# DETERMINANTS OF BANKRUPTCY PROTECTION DURATION FOR CANADIAN FIRMS

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## ABSTRACT

The present thesis examines the determinants of the bankruptcy protection duration for Canadian firms. Using a sample of Canadian firms that filed for bankruptcy protection between the calendar years 1992 and 2009, we find that the firm age, the industry adjusted operating margin, the default spread, the industrial production growth rate or the interest rate are influential factors on determining the length of the protection period. Older firms tend to stay longer under protection from creditors. As older firms have more complicated structures and issues to settle, the risk of exiting soon the protection (the hazard rate) is small. We also find that firms that perform better than their benchmark as measured by the industry they belong to, tend to leave quickly the bankruptcy protection state. We conclude that the fate of relatively successful companies is determined faster. Moreover, we report that it takes less time to achieve a final solution to firms under bankruptcy when the default spread is low or when the appetite for risk is high. Conversely, during periods of high default spreads and flight for quality, it takes longer time to resolve the bankruptcy issue. This last finding may suggest that troubled firms should place themselves under protection when spreads are low. However, this ignores the endogeneity issue: high default spread may cause and incidentally reflect higher bankruptcy rates in the economy. Indeed, we find that bankruptcy protection is longer during economic downturns. We explain this relation by the natural increase in default rate among firms (and individuals) during economically troubled times. Default spreads are usually larger during these harsh periods as investors become more risk averse since their wealth

shrinks.

Using a Log-logistic hazard model, we also find that firms that file under the Companies' Creditors Arrangement Act (CCAA) protection spend longer time restructuring than firms that filed under the Bankruptcy and Insolvency Act (BIA). As BIA is more statutory and less flexible, solutions can be reached faster by court orders.

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# CHAPTER I

# INTRODUCTION

Bankruptcy costs are incurred when insolvent debtors file for bankruptcy protection. Both direct and indirect bankruptcy costs are affected by the debt restructuring process. Direct costs are those associated with the bankruptcy protection process including legal and administrative fees. Indirect costs include lost managerial opportunities (Altman (1984)), forgone revenues and profits, increased operating costs,[1] and reduced competitiveness. Though few studies empirically assess indirect costs, it is believed that they are substantial (Warner (1977); Fisher and Martel (2001)). Altman (1984) examines both direct and indirect bankruptcy costs. He finds that the bankruptcy costs are not marginal. Betker (1995) supports that finding. He finds that most firms paid trade creditors in full in order to avoid negotiating with a diverse creditor group. Franks and Torous (1989) and Weiss (1990) list substantial violations of the absolute priority of claims. They also support the economic significance of the indirect bankruptcy costs.

Obviously, reducing bankruptcy costs is a universal and important objective to most stakeholders involved in the bankruptcy process.[2] Economically, one should consider the total value destruction or salvation to judge on the effectiveness of bankruptcy protection process. Bankruptcy protection duration is essential because longer protection is associated with higher bankruptcy costs.

The financial literature examined the determinants of the bankruptcy protection duration (see Bandopadhyaya 1994; Li 1999; Partington *et al.* 2001; Partington *et al.* 2007; Orbe *et al.* 2002; Helwege 1999; Denis and Rodgers 2007; Fisher and Martel 2007). Major findings are that, besides the firm's specific attributes, relevant industrial sector, common market variables and bargain issues are also significant

[1] This costs refer to the lost of key employees or having to pay more to keep them in the firm.

[2] One can argue that some parties, i.e. lawyers maybe interested in longer process as their fees are positively associated with the duration. We refer here mainly to the various debtholders and the incumbent management.

determinants for the duration of bankruptcy protection. Prior research suffers two main limitations. First, some factors of interest were not investigated. Second, all empirical investigations focused on U.S. data.

The objective of this thesis is to identify the potential factors in explaining the variation in the duration of bankruptcy protection for firms with different bankruptcy protection outcomes. Using different theoretical hazard models, we investigate the effects of various variables on the duration of firms that filed under bankruptcy protection in Canada. Our empirical investigation is based on a sample of firms that filed under the Bankruptcy and Insolvency Act (BIA henceforth) or Companies' Creditors Arrangement Act (CCAA henceforth) protection between 1992 and 2009. The contributions of our study are three folds: 1) Unlike the vast literature that focuses on the U.S. insolvent firms, our study analyzes the problems in the context of Canadian public firms. 2) We extend the existing studies by initiating a dummy variable that differentiates between two distinct Canadian bankruptcy protection procedures. 3) The effects of the listing venues and trustee/monitor information are also captured. In bankruptcy study topics, the scarce of data resources and information limits the analysis of Canadian firms. The duration models enable us to use 128 public firms with complete information and 16 firms that are still under protection at the end of research period. We believe that the present study can offer a comparison to the Chapter 11 research.

We find that firm's industry adjusted operating margin, age, and default spread, industrial production growth or interest rate are significant factors in explaining bankruptcy protection duration across all three distinct hazard models. The better their pre-filing industry adjusted operating performance, the less time firms spend in bankruptcy protection. A wider default spread significantly increases the firm's protection duration time. Firms that file for bankruptcy protection during economic downturns need longer protection period. Firms which lived longer before the filing need more time to discharge from bankruptcy protection. We also find that firms that file under Companies' Creditors Arrangement Act (CCAA) spend longer duration in protection with Log-logistic hazard model. The secured debt ratio plays a role in

affecting the duration of time in that firms with higher secured debt ratio spend less time in bankruptcy protection, but this effect is insignificant. The bankrupt firms with big trustees/monitors do not spend shorter period in bankruptcy protection.

The remainder of this thesis is organized as follows. In the next chapter, we discuss the topics that have been talked about around the bankruptcy area. In chapter III, we briefly describe the legal process of Chapter 11 and the two Canadian bankruptcy protection procedures. We also compare the Chapter 11 and Canadian Bankruptcy Code, and differentiate between the two Canadian bankruptcy protection Codes. We detail the parametric hazard models and the Cox's proportional hazard model in chapter IV, where we also introduce the independent variables for estimation. The sample selection process is discussed in chapter V. The estimation results and analysis are presented in chapter VI. Chapter VII concludes the thesis and provides further discussion.

# CHAPTER II

# LITERATURE REVIEW

The Bankruptcy protection procedure is complex. It involves various parties with different and sometimes contradicting interests. There are ample both theoretical and empirical studies on the topic of bankruptcy. In the present thesis, we focus on the bankruptcy duration analysis. Furthermore, while briefly describe the literature on bankruptcy prediction and post-bankruptcy performance.

## 2.1. Bankruptcy Prediction

Early literature on bankruptcy prediction mainly adopted statistical methods using accounting explanatory variables. Altman (1968) applies various predictive ratios into a multivariate setting and forms a specific model that is used to predict bankruptcy with a comparatively high accuracy. He argues that earlier studies chose univariate ratio to predict bankruptcy, causing the results to be subject to misinterpretation. The multiple discriminant analysis (MDA) not only works well with the original sample, but also has an accurate predictability in several secondary samples. Instead of adopting the MDA, Ohlson (1980) uses conditional logit analysis which avoids certain shortcomings of MDA model.[3] Using the logit analysis method with nine independent variables (all accounting variables), Ohlson provides a newer model for predicting bankruptcy.

Shumway (2001) argues that the early studies were almost always conducted with static models (Altman (1968); Ohlson (1980)). By choosing one specific year of accounting data and applying the static model, a selection bias is introduced into the estimation results. A simple hazard model can produce consistent and unbiased results because it utilizes all available information in determining the firm's risk of

[3] The MDA model requires that the variance and covariance matrix of the predictors to be the same for both the bankrupt and the non-bankrupt firm sample and the independent variables be normally distributed.

bankruptcy. By using hazard based model, only half of the variables from Altman (1968) are significantly related to the failure. According to Shumway's research, adding market wide variables produces more accurate out of sample forecasts.

Recent bankruptcy prediction analysis is not limited to the statistical approach. Vassalou and Xing (2004) use an option pricing model to compute monthly default likelihood indicators. They show that the size and the book-to-market effects relate to the default risk, and that the default risk is systematic. Hillegeist *et al.* (2004) compare the statistical models (Altman's Z- and Ohlson's O-scores) with the implied default probability from the Black-Scholes-Merton model. They conclude that the latter model provides more information than the statistical models. The artificial neutral networks method is also used by many researchers in bankruptcy prediction, e.g., Zhang *et al.* (1999) and Calderon and Cheh (2002). Ravi Kumar and Ravi (2007) provide a survey of the various papers using different methods for bankruptcy prediction.

### 2.2. Bankruptcy Duration Analysis

Few papers study the duration of the bankruptcy protection process. Franks and Torous (1989) document that the process can be lengthy. Franks and Torous (1994) compare the durations between distressed exchanges and Chapter 11 reorganizations and find that the informal reorganizations require significantly less time to restructure as firms try first to informally negotiate a settlement before entering the formal Chapter 11 process. The median duration value for the distressed exchanges is 17 months, while the median duration value for the Chapter 11 reorganizations is 27 months. Weiss (1990) reports that the average firm spends 2.5 years under bankruptcy protection; which is significantly lower than the mean duration of 12.5 years reported by Warner (1977) for a sample of 11 railroad companies.

The main purpose of the former papers was not to measure the duration of the bankruptcy protection per se but rather that was a secondary issue. Bandopadhyaya (1994) specifically examines the duration of bankruptcy protection using a hazard rate model that follows a Weibull distribution. Based on a sample of 74 firms covering the

period 1979-1990, he finds that higher interest outstanding and capacity utilization reduce the duration of the bankruptcy protection. Bandopadhyaya documents positive duration dependence for the hazard rate, which indicates that firms that stay longer under protection are more likely to emerge or exit from the protection.

Partington *et al.* (2001) use Cox's proportional hazard model to predict whether stockholders lose all their claims or receive some value when a firm emerges from Chapter 11 protection. Both the protection duration and the value to the stockholders upon emergence from Chapter 11 are examined. The authors use a forward stepwise estimation procedure to create a parsimonious model based on firm specific and market wide variables. The covariates are applied to two different models. The first model contains only firm specific covariates, while the second adds the market wide covariates. The authors find that all market wide covariates are significant. For the firm specific covariates the ratio of earnings before interests taxes and depreciation to total assets, the natural log of market value of equity, and the current ratio are significant. The authors use the receiver operating characteristic (ROC) curves to assess the predictive accuracy, and find that the two models are similar in terms of predictive performance.

Similar to Bandopadhyaya (1994), Li (1999) examines the instantaneous probability of a firm's emergence from Chapter 11. Using a Log-logistic hazard model, the author finds that firms which spend more time in pre-packaged Chapter 11 and pre-Chapter 11 negotiation spend less time in Chapter 11 protection. Higher gross profit margin quickens the restructuring process, while the existence of legal disputes and larger firm size slow down the emergence process. Finally, the firms which filed in 1990s spent less time in Chapter 11 protection, implying that the courts and bankruptcy professionals were more experienced during that period of time. The inverted U-shaped hazard suggests that it is reasonable given the institutional features of Chapter 11.

Orbe *et al.* (2002) attempt to determine the factors that affect the length of time spend in Chapter 11 protection using a censored partial regression model. This study is similar to Li (1999) as the authors apply comparable covariates and employ the

same data set. The results show that firms that file for pre-packaged bankruptcy need less time to exit from Chapter 11, while firms with higher profitability emerge from Chapter 11 faster. The time of negotiation before Chapter 11, the size of the firm, the engagement of highly leveraged transactions, and the disputes covariates are also related to the duration spent under Chapter 11.

Helwege (1999) analyzes junk bond defaults to determine which variables affect the duration of time spent in distress. The findings suggest that firms with proportionally more bonds resolve their defaults faster. Bank debt leads to longer resolution times. The findings also show that the variation in the bankruptcy protection duration is related to bargaining issues. Larger firms with more contingent liabilities and lawsuits will have slower restructuring processes. Contrary to findings by Jensen (1991) and Wruck (1990), Helwege (1999) reports that highly leveraged transactions do not explain variations in bankruptcy duration. There is little evidence that firms restructure faster in order to preserve value. Information asymmetry between managers and creditors or between different creditor classes does not significantly affect the bankruptcy protection duration.

Partington *et al.* (2007) use a larger sample than their early 2001 work. They use Grambsch and Therneau's (1994) test and Allison's (1984) sensitivity analysis to assess the proportional hazard assumption and the independent censoring assumption. The findings suggest that the former model is unstable and sensitive to data selection as current ratio, term spread, and earnings before interests taxes depreciation and amortization to total assets become insignificant when new observations are added to the sample. Partington *et al.* (2007) confirm the proportional hazard assumption. However, they provide evidence against the independence censoring assumption as the term spread is sensitive to the censoring times.

Denis and Rodgers (2007) analyze the factors that affect the duration using Weibull hazard model. They find that the industry adjusted operating margin, the industry median operating margin, the firm size, and the interaction between weak industry and adjusted firm operating margin are significant determinants of the time spend under Chapter 11 protection. However, only the firm size significantly increases

the duration for ultimately acquired firms. Conversely, for the firms that chose to reorganize, the industry median operating margin and the interaction term between weak industry and adjusted firm operating margin are significant determinants.

To our knowledge, Fisher and Martel (2007) is the only paper that discusses the bankruptcy protection duration for Canadian firms. The main purpose of Fisher and Martel is to examine the impact of the 1992 change in legislation from the Bankruptcy Act (BA) into the Bankruptcy and Insolvency Act (BIA) which is described as more "debtor-friendly like Chapter-11". Fisher and Martel (2007) find that higher cash payments to creditors lead to significantly lower bankruptcy duration. They also find that after the legislative change, bankruptcy duration increased post BIA adoption.

### 2.3. Post-Bankruptcy Performance

Hotchkiss (1995) examines the effects of CEO turnover on the post-bankruptcy performance in order to test whether Chapter 11 is biased toward reorganization over liquidation. The author uses three approaches to assess the sample firms' post-bankruptcy performance: (i) accounting based measures, (ii) the ability of the firm to meet its cash flows forecast, (iii) and the need to restructure once more after emergence. She finds that firms' profitability does not increase significantly and that actual performance is worse than projected. Thirty-two percent of her sample firms need to restructure again post emergence. Retaining pre-bankruptcy management is significantly related to a poorer post-bankruptcy performance.

Alderson and Betker (1999) examine the post-bankruptcy performance using cash flows based methods. The return on investment after liquidation is defined as the benchmark for assessing the post-bankruptcy performance. They find that the cash flow return is greater than the return on the benchmark portfolios. Robustness analysis indicates that this result does not change with different methods of assessing firm value nor benchmarks.

Hotchkiss (1995) and White (1994) argue that Chapter 11 tends to let economically inefficient firms continue to operate. Eberhart, Altman and Aggarwal (1999) suggest that even if firms perform poorly after emerging from bankruptcy

protection, they still perform better than what the market had expected them to achieve. They use various matched samples to estimate expected returns. They find that both average cumulative abnormal returns and median cumulative abnormal returns are positive and significant around the earnings announcements.

While Hotchkiss (1995) focuses on the CEO retention effect, Dawley *et al.* (2003) consider the degree of diversification and firm size on post-bankruptcy outcome and recovery process length. They show that unrelated diversified firms have a greater probability of surviving from bankruptcy than related diversified firms. However, unrelated diversification results in longer recovery processes after bankruptcy.

Jensen (1991) considers acquisition as another possible method to redeploy firms' assets. Instead of focusing on post-bankruptcy performance of Chapter 11 emerging firms, Hotchkiss and Mooradian (1998) investigate how acquisition applies to insolvent firms. They find that information asymmetry problems about target firms impede the acquisition. Bidders are less informed about the value of the target and the use of its assets. To reduce information asymmetry, most of the acquirers are in the same industry as the bankrupt targets. Acquisition in bankruptcy creates value, and the post-merger performance of the acquired firms is better than that of matched non-bankrupt firms as well as the post-bankruptcy performance for reorganized firms. Hotchkiss and Mooradian also document positive abnormal returns to both bidder and target at the announcement of the acquisition transaction.

# CHAPTER III

# BANKRUPTCY PROCESS, COMPARISON BETWEEN CANADA AND THE U.S.

## 3.1. Description of Bankruptcy Process under Chapter 11

Chapter 11 is a chapter of the United States Bankruptcy Code which permits insolvent debtor to continue operating while a final solution is negotiated between involved parties. Alternatively, Chapter 11 enables the debtor a debt-in-possession privilege so that the bankrupt firm can continue operating while inhibiting creditors' collection ability of their claims against the distressed entity during the period of reorganization.

When a firm files for protection under Chapter 11, the court gives the incumbent management 120 days to come up with a reorganization plan, and time extensions are frequently granted. The creditors can oppose extensions if they believe management is unable to provide realistic reorganization plan or is acting dishonestly. The creditors may also propose their own plan under some conditions when the exclusion period expires and the plan from the debtor has not been accepted by the creditors within 180 days of filing.

In order for a reorganization plan to be approved, a majority of each class of creditors is required. Moreover, creditors representing two-thirds of the claimed amounts need to agree on the plan. An amended plan can be proposed if the original reorganization plan is not approved by the creditors. If the amended plan is not accepted, the creditors can request the judge to liquidate or distribute the assets among the claimants. In some cases where creditors are recalcitrant, the court can "cram down" a plan that requires claimants to be treated under the rule of absolute priority. However, the cases for "cram down" are rare since such a decision requires a long and

intensive hearing process to value the assets of the firm.

For a reorganization plan to be confirmed, the absolute priority rule must be satisfied. Absolute priority rule requires that junior creditors should not receive any payment before the senior creditors are paid in full.

### 3.2. The Canadian Bankruptcy Code BIA and CCAA

In Canada, there are two different formal reorganization procedures: (1) the Bankruptcy and Insolvency Act and (2) the Companies' Creditors Arrangement Act.

The Bankruptcy and Insolvency Act was introduced in December 1992 through a modification of Bankruptcy Act, which was enacted in 1919 and subsequently revised in 1949. The Bankruptcy Act was mainly based on the British Bankruptcy Act of 1904.

The 1992 revision was intended to encourage reorganization of distressed firms and thereby save jobs that would be lost if liquidation was the final solution. The revision comprises four principal changes. First, under the 1949 Act, in order for a reorganization plan to be approved, three-quarters of the total claims needed to be supported. Under the new Act, only two-thirds of the total claims are required to be in favor. Second, treatment to the secured creditors is changed. The secured creditors were not bound by the 1949 Act but are stayed for 30 days under the new Act. Third, under the 1949 Act, the federal and provincial claims (Crown claims) were to be paid before other unsecured creditors. Under the new Act, with some exceptions, the Crown priority is abolished. Fourth, wage claims for employees are raised from $500 for wages and $300 for expenses to $2000 for wages and $1000 for expenses.

Fisher and Martel (1994) examine the impact of the new 1992 Act. Despite an increase in acceptance rates of reorganization plans, the real effects of the reformed Act are quite small, due to the small number of jobs saved per year.

The CCAA was enacted in 1933 to assist in the reorganization of insolvent companies. It was originally applied to all insolvent firms, however, due to a 1953 amendment, the Act focuses on the firms that have outstanding secured or unsecured bonds. The CCAA is different from the BIA in several aspects. While the BIA process

is a statutory process, CCAA is more flexible and discretionary as the judge can make discretionary decisions. This feature results in larger corporations filing for bankruptcy under CCAA protection. A second important difference is that the CCAA does not have a time limit on the bankruptcy proceedings as the court can provide unlimited extensions for the firm under protection (under the BIA, total stay period cannot exceed six months). Third, BIA does not require any threshold of debt, whereas CCAA has a minimum of $5 million debt threshold.

### 3.3. A Comparison of Bankruptcy Protection between the U.S. and Canada

Despite the various similarities with regard to bankruptcy protection between the U.S. and Canada, there remains enough different features to make the two national systems distinct.

First, under Chapter 11, a trustee can be appointed if the court finds that the debtor is involved in inappropriate conduct, but this is not a mandatory act. In Canada, the appointment of a trustee is compulsory in every filing case (monitors play the similar role under the CCAA system). Second, treatment of secured creditors is different. Under Chapter 11, all creditors are bound by the stay of the proceedings following the bankruptcy filing, whereas secured creditors are not bound by the stay under the BIA and CCAA.[4] In Canada, as long as the secured creditors believe that collecting their claims is preferable, they can realize their interest in the event of the insolvency. However, when it comes to the voting of the plan, the secured creditors cannot vote on the plan unless their claims are partially satisfied. Third, "cram down" can be used by the debtor (or creditor) under Chapter 11 whereas there is no such specific procedure under the BIA and CCAA.

Fisher and Martel (1999) compare reorganization under the two different national systems. They find that the confirmation of the plans and the completion rates are significantly higher in Canada than under Chapter 11 in the U.S. They find however that the Canadian system became closer to the U.S. Chapter 11 after the 1992

[4] Secured creditors are given a stay of 30 days, but Fisher and Martel (2003) argue that the period is too short to have any effect on the bankruptcy process.

regulatory reforms. They argue that the 1992 reforms make the bankruptcy protection system less efficient because the new bankruptcy protection system assures the survival of unhealthy non viable firms which results in higher costs to Canadian economy.

# CHAPTER IV

# METHODOLOGY

Duration models are well specified to fit and explain data measuring the duration of various phenomena. Duration measured in time elapsed is usually a positive real number. Therefore, OLS estimation of regressing duration on various possible explanatory variables is ill specified as it leads to potential negative fitted or predicted duration measures conditional on the realization of the explanatory variables. For censored observations, the error term does not have conditional mean zero and is not uncorrelated with explanatory variables. The right censored observations makes OLS estimation inconsistent in our study. However, the duration models can deal with both the censored data and the duration time.

In the sub-sections to follow, we first introduce the (conditional) survival and hazard functions. Second, functional forms of these models are proposed. Third, we discuss the general proportional hazard rate and accelerate failure models. Fourth, parametric models assuming the Weibull distribution and Log-logistic distribution are discussed. Fifth, Cox's proportional hazard model is presented. At last, we discuss the explanatory variables that are chosen in this study.

## 4.1. Survival and Hazard Functions

In this thesis we will develop the theory behind duration models shaping the probability that a firm exits from bankruptcy protection. We measure the duration of the bankruptcy state by $\tau$, a random variable with probability density function (PDF) given by $f(t)$ and cumulative density function (CDF) given by $F(t)$, where $t$ is a realization of $\tau$. Then the survival function is as follow

$$S(t) \equiv 1 - F(t) \tag{1}$$

The unconditional probability that a state ends in any short period, say, between time $t$ and $t + \Delta t$ is;

$$Pr(t < \tau \leq t + \Delta t) = F(t + \Delta t) - F(t) \tag{2}$$

The conditional probability that a firm exits in a short period, between $t$ and $t + \Delta t$, conditional on having already reached time $t$, is defined as

$$\Pr(\, t < \tau \leq t + \Delta t | \tau \geq t) = \frac{F(t+\Delta t) - F(t)}{S(t)} \tag{3}$$

In a continuous time framework, we can compute the limit of $\frac{\Pr(\, t<\tau\leq t+\Delta t|\tau\geq t)}{\Delta t}$ as $\Delta t \to 0$ , which is from (3) given by

$$h(t) = \frac{f(t)}{S(t)} \tag{4}$$

$h(t)$ in (4) is the hazard function. It is very common to focus and work on the hazard function rather than the survival or density function.

Data on duration usually contain observations that are censored. Censoring can be either left or right type. An observation is right censored if it is still in the studied state (in our case the state is bankruptcy protection) when data collection or survey is stopped. Left censoring exists if a firm enters the survey while it is in the studied state. In our case, that means a firm that is already in bankruptcy when we start collecting data.[5]

For right censored observations, the likelihood can be seen as the probability that the duration exceeds $t_i$ ($t_i$ is the time that firm *i* has already spent under bankruptcy protection), which is given by the survival function. For uncensored data, we derive the likelihood from (4). Let $J$ denotes the set of uncensored observations. The log-likelihood of the total sample is given by

[5] As we have data on all firms in our sample, no observation is left censored. For more details on sample composition, see chapter V.

$$l(t,\beta) = \sum_{i=1,i\in J}^{n} \log[h(t_i|x_i, y_{ti}, \beta)] + \sum_{i=1}^{n} \log[S(t_i|x_i, y_{ti}, \beta)] \quad (5)$$

$x_i$ is the set of explanatory cross-section variables for observation $i$, $y_{ti}$ is the set of explanatory time variables and $\beta$ are the parameters to be estimated. $x_i$ is a vector of $K$ covariates. $x_{i,k}$ denotes the variable $k$ for individual (observation) $i$.[6] The parameters of the model are estimated by maximizing (5) or using the maximum likelihood estimation (MLE) approach.

### 4.2. Proportional Hazard Model and Accelerated Failure Time Model

Assume that the hazard rate for any given observation $i$ in the sample data is given by the following expression:

$$h(x_i, t) = g(x_i)h(t) \quad (6)$$

The hazard rate is the product of two functions. The first function $g(x_i)$ depends on the observation's characteristics. The second function $h(t)$, known as the baseline hazard function, depends only on time. The implication of (6) is that the ratio of the hazards for any two observations $i$ and $j$, depends only on their characteristics not time. The ratio is governed by

$$\frac{h(x_i,t)}{h(x_j,t)} = \frac{g(x_i)h(t)}{g(x_j)h(t)} = \frac{g(x_i)}{g(x_j)} \quad (7)$$

In particular, let's assume that $g(x_i)$ is determined by an exponential distribution, $g(x_i) = \exp(x_i\beta)$. Then the hazard function (6) becomes

$$h(x_i, t;\ \beta) = \exp(x_i\beta)\, h(t) \quad (8)$$

[6] We assume that $x_{i,0}$ is a vector of ones. Thus $x_i\beta = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \cdots + +\beta_{K-1} x_{i,K-1}$.

The issue now is defining a functional form for $h(t)$. In reality, the distribution for the baseline hazard function is unknown. Econometric empirical studies of various phenomena adopted few simplistic models for the baseline hazard rate $h(t)$.

Accelerated failure time (AFT) model assumes that the baseline hazard increases as function of the observation's characteristics. AFT can take the following functional form:

$$h(x_i, t) = g(x_i)h[tg(x_i)] \tag{9}$$

We notice that the baseline hazard $h[tg(x_i)]$ depends on covariates $x_i$. Both the Weibull and the Log-logistic hazard models belong to the AFT family.

### 4.3. Parametric Models

The widely used parametric forms of duration are the Weibull and the Log-logistic distribution models.[7]

#### *4.3.1 The Weibull Distribution*

The Weibull distribution, which is parametric, belongs to the proportional hazard family functions. The hazard function with parameter $b$ $\left(b = \frac{1}{\sigma}\right)$ for individual *i* can be written as follow

$$h(t_i;\ b, \beta) = bt^{b-1}\exp\left(\frac{x_i\beta}{\sigma}\right) \tag{10}$$

The density function, survival function, and the CDF for this distribution are

$$f(t_i; b, \beta) = \exp\left(\frac{x_i\beta}{\sigma}\right)bt^{b-1}\exp\left[-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b\right] \tag{11}$$

[7] Van de Gucht and Moore (1998) examine the duration of leveraged buyouts and their reversal from the private state to the public state using two hazard functions. Tudela (2004) analyzes the probability of currency crises using duration based approach. He applies a Cox proportional model to test factors causing currency crises. Van der Goot *et al.* (2009) analyze the effects of the determinants on the survival time for internet IPOs. They use the Log-logistic based duration model. They also compare the results from Log-logistic duration model with those from Cox's proportional hazard model.

$$S(t_i; b, \beta) = \exp\left[-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b\right] \quad (12)$$

$$F(t_i; b, \beta) = 1 - \exp\left[-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b\right] \quad (13)$$

The baseline hazard function is $bt^{b-1}$.[8] From the hazard function we can observe that both the baseline hazard function and the effects of the explanatory variables are well specified.

The estimates are obtained by maximum likelihood estimation. The log-likelihood function is as follow

$$l(t, \beta, \sigma) = m \times \log(b) + \sum_{i\in J}\frac{x_i\beta}{\sigma} + (b-1)\sum_{i\in J}\log t_i - \sum_{i=1}^{n} t_i{}^b \times \exp\left(\frac{x_i\beta}{\sigma}\right) \quad (14)$$

Where $m$ is the number of entities in $J$, which is the number of complete uncensored observations; $n$ is the total number of observations or sample size.

### *4.3.2 The Log-Logistic Distribution*

The Log-logistic duration model has a hazard function given by:

$$h(t_i; \sigma, a) = \frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{1+at^{\frac{1}{\sigma}}} \quad (15)$$

Where $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$ and captures the effect of the covariates.

The density, survival, and cumulative density functions are

[8] One can re-arrange the hazard function to where the baseline hazard is given by $h(t_i;\, b, \beta) = b\left(t \times \exp\left(\frac{x_i\beta}{\sigma}\right)\right)^{b-1}\exp\left(\frac{x_i\beta}{\sigma}\right) = h[tg(x_i)] \times g(x_i)$ with $b\left(t \times \exp\left(\frac{x_i\beta}{\sigma}\right)\right)^{b-1} = h[tg(x_i)]$ and $g(x_i) = \exp\left(\frac{x_i\beta}{\sigma}\right)$. This latter expression shows that the Weibull based model is also accelerated failure model.

$$f(t_i;\sigma,a)=\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left(1+at^{\frac{1}{\sigma}}\right)^2} \tag{16}$$

$$S(t_i;\sigma,a)=\frac{1}{1+at^{\frac{1}{\sigma}}} \tag{17}$$

$$F(t_i;\sigma,a)=1-\frac{1}{1+at^{\frac{1}{\sigma}}} \tag{18}$$

The shape for the distribution depends on the relative value of $\sigma$ compared to 1. The Log-logistic distribution produces an accelerated failure time (AFT) model. For an AFT model, the covariate effects are constant and multiplicative on the time. The covariate affects the hazard by a constant factor, which is the acceleration factor. If we set the survival function in (17) equal to 0.5 and solve the equation, assuming one unit increase in covariate $k$ $(1,\dots,K-1)$ while other variables are unchanged, we get an equation for the time ratio at the median[9]

$$\mathrm{TR}(t_{50\%})=\exp(-\beta_k) \tag{19}$$

The time ratio indicates the marginal effect of the specific covariate on the median survival time. The quantity $\exp(-\beta_k)$ is known as the acceleration factor. If the time ratio is greater than 1, it means that this covariate prolongs the restructuring duration. If it is less than 1, it implies that this variable shortens the protection process. The log-likelihood function for the Log-logistic duration model is

$$l(t,\beta,\sigma)=\sum_{i=1}^{n} d_i\log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right)+\sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right) \tag{20}$$

Where $d_i$ equals one if the observation is fully observed or uncensored and zero

[9] At the survival value of 0.5, the corresponding time is the median duration. See Hosmer and Lemeshow (1999) for more details on the time ratio and acceleration rates.

otherwise.

### 4.4. Semi-parametric Model

Cox's Proportional Hazard Model is a semi-parametric model. It defines the functional form the hazard rate given the covariates, but makes no parametric specification about the density function of the duration.

The Cox's proportional hazard model is defined as follow

$$h(x_i, t) = h(t)\exp(x_i\beta) \tag{21}$$

Where $\beta$ is the vector of coefficients to estimate, $x_i$ is the ($K$ dimension) covariates vector, $h(t)$ is the baseline hazard function. The parameters are obtained by maximizing the log-likelihood function

$$l(t, \beta) = \sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j \in R_{(y_i)}} \exp(x_i\beta)}\right] \tag{22}$$

We use the Kaplan-Meier's Product-Limit estimator to fit the empirical survival function.[10]

### 4.5. Explanatory Variables

Few studies investigated the determinants of bankruptcy duration in the U.S. We use these empirical studies as a starting point in selecting the explanatory covariates $x_i$. Specifically, we use several firm specific variables and market wide variables that have only a time dimension. In addition, we use some other variables based on the specificities of the Canadian framework.

*Firm size and age*

[10] The Kaplan-Meier estimator of the survival function results in a declining flat linear step-wise function. The length of each horizontal step is defined by the length of time between two successive uncensored duration observations. When a large enough sample is applied, the estimator will converge to the true survival function of the population.

Denis and Rodgers (2007), and Helwege (1999) use size as an explanatory variable for bankruptcy duration. The argument is that larger firms hold more debt thus need more time for negotiation. Our hypothesis is that there is a positive relation between size and bankruptcy protection duration. We measure the firm size by the logarithm of total assets from the balance sheet.

We also consider the firm age or tenure as an explanatory variable. We argue that older firms are more likely to have more complex debt structures and more creditors and thus need longer time to exit from bankruptcy protection.

*Secured debt ratio*

The secured debt ratio is a measurement of firm's creditor structure. As noted, secured creditors are not bound by the stay under Canadian bankruptcy laws. It is assumed that secured creditors prefer liquidation to reorganization as they have priority over other creditors. Fisher and Martel (1995) find higher secured debt ratio yields to a higher probability of reorganization plan acceptance. They conjecture that, when unsecured creditors do not have enough information, they may observe the behavior of secured creditors. The acceptance of a plan from secured creditors may thus be viewed as a signal of positive prospects. In the present thesis, we focus on how this ratio affects the duration of an entity under bankruptcy protection. According to the absolute priority rule, unsecured creditors get their claims after the payment to secured creditors. In order to bargain for larger payment, the unsecured creditors can threaten to protract the protection process. A higher secured debt ratio indicates fewer unsecured creditors involved. Moreover, the signaling effect of secured creditors also suggests that a higher secured debt ratio results in shorter resolution duration.

*Leverage*

The leverage of the firm is defined by the ratio of total liabilities to total assets. It describes the firm's financial structure before bankruptcy filing. Higher leverage means more debt for the same assets. Creditors will have to negotiate harder to split the relatively smaller collateral (total assets) among themselves as they must accept a deeper discount. Hence, one can argue that bankrupt firms with higher leverage ratio may have to deal with more bargaining issues among stakeholders to find a solution.

Therefore, we expect firms with larger leverage ratio to stay longer under bankruptcy protection. Bandopadhyaya (1994) uses long term debt to assets ratio as a measurement for leverage. However, his findings show that this variable is not significantly related to the bankruptcy protection duration.

*Return's volatility*

Volatility is measured as the standard deviation of daily returns over one calendar year prior to filing for bankruptcy. We argue that if the volatility of total assets increases, then the value of equity itself increases as equity is similar to a call option on firm total assets. Higher equity reduces the bankruptcy risk. At the limit, the argument can force shareholders to more likely and willingly accept an arrangement with creditors to and thus save some salvage value that would be destroyed in case of liquidation. Similarly, creditors are likely interested in converting their debt into equity and reap the potential option value. However, a company that is already bankrupt indicates that the value of equity is already nil. Equity and assets' volatility may not have any value at this point in time.

*Net profit margin*

We define net profit margin as the ratio of firm's net income to sales. Higher net profit margin implies that the firm has greater ability to turn revenues into profits. We conjecture that firms with higher net profit margin are deemed viable and are primary targets for acquisition. Stakeholders tend to settle the bankruptcy issues quickly in order to preserve the firm's ability to turnover revenues into profits. Hence, we hypothesize that bankrupt firms with higher net profit margin spend less time under bankruptcy protection.

*Industry adjusted operating margin and industry median operating margin*

Following Denis and Rodgers (2007), we define the operating margin as the ratio of earnings before interests and taxes (EBIT) over total assets (TA).[11] As suggested by Maksimovic and Phillips (1998), the industry health is a significant factor in affecting the fate of firms in financial distress. We consider the state of the industry by

[11] The ratio is also known as the return on assets (ROA).

including the industry median operating margin as an explanatory variable for the bankruptcy duration. We conjecture that firms that operate in healthy economic sectors spend less time in bankruptcy protection as potential acquirer and debt holders see future opportunities in these firms. Similarly, we conjecture that firms that do better than their industrial benchmark spend less time in bankruptcy protection. The relative performance is measured by the industry adjusted operating margin (IAOM). We construct IAOM by matching the sample firms with non filing firms using the 4-digit Standard Industry Classification (SIC) Code. SIC codes are extracted from Compustat. The industry median operating margin is then calculated from the matched companies. If the same 4-digit SIC Code entities are not found for the firm, then we use the 3-digit SIC Code for matching, and so on. The industry adjusted operating margin is obtained by subtracting the industry median operating margin from the sample firm's operating margin. Data on EBIT and TA are also extracted from Compustat.

*Default spread*

The default spread is measured as the yield differential between long-term corporate bond and the long-term government of Canada bond yields at the time before the firm's filing date. We use the data on the first day prior to the firm's filing date. Contrary to the previous variables, the default spread is a market wide variable. It shows no cross-sectional variation except for the passage of time. Larger default spread could be thought of as a systematic risk factor.[12] We hypothesize that periods with high default spreads are associated with higher bankruptcy risk and longer bankruptcy protection. When default spreads are high, the flight-to-quality effect implies that investors tend to buy higher quality securities and avoid investing in risky securities. This makes it difficult to rescue low quality firms, and makes the restructuring duration longer. Conversely, with low credit spread during economic expansions, investors have a tendency to take more risk as their return is higher than

[12] Vassalou and Xing (2004) show that default is a systematic risk and that default should be priced. The appetite for risk hypothesis is predominant in the popular financial press. For tests of the appetite for risk hypothesis, please refer to Eichengreen and Mody (2000).

the less risky investments. They do not perceive risk similarly during contraction periods. Their increased appetite for risk makes default less likely and shortens bankruptcy duration when it occurs.

*Industrial production and GDP growth*

Industrial production is a highly pro-cyclical economic indicator. Hamilton and Lin (1996) argue that industrial production growth is related to economic conditions. They report that the industrial production growth declines sharply during economic recession. As such, we can infer the link between bankruptcy duration and economic activity using the growth in industrial production. We hypothesize that during periods of economic slowdowns or even recessions, bankruptcy filing intensity increases. Therefore, with busier institutional systems, it takes longer to finally settle the bankruptcy processes. Hence, we expect a negative relation between economic growth and bankruptcy duration. We also use GDP growth as an alternative measure to the economic activity proxy for robustness purposes.

*Interest rate*

Short term interest rate is also an economic indicator. Short rates are usually used by monetary authorities as an instrument to influence the economic activity. During economic downturns (expansions), central banks decrease (increase) short rates to stimulate consumption and investments (limit overheating of the economy). Hence and in accordance to the last paragraph, we expect a negative relation between short interest rates and bankruptcy duration. We proxy short interest rates by the 90-days rates on government of Canada Treasury Bills.

*Term spread*

Term spread is usually used in the macroeconomic literature to describe the state of the business cycle. It is also used to characterize the time series variation in returns (Chen *et al* 1986). High term spreads are associated with high expected inflation rates which indicates future economic recovery and expansion. Plosser and Rouwenhorst (1994) show that long rates have strong relation to future growth of industrial production. Dueker (1997) shows that the term structure has strong predictive power of economic recessions. Hence, high term spread suggests that current economic

conditions are more likely dire. We then expect term spread to have a positive impact on the bankruptcy duration.

*Control dummy variables*

As we have mentioned in Chapter III, there are differences between Chapter 11 and Canadian Bankruptcy Code. In Canada, trustees or monitors are required in every bankruptcy filing case. More specifically, when a firm files for bankruptcy protection under BIA (CCAA), the trustee (monitor) is in charge of supervising and informing all parties about the successive events. We hypothesize that the quality of the trustee or monitor can influence the protection duration. For instance, high quality trustee with solid reputation can help reduce information asymmetry between parties involved in the default negotiation process. As a consequence, the process can be settled faster for either possible outcomes (reorganization, liquidation, acquisition etc.). In order to capture this potential effect, we introduce a dummy variable which equals one if the trustee or monitor belongs to one of the four largest accounting and professional services firms, and zero otherwise. The largest four firms are: PricewaterhouseCoopers, Deloitte Touche Tohmatsu, Ernst & Young, and KPMG.

In Canada, firms can choose to file under either the BIA or the CCAA, provided that they satisfy filling conditions specifically the minimum $5 million debt requirement for CCAA. We propose to test whether the choice of both filing methods and jurisdictions can impact the bankruptcy protection duration. As discussed in section III, BIA is more restrictive procedure where extensions are not the rule as opposed to CCAA where judges have more discretion in providing extensions to parties to find solutions. We use a dummy variable to capture the difference in durations between the two distinct procedures. The variable takes value of one if the firm files under the CCAA, and zero otherwise.

Furthermore, we also include a dummy variable that differentiates between firms listed on Toronto Stock Exchange (TSX) and other listing venues (TSX Venture Exchange and the Montreal Exchange). The variable is equal to one if the filing firm is listed on the TSX and zero otherwise. Most blue chip Canadian firms are listed on

the TSX. Finally, we construct four dummy variables to test whether the province where the headquarters of the filing firm are located matter in determining the protection duration. These binary variables are associated with the following provinces: Alberta, Ontario, Quebec, and British Columbia.

# CHAPTER V

# SAMPLE AND DATA

Our research is different from previous studies in the sense that the sample contains public firms filed under BIA or CCAA in Canada. The sample selection process is tedious and time consuming because most of the firms filed for bankruptcy protection are private entities with little publicly available data. We identify 145 public firms that files for bankruptcy through multiple databases during the period 1992-2009. Our sample contains 128 unique public firms with complete duration and resolution outcomes. Since one firm filed twice under BIA in 1999 and 2002, we have 129 observations as uncensored observations. Moreover, we identify 16 right censored observations that are still under bankruptcy at the end of 2009.[13]

The sample selection procedure is as follow. First, we search for the firms that filed for bankruptcy protection through Lexis-Nexis and Canadian Business & Current Affairs (CBCA) by using keywords such as "bankruptcy", "bankruptcy protection", "BIA", and "CCAA" for the period 1992-2009. This process results in 205 firms/observations in total, among which 31 are privately held, 16 are still under restructuring as of January 31$^{st}$, 2010, and 30 are liquidated immediately on the filing day. Therefore, the sample selection procedure results in 145 observations including the 16 censored cases. Table 1 details the number of filings by final outcome for each calendar year. We observe that there is a concentration of filing for bankruptcy protection between 1999 and 2003. This may be caused by the crash of the dotcom bubble in year 2000 and subsequent and contemporaneous increase in business failure specifically in the high tech area. Conversely, no firm in our sample filed under bankruptcy protection for the years 1993 and 1994.

[13] We would like to thank Efrim Boritz, Duane Kennedy and Jerry Sun for their kind support of the list of bankrupt companies.

**[Please insert Table 1 about here.]**

Table 1 shows that there are 43 firms that reorganized from BIA or CCAA protection. We follow the 43 reorganized firms through the three years following reorganization (for firms that emerged from bankruptcy protection after the year 2006, we follow them through the end of this study). We find that two firms went private immediately after exiting from bankruptcy protection, while five firms were acquired within the three full years following reorganization. Among the 43 reorganized firms, one was liquidated in its third year following exiting, and one filed for bankruptcy protection again and is still under bankruptcy protection.

The next step is to locate the exact dates of entering and exiting from bankruptcy protection. For bankrupt firms that are ultimately liquidated or acquired, we require the date of the court announcement. We manually collected data on these dates using various sources including the System for Electronic Document Analysis and Retrieval (SEDAR) and CBCA. Occasionally, when data was not available from these databases, we proceed to specific targeted search for these cases using various internet sources to faithfully report those dates. Duration of bankruptcy is measured as the number of days separating the filing for bankruptcy date and the release from the protection. Table 2 contains descriptive statistics on the sample duration used for the current thesis. The median value for the firms that reorganized is 281 days, which is longer than the median value of acquired firms (169 days) and liquidated firms (96 days). We note that for all subsamples, the mean duration is higher than the median duration which documents that duration is positively skewed and is influenced by firms with extremely lengthy bankruptcy protection. To illustrate, Modatech Systems Inc spent almost five years in bankruptcy protection from November 1995 to September 2000.

**[Please insert Table 2 about here.]**

Our sample has shorter bankruptcy protection duration when compared with the sample in Denis and Rodgers (2007). The median duration values from Denis and

Rodgers (2007) are 597 days for the reorganized group, 502 days for the acquired group, and 276 days for the liquidated group. Denis and Rodgers (2007) use a sample that contains U.S. firms over the period 1985-1994, while our sample cover Canadian firms over the more recent period 1992-2009.

We further compare the bankruptcy duration between (i) the three subsamples based on the bankruptcy outcome and (ii) the censored vs. uncensored groups. Columns (1) and (2) of panel A from table 3 shows that firms that were reorganized spent significantly longer time (mean of 412 days) under bankruptcy protection than those that were acquired or liquidated. Similar conclusion can be drawn from median Wicoxon-Mann-Whitney tests. Column (3) of the same panel shows that acquired firms spent also significantly longer time under protection than those who ultimately were liquidated. The multivariate test in panel b of table 3 shows that all three subsamples jointly have different bankruptcy durations according to both parametric Fisher and nonparametric Kruskal-Wallis statistical tests. Column (4) of panel A from table 3 shows that censored observations have higher bankruptcy protection duration than uncensored observation according to both mean and median based tests. This result is somehow expected as censored observations are those that are still under bankruptcy when data is collected.

**[Please insert Table 3 about here.]**

We collected data on explanatory variables using various databases. Total assets, total liabilities, secured debt, net income, and the firm's SIC code are collected from the Compustat database. Some Canadian firms are not covered by the Compustat database. For these firms, we hand-collected the data from the financial statements recovered from the SEDAR system. As for the SIC codes and headquarter's province, we use Hoover's database and various web sites. All firms' accounting variables are collected from the latest annual report issued within one calendar year before the filing date. If no data is available for that particular year, the latest financial data before the filing date are used instead. In order to capture the industry effects on the insolvent entities, the industry adjusted operating margin is calculated by subtracting

the industry median operating margin from the firm's operating margin. The industry median operating margin is calculated for the same year as the firm's operating margin. The industry operating margin for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. If we are not able to identify contemporaneous firms with the same 4-digits SIC Code as one bankrupt company, then we match instead using the last 3-digits SIC Code. This procedure is repeated until matching occurs using one-digit SIC code. In our final sample, there are 10 firms that are matched using 3-digits SIC Code, 13 firms are matched using 2-digits SIC Code, and 1 firm (censored observation) that is matched in the same 1-digit SIC Code. In order to identify the different sample bankruptcy procedures, we document the filing information for each firm from SEDAR, and find whether the firm filed for BIA or CCAA. We also record the trustee or monitor identity and the firm's inception date for each filing case by searching SEDAR. In Canada, a trustee/monitor is required for each firm that filed for bankruptcy protection. We collect the trustee/monitor information directly from the news report on the filing date from SEDAR or CBCA. For the firms whose inception dates are not covered in SEDAR, we get the information from various websites including those published by the respective bankrupt firms. Age is measured as the duration time in years between the firm's inception year and the bankruptcy filing.

Data on stock returns is collected from the Canadian Financial Markets Research Center (CFMRC) and the Datastream database. Standard deviation is calculated using daily return over one calendar year period before the firm's filing date. For calculating the default spread, the long-term corporate bond indices yield and long-term government of Canada bond indices yield are recoded from Datastream and Canadian Socio-economic Information Management System (CANSIM) respectively. The yield on of long-term corporate bond index is from Scotia Capital Inc on the Datastream system. Both the long-term corporate bond yield and the long-term government of Canada bond yield are reported on a weekly basis. For these two variables, we use the data that is closest in time to firm's filing date to calculate the default spread. We define the term spread as the differences between the long-term government of

Canada bond indices yield as describe above and the 90 day government of Canada Treasury Bill rate. Both rates are measured on the Wednesday preceding firm's filing date. The interest rate, the total industrial data, and the GDP data before firm's filing date are collected from CANSIM. We collect the listing venue information before or on firm's filing date either through CFMRC database or through TSX-Venture web site. Table 4 presents some descriptive statistics about our bankrupt firms' sample. We can clearly state that outliers are common in our sample as for instance the minimum and maximum values of internal liquidity (current assets over current liabilities) for the full sample are respectively at 0% and 4.420%.[14]

**[Please insert Table 4 about here.]**

Both the mean and median industry adjusted operating margins are statistically significantly negative. Panel A of table 4 shows that the mean industry adjusted operating margin is around -42%, suggesting that sample firms performed poorly compared with the industry median performance. The average sample firm has total assets of $483 million. The distribution of total assets is extremely skewed as the median firm has total assets of $49 million.[15] The mean leverage ratio, which is defined as total liabilities over total assets, is 1.059, which is greater than 1. The mean sample firm has more outstanding liabilities than assets to cover them. This is highly expected as all sample firms are in bankruptcy status. However, the median leverage ratio is 0.726, implying that there are extreme values that skew the mean leverage. The mean net profit margin is -4.329, implying that sample firms have very low (negative) efficiency in turning revenues into profits. Over 50% of sample firms have severe internal liquidity problems with negative working capital. The median current assets over current liabilities ratio is 0.87. We observe similar characteristics of explanatory variables in panel E as those in panel A which describe the subsamples based on final outcome and bankruptcy status when data collection was finalized.

[14] To address the outliers' issue, we winsorize our data using 1% and 99% cut-off points.
[15] Few companies in our sample like Nortel Networks and Teleglobe had assets worth more than $ 8 billion when filing for bankruptcy.

Firms perform poorly relative to their industry benchmarks as both the mean and median values of industry adjusted operating margin are negative. Moreover, we also find extreme values for the total assets, leverage ratio, net profit margin and internal liquidity, indicating that the outliers we found in panel A are robust to the ultimate bankruptcy outcome. In sum, the descriptive statistics in table 4 show that our sample firms are essentially in poor financial and economic situation.

We further compare the variables among the three subsamples (the reorganized, the acquired, and the liquidated subsamples). The sample statistics and difference test statistics for the equality of mean and median tests are reported in panels B to D of table 4 and in table 5 respectively. Panel A of table 5 shows the results of mean and median comparison between the three groups. We use a Fisher based analysis of variance (Kruskal-Wallis test) to test for equality of means (medians). We can state that both our parametric and nonparametric statistical tests fail to reject the equality between the three groups in all cases but one. Only the mean age shows differences between the three groups at the 10% confidence level. We believe that the extreme heterogeneity of the group members with extreme values and high variability coupled with the small sample size highly reduce the power of our statistical tests.

**[Please insert Table 5 about here.]**

Panel B of table 4 shows that the mean industry adjusted operating margin for reorganized firms is -36.2% which is higher than that for the acquired firms at -63.6%. This indicates that the reorganized firms performed better in terms of their industry than the acquired firms. However, panel B of table 5 shows that this difference is not statistically significant. The median industry adjusted operating margin for the reorganized firms is higher than that for the acquired firms, but the test statistic is also insignificant. For paired-groups comparisons, we used the t-test (Wilcoxon Mann Whitney test) for equality of means (medians).

Similar results are found for the leverage ratio, net profit margin measured as net income divided by sales, and liquidity measured as current assets over current liabilities. Although the mean leverage ratio for the reorganized firms is higher than

that for the other subsamples, the differences of the mean and median leverage ratio are not statistically significant for each pair of the three subsamples.

The median value of total assets for the reorganized firms is $69 million, and it is higher than that of the other two subsamples. Reorganized firms seem to hold more assets than other firms. According to panels B and C of table 5, we do not find significant differences of the median total assets between the three subsamples. The mean value of total assets for reorganized firms is however significantly higher than that for liquidated firms at the usual 5% confidence level. We may hint that larger firms are more likely to reorganize themselves whereas smaller firms with less assets are more easily acquired or liquidated as they involve less resources from the acquirer or the liquidator.

The mean (median) firm age for the reorganized firms is 22 (15) years, which is significantly higher than that for liquidated firms subsample at 13 (9). This suggests that older firms are more likely to reorganize themselves and emerge as a new entity than to be liquidated.

Table 6 reports the correlation matrix for the explanatory variables. From table 6 we can observe that firm's total assets is correlated with the trustee dummy variable, CCAA dummy variable, TSX dummy variable, and firm age, mirroring that larger firms are usually older and employ bigger well known trustees. Consistent with previous discussion, larger firms are more likely to be listed on the Toronto Stock Exchange and tend to file under CCAA protection. Furthermore, larger firms usually have lower equity volatility. We should note however that the correlations are small in magnitude. Over 66 different correlation coefficients for the cross-section covariates, only two are higher than 0.5. The highest correlation is between (logarithm of) total assets and the CCAA dummy at 0.556.

**[Please insert Table 6 about here.]**

As expected, we observe significant correlations among some time series covariates as they describe the prevalent economic conditions. For instance, higher interest rates are related to lower term and default spreads. The two correlation

coefficients are strongly significant and have high absolute magnitudes at 0.746 and 0.682 respectively. Moreover, there are (i) significantly negative correlation between default spread and industrial production growth at 0.65 and (ii) significantly positive correlation between interest rates and industrial production growth at 0.53. One can infer that periods of low economic activity are characterized by (i) low or negative growth in industrial production, (ii) low interest rates used as a tool to stimulate the economy, (iii) high term spread as a sign of higher long term interest rates or increase in interest rates after economic recovery (iv) and a high default spread indicating increased probability of default during economically dire periods. The latter relates also to market flight to safer assets when default risk materializes as actual bankruptcy occurs at these particularly difficult times. During economic expansion times, bankruptcy likelihood decreases. As a result, investors are willing to take more risk since the occurrence of bankruptcy is less likely. Therefore, the increased demand for risky assets reduces their required yield compared to safer securities and the default spread shrinks. We further discuss these mechanisms later in the thesis.

# CHAPTER VI

# EMPIRICAL RESULTS

We estimate the three specified duration models by maximizing the log-likelihood in expressions (14), (20), and (22) for respectively the Weibull the Log-logistic and the Cox semi-parametric models. Finally, various tests are conducted to check the robustness of our empirical findings to various scenarios.

## 6.1. Results with Full Sample

Tables 7, 8, and 9 present respectively the results from the Weibull, the Log-logistic and the Cox proportional hazard based models. The tables report the coefficients and their respective standard errors on the explanatory for each hazard rate based model.

Each column corresponds to a different specification for each model depending on the included explanatory variables. At the end of each run, pseudo adjusted R squared as proposed by Cox and Snell (1989) is computed. This measure of goodness-of-fit measure is given by

$$R^2 = 1 - \exp\left[\frac{2}{N}\left(LL_0 - LL_{\hat{\beta}}\right)\right] \tag{23}$$

Where $LL_0$ denotes the log-likelihood for the restricted model where all coefficients of explanatory covariates are zeros, while $LL_{\hat{\beta}}$ is the log-likelihood for the unrestricted fitted model.[16]

Table 7 shows that the age of firm has a significant impact on the duration. The coefficient on the (logarithm) of age ranges from -0.250 to -0.234 for the 5 models presented in table 7. We express the median survival time as a function of the

[16] This measure is similar to computing a likelihood ratio test to test for restriction that all coefficients are zero.

coefficients. The time ratio from expression (19) for the variable age is 1.2636 based on estimate from column 5 in table 7. This leads to the following statement: one unit increase in the logarithm of firm age increases the median protection time by 26.36%.[17] Hence, one can conclude that older firms are more likely to stay longer under bankruptcy protection before a final resolution is achieved. We argue that older firms have more complicated structure in terms of debt and more issues to settle, hence they need more time to complete their bankruptcy protection. Although a higher leverage ratio quickens the duration time, the impact is not statistically significant. In all five specifications in table 7, the coefficient on the leverage ratio is not statistically significant. This finding is consistent with Bandopadhyaya (1994). The leverage ratio is important in bankruptcy prediction studies, but its effect on bankruptcy protection duration is not prominent.

Similar to the result from Denis *et al.* (2007), the industry adjusted operating margin is significant. Our results show that for all the estimated specifications in table 7, the coefficient on the industry adjusted operating margin is significantly positive and ranges from 0.259 to 0.288. Based on column 5 of table 7 and holding other variables unchanged, one unit increase in the industry adjusted operating margin decreases the median protection time by 22.82%. The positive sign on the coefficient indicates that higher industry adjusted performance increases the hazard rate and hence boosts the likelihood of the firm exiting the bankruptcy protection state. Higher industry adjusted operating margin reduces the bankruptcy protection duration. This can be explained by the fact that firms with better performance are more likely to reorganize, be liquidated or acquired in a short time period or that the fate of successful firms is decided sooner.

**[Please insert Table 7 about here.]**

Table 7 reports that the default spread has a significant negative impact on the

[17] The coefficient on log of age from column 5 is -0.234. According to expression (19), the exponential of 0.234 equals 1.2636, indicating that this variable prolongs the bankruptcy protection duration. This value minus one results in the effect of log of age on the duration time.

hazard rate, which is consistent with our hypothesis. The estimate ranges from -0.446 to -0.412. Wider default spreads yield to lower probability of leaving bankruptcy protection and hence increases the time that the firm needs to be discharged from bankruptcy protection. One unit increase in default spread increases the median protection time by 50.98%. Periods with low default spread are characterized by more risk taking behavior during upward markets.[18] During these times, the increased appetite for risk lowers the yield on high risk securities as the demand increase. During such times, bankruptcy becomes unlikely and when occurs, it takes less time to resolve. On the contrary, when default spreads are large, yields on risky assets increase as investors fear more risk. The flight to higher quality assets renders the likelihood of restructuring marginal. Chalmers *et al.* (2010) support the notion of flight to quality effect. They find that investors flow away from equity fund and toward the money market funds during a major recession. Beber *et al.* (2009) find that investors care both the credit quality and the liquidity. They show that investors react distinctly at different times and for different reasons.

CCAA variable shows the differential in hazard rate between firms that filed for bankruptcy under BIA and those that filed under the CCAA. The estimate is negative for all three specifications where the CCAA variable is included which indicates that firms that file under CCAA protection spends longer time in bankruptcy protection. This result confirms our discussion in Chapter III, where we stated that there is no statutory time limit on the proceeding for firm files under CCAA. Estimates are however not statistically significant in table 7 using the Weibull distributional assumption.

Higher secured debt ratio reduces the duration time is consistent with our hypothesis, but it is not statistically significant. The coefficient on the secured debt ratio ranges from 0.206 to 0.230. Higher secured debt ratio implies that fewer unsecured creditors are involved, and this mitigates the bargain issue among the creditors. However, since unsecured creditors are always willing to protract the

[18] Chen *et al.* (1986) test for pricing of the default spread. Fama and French (1989) report that default spreads are related to economic conditions and can help predict returns.

bankruptcy protection process for more interests, higher secured debt ratio may not significantly quicken the process.

The trustee variable is not significant. Appointing a trustee/monitor who is a priori highly regarded/respected does not guarantee a shorter stay in the bankruptcy status. We argue that it may be because these trustees/monitors are not as efficient as expected. Conversely, the higher requirement of transparency by these reputed trustees may also lengthen the bankruptcy protection process. These effects can offset the information transmission impact from the large accounting firms hence make this variable insignificant.

The stock return volatility is positively related to the hazard, which confirms our hypothesis in Chapter IV. Firms with higher stock return volatility spend less time in bankruptcy protection. However, the estimation results show that it does not have a significant impact on the hazard rate.

Table 8 shows the results from estimation of Log-logistic hazard model. Similar to those from the Weibull hazard model, the default spread is significant and has a negative impact on the hazard rate. A higher industry adjusted operating margin is associated with shorter resolution duration. Firms with greater age need longer time to discharge from bankruptcy protection. Compared with the results in table 7, the estimation coefficients for the three variables are larger. The estimates of the coefficient on the logarithm of firm age range from -0.283 to -0.265. Those of the default spread ranges from -0.503 to -0.468.

**[Please insert Table 8 about here.]**

The coefficient on the CCAA variable stays negative but becomes significant and confirms our previous hypothesis/findings. The estimate ranges from -0.598 to -0.557. The negative relation between CCAA dummy variable and the hazard rate implies that firm that file for bankruptcy under the CCAA system spend longer time in bankruptcy protection compared to those that file under the BIA system. The fact that there is no statutory time limit on the proceeding for firm files under CCAA may lead to longer protection duration.

The interpretation of the coefficient estimates for the Log-logistic hazard model is similar to that of the Weibull hazard model. Using the coefficient on CCAA variable from the fifth specification, we can compute the time ratio to be 1.818. Hence, the median protection time for firms that filed under CCAA is 1.818 times the protection time of the firms filed under BIA

The scale parameter ranges from 0.652 to 0.673. From Chapter IV we find that the inverse of the scale parameter captures the evolution of the hazard. Since the inverse of the scale parameter is greater than one, we conclude that the hazard is inverted U-shaped.

Table 9 presents the estimation results of Cox's proportional hazard model that abandons the parametric form of the baseline hazard function for the duration. We observe sensibly similar results as those from Weibull hazard model. The default spread and industry adjusted operating margin are significant. However, the significance level of the industry adjusted operating margin falls. The estimates of the coefficient on industry adjusted operating margin range from 0.238 to 0.265. Firm age variable continues to play a significant role in determining the bankruptcy protection duration. CCAA variable is still negatively (positively) related to the hazard (bankruptcy duration) but again insignificantly. Since Cox's proportional hazard model has proportional hazards, we can express the marginal effects of the variables as a hazard ratio. Using the hazard function (21), and holding other variables unchanged while increase one unit of a specific variable $k$, the hazard ratio becomes

$$\text{HR} = \exp(\beta_k) \tag{24}$$

The estimation coefficient on the default spread for the fifth specification is -0.447. A one unit increase in the default spread gives a reduction in the hazard by 36.05% when other variables are kept unchanged.[19]

**[Please insert Table 9 about here.]**

[19] The exponential of -0.447 is 0.6395. Since a hazard ratio with value less than one indicates it reduces the hazard rate, we use one minus this value to calculate its effect on the hazard. This gives us 0.3605.

To summarize, we find that the default spread is strongly indicative of an increased duration time. Firm's performance compared to its industry is important in determining its bankruptcy duration time. Furthermore, firm age is positively related to the bankruptcy protection duration. These results hold overall across the three models. Though the sigma variable is positively related to the hazard, it is not significant across all three models. The estimation results of Log-logistic hazard model show that firms that filed for bankruptcy under CCAA legislation spend longer time under bankruptcy protection. However, the coefficients are insignificant when the Weibull and Cox's proportional hazard models are applied. The leverage ratio is not related to bankruptcy duration when we account for other factors, indicating that the hazard of exiting from bankruptcy protection is insensitive to the firm's capital structure. This is consistent with the results from Bandopadhyaya (1994). We fail to observe a significant positive impact of the secured debt ratio on the hazard rate. Finally, firms that hired large and known trustees/monitors do not spend less time in bankruptcy protection.

### 6.2. Effect of Bankrupt Firm's Province

We test here whether different firms' headquarters physical location and hence bankruptcy filing court location have an impact on the bankruptcy duration process. All our bankrupt firms have their headquarters in either Quebec Ontario British Columbia Alberta or Nova Scotia provinces. To that end, we construct four dummy variables to account for the first mentioned four provinces and leave Nova Scotia as the base case. Table 10 presents the estimates of Weibull hazard model including these location variables. Table 10 shows that coefficient estimates are similar to those from table 7 for variables other than locations themselves. Age, industry adjusted operating margin, and default spread are still significantly (positively, negatively and positively respectively) related to the bankruptcy protection duration. However, location variables are not significantly related to bankruptcy protection duration.

**[Please insert Table 10 about here.]**

Table 11 presents the results from the estimation of the Log-logistic hazard function using the location variables. Inference and conclusions drawn from table 11 are identical to those of table 8 with respect to the significant determinants of the hazard rate. Similarly to inference from table 10, location dummy variables are not significantly affecting bankruptcy duration.

**[Please insert Table 11 about here.]**

Table 12 provides estimation results of Cox's proportional hazard model with location variables. The results are again identical to those reported in table 9 for the initial set of explanatory covariates. As for location variables, as tables 10 and 11 show, headquarters' province does not impact the bankruptcy duration.

**[Please insert Table 12 about here.]**

To summarize the results of this sub-section, we conclude that tables 10, 11, and 12 present similar results as tables 7, 8, and 9. Headquarters' location does not affect the duration of the bankruptcy. We conclude that no significant difference exists between various provincial jurisdictions with respect to the bankruptcy protection duration.

### 6.3. Effect of Ignoring Right Censored Observations

We find that periods where default spreads are high are associated with longer bankruptcy protection duration. The 2008-2009 period is associated with higher than usual default spread as volatility spiked and financial crisis and economic recession took place. That particular period is also associated with our censored observations as this is the end of our sample period. Therefore, to test for the robustness of our previous results, we run our models using uncensored data only. Tables 13, 14, and 15 show the results for uncensored data using respectively the Weibull, the Log-logistic, and the Cox's proportional hazard models. Although the firm's age and its industry adjusted operating margin are still significantly affecting the bankruptcy duration as before, default spread is no longer significant.

**[Please insert Tables 13, 14, and 15 about here.]**

### 6.4. Effect of Outliers

Tables 2 and 4 clearly show that there are outliers in our sample of bankrupt firms. Outliers can impact our estimation. Instead of trimming an already small sample and as suggested by Barber and Lyon (1996), we winsorize our data. We set the ratios below the 1% percentile and the above the 99% percentile to respectively the 1% percentile and the 99% percentile values. Tables 16, 17, and 18 present results using winsorized data for respectively the Weibull, the Log-logistic and the Cox's proportional hazard rate models. We find that most of our results are robust to outliers except for the industry adjusted operating margin. The latter variable becomes significant only for the Weibull based model (significance in two out of five tested specifications).

**[Please insert Tables 16, 17, and 18 here.]**

In sum, our findings are robust after dealing with the outliers. Firms that file for bankruptcy *(i)* under CCAA regulation *(ii)* when they are older *(iii)* when they deeply underperform their industry benchmark and *(iv)* during periods of high default spread experience longer bankruptcy protection duration.

### 6.5. Effect of Other Market Variables

Our previous results showed that the default spread is a significant determinant of bankruptcy protection duration in Canada. As discussed in chapter V, default spread is correlated to other market wide covariates. In order to capture other market effects on the bankruptcy duration, we include the industrial production growth rate and the interest rate as two additional explanatory variables. Tables 19, 20, and 21 report estimation results with these two market wide variables by using the Weibull, the

Log-logistic, and the Cox's proportional hazard models respectively.[20] We also estimate the models using either of the quarterly GDP growth immediately before filing for bankruptcy or the year-to-year GDP growth and found that neither of these variables is significantly related to bankruptcy duration. We draw same conclusion with regard to the term spread variable.

Columns (1) to (3) of tables 19 to 21 show that default spread, interest rate, and industrial production growth rate are significantly related to the bankruptcy protection duration when used as a sole economic indicator variable. Columns (4) and (5) show that the statistical significance largely drops when we use these three variables jointly. The latter result is caused by the multicollinearity that is documented in table 6. Multicollinearity inflates the standard errors and causes estimates to become inefficient.[21]

**[Please insert Tables 19, 20, and 21 here.]**

Columns (2) of tables 19, 20, and 21 show that the industrial production growth rate has a significant positive effect on the hazard rate. We conclude that firms spend longer time under bankruptcy protection during periods with low industrial production or low economic activity as IP growth is extremely pro-cyclical. During economic downturns, more firms face even more difficult situations as the commonality in default increases. As a result, courts face a higher rate of bankruptcy filing. Busier courts spend more time to study and rule for bankruptcy applications. Columns (3) of table 19 to 21 show positive relation between the interest and the hazard rates. As we discussed earlier in chapter V, interest rates are usually low during economically troubled times. Monetary policy is eased particularly at these specific times to encourage investment and consumption. Therefore, our argument relating prevailing economic conditions and bankruptcy duration still hold with regard to interest rate

[20] We also include the other variables such as the trustee, CCAA and TSX dummy variables, log of total assets, sigma, and secured debt ratio which are still not significant. For simplicity, estimations in tables 19 to 21 drop these variables.

[21] As an alternative, we orthogonalize the variables by linearly regressing industrial production growth on default spread then the interest rate on the default spread and the residuals from the first regression. We use the default spread and the residuals from both former regressions in our duration models estimation. We find that only the default spread is significant under these conditions.

levels.

# CHAPTER VII

# CONCLUSION

Filers for bankruptcy protection try to work out a reorganization plan with their different creditors and stakeholders to survive. The protection period grants them the ability to escape creditors' claims for some time. For obvious reasons, managers prefer to have a long enough protection to bring the bankrupt firm into viable path. However, by the same token, longer protection reduces the incentives of creditors to seek a solution that will lead to the survival as they take much more risk in that case. In other words, the longer the bankruptcy duration, the higher are the bankruptcy costs.

The present thesis investigates the following research question: **what determines the length of the bankruptcy protection for a given firm**?

Previous literature tried to answer this particular question. Using mainly U.S. data, various papers identified possible firm characteristics and market conditions that impact the bankruptcy duration. The current thesis builds on this literature to explain the cross-section and time variation of the bankruptcy duration for Canadian firms.

Canadian framework is extremely interesting. First of all, using a fresh data set can avoid the data mining issue. Using fresh data will reduce biases caused through fishing for explanatory variables after identifying those that are statistically significant in explaining the herein studies phenomena. Second, Canadian bankruptcy rules are somehow similar to the U.S. proceedings with specific differences. Hence, we can use that to test for specific differences in legislations to identify the potential impact on the bankruptcy duration. The present thesis contributes to the literature by using various econometric specifications for the duration models and the hazard rate. We also use new variables that were not tested in early literature.

Our empirical findings show that the default spread, industrial production growth or short interest rates, the industry adjusted operating margin and the firm's tenure are

significant factors in explaining bankruptcy duration using three different hazard models. The default spread has a negative impact on the hazard rate. More specifically, wider default spreads lengthen the bankruptcy protection time. We explain this phenomenon by the flight to quality during economically challenging times. When risk aversion is high, the yields on lower quality investment instruments are high as investors bid for higher quality securities. As a consequence, rescue for bankrupt and hence lower quality firms is delayed. Moreover, economic downturns measured by low industrial production growth or low interest rates are characterized by increased default occurrence and hence longer bankruptcy durations.

We also find that the industry adjusted operating margin is positively related to the hazard rate. Firms that perform better within their respective industries need less time to reach final resolutions. It is possible that firms that perform well are easy to spot, and they are quickly acquired or liquidated. Firms' age slow down the resolution process. We believe that older firms have more complex structures and supplementary issues to deal with. Consequently, they need longer time to exit from bankruptcy protection.

Our results show that the capital structure does not have significant impact on the hazard rate. The leverage ratio is not significant either in all our estimation results. This finding provides an indirect support to Bandopadhyaya (1994). Though the leverage ratio may be an important factor in predicting bankruptcy, it does not have a significant impact on the bankruptcy duration. The secured debt ratio retains its positive effect on the hazard rate over all duration regressions but is not statistically significant. Although there are less severe bargain issues for a firm with a higher secured debt ratio, unsecured creditors can still protract the bankruptcy protection process. The CCAA dummy variable is negatively related to the hazard rate across all the Log-logistic hazard models. We explain this result by the fact that the CCAA procedure is more flexible and does not have time limit in the duration. We fail to observe a significant effect of the trustee dummy variable over all the hazard models. It is possible that these trustees/monitors do not perform as well as they are expected. The large professional firms may also have higher requirement of transparency to

supervise the bankruptcy procedures. These effects may lead the information transmission effect to be insignificant.

We find that including the location variables does not have significant impact on the estimation results, and adjusting for outliers of explanatory ratios reduces the effects of industry adjusted operating margin.

Finally, the default spread turns out to be non significant when we exclude the censored observations. However, since including more observations can enlarge our sample size leading to the reduction of the sample selection bias and increasing the statistical testing power, we believe that it is necessary to include these censored data in our estimation.

According to these findings, the future studies should consider exploring market and industry variables in explaining firm's bankruptcy protection duration. For firm specific factors, the firm age and bargain issues within creditors and stockholders may be good determinants. The future studies can explore new factors that capture these effects. At last, the comparatively small sample set restricts the power of our tests, the future studies should consider constructing larger bankruptcy filing sample to improve statistical inferences.

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## Table 1: Bankruptcy Filing Outcome

This table reports the initial filing by year and the outcomes for firms filing for bankruptcy protection. Panel A reports the initial filing for firms that have finished their bankruptcy protection. Panel B provides the initial filing for firms that are still under bankruptcy protection as of January 31, 2010. Firms' filing information are hand collected from Lexis-Nexis by entering the key words "bankruptcy", "bankruptcy protection", "BIA", and "CCAA". Then CBCA is applied in the same method as the previous database. Among the observations with the resolution outcomes, there are 128 distinct firms with one that filed twice under BIA in 1999 and 2002, thus this gives us 129 uncensored observations. The dates of the filing and outcomes are collected from Lexis-Nexis, CBCA, and SEDAR news reports.

**Panel A. Initial bankruptcy filing and outcomes**

| Year | Reorganized | Acquired | Liquidated | Total |
|---|---|---|---|---|
| 1992 | 0 | 1 | 0 | 1 |
| 1993 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 |
| 1995 | 2 | 0 | 1 | 3 |
| 1996 | 1 | 0 | 0 | 1 |
| 1997 | 2 | 0 | 5 | 7 |
| 1998 | 1 | 1 | 4 | 6 |
| 1999 | 2 | 3 | 10 | 15 |
| 2000 | 2 | 2 | 9 | 13 |
| 2001 | 3 | 2 | 10 | 15 |
| 2002 | 6 | 3 | 7 | 16 |
| 2003 | 8 | 3 | 4 | 15 |
| 2004 | 1 | 3 | 3 | 7 |
| 2005 | 3 | 0 | 1 | 4 |
| 2006 | 2 | 2 | 1 | 5 |
| 2007 | 1 | 3 | 0 | 4 |
| 2008 | 6 | 4 | 2 | 12 |
| 2009 | 3 | 1 | 1 | 5 |
| Total | 43 | 28 | 58 | 129 |

**Panel B. Initial bankruptcy filing for censored observations**

| Year | Total |
|---|---|
| 2007 | 1 |
| 2008 | 5 |
| 2009 | 10 |
| Total | 16 |

Note: The Plaintree Systems Inc. filed under BIA protection in 1999 and 2002.

## Table 2: Bankruptcy Filing Duration

The table lists summary statistics of duration for the uncensored and censored observations. The uncensored observations are the firms that have finished their protection procedures, and the censored observations are the firms that are still under bankruptcy protection as of January 31, 2010. There are 128 firms finished their protection with one firm that filed twice under BIA in 1999 and 2002. We calculate the duration by getting the filing date and discharge date from Lexis-Nexis, CBCA, and SEDAR. The duration is characterized in days.

**Panel A. Bankruptcy protection duration for uncensored observations (n=129)**

| Days in protection | Reorganized | Acquired | Liquidated | All |
|---|---|---|---|---|
| Mean | 412.279 | 218.679 | 147.759 | 251.326 |
| Std. Dev | 342.912 | 205.014 | 174.142 | 273.405 |
| Min | 48.000 | 14.000 | 3.000 | 3.000 |
| 25% | 164.000 | 91.500 | 29.000 | 84.000 |
| Median | 281.000 | 169.000 | 96.000 | 173.000 |
| 75% | 607.000 | 218.000 | 183.000 | 314.000 |
| Max | 1789.000 | 976.000 | 1081.000 | 1789.000 |

**Panel B. Bankruptcy protection duration for censored observations (n=16)**

| Days in protection | All |
|---|---|
| Mean | 394.438 |
| Std. Dev | 165.573 |
| Min | 227.000 |
| 25% | 291.500 |
| Median | 370.500 |
| 75% | 425.500 |
| Max | 914.000 |

## Table 3: Bankruptcy Filing Duration Statistical Tests

This table reports the statistical test results for the mean and median durations difference between the three bankrupt firm subsamples split by their final outcome: reorganized (43 cases), acquired (28 cases), and liquidated (58 cases) firms, and between the censored (16 cases) and the uncensored (129 cases) firms. In Panel A, column 1, 2, and 3 show results for the pairs reorganized-acquired, reorganized-liquidated, and acquired-liquidated firms, respectively. Column 4 presents the results for the pair censored-uncensored firms. Panel B shows the multivariate comparison between the three (reorganized, acquired, and liquidated) groups. Mean Diff (Median Diff) is the mean (median) duration difference between each pair of subsamples. Wilcoxon is the Wilcoxon Mann-Whitney test for equality of the median between two groups, and t-stat is the usual Student's t test for equality of the mean between two groups. K-W stat is the Kruskal-Wallis test for equality of the median between the three groups. F stat is the Fisher test for equality of the mean between the three groups.

| Statistics | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A. Two groups tests** | | | | |
| Mean Diff | 193.600 | 264.520 | 70.920 | 143.112 |
| t-stat | 2.687 | 5.065 | 1.669 | 2.044 |
| p-value | 0.009 | 0.000 | 0.099 | 0.043 |
| Median Diff | 112.000 | 185.000 | 73.000 | 197.500 |
| Wilcoxon | 3.077 | 5.302 | 2.147 | 3.692 |
| p-value | 0.002 | 0.000 | 0.032 | 0.000 |
| **Panel B. All three groups tests** | | | | |
| F-stat | | 14.259 | | |
| p-value | | 0.000 | | |
| K-W stat | | 30.317 | | |
| p-value | | 0.000 | | |

## Table 4: Descriptive Statistics for Sample Bankrupt Firms

This table reports summary statistics for Canadian bankrupt firms for the period 1992-2009. Firm specific variables are collected from Compustat and SEDAR. Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Total assets (TA) is measured in $ million. Leverage is computed as total liabilities over total assets. Age is measured in years from the inception to the bankruptcy filing date. Net income (NI) and sales are from the firms' income statement the year preceding the bankruptcy filing. Liquidity is measured as current assets over current liabilities. Industry Adjusted Operating Margin (IAOM) is calculated by subtracting the median operating margin of the firms that have the same SIC Code as the sample firm one year before the filing. For the sample firms that we do not have the same 4-digit SIC Code, the same 3-digit SIC Code is chosen, and so on. Operating Margin is defined as the operating income before depreciation divided by total assets.

| Statistics | IAOM | SDR | TA | Leverage | Age | NI/Sales | CA/CL |
|---|---|---|---|---|---|---|---|
| **Panel A. Full Sample** | | | | | | | |
| Mean | -0.419 | 0.221 | 482.502 | 1.059 | 15.938 | -4.329 | 1.477 |
| Std. Dev | 0.993 | 0.248 | 1500.214 | 2.241 | 16.242 | 25.259 | 3.933 |
| Min | -7.947 | 0.000 | 0.051 | 0.042 | 1.000 | -283.758 | 0.000 |
| 25% | -0.268 | 0.001 | 16.518 | 0.486 | 5.000 | -1.646 | 0.342 |
| Median | -0.111 | 0.109 | 48.641 | 0.726 | 11.000 | -0.455 | 0.870 |
| 75% | -0.022 | 0.393 | 181.558 | 1.029 | 21.000 | -0.066 | 1.496 |
| Max | 0.673 | 0.872 | 8837.000 | 26.306 | 94.000 | 0.709 | 44.420 |
| **Panel B. Firms that reorganize** | | | | | | | |
| Mean | -0.362 | 0.185 | 639.905 | 1.455 | 21.558 | -1.794 | 1.195 |
| Std. Dev | 0.812 | 0.215 | 1534.570 | 3.937 | 20.317 | 3.697 | 1.106 |
| Min | -3.653 | 0.000 | 0.051 | 0.042 | 2.000 | -21.156 | 0.003 |
| 25% | -0.271 | 0.002 | 16.736 | 0.419 | 8.250 | -2.559 | 0.337 |
| Median | -0.057 | 0.109 | 69.375 | 0.727 | 15.000 | -0.514 | 1.115 |
| 75% | 0.001 | 0.290 | 371.006 | 1.128 | 26.750 | -0.101 | 1.634 |
| Max | 0.673 | 0.798 | 7416.000 | 26.306 | 94.000 | 0.709 | 5.189 |
| **Panel C. Firms that are acquired** | | | | | | | |
| Mean | -0.636 | 0.240 | 455.660 | 0.745 | 16.786 | -2.500 | 1.154 |
| Std. Dev | 1.110 | 0.294 | 1606.337 | 0.423 | 16.663 | 8.292 | 1.182 |
| Min | -4.506 | 0.000 | 1.638 | 0.254 | 2.000 | -42.703 | 0.081 |
| 25% | -0.640 | 0.004 | 8.453 | 0.481 | 7.500 | -1.692 | 0.299 |
| Median | -0.177 | 0.086 | 56.710 | 0.643 | 11.000 | -0.387 | 1.009 |
| 75% | -0.018 | 0.435 | 139.457 | 0.909 | 18.500 | -0.048 | 1.444 |
| Max | 0.146 | 0.872 | 8479.000 | 1.997 | 73.000 | 0.325 | 4.824 |

**Panel D. Firms that are liquidated**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mean | -0.380 | 0.253 | 194.692 | 1.002 | 12.655 | -7.420 | 1.245 |
| Std. Dev | 1.142 | 0.258 | 592.286 | 0.970 | 12.945 | 38.854 | 2.193 |
| Min | -7.947 | 0.000 | 0.222 | 0.067 | 1.000 | -283.758 | 0.000 |
| 25% | -0.208 | 0.002 | 17.574 | 0.551 | 4.000 | -0.994 | 0.408 |
| Median | -0.106 | 0.202 | 47.568 | 0.748 | 9.000 | -0.262 | 0.789 |
| 75% | -0.029 | 0.467 | 148.846 | 1.065 | 18.000 | -0.037 | 1.187 |
| Max | 0.341 | 0.857 | 4272.300 | 6.078 | 84.000 | 0.064 | 15.551 |

**Panel E. Uncensored observations**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mean | -0.430 | 0.228 | 399.741 | 1.097 | 16.519 | -4.506 | 1.208 |
| Std. Dev | 1.034 | 0.253 | 1229.763 | 2.370 | 16.850 | 26.597 | 1.685 |
| Min | -7.947 | 0.000 | 0.051 | 0.042 | 1.000 | -283.758 | 0.000 |
| 25% | -0.282 | 0.002 | 14.611 | 0.486 | 5.750 | -1.530 | 0.351 |
| Median | -0.111 | 0.131 | 48.641 | 0.727 | 11.000 | -0.340 | 0.840 |
| 75% | -0.018 | 0.390 | 175.710 | 1.029 | 21.250 | -0.051 | 1.486 |
| Max | 0.673 | 0.872 | 8479.000 | 26.306 | 94.000 | 0.709 | 15.551 |

## Table 5: Descriptive Statistics for Sample Bankrupt Firms Statistical Tests

This table reports the statistical test results between the three bankrupt firm groups: reorganized (43 cases) acquired (28 cases) and liquidated (58 cases) firms. Panel A shows the multivariate comparison between the three groups. Panels B, C, and D respectively show results for the pairs reorganized-acquired reorganized-liquidated and acquired-liquidated firms. We test the differences in the following variables. Industry Adjusted Operating Margin (IAOM) is calculated by subtracting the median operating margin of the firms that have the same SIC Code as the sample firm one year before the filing. For the sample firms that we do not have the same 4-digit SIC Code, the same 3-digit SIC Code is chosen, and so on. Operating Margin is defined as the operating income before depreciation divided by total assets. Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Total assets (TA) are measured in $ million. Leverage is computed as total liabilities over total assets. Age is measured in years from the inception to the bankruptcy filing date. Net income (NI) and sales are from the firms' income statement the year preceding the bankruptcy filing. Liquidity is measured as current assets over current liabilities. Data is collected from Compustat database and from SEDAR. K-W is the Kruskal-Wallis test for equality of the median between the three groups. F is the F test for equality of the mean between the three groups. Wilcoxon is the Wilcoxon Mann-Whitney test for equality of the median between two groups, and t is the t test for equality of the mean between two groups.

| Statistics | IAOM | SDR | TA | Leverage | Age | NI/Sales | CA/CL |
|---|---|---|---|---|---|---|---|
| **Panel A. All three groups** | | | | | | | |
| F-stat | 0.711 | 0.951 | 1.673 | 0.845 | 3.591 | 0.631 | 0.029 |
| p-value | 0.493 | 0.389 | 0.192 | 0.432 | 0.030 | 0.534 | 0.971 |
| K-W stat | 3.728 | 1.074 | 1.266 | 1.676 | 7.182 | 1.377 | 0.549 |
| p-value | 0.155 | 0.584 | 0.531 | 0.433 | 0.028 | 0.502 | 0.760 |
| **Panel B. Reorganized vs acquired firms** | | | | | | | |
| t-stat | 1.198 | -0.916 | 0.485 | 0.949 | 1.036 | 0.481 | 0.150 |
| p-value | 0.235 | 0.363 | 0.629 | 0.346 | 0.304 | 0.632 | 0.881 |
| Wilcoxon | 1.606 | 0.288 | 0.700 | 0.371 | 1.241 | 0.663 | 0.512 |
| p-value | 0.108 | 0.773 | 0.484 | 0.711 | 0.215 | 0.508 | 0.609 |
| **Panel C. Reorganized vs liquidated firms** | | | | | | | |
| t-stat | 0.087 | -1.417 | 2.019 | 0.845 | 2.684 | 0.934 | -0.136 |
| p-value | 0.931 | 0.160 | 0.046 | 0.400 | 0.009 | 0.353 | 0.892 |
| Wilcoxon | 0.869 | 1.116 | 1.123 | 0.766 | 2.637 | 1.158 | 0.704 |
| p-value | 0.385 | 0.264 | 0.262 | 0.444 | 0.008 | 0.247 | 0.481 |
| **Panel D. Acquired vs liquidated firms** | | | | | | | |
| t-stat | -0.982 | -0.213 | 1.098 | -1.340 | 1.260 | 0.637 | -0.205 |
| p-value | 0.329 | 0.832 | 0.276 | 0.184 | 0.211 | 0.526 | 0.838 |
| Wilcoxon | 1.636 | 0.318 | 0.051 | 1.304 | 1.124 | 0.299 | 0.106 |
| p-value | 0.102 | 0.751 | 0.960 | 0.192 | 0.261 | 0.765 | 0.916 |

**Table 6: Correlation Matrix for Explanatory Variables**

This table reports the correlation matrix for the independent variables. The sample contains 145 firms. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Total assets (TA) is measured in $ million. Leverage is computed as total liabilities over total assets. Coverage Ratio (CR) is calculated as the ratio of Earnings before interest and taxes (EBIT) to interest expenses. Age is measured in years from the inception to the bankruptcy filing date. Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Net income (NI) and sales are from the firms' income statement the year preceding the bankruptcy filing. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Term Spread (TS) is measured by the differences between the long-term government of Canada bond yield and the 90 day government of Canada T-bill rate at the time before the firm's filing date. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Industry Adjusted Operating Margin (IAOM) is calculated by subtracting the median operating margin of the firms that have the same SIC Code as the sample firm one year before the filing. For the sample firms that we do not have the same 4-digit SIC Code, the same 3-digit SIC Code is chosen, and so on. Operating Margin is defined as the operating income before depreciation divided by total assets. Interest Rate (IR) is measured by 3 month Canadian Treasury Bill rate from CANSIM at the time before the firm's filing date. Market Return (MR) is measured by S & P/TSX composite index from Datastream at the time before the firm's filing date. GDP Growth Rate (GDPG) is based on the two successive quarters before the firm's filing quarter and GDP data is the unadjusted 2002 constant price from CANSIM. Industrial Production Growth Rate (IPG) is calculated between two successive quarters before the firm's filing quarter and total industrial data is from CANSIM. a, b, and c denote statistical significance at 10%, 5%, and 1%, respectively.

**Table 6 (Continued)**

| Variable | Trustee | CCAA | TSX | L(Age) | Sigma | L(TA) | SDR | Leverage | CR | NM | IOM | IAOM | DS | TS | IR | MR | GDPG | IPG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trustee | 1.000 | | | | | | | | | | | | | | | | | |
| CCAA | 0.394[c] | 1.000 | | | | | | | | | | | | | | | | |
| TSX | 0.089 | 0.253[c] | 1.000 | | | | | | | | | | | | | | | |
| L(Age) | 0.105 | 0.056 | 0.235[c] | 1.000 | | | | | | | | | | | | | | |
| Sigma | -0.152[a] | -0.286[c] | -0.217[b] | -0.157[a] | 1.000 | | | | | | | | | | | | | |
| L(TA) | 0.313[c] | 0.556[c] | 0.490[c] | 0.179[b] | -0.470[c] | 1.000 | | | | | | | | | | | | |
| SDR | 0.177[b] | 0.026 | -0.138[a] | -0.128 | 0.036 | -0.074 | 1.000 | | | | | | | | | | | |
| Leverage | -0.098 | -0.132 | -0.137[a] | -0.018 | 0.235[c] | -0.331[c] | -0.029 | 1.000 | | | | | | | | | | |
| CR | 0.022 | 0.126 | 0.070 | -0.019 | -0.055 | 0.230[c] | 0.140 | -0.035 | 1.000 | | | | | | | | | |
| NM | -0.073 | -0.063 | -0.045 | 0.060 | -0.011 | -0.028 | 0.040 | 0.067 | -0.006 | 1.000 | | | | | | | | |
| IOM | 0.010 | 0.171[b] | 0.030 | -0.145[a] | -0.078 | 0.177[b] | 0.236[c] | -0.011 | 0.110 | -0.035 | 1.000 | | | | | | | |
| IAOM | 0.170[b] | 0.333[c] | 0.098 | 0.076 | -0.304[c] | 0.511[c] | 0.102 | -0.378[c] | 0.260[c] | -0.011 | 0.155[a] | 1.000 | | | | | | |
| DS | 0.062 | 0.061 | -0.048 | -0.068 | 0.114 | 0.116 | -0.170[b] | -0.078 | -0.220[b] | -0.252[c] | -0.121 | -0.007 | 1.000 | | | | | |
| TS | 0.031 | 0.013 | -0.108 | 0.052 | 0.134 | -0.047 | -0.222[c] | 0.013 | -0.050 | -0.106 | -0.159[a] | -0.099 | 0.304[c] | 1.000 | | | | |
| IR | -0.070 | -0.078 | 0.134 | 0.033 | -0.072 | 0.005 | 0.224[c] | 0.087 | 0.120 | 0.162[a] | 0.165[b] | 0.054 | -0.682[c] | -0.746[c] | 1.000 | | | |
| MR | 0.037 | 0.092 | -0.171[b] | 0.035 | 0.032 | -0.073 | 0.222[c] | 0.209[b] | 0.136 | 0.087 | 0.189[b] | -0.124 | -0.374[c] | -0.050 | 0.156[a] | 1.000 | | |
| GDPG | -0.044 | -0.047 | 0.208[b] | 0.010 | 0.041 | -0.088 | -0.017 | -0.018 | -0.044 | -0.035 | -0.049 | -0.006 | -0.167[b] | -0.216[c] | 0.270[c] | -0.212[b] | 1.000 | |
| IPG | -0.027 | -0.096 | -0.022 | 0.092 | -0.014 | -0.184[b] | 0.171[b] | 0.074 | 0.094 | 0.113 | 0.023 | 0.018 | -0.650[c] | -0.269[c] | 0.530[c] | -0.010 | 0.281[c] | 1.000 |

## Table 7: Determinants of Bankruptcy Duration Using Weibull Hazard Model

This table reports results from estimation of the Weibull distribution hazard model. The density function for Weibull hazard model is $\exp(\frac{x_i\beta}{\sigma})bt^{b-1}\exp(-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b)$. The log-likelihood function is as given in (14), $m\log(b) + \sum_{i\in J}\frac{x_i\beta}{\sigma} + (b-1)\sum_{i\in J}\log t_i - \sum_{i=1}^{n} t_i{}^b\exp(\frac{x_i\beta}{\sigma})$; where $J$ is the number of complete observations; $m$ is the number of entities in $J$; $n$ is the number of observations.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -4.434*** | -4.436*** | -4.508*** | -4.506*** | -4.775*** |
| | (0.391) | (0.395) | (0.416) | (0.417) | (0.480) |
| Trustee | 0.011 | 0.009 | -0.029 | -0.023 | -0.030 |
| | (0.206) | (0.221) | (0.219) | (0.228) | (0.232) |
| CCAA | | 0.009 | | -0.028 | -0.067 |
| | | (0.281) | | (0.289) | (0.304) |
| TSX | 0.116 | 0.115 | 0.102 | 0.105 | 0.213 |
| | (0.234) | (0.238) | (0.235) | (0.238) | (0.251) |

| | | | | | |
|---|---|---|---|---|---|
| L(Age) | -0.250** | -0.250** | -0.245** | -0.246** | -0.234** |
| | (0.099) | (0.099) | (0.099) | (0.099) | (0.101) |
| Sigma | | | | | 0.496 |
| | | | | | (1.915) |
| L(TA) | -0.034 | -0.034 | -0.026 | -0.024 | -0.004 |
| | (0.065) | (0.067) | (0.067) | (0.070) | (0.074) |
| SDR | | | 0.206 | 0.216 | 0.230 |
| | | | (0.402) | (0.415) | (0.422) |
| Leverage | 0.142 | 0.141 | 0.149 | 0.153 | 0.137 |
| | (0.146) | (0.150) | (0.148) | (0.153) | (0.178) |
| NM | -0.007 | -0.007 | -0.007 | -0.007 | -0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | -0.072 | -0.076 | -0.232 | -0.226 | -0.240 |
| | (1.183) | (1.191) | (1.218) | (1.221) | (1.248) |
| IAOM | 0.288** | 0.286* | 0.278* | 0.282* | 0.259* |
| | (0.145) | (0.152) | (0.144) | (0.151) | (0.156) |
| DS | -0.446*** | -0.446*** | -0.434*** | -0.433*** | -0.412*** |
| | (0.150) | (0.150) | (0.151) | (0.151) | (0.155) |
| Scale | 0.999 | 0.999 | 0.997 | 0.998 | 0.982 |
| | (0.071) | (0.071) | (0.071) | (0.071) | (0.073) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -204.328 | -204.328 | -204.198 | -204.193 | -189.791 |
| Adjusted $R^2$ | 0.152 | 0.152 | 0.154 | 0.154 | 0.147 |

## Table 8: Determinants of Bankruptcy Duration Using Log-logistic Hazard Model

The table lists the estimation results of the Log-logistic distribution hazard model. The density function for Log-logistic hazard model is $\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}$. The log-likelihood function for Log-logistic hazard model is as given in (20), $\sum_{i=1}^{n} d_i \log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right) + \sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right)$; where $d_i$ is one if the observation is fully observed, zero otherwise; $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -3.559*** | -3.383*** | -3.656*** | -3.486*** | -3.761*** |
| | (0.424) | (0.427) | (0.447) | (0.447) | (0.536) |
| Trustee | -0.145 | -0.078 | -0.177 | -0.112 | -0.108 |
| | (0.221) | (0.219) | (0.227) | (0.225) | (0.228) |
| CCAA | | -0.557* | | -0.567* | -0.598** |
| | | (0.290) | | (0.291) | (0.295) |

| | | | | | |
|---|---|---|---|---|---|
| TSX | 0.150 | 0.143 | 0.147 | 0.143 | 0.261 |
| | (0.260) | (0.257) | (0.259) | (0.257) | (0.269) |
| L(Age) | -0.270** | -0.283*** | -0.265** | -0.279** | -0.266** |
| | (0.111) | (0.109) | (0.111) | (0.109) | (0.112) |
| Sigma | | | | | 0.325 |
| | | | | | (2.101) |
| L(TA) | -0.068 | -0.024 | -0.062 | -0.017 | 0 |
| | (0.069) | (0.072) | (0.069) | (0.073) | (0.079) |
| SDR | | | 0.288 | 0.320 | 0.280 |
| | | | (0.452) | (0.447) | (0.458) |
| Leverage | -0.033 | 0.030 | -0.021 | 0.044 | 0.050 |
| | (0.144) | (0.147) | (0.146) | (0.149) | (0.158) |
| NM | -0.005 | -0.006 | -0.005 | -0.006 | -0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 1.384 | 1.830 | 1.174 | 1.614 | 1.528 |
| | (1.277) | (1.291) | (1.321) | (1.329) | (1.346) |
| IAOM | 0.231* | 0.290** | 0.227* | 0.288** | 0.245* |
| | (0.135) | (0.137) | (0.135) | (0.137) | (0.141) |
| DS | -0.503*** | -0.503*** | -0.489*** | -0.489*** | -0.468*** |
| | (0.136) | (0.135) | (0.137) | (0.135) | (0.138) |
| Scale | 0.673 | 0.662 | 0.673 | 0.662 | 0.652 |
| | (0.051) | (0.050) | (0.051) | (0.050) | (0.051) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -206.422 | -204.629 | -206.219 | -204.371 | -189.873 |
| Adjusted $R^2$ | 0.194 | 0.214 | 0.196 | 0.217 | 0.206 |

## Table 9: Determinants of Bankruptcy Duration Using Cox's Proportional Hazard Model

This table reports results from estimation of the Cox's proportional hazard model. The log-likelihood function for Cox's proportional hazard model is as follow, $\sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j\in R_{(y_i)}} \exp(x_i\beta)}\right]$. Where $d_i$ equals one if the observation is fully observed, zero otherwise.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Trustee | 0.014 | 0.021 | -0.010 | 0 | -0.008 |
| | (0.208) | (0.223) | (0.221) | (0.230) | (0.238) |
| CCAA | | -0.027 | | -0.051 | -0.083 |
| | | (0.287) | | (0.294) | (0.314) |
| TSX | 0.109 | 0.113 | 0.100 | 0.106 | 0.209 |
| | (0.236) | (0.240) | (0.238) | (0.241) | (0.258) |
| L(Age) | -0.246** | -0.246** | -0.242** | -0.243** | -0.231** |
| | (0.100) | (0.100) | (0.101) | (0.101) | (0.104) |

| | | | | | |
|---|---|---|---|---|---|
| Sigma | | | | | 0.588 |
| | | | | | (1.975) |
| L(TA) | -0.034 | -0.032 | -0.029 | -0.025 | -0.005 |
| | (0.065) | (0.067) | (0.067) | (0.070) | (0.075) |
| SDR | | | 0.129 | 0.146 | 0.154 |
| | | | (0.407) | (0.419) | (0.432) |
| Leverage | 0.124 | 0.127 | 0.129 | 0.136 | 0.112 |
| | (0.151) | (0.155) | (0.153) | (0.157) | (0.184) |
| NM | -0.007 | -0.007 | -0.007 | -0.007 | -0.007 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 0.095 | 0.111 | -0.011 | 0.006 | -0.027 |
| | (1.211) | (1.224) | (1.255) | (1.258) | (1.305) |
| IAOM | 0.261* | 0.265* | 0.256* | 0.263* | 0.238 |
| | (0.145) | (0.151) | (0.145) | (0.151) | (0.158) |
| DS | -0.471*** | -0.471*** | -0.463*** | -0.461*** | -0.447*** |
| | (0.148) | (0.148) | (0.150) | (0.150) | (0.156) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Adjusted $R^2$ | 0.156 | 0.156 | 0.157 | 0.157 | 0.148 |

## Table 10: Determinants of Bankruptcy Duration Using Weibull Hazard Model, Effect of Firm Location

This table reports the estimation results of the Weibull distribution hazard model. The density function for Weibull hazard model is $\exp(\frac{x_i\beta}{\sigma})bt^{b-1}\exp(-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b)$. The log-likelihood function is as given in (14), $m\log(b) + \sum_{i\in J}\frac{x_i\beta}{\sigma} + (b-1)\sum_{i\in J}\log t_i - \sum_{i=1}^{n} t_i{}^b \exp(\frac{x_i\beta}{\sigma})$; where $J$ is the number of complete observations; $m$ is the number of entities in $J$; $n$ is the number of observations.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Alberta is a dummy variable equal to one if the firm's headquarter is located in Alberta province and zero otherwise. British Columbia is a dummy variable equal to one if the firm's headquarter is located in British Columbia province and zero otherwise. Ontario is a dummy variable equal to one if the firm's headquarter is located in Ontario province and zero otherwise. Quebec is a dummy variable equal to one if the firm's headquarter is located in Quebec province and zero otherwise. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -3.974*** | -3.989*** | -3.983*** | -4.003*** | -4.277*** |
| | (0.798) | (0.817) | (0.798) | (0.819) | (0.824) |

| | | | | | |
|---|---|---|---|---|---|
| Trustee | 0.093 | 0.099 | 0.076 | 0.083 | 0.086 |
| | (0.202) | (0.214) | (0.216) | (0.225) | (0.227) |
| CCAA | | -0.027 | | -0.035 | -0.119 |
| | | (0.305) | | (0.306) | (0.317) |
| TSX | 0.194 | 0.200 | 0.186 | 0.192 | 0.336 |
| | (0.229) | (0.238) | (0.233) | (0.240) | (0.252) |
| L(Age) | -0.255** | -0.256** | -0.252** | -0.253** | -0.233** |
| | (0.100) | (0.100) | (0.101) | (0.101) | (0.104) |
| Sigma | | | | | -0.138 |
| | | | | | (1.837) |
| Alberta | -0.118 | -0.090 | -0.155 | -0.122 | -0.003 |
| | (0.729) | (0.793) | (0.748) | (0.804) | (0.798) |
| British Columbia | -0.853 | -0.833 | -0.878 | -0.853 | -0.840 |
| | (0.730) | (0.765) | (0.738) | (0.770) | (0.761) |
| Ontario | -0.292 | -0.275 | -0.315 | -0.294 | -0.242 |
| | (0.720) | (0.745) | (0.727) | (0.749) | (0.747) |
| Quebec | -0.050 | -0.030 | -0.085 | -0.061 | -0.007 |
| | (0.745) | (0.779) | (0.761) | (0.790) | (0.783) |
| L(TA) | -0.070 | -0.068 | -0.066 | -0.063 | -0.052 |
| | (0.065) | (0.069) | (0.068) | (0.072) | (0.077) |
| SDR | | | 0.093 | 0.099 | 0.100 |
| | | | (0.416) | (0.420) | (0.425) |
| Leverage | 0.070 | 0.073 | 0.073 | 0.077 | 0.063 |
| | (0.161) | (0.165) | (0.162) | (0.166) | (0.187) |
| NM | -0.008* | -0.008* | -0.008* | -0.008* | -0.008* |
| | (0.004) | (0.004) | (0.005) | (0.005) | (0.004) |
| IOM | -0.120 | -0.113 | -0.188 | -0.183 | -0.124 |
| | (1.151) | (1.155) | (1.189) | (1.192) | (1.223) |
| IAOM | 0.241* | 0.244* | 0.238* | 0.242* | 0.234 |
| | (0.137) | (0.142) | (0.137) | (0.142) | (0.149) |
| DS | -0.491*** | -0.491*** | -0.484*** | -0.483*** | -0.446*** |
| | (0.152) | (0.152) | (0.155) | (0.155) | (0.158) |
| Scale | 0.961 | 0.962 | 0.961 | 0.962 | 0.942 |
| | (0.069) | (0.069) | (0.069) | (0.069) | (0.070) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -200.394 | -200.390 | -200.369 | -200.362 | -185.576 |
| Adjusted $R^2$ | 0.200 | 0.200 | 0.200 | 0.200 | 0.201 |

## Table 11: Determinants of Bankruptcy Duration Using Log-logistic Hazard Model, Effect of Firm Location

The table lists the estimation results of the Log-logistic distribution hazard model. The density function for Log-logistic hazard model is $\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}$. The log-likelihood function for Log-logistic hazard model is as given in (20), $\sum_{i=1}^{n} d_i \log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right) + \sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right)$; where $d_i$ is one if the observation is fully observed, zero otherwise; $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Alberta is a dummy variable equal to one if the firm's headquarter is located in Alberta province and zero otherwise. British Columbia is a dummy variable equal to one if the firm's headquarter is located in British Columbia province and zero otherwise. Ontario is a dummy variable equal to one if the firm's headquarter is located in Ontario province and zero otherwise. Quebec is a dummy variable equal to one if the firm's headquarter is located in Quebec province and zero otherwise. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Intercept | -3.427*** | -3.788*** | -3.439*** | -3.794*** | -4.055*** |
| | (0.864) | (0.852) | (0.862) | (0.850) | (0.868) |
| Trustee | -0.097 | 0.007 | -0.126 | -0.016 | -0.001 |
| | (0.224) | (0.223) | (0.232) | (0.231) | (0.236) |
| CCAA | | -0.702** | | -0.698** | -0.736** |
| | | (0.314) | | (0.315) | (0.321) |
| TSX | 0.120 | 0.181 | 0.103 | 0.170 | 0.321 |
| | (0.270) | (0.268) | (0.272) | (0.270) | (0.287) |
| L(Age) | -0.258** | -0.265** | -0.255** | -0.262** | -0.246** |
| | (0.112) | (0.109) | (0.112) | (0.109) | (0.113) |
| Sigma | | | | | -0.025 |
| | | | | | (2.187) |
| Alberta | 0.060 | 0.718 | -0.038 | 0.641 | 0.757 |
| | (0.800) | (0.828) | (0.822) | (0.850) | (0.857) |
| British Columbia | -0.602 | -0.077 | -0.668 | -0.130 | -0.078 |
| | (0.809) | (0.817) | (0.818) | (0.827) | (0.832) |
| Ontario | -0.121 | 0.392 | -0.169 | 0.353 | 0.370 |
| | (0.773) | (0.782) | (0.778) | (0.787) | (0.798) |
| Quebec | -0.052 | 0.377 | -0.125 | 0.318 | 0.396 |
| | (0.798) | (0.793) | (0.810) | (0.806) | (0.812) |
| L(TA) | -0.076 | -0.026 | -0.070 | -0.023 | -0.016 |
| | (0.069) | (0.072) | (0.070) | (0.073) | (0.081) |
| SDR | | | 0.236 | 0.179 | 0.089 |
| | | | (0.473) | (0.460) | (0.471) |
| Leverage | -0.009 | 0.076 | -0.002 | 0.081 | 0.088 |
| | (0.149) | (0.153) | (0.150) | (0.154) | (0.164) |
| NM | -0.007* | -0.007* | -0.007* | -0.007* | -0.007** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 0.755 | 1.142 | 0.653 | 1.065 | 0.865 |
| | (1.328) | (1.336) | (1.343) | (1.350) | (1.379) |
| IAOM | 0.227* | 0.305** | 0.226* | 0.304** | 0.265* |
| | (0.136) | (0.139) | (0.136) | (0.139) | (0.145) |
| DS | -0.509*** | -0.501*** | -0.494*** | -0.491*** | -0.474*** |
| | (0.141) | (0.137) | (0.143) | (0.139) | (0.143) |
| Scale | 0.665 | 0.650 | 0.664 | 0.650 | 0.641 |
| | (0.051) | (0.050) | (0.051) | (0.050) | (0.051) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -204.786 | -202.367 | -204.661 | -202.290 | -187.579 |
| Adjusted $R^2$ | 0.213 | 0.240 | 0.214 | 0.241 | 0.234 |

## Table 12: Determinants of Bankruptcy Duration Using Cox's Proportional Hazard Model, Effect of Firm Location

This table lists estimation results of the Cox's proportional hazard model. The log-likelihood function for Cox's proportional hazard model is as follow, $\sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j\in R_{(y_i)}} \exp(x_i\beta)}\right]$. Where $d_i$ equals one if the observation is fully observed, zero otherwise.

Each regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Alberta is a dummy variable equal to one if the firm's headquarter is located in Alberta province and zero otherwise. British Columbia is a dummy variable equal to one if the firm's headquarter is located in British Columbia province and zero otherwise. Ontario is a dummy variable equal to one if the firm's headquarter is located in Ontario province and zero otherwise. Quebec is a dummy variable equal to one if the firm's headquarter is located in Quebec province and zero otherwise. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Trustee | 0.108 | 0.122 | 0.104 | 0.117 | 0.119 |
| | (0.214) | (0.226) | (0.228) | (0.237) | (0.244) |
| CCAA | | -0.063 | | -0.066 | -0.142 |
| | | (0.325) | | (0.326) | (0.345) |
| TSX | 0.187 | 0.199 | 0.184 | 0.197 | 0.344 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.241) | (0.250) | (0.245) | (0.252) | (0.272) |
| L(Age) | -0.265** | -0.266** | -0.264** | -0.265** | -0.247** |
| | (0.106) | (0.106) | (0.107) | (0.108) | (0.112) |
| Sigma | | | | | 0.034 |
| | | | | | (1.966) |
| Alberta | -0.118 | -0.053 | -0.128 | -0.064 | 0.054 |
| | (0.761) | (0.830) | (0.781) | (0.842) | (0.855) |
| British Columbia | -0.860 | -0.809 | -0.867 | -0.816 | -0.815 |
| | (0.765) | (0.809) | (0.776) | (0.815) | (0.825) |
| Ontario | -0.315 | -0.274 | -0.320 | -0.280 | -0.242 |
| | (0.752) | (0.780) | (0.760) | (0.785) | (0.799) |
| Quebec | -0.042 | 0.005 | -0.051 | -0.005 | 0.041 |
| | (0.778) | (0.814) | (0.796) | (0.827) | (0.837) |
| L(TA) | -0.071 | -0.067 | -0.070 | -0.066 | -0.051 |
| | (0.069) | (0.072) | (0.071) | (0.075) | (0.082) |
| SDR | | | 0.023 | 0.032 | 0.029 |
| | | | (0.438) | (0.441) | (0.455) |
| Leverage | 0.072 | 0.078 | 0.073 | 0.080 | 0.057 |
| | (0.170) | (0.173) | (0.171) | (0.175) | (0.199) |
| NM | -0.009* | -0.009* | -0.009* | -0.009* | -0.009* |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| IOM | -0.023 | 0.000 | -0.040 | -0.024 | -0.019 |
| | (1.225) | (1.231) | (1.269) | (1.273) | (1.329) |
| IAOM | 0.238* | 0.245* | 0.237* | 0.244* | 0.235 |
| | (0.143) | (0.148) | (0.144) | (0.148) | (0.159) |
| DS | -0.526*** | -0.525*** | -0.524*** | -0.522*** | -0.492*** |
| | (0.156) | (0.155) | (0.159) | (0.159) | (0.165) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Adjusted $R^2$ | 0.199 | 0.200 | 0.199 | 0.200 | 0.197 |

## Table 13: Determinants of Bankruptcy Duration Using Weibull Hazard Model, Uncensored Data Only

This table lists results from estimation of the Weibull distribution hazard model. The density function for Weibull hazard model is $\exp(\frac{x_i\beta}{\sigma})bt^{b-1}\exp(-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b)$. The log-likelihood function is as given in (14), $m\log(b)+\sum_{i\in J}\frac{x_i\beta}{\sigma}+(b-1)\sum_{i\in J}\log t_i-\sum_{i=1}^{n}t_i{}^b\exp(\frac{x_i\beta}{\sigma})$; where $J$ is the number of complete observations; $m$ is the number of entities in $J$; $n$ is the number of observations.

Each duration regression contains 129 observations in the estimation. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 115 firms compared to 123 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -4.886*** | -4.898*** | -5.070*** | -5.069*** | -5.355*** |
| | (0.380) | (0.382) | (0.396) | (0.396) | (0.460) |
| Trustee | -0.010 | -0.032 | -0.114 | -0.110 | -0.102 |
| | (0.201) | (0.215) | (0.210) | (0.220) | (0.223) |
| CCAA | | 0.075 | | -0.017 | -0.031 |
| | | (0.280) | | (0.286) | (0.308) |
| TSX | 0.143 | 0.132 | 0.092 | 0.094 | 0.192 |
| | (0.226) | (0.229) | (0.226) | (0.229) | (0.240) |
| L(Age) | -0.246** | -0.243** | -0.235** | -0.235** | -0.221** |

| | | | | | |
|---|---|---|---|---|---|
| | (0.097) | (0.097) | (0.096) | (0.096) | (0.098) |
| Sigma | | | | | 0.887 |
| | | | | | (1.925) |
| L(TA) | -0.047 | -0.051 | -0.027 | -0.026 | -0.005 |
| | (0.065) | (0.067) | (0.066) | (0.069) | (0.072) |
| SDR | | | 0.537 | 0.543 | 0.518 |
| | | | (0.377) | (0.390) | (0.395) |
| Leverage | 0.131 | 0.121 | 0.149 | 0.152 | 0.119 |
| | (0.140) | (0.144) | (0.141) | (0.146) | (0.174) |
| NM | -0.003 | -0.003 | -0.002 | -0.002 | -0.003 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 0.251 | 0.225 | -0.133 | -0.132 | -0.150 |
| | (1.199) | (1.201) | (1.211) | (1.212) | (1.239) |
| IAOM | 0.281** | 0.269* | 0.259* | 0.261* | 0.233 |
| | (0.137) | (0.142) | (0.134) | (0.139) | (0.144) |
| DS | 0.014 | 0.010 | 0.056 | 0.057 | 0.055 |
| | (0.155) | (0.155) | (0.153) | (0.154) | (0.155) |
| Scale | 0.977 | 0.975 | 0.968 | 0.968 | 0.951 |
| | (0.069) | (0.069) | (0.068) | (0.069) | (0.070) |
| Number of Obs. | 123 | 123 | 123 | 123 | 115 |
| Log Likelihood | -190.065 | -190.029 | -189.091 | -189.089 | -174.884 |
| Adjusted $R^2$ | 0.095 | 0.095 | 0.109 | 0.109 | 0.104 |

## Table 14: Determinants of Bankruptcy Duration Using Log-logistic Hazard Model, Uncensored Data Only

This table reports the results from estimation of the Log-logistic distribution hazard model. The density function for Log-logistic hazard model is $\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}$. The log-likelihood function for Log-logistic hazard model is as given in (20), $\sum_{i=1}^{n} d_i \log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right) + \sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right)$; where $d_i$ is one if the observation is fully observed, zero otherwise; $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$.

Each duration regression contains 129 observations in the estimation. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 115 firms compared to 123 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -3.846*** | -3.663*** | -3.996*** | -3.820*** | -4.179*** |
| | (0.423) | (0.423) | (0.443) | (0.440) | (0.533) |
| Trustee | -0.182 | -0.113 | -0.237 | -0.172 | -0.166 |
| | (0.221) | (0.217) | (0.228) | (0.224) | (0.227) |
| CCAA | | -0.609** | | -0.639** | -0.646** |
| | | (0.289) | | (0.291) | (0.295) |

| | | | | | |
|---|---|---|---|---|---|
| TSX | 0.115 | 0.090 | 0.105 | 0.083 | 0.175 |
| | (0.257) | (0.252) | (0.257) | (0.252) | (0.261) |
| L(Age) | -0.301*** | -0.313*** | -0.290** | -0.305*** | -0.295*** |
| | (0.113) | (0.110) | (0.113) | (0.110) | (0.113) |
| Sigma | | | | | 1.195 |
| | | | | | (2.160) |
| L(TA) | -0.069 | -0.019 | -0.061 | -0.008 | 0.021 |
| | (0.068) | (0.072) | (0.068) | (0.072) | (0.078) |
| SDR | | | 0.461 | 0.528 | 0.431 |
| | | | (0.449) | (0.444) | (0.457) |
| Leverage | -0.024 | 0.048 | -0.005 | 0.073 | 0.061 |
| | (0.140) | (0.143) | (0.142) | (0.145) | (0.154) |
| NM | -0.001 | -0.002 | -0.002 | -0.002 | -0.002 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 1.542 | 2.004 | 1.183 | 1.628 | 1.622 |
| | (1.271) | (1.268) | (1.322) | (1.312) | (1.322) |
| IAOM | 0.235* | 0.303** | 0.232* | 0.304** | 0.251* |
| | (0.134) | (0.135) | (0.134) | (0.135) | (0.139) |
| DS | -0.122 | -0.110 | -0.099 | -0.082 | -0.080 |
| | (0.161) | (0.158) | (0.162) | (0.160) | (0.159) |
| Scale | 0.650 | 0.637 | 0.649 | 0.636 | 0.625 |
| | (0.050) | (0.049) | (0.049) | (0.048) | (0.049) |
| Number of Obs. | 123 | 123 | 123 | 123 | 115 |
| Log Likelihood | -193.858 | -191.716 | -193.323 | -190.995 | -176.655 |
| Adjusted $R^2$ | 0.126 | 0.156 | 0.134 | 0.166 | 0.152 |

## Table 15: Determinants of Bankruptcy Duration Using Cox's Proportional Hazard Model, Uncensored Data Only

This table reports results from estimation of the Cox's proportional hazard model. The log-likelihood function for Cox's proportional hazard model is as follow, $\sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j\in R_{(y_i)}} \exp(x_i\beta)}\right]$. Where $d_i$ equals one if the observation is fully observed, zero otherwise.

Each duration regression contains 129 observations in the estimation. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 115 firms compared to 123 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Trustee | -0.007 | -0.017 | -0.092 | -0.082 | -0.078 |
| | (0.208) | (0.223) | (0.219) | (0.229) | (0.236) |
| CCAA | | 0.035 | | -0.043 | -0.049 |
| | | (0.294) | | (0.300) | (0.329) |
| TSX | 0.135 | 0.130 | 0.089 | 0.094 | 0.190 |
| | (0.233) | (0.238) | (0.237) | (0.240) | (0.256) |
| L(Age) | -0.254** | -0.254** | -0.246** | -0.246** | -0.234** |
| | (0.100) | (0.100) | (0.100) | (0.100) | (0.104) |
| Sigma | | | | | 0.968 |
| | | | | | (2.055) |

| | | | | | |
|---|---|---|---|---|---|
| L(TA) | -0.045 | -0.047 | -0.029 | -0.026 | -0.004 |
| | (0.066) | (0.068) | (0.068) | (0.072) | (0.075) |
| SDR | | | 0.464 | 0.477 | 0.451 |
| | | | (0.397) | (0.407) | (0.419) |
| Leverage | 0.117 | 0.113 | 0.136 | 0.141 | 0.102 |
| | (0.149) | (0.152) | (0.151) | (0.156) | (0.186) |
| NM | -0.003 | -0.003 | -0.003 | -0.003 | -0.003 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IOM | 0.397 | 0.382 | 0.043 | 0.049 | 0.010 |
| | (1.255) | (1.262) | (1.286) | (1.287) | (1.338) |
| IAOM | 0.260* | 0.256* | 0.246* | 0.251* | 0.221 |
| | (0.140) | (0.146) | (0.139) | (0.144) | (0.152) |
| DS | -0.016 | -0.017 | 0.024 | 0.026 | 0.026 |
| | (0.160) | (0.160) | (0.161) | (0.162) | (0.165) |
| Number of Obs. | 123 | 123 | 123 | 123 | 115 |
| Adjusted $R^2$ | 0.090 | 0.090 | 0.100 | 0.100 | 0.094 |

## Table 16: Determinants of Bankruptcy Duration Using Weibull Hazard Model, Effect of Outliers

The table lists results from estimation of the Weibull distribution hazard model. The density function for Weibull hazard model is $\exp(\frac{x_i\beta}{\sigma})bt^{b-1}\exp(-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b)$. The log-likelihood function is as given in (14), $m\log(b) + \sum_{i\in J}\frac{x_i\beta}{\sigma} + (b-1)\sum_{i\in J}\log t_i - \sum_{i=1}^{n} t_i{}^b\exp(\frac{x_i\beta}{\sigma})$; where $J$ is the number of complete observations; $m$ is the number of entities in $J$; $n$ is the number of observations.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. Winsorizing is performed by setting the ratio that below the 1st and above the 99th percentile to the values of the 1st and 99th percentiles. Winsorizing is conducted on the all the explanatory variables except for Trustee, CCAA and TSX dummy variables.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -4.394*** | -4.393*** | -4.460*** | -4.455*** | -4.765*** |
| | (0.401) | (0.408) | (0.425) | (0.427) | (0.492) |
| Trustee | 0.027 | 0.028 | -0.008 | -0.001 | -0.002 |
| | (0.209) | (0.223) | (0.221) | (0.231) | (0.235) |
| CCAA | | -0.003 | | -0.033 | -0.053 |

| | | | | | |
|---|---|---|---|---|---|
| | | (0.288) | | (0.294) | (0.311) |
| TSX | 0.108 | 0.108 | 0.095 | 0.100 | 0.213 |
| | (0.235) | (0.240) | (0.236) | (0.240) | (0.255) |
| L(Age) | -0.242** | -0.242** | -0.238** | -0.239** | -0.223** |
| | (0.100) | (0.100) | (0.100) | (0.100) | (0.102) |
| Sigma | | | | | 0.763 |
| | | | | | (1.938) |
| L(TA) | -0.039 | -0.039 | -0.031 | -0.029 | -0.008 |
| | (0.068) | (0.070) | (0.071) | (0.073) | (0.077) |
| SDR | | | 0.193 | 0.203 | 0.202 |
| | | | (0.411) | (0.422) | (0.429) |
| Leverage | 0.088 | 0.088 | 0.091 | 0.096 | 0.055 |
| | (0.160) | (0.165) | (0.160) | (0.166) | (0.189) |
| NM | -0.004 | -0.004 | -0.003 | -0.003 | -0.004 |
| | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) |
| IOM | -0.043 | -0.041 | -0.199 | -0.190 | -0.207 |
| | (1.204) | (1.213) | (1.244) | (1.247) | (1.278) |
| IAOM | 0.341* | 0.342 | 0.325* | 0.333 | 0.295 |
| | (0.195) | (0.208) | (0.197) | (0.208) | (0.223) |
| DS | -0.425*** | -0.425*** | -0.414*** | -0.413*** | -0.394*** |
| | (0.147) | (0.147) | (0.148) | (0.148) | (0.151) |
| Scale | 1.007 | 1.007 | 1.005 | 1.006 | 0.990 |
| | (0.072) | (0.072) | (0.072) | (0.072) | (0.073) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -205.641 | -205.641 | -205.532 | -205.526 | -191.110 |
| Adjusted $R^2$ | 0.136 | 0.136 | 0.137 | 0.137 | 0.129 |

## Table 17: Determinants of Bankruptcy Duration Using Log-logistic Hazard Model, Effect of Outliers

This table lists results from estimation of the Log-logistic hazard model. The density function for Log-logistic hazard model is $\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}$. The log-likelihood function for Log-logistic hazard model is as given in (20), $\sum_{i=1}^{n} d_i \log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right) + \sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right)$; where $d_i$ is one if the observation is fully observed, zero otherwise; $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. Winsorizing is performed by setting the ratio that below the 1st and above the 99th percentile to the values of the 1st and 99th percentiles. Winsorizing is conducted on the all the explanatory variables except for Trustee, CCAA and TSX dummy variables.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -3.574*** | -3.417*** | -3.665*** | -3.510*** | -3.845*** |
| | (0.437) | (0.441) | (0.458) | (0.459) | (0.545) |
| Trustee | -0.122 | -0.056 | -0.153 | -0.089 | -0.081 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.222) | (0.221) | (0.228) | (0.227) | (0.230) |
| CCAA | | -0.508* | | -0.514* | -0.525* |
| | | (0.292) | | (0.293) | (0.297) |
| TSX | 0.135 | 0.125 | 0.133 | 0.126 | 0.243 |
| | (0.259) | (0.257) | (0.258) | (0.256) | (0.270) |
| L(Age) | -0.271** | -0.279** | -0.266** | -0.276** | -0.261** |
| | (0.113) | (0.111) | (0.113) | (0.111) | (0.114) |
| Sigma | | | | | 0.585 |
| | | | | | (2.123) |
| L(TA) | -0.060 | -0.020 | -0.054 | -0.014 | 0.008 |
| | (0.071) | (0.074) | (0.071) | (0.075) | (0.080) |
| SDR | | | 0.284 | 0.303 | 0.238 |
| | | | (0.454) | (0.450) | (0.461) |
| Leverage | -0.108 | -0.053 | -0.098 | -0.041 | -0.046 |
| | (0.160) | (0.165) | (0.162) | (0.166) | (0.177) |
| NM | -0.001 | -0.003 | -0.001 | -0.002 | -0.003 |
| | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) |
| IOM | 1.387 | 1.806 | 1.178 | 1.596 | 1.520 |
| | (1.279) | (1.298) | (1.324) | (1.338) | (1.352) |
| IAOM | 0.193 | 0.256 | 0.189 | 0.253 | 0.176 |
| | (0.170) | (0.174) | (0.170) | (0.174) | (0.172) |
| DS | -0.472*** | -0.473*** | -0.457*** | -0.458*** | -0.441*** |
| | (0.134) | (0.133) | (0.135) | (0.134) | (0.136) |
| Scale | 0.681 | 0.672 | 0.680 | 0.671 | 0.661 |
| | (0.052) | (0.051) | (0.052) | (0.051) | (0.052) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Log Likelihood | -207.866 | -206.386 | -207.671 | -206.159 | -191.641 |
| Adjusted $R^2$ | 0.176 | 0.194 | 0.179 | 0.197 | 0.184 |

## Table 18: Determinants of Bankruptcy Duration Using Cox's Proportional Hazard Model, Effect of Outliers

This table reports results from estimation of the Cox's proportional hazard model. The log-likelihood function for Cox's proportional hazard model is as follow, $\sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j\in R_{(y_i)}} \exp(x_i\beta)}\right]$. Where $d_i$ equals one if the observation is fully observed, zero otherwise.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. CCAA variable is a dummy variable equal one (zero) if the firm files for bankruptcy protection under CCAA (BIA) regulations. TSX variable is a dummy variable that takes the value of one if the filing firm is listed on the Toronto Stock Exchange and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Sigma is the standard deviation of the firm's stock returns during the one year period before the filing date. Log TA (L(TA)) is the logarithm of total assets (total assets is defined in $ million). Secured Debt Ratio (SDR) is calculated as the ratio of secured debt to total liabilities. Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Industry Median Operating Margin (IOM) for each bankrupt firm is constructed using all other contemporaneous Compustat firms with the same 4-digits SIC Code. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Stock returns are missing for 8 firms, while Net income by sales are missing for 8 firms. Specification model using the standard deviation (5) below uses only 129 firms compared to 137 for models (1) to (4). Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. Winsorizing is performed by setting the ratio that below the 1st and above the 99th percentile to the values of the 1st and 99th percentiles. Winsorizing is conducted on the all the explanatory variables except for Trustee, CCAA and TSX dummy variables.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Trustee | 0.032 | 0.039 | 0.009 | 0.020 | 0.017 |
| | (0.209) | (0.224) | (0.221) | (0.230) | (0.239) |
| CCAA | | -0.029 | | -0.050 | -0.057 |
| | | (0.291) | | (0.297) | (0.318) |
| TSX | 0.095 | 0.100 | 0.086 | 0.094 | 0.198 |
| | (0.234) | (0.239) | (0.236) | (0.240) | (0.260) |
| L(Age) | -0.237** | -0.238** | -0.235** | -0.236** | -0.220** |

| | | | | | |
|---|---|---|---|---|---|
| | (0.100) | (0.100) | (0.101) | (0.101) | (0.104) |
| Sigma | | | | | 0.917 |
| | | | | | (1.973) |
| L(TA) | -0.035 | -0.034 | -0.030 | -0.027 | -0.005 |
| | (0.068) | (0.069) | (0.070) | (0.072) | (0.077) |
| SDR | | | 0.130 | 0.145 | 0.138 |
| | | | (0.413) | (0.421) | (0.435) |
| Leverage | 0.058 | 0.061 | 0.061 | 0.067 | 0.016 |
| | (0.163) | (0.167) | (0.163) | (0.168) | (0.191) |
| NM | -0.004 | -0.004 | -0.003 | -0.003 | -0.004 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.010) |
| IOM | 0.104 | 0.122 | -0.005 | 0.013 | -0.038 |
| | (1.220) | (1.233) | (1.266) | (1.271) | (1.318) |
| IAOM | 0.288 | 0.295 | 0.279 | 0.289 | 0.244 |
| | (0.197) | (0.208) | (0.198) | (0.208) | (0.224) |
| DS | -0.446*** | -0.445*** | -0.438*** | -0.436*** | -0.425*** |
| | (0.144) | (0.144) | (0.146) | (0.146) | (0.151) |
| Number of Obs. | 137 | 137 | 137 | 137 | 129 |
| Adjusted $R^2$ | 0.138 | 0.138 | 0.138 | 0.139 | 0.129 |

**Table 19: Determinants of Bankruptcy Duration Using Weibull Hazard Model, Effect of Other Market Variables**

This table reports results from estimation of the Weibull distribution hazard model. The density function for Weibull hazard model is $\exp(\frac{x_i\beta}{\sigma})bt^{b-1}\exp(-\exp\left(\frac{x_i\beta}{\sigma}\right)t^b)$. The log-likelihood function is as given in (14), $m\log(b) + \sum_{i\in J}\frac{x_i\beta}{\sigma} + (b-1)\sum_{i\in J}\log t_i - \sum_{i=1}^{n} t_i{}^b \exp(\frac{x_i\beta}{\sigma})$; where $J$ is the number of complete observations; $m$ is the number of entities in $J$; $n$ is the number of observations.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Trustee is a dummy variable and equals one if the firm's trustee/monitor belongs to one of the four biggest accountancy and professional services firms, and zero otherwise. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Industrial Production Growth Rate (IPG) is calculated between two successive quarters industrial data before the firm's filing date. Interest Rate (IR) is measured by 3 month Canadian Treasury Bill rate at the time before the firm's filing date. Net income by sales are missing for 8 firms. Specification models (1) to (5) use 137 firms. Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -4.475*** | -4.943*** | -5.831*** | -4.540*** | -4.989*** |
| | (0.337) | (0.276) | (0.338) | (0.337) | (0.557) |
| L(Age) | -0.247*** | -0.257*** | -0.206** | -0.265*** | -0.234** |
| | (0.093) | (0.095) | (0.092) | (0.093) | (0.097) |
| Leverage | 0.131 | 0.045 | 0.163 | 0.079 | 0.093 |
| | (0.146) | (0.157) | (0.147) | (0.154) | (0.156) |
| NM | -0.007* | -0.004 | -0.005 | -0.006 | -0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IAOM | 0.247** | 0.186 | 0.245** | 0.218* | 0.205* |
| | (0.118) | (0.120) | (0.120) | (0.121) | (0.122) |
| DS | -0.471*** | | | -0.320** | -0.239 |
| | (0.147) | | | (0.163) | (0.189) |

| | | | | | |
|---|---|---|---|---|---|
| IPG | | 0.199*** | | 0.125* | 0.119 |
| | | (0.058) | | (0.070) | (0.072) |
| IR | | | 0.169*** | | 0.060 |
| | | | (0.061) | | (0.080) |
| Scale | 1.001 | 0.990 | 0.997 | 0.994 | 0.982 |
| | (0.071) | (0.070) | (0.071) | (0.070) | (0.071) |
| Number of Obs. | 137 | 137 | 137 | 137 | 137 |
| Log Likelihood | -204.517 | -205.200 | -207.739 | -202.955 | -188.870 |
| Adjusted $R^2$ | 0.150 | 0.141 | 0.109 | 0.169 | 0.324 |

## Table 20: Determinants of Bankruptcy Duration Using Log-logistic Hazard Model, Effect of Other Market Variables

This table lists results from estimation of the Log-logistic hazard model. The density function for Log-logistic hazard model is $\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}$. The log-likelihood function for Log-logistic hazard model is as given in (20), $\sum_{i=1}^{n} d_i \log\left(\frac{a}{\sigma}\frac{t^{\frac{1}{\sigma}-1}}{\left[1+at^{\frac{1}{\sigma}}\right]^2}\right) + \sum_{i=1}^{n}(1-d_i)\log\left(\frac{1}{1+at^{\frac{1}{\sigma}}}\right)$; where $d_i$ is one if the observation is fully observed, zero otherwise; $a = \exp\left(\frac{x_i\beta}{\sigma}\right)$.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Industrial Production Growth Rate (IPG) is calculated between two successive quarters industrial data before the firm's filing date. Interest Rate (IR) is measured by 3 month Canadian Treasury Bill rate at the time before the firm's filing date. Net income by sales are missing for 8 firms. Specification models (1) to (5) use 137 firms. Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intercept | -3.639*** | -4.292*** | -5.278*** | -3.810*** | -4.503*** |
| | (0.369) | (0.304) | (0.362) | (0.380) | (0.570) |
| L(Age) | -0.302*** | -0.302*** | -0.303*** | -0.306*** | -0.284*** |
| | (0.106) | (0.105) | (0.104) | (0.105) | (0.108) |
| Leverage | -0.050 | -0.029 | -0.007 | -0.050 | -0.034 |
| | (0.146) | (0.145) | (0.146) | (0.145) | (0.145) |
| NM | -0.006 | -0.003 | -0.003 | -0.005 | -0.005 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| IAOM | 0.153 | 0.163 | 0.137 | 0.156 | 0.115 |
| | (0.118) | (0.117) | (0.116) | (0.117) | (0.117) |
| DS | -0.541*** | | | -0.367** | -0.246 |
| | (0.135) | | | (0.171) | (0.191) |

| | | | | | |
|---|---|---|---|---|---|
| IPG | | 0.256*** | | 0.135 | 0.104 |
| | | (0.068) | | (0.086) | (0.086) |
| IR | | | 0.246*** | | 0.114 |
| | | | (0.066) | | (0.086) |
| Scale | 0.681 | 0.678 | 0.677 | 0.674 | 0.660 |
| | (0.052) | (0.052) | (0.052) | (0.051) | (0.052) |
| Number of Obs. | 137 | 137 | 137 | 137 | 137 |
| Log Likelihood | -207.779 | -208.899 | -210.136 | -206.505 | -191.572 |
| Adjusted $R^2$ | 0.177 | 0.164 | 0.149 | 0.193 | 0.351 |

## Table 21: Determinants of Bankruptcy Duration Using Cox's Proportional Hazard Model, Effect of Other Market Variables

This table reports results from estimation of the Cox's proportional hazard model. The log-likelihood function for Cox's proportional hazard model is as follow, $\sum_{i=1}^{n} d_i \log\left[\frac{\exp(x_i\beta)}{\sum_{j\in R_{(y_i)}} \exp(x_i\beta)}\right]$. Where $d_i$ equals one if the observation is fully observed, zero otherwise.

Each duration regression contains 145 observations in the estimation. Among the 145 observations, there are 129 observations with complete filing and discharge dates, and 16 observations are still under bankruptcy protection. Duration is defined as the number of days between the filing and the discharge of the firm from bankruptcy protection. Log Age (L(Age)) variable is the logarithm of firm's age before the filing (Age is defined in years). Leverage is defined as the ratio of total liabilities to total assets. Net income by sales (NM) is measured by the ratio of net income (loss) to firm's sales. Industry Adjusted Operating Margin (IAOM) is an industry variable that captures the different industry effect on the duration time. It is based on the differences between firm's operating margin and the contemporaneous industry median operating margin. Default Spread (DS) is defined as the differences between the long-term corporate bond yield and the long-term government of Canada bond yield at the time before the firm's filing date. Industrial Production Growth Rate (IPG) is calculated between two successive quarters industrial data before the firm's filing date. Interest Rate (IR) is measured by 3 month Canadian Treasury Bill rate at the time before the firm's filing date. Net income by sales are missing for 8 firms. Specification models (1) to (5) use 137 firms. Standard errors are between parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| L(Age) | -0.245*** | -0.260*** | -0.204** | -0.266*** | -0.234** |
| | (0.094) | (0.098) | (0.093) | (0.096) | (0.100) |
| Leverage | 0.112 | 0.040 | 0.149 | 0.064 | 0.077 |
| | (0.151) | (0.163) | (0.154) | (0.159) | (0.163) |
| NM | -0.007* | -0.004 | -0.005 | -0.006 | -0.007 |
| | (0.004) | (0.004) | (0.004) | (0.005) | (0.004) |
| IAOM | 0.221* | 0.178 | 0.228* | 0.198 | 0.182 |
| | (0.122) | (0.125) | (0.125) | (0.125) | (0.128) |
| DS | -0.495*** | | | -0.331** | -0.226 |
| | (0.144) | | | (0.165) | (0.193) |
| IPG | | 0.212*** | | 0.135* | 0.133* |
| | | (0.058) | | (0.071) | (0.075) |
| IR | | | 0.188*** | | 0.084 |
| | | | (0.061) | | (0.082) |
| Number of Obs. | 137 | 137 | 137 | 137 | 137 |
| Adjusted $R^2$ | 0.154 | 0.148 | 0.117 | 0.175 | 0.158 |