BB	8.79%	35.04%
B+	14.73%	76.39%
B	18.94%	97.41%
B-	20.68%	107.31%
CC	23.22%	118.31%
C	21.18%	130.28%
Not Rated	4.93%	21.06%
In Default	44.39%	188.73%
Mean	7.4%	30.01%

Panel B

Credit Rating	Before and After Crisis		During Crisis	
	Risk-Adjusted Cost of Financial Distress	NPV of Cost of Financial Distress Using CDS Spreads	Risk-Adjusted Cost of Financial Distress	NPV of Cost of Financial Distress Using CDS Spreads
AA	2.45%	10.14%	4.48%	12.53%
A+	3.97%	12.52%	5.21%	13.75%
A	4.35%	15.07%	5.22%	15.14%
A-	5.18%	17.90%	6.47%	16.92%
BB	8.49%	33.74%	9.94%	40.01%
B+	13.44%	68.53%	18.22%	97.69%
B	18.67%	93.44%	20.32%	117.91%
B-	17.22%	89.57%	27.54%	142.50%
CC	21.39%	110.53%	28.87%	142.28%
C	27.01%	143.60%	20.82%	129.45%
Not Rated	4.86%	20.50%	5.22%	23.34%
In Default			44.38%	188.72%

Table III

Summary Statistics

This table reports the summary statistics for the sample. *NPV_Distress_Bonds* is the risk-adjusted NPV of financial distress derived from the Almeida and Philippon (2007) framework. *NPV_Distress_CDS* is the NPV of financial distress derived from the CDS spreads. *Leverage* is the leverage ratio of firms in the sample defined as total debt over market value of assets. *Prof.* is a measure of profitability and it is the ratio of operating income before depreciation over assets. *Tang* is the tangibility of assets of a firm and is defined as the ratio of net property, plant, and equipment over total assets. *Intang* is the ratio of intangible assets over total assets of a firm. *Size* is defined as the log of sales or revenues for each firm which is my second measure of size. *Cash* is defined as cash and marketable securities held by a firm. *Tobin's Q* is defined as the market value of a company divided by the replacement value of the firm's assets. *Volatility* is the 30-day implied volatility from OptionMetrics. *Illiquidity* is Amihud's illiquidity measure and it is the price impact of trading on bonds. *Unemp* is the unemployment rate. *Term spread* is the difference between the yields of 10-year and 2-year Treasury notes. *S&P500* is the return on the S&P 500 index.

Variable	Obs	Mean	Std.Dev.	Min	Max
NPV_CDS	59223	0.300	0.353	0.000	1.984
NPV_Bonds	59223	0.074	0.083	-0.010	0.646
Leverage	59223	0.275	0.179	0.000	1.051
Prof.	59223	0.036	0.025	-0.491	0.216
Tang.	59223	0.298	0.234	0.000	0.922
Tobin's Q	59223	3.119	1.425	0.011	12.223
Intang.	59223	0.220	0.195	0.000	0.803
Cash	59223	0.004	0.008	0.000	0.093
Size	59212	8.327	1.200	3.141	11.117
Illiquidity	59223	0.190	0.430	0.000	29.600
Volatility	59223	0.300	0.209	0.004	2.729
Unemp.	59223	7.088	1.946	4.400	10.000
Term Spread	59223	1.538	0.933	-0.140	2.830
S&P500	59223	0.006	0.043	-0.169	0.108

Table IV

Estimation Results of the Financial Distress Costs Model

This table reports the estimation results of the financial distress costs models. In panel A, the dependent variable is the NPV of financial distress costs derived from CDS spreads and in panel B the dependent variable is the risk-adjusted NPV of financial distress derived from the Almeida and Philippon (2007) framework. *Leverage* is the leverage ratio of firms in the sample defined as total debt over market value of assets. *Profitability* is a measure of profitability and it is the ratio of operating income before depreciation over assets. *Tangibility* is the tangibility of assets of a firm and is defined as the ratio of net property, plant, and equipment over total assets. *Intangibility* is the ratio of intangible assets over total assets of a firm. *Size* is defined as the log of sales or revenues for each firm which is my second measure of size. *Cash* is defined as cash and marketable securities held by a firm. *Tobin's Q* is defined as the market value of a company divided by the replacement value of the firm's assets. *Volatility* is the 30-day implied volatility from OptionMetrics. *Amihud* is Amihud's illiquidity measure and it is the price impact of trading on bonds. *Unemployment* is the unemployment rate. *Term spread* is the difference between the yields of 10-year and 2-year Treasury notes. *S&P500* is the return on the S&P 500 index. Robust standard errors are presented in parentheses and *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

	Panel A		
VARIABLES	I	II	III
Leverage	0.973***		0.489**
	(0.208)		(0.192)
Profitability	-1.197***		-1.031***
	(0.387)		(0.321)
Tangibility	-0.312		-0.267
	(0.243)		(0.203)
Tobin's Q	-0.093***		-0.049**
	(0.023)		(0.025)
Intangibility	-0.496**		-0.434**
	(0.241)		(0.203)
Cash	-3.586		-6.198
	(8.273)		(6.880)
Size	-0.060		-0.041
	(0.038)		(0.029)
Amihud		0.026***	0.026***
		(0.005)	(0.005)
Volatility		0.129***	0.070**
		(0.041)	(0.033)
Unemployment		0.081***	0.074***
		(0.004)	(0.007)
Term Spread		-0.040***	-0.041***
		(0.009)	(0.010)
S&P500		-0.166***	-0.129***
		(0.029)	(0.036)
Constant	1.010***	-0.320***	0.338
	(0.327)	(0.021)	(0.241)
Observations	52,106	52,117	52,106
R-Squared	0.2730	0.0624	0.2115

Table IV

Estimation Results of the Financial Distress Costs Model (Cont.)

This table reports the estimation results of the financial distress costs models. In panel A, the dependent variable is the NPV of financial distress costs derived from CDS spreads and in panel B the dependent variable is the risk-adjusted NPV of financial distress derived from the Almeida and Philippon (2007) framework. *Leverage* is the leverage ratio of firms in the sample defined as total debt over market value of assets. *Profitability* is a measure of profitability and it is the ratio of operating income before depreciation over assets. *Tangibility* is the tangibility of assets of a firm and is defined as the ratio of net property, plant, and equipment over total assets. *Intangibility* is the ratio of intangible assets over total assets of a firm. *Size* is defined as the log of sales or revenues for each firm which is my second measure of size. *Cash* is defined as cash and marketable securities held by a firm. *Tobin's Q* is defined as the market value of a company divided by the replacement value of the firm's assets. *Volatility* is the 30-day implied volatility from OptionMetrics. *Amihud* is Amihud's illiquidity measure and it is the price impact of trading on bonds. *Unemployment* is the unemployment rate. *Term spread* is the difference between the yields of 10-year and 2-year Treasury notes. *S&P500* is the return on the S&P 500 index. Robust standard errors are presented in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

	Panel B		
VARIABLES	I	II	III
Leverage	0.237***		0.085
	(0.062)		(0.060)
Profitability	-0.215**		-0.176**
	(0.104)		(0.076)
Tangibility	-0.064		-0.057
	(0.056)		(0.048)
Tobin's Q	-0.026***		-0.012**
	(0.006)		(0.006)
Intangibility	-0.120**		-0.111**
	(0.059)		(0.047)
Cash	-0.667		-1.652
	(1.936)		(1.571)
Size	-0.014		-0.008
	(0.009)		(0.007)
Amihud		0.008***	0.008***
		(0.002)	(0.002)
Volatility		0.015**	0.005
		(0.008)	(0.008)
Unemployment		0.026***	0.025***
		(0.001)	(0.002)
Term Spread		-0.011***	-0.011***
		(0.002)	(0.002)
S&P500		-0.053***	-0.047***
		(0.008)	(0.010)
Constant	0.239***	-0.116***	0.027
	(0.083)	(0.007)	(0.058)
Observations	52,106	52,117	52,106
R-Squared	0.1589	0.1029	0.1652