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# Estimating likelihood of filing a petition for reorganization and bankruptcy: evidence from Finland

## ABSTRACT

*The objective of Finnish Company Reorganization Act (FCRA) is to recover a temporally financially distressed but viable firm, that is able to pay its obligations in the future. In Finnish Bankruptcy Act (FBA) bankruptcy means that the assets of an unviable firm are liquidated and divided by the creditors of the firm. It is argued that firms filing for FCRA include unviable firms (hypothesis 1). Similarly, it is argued that firms filing for FBA include viable firms (hypothesis 2). The first purpose of this study is to test these hypotheses to analyse the potential filtering failures of FCRA and FBA. Logistic regression analysis is applied to estimate likelihood of filing for reorganization and bankruptcy, to test the hypotheses. The hypotheses are tested by contrasting reorganizing and bankrupt firms with viable firms. The second purpose is to test two hypotheses set for the estimated probabilities: 1) pre-filing bankruptcy increases the probability to file a reorganization petition (hypothesis 3) and 2) reorganization increases the probability of bankruptcy (hypothesis 4). The probabilities are estimated using data from 47143 non-default (viable) firms, and from 81 and 244 firms filing reorganization or bankruptcy petition, respectively. The results are validated in hold-out samples. Both financial and non-financial variables are used as predictors. Evidence implied that both FCRA and FBA suffer from a filtering failure as argued by hypotheses 1 and 2. In addition, pre-filing bankruptcy remarkably affected the likelihood to*

reorganize (hypothesis 3). Finally, reorganization had a significant effect on the likelihood to bankrupt (hypothesis 4).

**Key words:** reorganization, bankruptcy, Finnish Company Reorganization Act, logistic regression analysis, Finnish firms

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## 1. INTRODUCTION

Conflicts of interest and asymmetry of information between equity and debt holders can force a financially distressed but viable (efficient) firm to liquidate and may enable a distressed unviable (inefficient) firm to continue (Mooradian, 1994). If there is no cost for an unviable firm to get access to reorganization instead of liquidation, the efficiency of the reorganization system will be ruined. That may lead to lengthy and expensive reorganization proceedings, which are not beneficial for any stakeholder of the firm. Because of the controversial nature of reorganization, it has been the object of keen discussion and research. For example, Thorburn (2000) has analysed Swedish, Spear (1989) French, Sundgren (1998) and Laitinen (2011) Finnish, Takagi (2003) Japanese, and Eger (2001), Franks, Nyborg & Torous (1996), and Schwehr (2003) German reorganization procedure while Kaiser (1996), Couwenberg (2004), Philippe & Partners and Deloitte & Touche (2002), Davydenko & Franks (2008), and Blazy, Chopard & Fimayer (2008) have compared procedures in different countries. In fact, all countries seek to improve the efficiency of their procedures by encouraging the reorganization of viable firms and the liquidation of unviable ones. Nearly 90 countries around the world have reformed their bankruptcy codes since World War II and more than half of them have done so during the last decade (Gine & Love, 2006: 2).

Most of the reorganization legislation is more or less based on the reorganization system of the United States. The U.S. system offers businesses two main procedures to resolve financial distress: Chapter 7 (liquidation of the firm) and Chapter 11 (reorganization of the firm). The U.S. reorganization procedure has been analysed and compared with foreign procedures by a number of researchers (see Altman, 1993; Franks et al., 1996; Kaiser, 1996; LoPucki & Doherty, 2002; LoPucki, 2004). Firms that file for bankruptcy have a choice between liquidating under Chapter 7 and reorganizing under Chapter 11. In reorganization, the existing managers usually remain in control and the firm continues to operate. The coalition behaviour theory based on the behaviour

of three claimants (bondholders, bank lenders and equity) suggests that not all firms observed in bankruptcy liquidation should shut down (White, 1989). However, managers may tend to choose reorganization if it is best for them and for equity regardless of whether it is more valuable if the firm shuts down or continues to operate. This suggests that under the U.S. system firms in bankruptcy might not always be economically inefficient (unviable) and that inefficient firms might not always end up in bankruptcy (White, 1989: 129).

In Finland, the Finnish Company Reorganization Act (FCRA) originally came into force on 8 February 1993. FCRA allows a distressed firm itself or its creditors to file a petition for reorganization directly or after a petition for bankruptcy is filed and active. In the Finnish Bankruptcy Act (FBA) bankruptcy means that the assets of the firm are given to the bankrupt estate and divided by the creditors of the firm (liquidation). FCRA can be used to avoid bankruptcy if the firm is financially distressed but viable and only temporarily unable to pay its financial obligations. When the reorganization petition is submitted to the court, the firm can be protected against the demands of creditors (automatic stay). Thus, it can be used as a way to avoid bankruptcy liquidation at least temporarily even if the firm is unviable. When the firm is not selected by the court for reorganization, it may become bankrupt. It may go bankrupt when it fails to carry out reorganization program too. If unviable firms file for reorganization, it can make reorganization proceedings inefficient due to the increased bureaucracy and cost for stakeholders. In the same way, large economic values are lost when a distressed but viable firm files for bankruptcy. Thus, the efficiency of reorganization and bankruptcy procedures is also important for government and corporate policy.

The history of FCRA originates in the rapid increase of bankrupted firms during the depression 1989–1992. Sundgren (1998) showed that the payback rate for the creditors in Finnish bankruptcies was on an average 22% whereas the median was only 18%. However, in 96.8 % of all liquidations, general creditors received nothing (Bergström & Sundgren, 1998). Thus, bankruptcies caused large economic losses to the Finnish economy, in addition to other negative consequences. It was argued that FBA obviously had led to a situation where a large number of viable firms went bankrupt, reducing the competitiveness of the economy. Ravid & Sundgren (1998) showed that the survival rate in Finnish bankruptcies was only 29%. Because of the obvious pitfalls in FBA, FCRA was enacted in 1993. In terms of payoff, FCRA has shown itself to be efficient. The evidence presented by Sundgren (1998) indicates that creditors have received a better payoff in reorganization than in bankruptcy liquidation.

FCRA however demonstrates obvious inefficiencies in picking up and rejecting reorganization petitions filed by unviable firms. In all, 4 842 reorganization petitions were filed 1993–2007 (Statistics Finland). Finnish reorganization statistics show that on average 45% of the petitions will lead to a confirmed reorganization plan. In addition, up to 40–50% of reorganizing firms are

not able to complete their reorganization plan and will go bankrupt during the programme. The failure rate of reorganizing firms is thus exceptionally high and comparable with the consummation rate of Chapter 11 (Jensen-Conklin, 1992). In the same period, 39 778 firms and 12 055 entrepreneurs have filed for bankruptcy under FBA. On average, more than 30% of the bankruptcy petitions are withdrawn. Thus, FCRA and FBA may suffer from a filtering failure that impairs their efficiency. If a system allows an unviable firm to reorganize or a viable firm to go bankrupt, two kinds of filtering failure may occur. Under the null hypothesis that a bankrupt firm is not viable, a Type I error occurs when an unviable firm is allowed to reorganize and a Type II error occurs when a viable firm is bankrupted (White, 1994; Fisher & Martel, 2004; Laitinen, 2011).

It is therefore important to investigate the degree to which reorganizing and bankrupting firms share characteristics with viable firms. This investigation will be done by testing four hypotheses. Firstly, it is argued that firms filing for FCRA include unviable firms (hypothesis 1) and that firms filing for FBA include viable firms (hypothesis 2). In this context, viability is defined as the ability of the firm to continue its business reflecting the message of FCRA. Empirically, the viability of a firm is measured by its similarity with the characteristics of firms continuing in business. This similarity is assessed by the (binary) logistic regression analysis (LRA) applied to discriminate between reorganizing or bankrupt firms and ongoing firms. LRA estimates the likelihood of filing a petition for reorganization or bankruptcy. It is also argued that pre-filing a bankruptcy petition increases the likelihood of filing a reorganization petition (hypothesis 3) and that reorganization increases the likelihood of filing a bankruptcy petition (hypothesis 4). The four research hypotheses are tested for data from 47 143 viable (non-default) firms, and 81 and 244 firms filing reorganization or bankruptcy petitions respectively in 2004. In their proceedings, FCRA and FBA are comparable with systems in other countries (see Philippe et al., 2002). Therefore, the results reported here would be of relevance for several countries.

The paper is organized as follows. First, the background and objectives of the study are discussed in the introduction. The second section deals with relevant prior studies concentrating on the characteristics of reorganizing and bankruptcy firms. These characteristics are used as a basis for variable selection in estimating reorganization and bankruptcy probabilities. In addition, the section briefly discusses FBA and FCRA to justify the four hypotheses drawn for these proceedings. In the third section, the data and statistical methods for the empirical analysis are presented. LRA is introduced as a method to estimate the probabilities using a pre-justified set of financial and non-financial variables as predictors. Empirical results are presented and discussed in the fourth section. It will be shown that empirical evidence gives support to the research hypotheses. The last section summarizes the findings of the study and discusses the limitations of the approach. Several suggestions for further research are presented.

## 2. REORGANIZATION AND BANKRUPTCY DECISIONS

### 2.1. Predictors of reorganization and bankruptcy likelihood

The efficiency of bankruptcy and reorganization procedures is not only an academic issue but also a matter of importance for government and corporate policy (Ravid & Sundgren, 1998). Efficient procedures should ensure that only economically inefficient (unviable) firms declared bankrupt and that, efficient (viable) firms are reorganized and can continue to operate. In this context, the crucial question is how to measure viability *ex ante* in order to make the proceedings efficient. By its definition, viability means ability to survive so that the question is about prediction. Thus, an *ex-ante* measure should be constructed using predicted outcomes from an econometric model of the outcome of process (Fisher & Martel, 2004). This predicted outcome (based on relevant predictors or characteristics) measures the *ex-ante* viability of the firm that is important for the stakeholders when making the decision whether to reorganize or to liquidate and also to assess the efficiency of procedures. In this study, an econometric model will be developed to get an *ex-ante* measure of viability to test the four research hypotheses. Therefore, it is important to justify the predictors of the model using relevant prior studies.

Many studies on reorganization or bankruptcy decisions are based on the coalition behaviour theory first proposed by Bulow & Shoven (1978). They considered three claimants to the cash flows and assets of the firm: bondholders, bank lenders and equity. Bulow and Shoven used coalition behaviour theory to show the conditions under which bankruptcy would occur. This theory is adopted to determine whether a firm under the U.S. bankruptcy system would continue (Chapter 11) or liquidate (Chapter 7). They used their theory to explain the tendency for inefficient firms to survive Chapter 11 proceedings. White (1980, 1984, and 1989) applied coalition theory to investigate decision making under the U.S. Chapter 11 reorganization procedure. White showed that the choice between reorganization and liquidation is directly related to the financial position of the firm. She postulated the following financial characteristics that affect the reorganization decision: equity commitment, leverage position, payoff in reorganization compared to liquidation, future profitability, and the amount of secured debt.

The coalition behaviour theory is interesting, since it can be applied to describe the behaviour of financially distressed firms in different situations (Routledge & Gadenne, 2000: 236). In addition, the theory has been used in development of reorganization prediction models. Examples of important studies in this line are Frost-Drury, Greinke & Shailer (1998), Campbell (1996), Fisher & Martel (1995), Hotchkiss (1995), Jensen-Conklin (1992), Franks & Torous (1989), Casey, McGee & Stickney (1986), Hong (1983), LoPucki (1983a and 1983b), Comerford (1976), Barniv et al. (2002), and Fisher & Martel (2004). These studies show that size, capital structure, liquidity, and profitability are important determinants of reorganization decisions. Routledge & Gadenne (2000)

applied this theory to the Australian voluntary administration (VA) insolvency decision but the leverage effect contradicted the theory. They suggested that this contradictory result needs to be considered in the context of financial restructuring that will likely take place in reorganization. The capital structure and leverage may be altered significantly because of reorganization due to the rate of debt remission. In Finland, Sundgren (1998) and Laitinen (2011) have analysed the reorganization decision. Most studies are concentrated on financial variables, because financial statements are usually publicly available and presented in a standardized form (Poston, Harmon & Gramlich, 1994).

The likelihood of bankruptcy largely depends on the same predictors as the likelihood of reorganization because bankruptcy and reorganization are different aspects of the same decision for a distressed firm. For example, Beaver (1966), Altman (1968), Scott (1981), Jones (1987), Karels & Prakash (1987), Laitinen & Kankaanpää (1999), Lensberg et al. (2006) and Balcaen & Ooghe (2006) discuss financial determinants of distress on theoretical and empirical grounds. Leverage, profitability, liquidity, cash flow, and size are supported as predictors by bankruptcy theory and related empirical evidence (Scott, 1981, Jones, 1987, and Laitinen, 1991). Bankruptcy theory hints at how the predictors should be selected to be theoretically justified (Scott, 1981). Wilcox (1971; 1973; 1976) and Santomero & Vinso (1977) developed a bankruptcy theory based on the gambler's ruin model. Scott (1981) developed the theory further and showed that the probability of failure is an explicit function of the expected value and the standard deviation of the change in retained earnings (net income minus dividends), and the current market value of equity, all divided by total assets. Thus, this kind of approach suggests that the profitability together with its volatility and the equity ratio are important predictors of bankruptcy. Scott showed that in this form the probability has obvious similarities with the ZETA model by Altman et al. (1977). Both models contain stock variables that reflect financial position at a point of time and flow variables that involve estimates of future cash flow distribution. Scott also expanded the basic model and showed theoretically that the size (total assets in ZETA) and the liquidity of the firm (current ratio in ZETA) can also affect the probability of bankruptcy.

Most studies concentrate on financial predictors alone. However, reorganization decisions and bankruptcy are also dependent on some non-financial characteristics of the firm (Poston, Harmon & Gramlich, 1994). Keasey & Watson (1987) discussed non-financial predictors of bankruptcy such as managerial structure, inadequacy of accounting information systems and audit lags, submission lags, audit qualifications, and changes in auditors. In their analysis, the number of directors and submission lags were important predictors of distress. Laitinen (1999) used several non-financial variables to explain risk assessments made by financial analysts. He showed that the prior payment history and characteristics of directors are most significant dimensions. Back (2005) classified non-financial determinants in his study into the following classes: characteristics

of management, prior payment behaviour, group membership, and age. His analysis also showed that prior payment behaviour is the most important dimension in explaining financial distress. In addition to the dimensions above, industry and age of firm have proven to be significant predictors of financial distress (El Hennawy & Morris, 1983; Shumway, 2001). In addition, industry is shown to be an important determinant of successful reorganization (Campbell, 1996, Hotchkiss, 1995, LoPucki, 1983, and Routledge & Gadenne, 2000). Kennedy & Shaw (1991) argued that going concern audit opinion also has an incremental predictive value in discriminating between reorganized and liquidated firms. However, evidence on this value is mixed (Casterella, Lewis & Walker, 2000). In Finland, Laitinen (2011) has used a large set of financial and non-financial variables to develop a statistical measure of viability. He showed that non-financial variables (such as those above) contribute important incremental information over financial variables when measuring the viability of firms.

## **2.2. Finnish bankruptcy and reorganization acts**

In Finland, bankruptcy proceedings are governed by the Finnish Bankruptcy Act (FBA), which includes liquidation proceedings (Philippe et al., 2002; Koskelo, 2003). The purpose of proceedings is to liquidate the assets of the debtor (a distressed firm) for the benefit of the creditors. Bankruptcy proceedings may be initiated either by the debtor or by a creditor. The petitions for bankruptcy proceedings are handled by the district courts. When the firm itself files for bankruptcy, the proceedings are opened forthwith, without any examination as to the insolvency. However, when a petition is filed by its creditor the court shall provide the firm with an opportunity to be heard. A prerequisite for the opening of bankruptcy proceedings on the basis of a petition from a creditor is that the firm is insolvent. When opening the proceedings, the court appoints a provisional receiver to administer the estate of the debtor. The receiver submits an inventory of the estate to the court after a hearing of creditors. If the court judges that there are sufficient assets in the estate to merit full bankruptcy proceedings, the court appoints one or more administrators. If there are not sufficient assets, bankruptcy will be dropped due to lack of means. In the period 1993–2007, 39 778 firms and 12 055 entrepreneurs filed for bankruptcy under FBA. More than 30% of the bankruptcy petitions are withdrawn. FBA may thus be used as a method to force a viable debtor firm to repay its debt. In addition, FBA is criticized for liquidating viable firms although they would be able to continue business. These criticisms have led to the research hypothesis below (*H2*).

The Finnish Company Reorganization Act (FCRA) in its original form came into force 8 February 1993 (Act 1993/47). It establishes a legal framework for the reorganization of enterprises that are economically viable but currently suffering financial difficulties. The aim of the reorganization proceedings is to provide the administrator, debtor, and creditors with an opportunity

to produce a reorganization plan aimed at recovering the firm and a debt adjustment program necessary to this end. Proceedings for reorganization may be used as an alternative to bankruptcy proceedings in cases where financial crisis may be averted or resolved by a reorganization plan. A petition for reorganization proceedings may be filed by the debtor or by a creditor. The time allowed for filing is typically less than 30 days when the bankruptcy petition is active. Proceedings may be opened if the debtor is insolvent or insolvency is impending. It is important that a petition for reorganization proceedings supersedes a petition for bankruptcy until the court decides whether or not to open reorganization proceedings. Once bankruptcy proceedings concerning the debtor have been opened, reorganization proceedings are no longer possible. Therefore, a firm in liquidation cannot apply for reorganization proceedings.

Every year, a large number of Finnish firms apply for FCRA. Statistics Finland shows that 4 842 firms have filed a reorganization petition in the period 1993–2007. However, only a fraction of these petitions will lead to a legal reorganization programme. First, up to 60% of the reorganization petitions are approved by the court. Second, only 75% of those petitions will result in a reorganization plan confirmed in court. Finally, as many as 40–50% of reorganizing firms fail in carrying out the confirmed plan and will go bankrupt during the program. This means that only 18–22% of the firms applying for reorganization will finally carry out the programme successfully. Thus, the failure rate of reorganizing firms is high when compared for example with reorganization in Canada (Fisher & Martel, 1995). It is however comparable with the consummation rate of Chapter 11 in the United States (Jensen-Conklin, 1992). This implies that FCRA is not very efficient when trying to pick out viable firms for reorganization leading to the research hypothesis below (*H1*).

The inefficiency of the reorganization procedure is caused primarily by the difficulty the court has in picking out and rejecting unviable firms in different stages of proceedings, since these firms are pooled with their viable counterparts. Because a prerequisite for opening proceedings is that the firm is insolvent or that insolvency is impending, it is difficult to discriminate between viable and unviable firms that fulfil this condition. In addition, FCRA may motivate unviable firms to postpone bankruptcy, since a superseding reorganization petition can be filed when the creditor has filed a petition for bankruptcy and it is active. This means that pre-filing a bankruptcy petition may increase the likelihood of submitting a reorganization petition, as argued in the hypothesis below (*H3*). In the same way, these inefficiencies may cause reorganizing firms to show an exceptionally high risk of going bankrupt, leading to the fourth research hypothesis (*H4*).

The characteristics of the bankruptcy act (FBA) and the reorganization act (FCRA) may thus allow a viable firm to liquidate under FBA and an unviable firm to continue under FCRA. FCRA also makes it possible for a distressed firm to file for reorganization when the bankruptcy petition is active. Thus pre-filing for bankruptcy may increase the likelihood of reorganizing. In addition,



firms reorganizing under FCRA tend to show an exceptionally high risk of bankruptcy. Hence, it can be expected that reorganization will increase the likelihood of bankruptcy. These inefficiencies reflect a filtering failure in the first stages of the legal bankruptcy and reorganization procedures. Therefore, the following four research hypotheses are drawn:

*H1:* Firms filing for reorganization under FCRA include unviable firms.

*H2:* Firms filing for bankruptcy under FBA include viable firms.

*H3:* Pre-filing a bankruptcy petition increases the likelihood of filing a reorganization petition.

*H4:* Reorganization increases the likelihood of filing a petition for bankruptcy.

### 3. EMPIRICAL DATA AND STATISTICAL METHODS

#### 3.1. Empirical data

The data available for the study include financial statements and non-financial background information from 65 164 firms. The empirical data have been obtained in a disguised form from the largest Finnish credit information company Finska (Suomen Asiakastieto Oy) for research purposes (see [http: www.asiakastieto.fi](http://www.asiakastieto.fi)). The data have been gathered from the data base of Finska as at 13.12.2003 and include a large set of financial and non-financial variables. The reorganization and bankruptcy filings to be predicted have emerged after the beginning of 2004 but before 31 December 2004. The selection of viable firms was made in two stages. First, the firms that do not have any payment defaults during the event period are selected. It is however possible that a non-default firm can fail immediately after the event period. In the second stage, the firms having payment defaults after this period until the end of April 2005 were therefore dropped from the sample. This process ensured that the sample of viable firms only includes firms demonstrating an ability to survive. The number of such firms is 63 177. In the event period, 109 firms filed for reorganization and 330 firms filed for bankruptcy. In this period (1 September 2004), FBA was revised. However, this revision was minor and does not affect the present analysis or the generalization of the results. From the data, a sample of 75% was randomly selected for estimation (estimation data). In addition, 25% of the data were used in validation of the classification results (test data).

These data include a majority of Finnish firms which publish annual financial statements according to the Accounting Law. Therefore, the estimation data form a statistically representative sample of firms publishing annual statements. However, the population does not correspond to the size distribution of all Finnish firms, because some non-corporations and very small (micro) firms are missing, as at the time such firms were not obliged to publish their financial statements (the legislation has since changed). Reorganization and bankruptcy firms are typically small and

many of them are non-corporations. Therefore, the present sample includes only a fraction of them. In the event period (2004), 315 firms filed a petition for reorganization and 2 417 firms filed for bankruptcy (Statistics Finland). Thus, the sample includes 34.6% of reorganizing firms and only 13.7% of bankruptcy petitioning firms. Very small firms and many non-corporations are not represented by the data. These data are similar to those applied by Laitinen (2011).

Appendix 1 shows descriptive statistics of the present sample. Panel 1 of the appendix presents the industrial distribution of the sample firms separately for viable, reorganizing, and bankrupt firms. The chi-square statistics show that the distributions of reorganizing and bankrupt firms differ from that of viable firms in a statistically significant manner ( $p$ -values are 0.0018 and 0.000, respectively). In reorganizing firms, the proportion of manufacturing firms is exceptionally high (32.1%) in comparison with viable firms (14.8%). Among bankrupt firms, construction firms are exceptionally frequent (23.9%) when compared with viable firms (11.8%). Panel 2 shows that on average reorganizing and bankruptcy firms are younger than viable firms. The  $p$ -values of F test are 0.047 and 0.000 respectively for reorganizing and bankruptcy firms in comparison with viable firms. The size distributions measured by net sales and total assets show that the average size of viable firms remarkably exceeds that of reorganizing and bankruptcy firms. However, the median values for all groups are small, but larger for reorganizing and bankruptcy firms than for viable firms. All size distributions are strongly skewed and there are no statistically significant differences in the distribution between the groups.

### 3.2. Statistical methods and variables

In the present study, binary LRA will be applied to estimate the conditional probabilities to reorganize and to go bankrupt to test the four research hypotheses. LRA can be used to predict a dependent variable on the basis of continuous or categorical independent variables and also to determine the percentage of variance in the dependent variable explained by the independent variables. This analysis does not require that independent variables are multivariate normal or that groups have equal covariance matrices that are basic assumptions in linear discriminant analysis (Hosmer & Lemeshow, 1989). LRA creates a score (logit)  $L$  for every firm. It is assumed that the independent variables be linearly related to  $L$ . This score is used to determine the conditional probability to reorganize or go bankrupt as follows:

$$(4) \quad p^i(X) = \frac{1}{1 + e^{-L}} = \frac{1}{1 + e^{-(b_0 + b_1 x_1 + \dots + b_n x_n)}}$$

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where  $i$  refers either to reorganization ( $i = R$ ) or bankruptcy ( $i = B$ ),  $b_j$  ( $j = 0, \dots, n$ ) are coefficients and  $n$  is the number of independent variables  $x_j$  ( $j = 1, \dots, n$ ).

The LR (logistic regression) models are estimated by the maximum likelihood method in SPSS. The significance of the coefficients is tested by the Wald test statistic. This test is used to test hypotheses *H3* and *H4* on the effects of pre-filing bankruptcy and reorganization on reorganizing and bankruptcy probabilities, respectively. The strength of association is assessed by the standard tests for LRA such as the Nagelkerke R Square, Cox & Snell R Square and  $-2 \log$  likelihood. The goodness of fit of the model is tested by the Hosmer-Lemeshow chi-square test. This test is performed by dividing the predicted probabilities into deciles and then computing a chi-square to compare the predicted and observed frequencies. Higher  $p$ -values indicate a good fit to the data. In fact, this tests the linearity of the logit. The classification accuracy of the LR model in the sample is measured by the frequencies of Type I and Type II classification errors. The proportion of event firms is used as the cut-off value in the classification. The classification results are validated in the hold-out validation data (25% of the data). The strength of association, the goodness of fit, and especially the accuracy of classification are used to test hypotheses *H1* and *H2*. The higher (lower) the degree to which reorganization (bankruptcy) firms differ from viable firms, the more likely it is that the firms include unviable (viable) firms as assumed by *H1* (*H2*). This degree is assessed here by the statistical tests above but also graphically by the ROC (Receiver Operating Characteristic) curve.

When estimating the probability of filing a reorganization petition ( $p^R(X)$ ), the dependent variable ( $Z$ ) in LRA is a binary variable that is 0 for a viable firm and 1 for a firm filing a reorganization petition in the event period. When estimating the probability of going bankrupt ( $p^B(X)$ ),  $Z$  is 0 for a viable firm and 1 for a firm filing a bankruptcy petition in that period. The set of independent variables  $X$  is the same for each probability as supposed by previous research. In order to test hypotheses *H3* and *H4*, it is important that the set  $X$  is as comprehensive as possible and drawn from prior research on the predictors, since the variables in the set act as control variables for the effects of pre-filing bankruptcy and reorganization. Therefore, 13 non-financial and five financial variables are selected to represent the predictors of reorganizing and bankruptcy probabilities ( $n=18$ ). Each of these variables has been found to be statistically significant in prior reorganization and/or bankruptcy studies (see above). However, they are not all applied in the same earlier study.

First, the non-financial independent variables applied in LRA are: industry propensity for bankruptcy (industry effect); logarithmic age in months (age); logarithmic number of board members; percentage of board members resigned during the last year; logarithmic number of board member personal defaults; logarithmic number of board member links to bankrupt firms (characteristics of managers); corporation dummy (0 = limited company, 1 otherwise); modified audit report dummy (0 = non-modified report, 1 otherwise); length of last accounting period in months

(submission lag); months to the date of last financial statements (age of financial data); logarithmic number of payment defaults during the last 12 months; logarithmic number of active delays in payment; and logarithmic number of active positive payment signals (prior payment behaviour). Second, the five financial independent variables are as follows: logarithmic net sales (size); equity ratio (leverage); traditional cash flow to sales (cash flow); quick ratio (liquidity); and return on investment ratio (profitability). In addition, two dummy variables are used in LRA as covariates to test hypotheses *H3* and *H4*, respectively. The first (second) dummy variable is 1 when a creditor (the firm) has filed a bankruptcy (reorganization) petition before the event period and 0 otherwise. If the coefficient of the first (second) dummy variable is positive and statistically significant, pre-filing a bankruptcy (reorganization) petition has an effect on the likelihood of filing a reorganization (bankruptcy) petition that is consistent with *H3* (*H4*).

The correlations between the independent variables in the estimation sample (not reported here) are in general very low. Most correlation coefficients of the 153 correlations  $((18 \cdot 17) / 2)$  are below 0.10. Only 24 correlation coefficients exceed 0.10 and nine of them exceed 0.20. The highest Pearson correlations are found between the following variables: logarithmic number of payment defaults during last 12 months and logarithmic number of active delays in payment (0.445); traditional cash flow to sales and return on investment ratio (0.442); logarithmic number of positive payment signals and logarithmic net sales (0.424); and equity ratio and quick ratio (0.370). Thus, there are no severe multicollinearity problems with the independent variables in LRA.

## 4. EMPIRICAL RESULTS

### 4.1. Estimating probability of filing a reorganization petition

Appendix 2 shows descriptive statistics of the eighteen independent variables for viable and reorganizing firms in the estimation sample. The appendix also shows the statistics for the pre-filing bankruptcy dummy variable. The mean of this variable shows that only about 5% of the firms filing for reorganization in the event period, have a pre-filing bankruptcy petition. It is clear that the percentage is small because the time for submitting the reorganization petition when the bankruptcy petition is filed by the creditor, is usually only than 30 days or less and the event period is as long as one year (on an average 40–50% of reorganization firms may have a pre-filing bankruptcy). Thus, predictive information that is older than 30 days cannot take account of this petition that is filed later in the event period. This kind of bankruptcy petition is however naturally very rare for viable (non-default control) firms. Therefore, the difference is statistically very significant that at the univariate level gives support to *H3*. Besides this variable, the most significant differences between reorganizing and viable firms are found in the logarithmic number of delays

in payment; the logarithmic number of payment defaults (prior payment behaviour); the equity ratio (leverage); the logarithmic number of board member links to bankrupt firms (characteristics of managers); the modified audit report dummy (audit report modification); and the return on investment ratio (profitability).

Table 1 presents the estimation results for LRA. Panel 1 shows the model summary tests. The Nagelkerke R Square of the estimated probability model is 0.36 %, which indicates a moderately high strength of fit. Furthermore, the Hosmer & Lemeshow test statistic is not statistically significant referring to a high goodness of fit with the data (linearity of the logit). Panel 3 shows the classification accuracy of the estimated LR model. In the estimation and test data, the model classifies correctly about 90% of the viable firms and about 77% of the reorganizing firms. Thus, 10% of viable firms may have similar characteristics to the reorganizing firms while 23% of reorganizing firms share characteristics with viable firms. The classification accuracies are almost identical in the estimation data and in the test data indicating a valid classification model. Hence, a large majority of reorganizing firms clearly differ from typical viable firms. However, a small fraction of viable firms does not differ from typical reorganizing firms.

Figure 1 shows the ROC curve for the total sample including all firms (estimation and test samples). The x-axis shows the percentage of viable firms that are incorrectly classified as reorganizing firms when the cut-off value is changed. The y-axis presents the percentage of reorganizing firms that are classified correctly. The area under the ROC curve (AUC) is 0.927 that suggests a high degree of accuracy in classification. The curve shows that about 50% of reorganizing firms are correctly classified when at the same time (for the same cut-off value) approximately 0% of viable firms are incorrectly classified as reorganizing firms. Thus, it can be supposed that approximately at least 50% of reorganizing firms are not viable and do not share the characteristics of viable firms at all. In conclusion, these classification results give support to *H1*. A large percentage of the firms filing a reorganization petition in the event period cannot be considered viable on the basis of the *ex ante* prediction model. This result conforms to the message from the reorganization *ex post* statistics.

Panel 2 of the table shows the parameters of the estimated LR model. The prior bankruptcy dummy is statistically significant at a *p*-level of 2.3% that at least partly supports *H3*. The coefficient of the variable is large showing that prior bankruptcy strongly increases probability of filing a reorganization petition. The last column of the panel (Exp(B)) shows that when a creditor of the firm has filed a petition for bankruptcy, the probability of filing a reorganization petition for the firm is more than 50 times higher than for a firm without such a petition. The most significant coefficients of the LR model are obtained for the logarithmic number of delays in payment; the logarithmic number of payment defaults (prior payment behaviour); the equity ratio (leverage); the logarithmic age in months (age); and the logarithmic net sales (size). The coefficient

**TABLE 1. Logistic regression model for the reorganization probability.****PANEL 1. Model summary tests.**

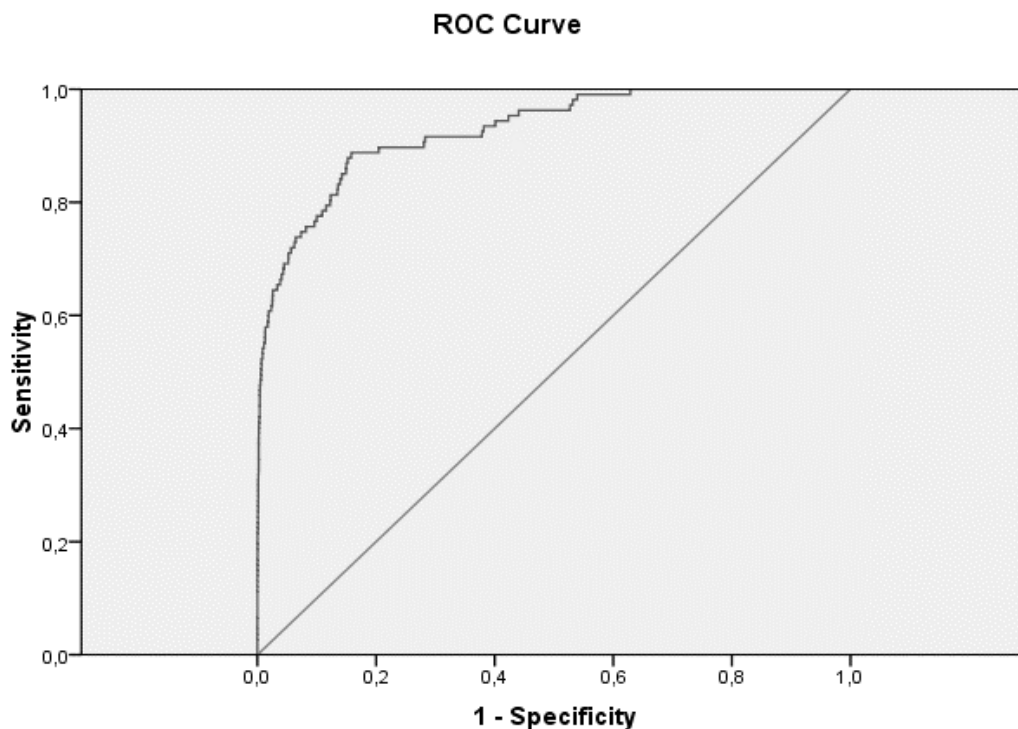
Model summary			Hosmer and Lemeshow Test	
-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	Chi-square	p-value
761.4105	0.0095	0.3596	6.2002	0.6248

**PANEL 2. Parameters of the binary logistic regression model.**

Variables in the equation	Coefficient	Standard Deviation	Wald	p-value	Exp(B)
Prior bankruptcy dummy	3.9329	1.7267	5.1880	0.0227	51.0563
Industry propensity for bankruptcy (%)	0.2270	0.1974	1.3219	0.2503	1.2548
Log. age in months	-0.5816	0.1758	10.9489	0.0009	0.5590
Log. number of members on board	-0.3725	0.4760	0.6123	0.4339	0.6890
Number of resigned board members (%)	0.0110	0.0137	0.6358	0.4252	1.0110
Log. number of board member personal defaults	-0.0239	0.3740	0.0041	0.9490	0.9764
Log. number of board member links to bankrupt firms	0.5991	0.4375	1.8751	0.1709	1.8205
Corporation dummy	1.0255	0.7969	1.6561	0.1981	2.7886
Modified audit report dummy	0.0215	0.2979	0.0052	0.9424	1.0218
Length of last accounting period (months)	-0.0489	0.0988	0.2447	0.6209	0.9523
Months to the date of last financial statements	-0.0025	0.0251	0.0098	0.9211	0.9975
Log. number of payment defaults	1.2999	0.2601	24.9853	0.0000	3.6690
Log. number of delays in payment	2.6789	0.2013	177.1194	0.0000	14.5684
Log. number of positive payment signals	-0.1683	0.1300	1.6768	0.1954	0.8451
Log. net sales	0.2702	0.0874	9.5565	0.0020	1.3102
Equity ratio (%)	-0.0140	0.0037	14.1675	0.0002	0.9861
Traditional cash flow to sales (%)	-0.0010	0.0070	0.0221	0.8818	0.9990
Quick ratio	-0.0370	0.0732	0.2561	0.6128	0.9636
Return on investment ratio (%)	-0.0064	0.0038	2.8832	0.0895	0.9936
Constant	-6.2757	1.7340	13.0986	0.0003	0.0019

**PANEL 3. Classification accuracy of the model.**

Observed:	Estimation data: Predicted:			Test data: Predicted:		
	Viable	Reorgani- zation	Correct, %	Viable	Reorgani- zation	Correct, %
Viable firms	39754	4502	89.8	13438	1509	89.9
Reorganization firms	18	63	77.8	6	20	76.9
Overall accuracy			89.8			89.9



**FIGURE 1.** ROC curve of the estimated reorganization probability (estimation and test sample firms).

of logarithmic net sales is positive, indicating that the greater the size, the higher is the probability of filing a petition for reorganization.

#### **4.2. Estimating probability of filing a bankruptcy petition**

Appendix 3 presents descriptive statistics of the eighteen independent variables for viable and bankrupt firms in the estimation sample. There are also statistics for the pre-filing reorganization dummy variable. This variable shows that about 10% of bankruptcy petition firms are reorganizing firms. For viable firms, the percentage is only 0.2%. Therefore, the difference in the dummy variable is statistically very significant, which on a univariate basis, lends support to *H4*. In addition to this variable, the most significant differences between bankruptcy and viable firms are in the logarithmic number of payment defaults; the logarithmic number of delays in payment (prior payment behaviour); the equity ratio (leverage); the logarithmic number of board member personal defaults; the logarithmic number of board member links to bankrupt firms; the logarithmic number of members of the board (characteristics of managers); and the modified audit report dummy (audit report modification).

**TABLE 2. Logistic regression model for the bankruptcy probability.****PANEL 1. Model summary tests.**

Model summary			Hosmer and Lemeshow Test	
-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	Chi-square	<i>p</i> -value
1791.0380	0.0260	0.3990	14.3950	0.0720

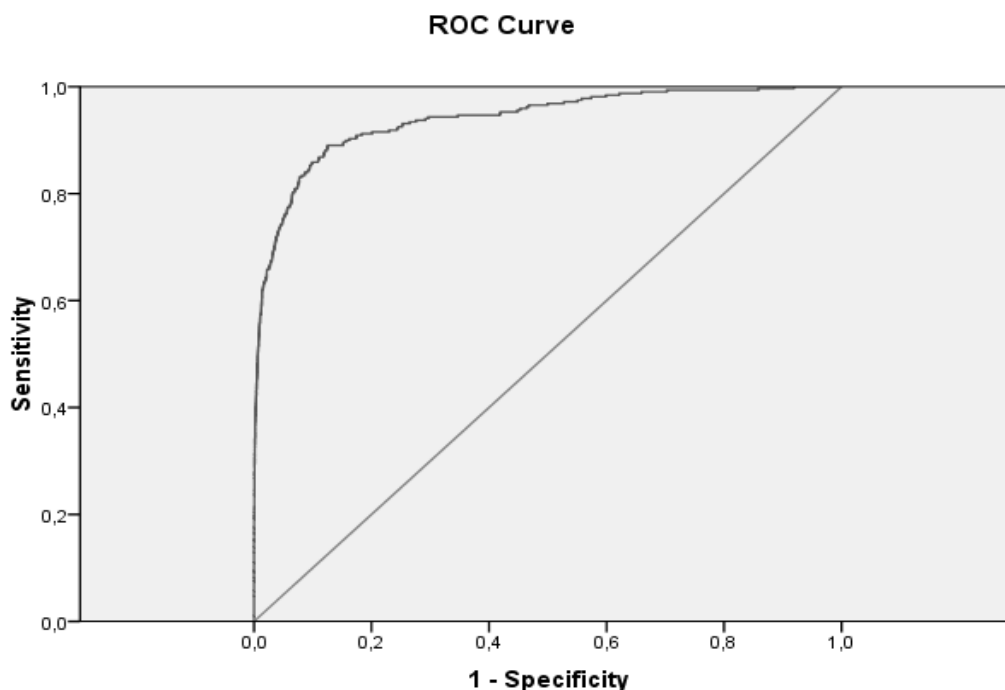
**PANEL 2. Parameters of the binary logistic regression model.**

Variables in the equation	Coefficient	Standard Deviation	Wald	<i>p</i> -value	Exp(B)
Prior reorganization dummy	1.7890	0.3810	22.0590	0.0000	5.9850
Industry propensity for bankruptcy (%)	0.3860	0.1140	11.4650	0.0010	1.4710
Log. age in months	-0.6380	0.1140	31.1940	0.0000	0.5290
Log. number of members on board	-2.2970	0.3570	41.4310	0.0000	0.1010
Number of resigned board members (%)	0.0240	0.0070	12.3140	0.0000	1.0240
Log. number of board member personal defaults	0.6830	0.2230	9.3780	0.0020	1.9800
Log. number of board member links to bankrupt firms	0.9200	0.2690	11.6930	0.0010	2.5090
Corporation dummy	-0.5260	0.6430	0.6700	0.4130	0.5910
Modified audit report dummy	0.5600	0.1730	10.4170	0.0010	1.7500
Length of last accounting period (months)	-0.0180	0.0620	0.0850	0.7700	0.9820
Months to the date of last financial statements	0.0030	0.0160	0.0350	0.8510	1.0030
Log. number of payment defaults	1.6550	0.1750	89.7930	0.0000	5.2340
Log. number of delays in payment	2.2880	0.1480	240.6510	0.0000	9.8580
Log. number of positive payment signals	-0.3830	0.0900	17.9230	0.0000	0.6820
Log. net sales	0.1290	0.0510	6.4420	0.0110	1.1380
Equity ratio (%)	-0.0080	0.0020	13.3260	0.0000	0.9920
Traditional cash flow to sales (%)	0.0060	0.0040	2.3010	0.1290	1.0060
Quick ratio	-0.0260	0.0280	0.8530	0.3560	0.9750
Return on investment ratio (%)	-0.0030	0.0020	2.0150	0.1560	0.9970
Constant	-1.4440	1.1170	1.6700	0.1960	0.2360

**PANEL 3. Classification accuracy of the model.**

Observed:	Estimation data: Predicted:			Test data: Predicted:		
	Viable	Bankruptcy	Correct, %	Viable	Bankruptcy	Correct, %
Viable firms	39144	5114	88.4	13211	1736	88.4
Bankruptcy firms	34	202	85.6	8	75	90.4
Overall accuracy			88.4			88.4





**FIGURE 2.** ROC curve of the estimated bankruptcy probability (estimation and test sample firms).

Table 2 reports the estimated LR model of probability of bankruptcy. The Nagelkerke R Square is 0.399% indicating that the strength of dependence is stronger than for the reorganization model (Panel 1). However, the  $p$ -value for the Hosmer & Lemeshow test statistic is 7.2% showing that the linearity of the logit is not high. Panel 3 reports a classification accuracy that is higher than for the reorganization model. The classification accuracy for the viable firms is over 88% and for the bankruptcy firms about 90% (in the test data). Thus, about 12% of viable firms have common characteristics with bankruptcy firms while approximately 10% of the bankruptcy firms in the test sample (14% in the estimation sample) share characteristics with viable firms. Figure 2 shows the ROC curve for the bankruptcy probability (AUC = 0.939). The curve shows that about 65% of bankruptcy firms are correctly classified when approximately 0% of viable firms are incorrectly classified as bankrupt firms. In addition, about 5% of bankruptcy firms have a lower probability of bankruptcy than 50% of viable firms. In conclusion, bankruptcy firms differ more clearly from viable firms than reorganization firms. However, a small percentage of bankrupt firms do not differ from a typical (median) viable firm which gives support for  $H2$ .

Panel 2 of the table reports the parameters of the estimated bankruptcy model. The prior reorganization dummy is statistically significant at a  $p$ -level of 0.0% which strongly supports  $H4$ .

The coefficient of the variable is not as high as that of the bankruptcy dummy variable in the previous model. However, the last column of the panel (Exp(B)) shows that when a firm is reorganizing, the probability of filing a bankruptcy petition for the firm is about six times higher than for a firm not reorganizing. The most significant coefficients of the LR model are obtained for the logarithmic number of delays in payment; the logarithmic number of payment defaults; the logarithmic number of positive payment signals (prior payment behaviour); the logarithmic number of members of the board (characteristics of managers); the logarithmic age in months (age); and the equity ratio (leverage). There are twelve variables in all that are statistically significant in the model at a  $p$ -level of 1%. However, the equity ratio is the only statistically significant financial variable at this level. For the logarithmic net sales (size)  $p$ -value is 1.1%.

## 5. CONCLUSION

The Finnish Company Reorganization Act (FCRA) came into force in 1993. FCRA can be used as a way to avoid bankruptcy liquidation at least temporarily even if the firm is unviable. When the firm is not approved by the court for reorganization, it may go bankrupt, an eventuality that may also result from a failure to carry out a reorganization programme. If unviable firms are filing for reorganization, it can make reorganization proceedings inefficient due to increased bureaucracy and costs for stakeholders. FCRA has shown obvious inefficiencies in picking up and rejecting reorganization petitions filed by unviable firms. In addition, a large proportion of bankruptcy petitions of firms bankrupting under the Finnish Bankruptcy Act (FBA) will be withdrawn. It is also questionable whether the system forces viable firms to be liquidated. Thus, FCRA and FBA may suffer from filtering failures that impair their efficiency. This study analyzed these inefficiencies of FCRA and FBA testing four research hypotheses. The first and second hypotheses assumed that firms filing for reorganization or bankruptcy include unviable or viable firms respectively. The third and fourth hypotheses proposed that pre-filing a bankruptcy or reorganization petition increases the likelihood of filing a bankruptcy or reorganization petition respectively.

The testing of the filtering hypotheses (hypotheses 1 and 2) requires that viability must be measured. In this study, viability is assessed by an *ex ante* measure based on a prediction model. This kind of econometric model does not measure viability directly but through the characteristics (predictors) of viable firms. The econometric model can be constructed on the basis of a data base including reorganizing, bankrupt, and viable firms. In this study, an event period of one year was used for reorganization and bankruptcy petitions. However, a firm was considered viable if it survived over a fourteen month period without any payment defaults. The characteristics of these kinds of firms were used as a benchmark to assess the viability of firms filing a petition for reorganization or bankruptcy during the event period. The larger the difference in the characteristics

between a firm and viable firms, the higher is the likelihood that the firm is not viable. In the study, the characteristics were summarized in a form of an LR model. Hypotheses 3 and 4 were tested by dummy variables included in the models.

The empirical results obtained in this study largely supported the research hypotheses. The estimated LR model for filing a reorganization petition showed a high degree of accuracy and discriminated efficiently between viable and reorganizing firms. The ROC curve showed that approximately at least 50% of the firms filing a petition for reorganization do not share the characteristics of viable firms at all and can therefore be considered unviable. Thus, the *ex ante* prediction model shows that many unviable Finnish firms are filing for reorganization under FCRA to avoid bankruptcy that supports the first hypothesis. The third hypothesis was tested in the LR model by using the pre-filing bankruptcy dummy variable. It was statistically significant at a *p*-level of 2.3% that (at least partly) supports the entry hypothesis. The probability of filing a reorganization petition is more than 50 times higher for a firm that has pre-filed a bankruptcy petition than for a similar firm without such a petition. However, it is not known how many firms filing for reorganization have filed a bankruptcy petition during the event period. The data available for prediction only include information about petitions prior to the event period.

The second research hypothesis was tested by the LRA discriminating between viable and bankruptcy firms. This statistical model efficiently classified firms as viable and bankrupt firms. However, at least 5% of bankrupt firms shared characteristics of typical (median) viable firms, indicating an inefficiency in FBA. The fourth hypothesis was tested by the pre-filing reorganization dummy variable in the LR model. It was statistically significant at a *p*-level of 0.0% which strongly supports the hypothesis. The probability of filing a bankruptcy petition is about six times higher for a reorganizing firm than for a similar firm not reorganizing. In summary, the study indicates inefficiencies in FCRA and FBA which have led to a filtering failure. These kinds of inefficiencies can be removed firstly by improving reorganization and bankruptcy legislation and secondly by developing efficient statistical methods to discriminate between viable and unviable firms. These statistical methods can help stakeholders (consultants, courts, lawyers, entrepreneurs, managers) *ex ante* measure the viability of a firm considering filing a petition for either reorganization or bankruptcy. This study shows that it is possible to develop such efficient methods.

There are a number of characteristics both financial and non-financial that, in a univariate analysis, discriminate between viable and reorganizing firms. However, the multivariate results showed that a reliable prediction model may include only a couple of statistically significant predictors. This kind of model can be built on a combination of characteristics such as the number of payment defaults and delays, size, age, equity ratio and return on investment ratio: the more a firm has payment defaults and delays, the larger and younger it is, the lower its equity ratio and return on investment ratio are; the higher is the likelihood that a reorganizing firm is unviable. If

the firm has pre-filed for bankruptcy in addition, the likelihood will increase remarkably. When modelling bankruptcy, the combination of significant characteristics in a multivariate model is similar with a few exceptions. First, the equity ratio is the only statistically significant financial ratio. Second, the characteristics of board members are important for viability. Third, industry affects the likelihood of remaining viable. Fourth, a modified audit report is a significant signal of risk. If the firm is reorganizing, the likelihood will significantly increase. The number of significant non-financial predictors is thus larger in assessing bankruptcy firms while the number of financial predictors is smaller.

Thus, the present study shows that it is possible to develop efficient econometric or statistical models to assess the viability of firms applying for reorganization or bankruptcy. These models can be based on publicly available information on pre-filing history, age, size, industry, and payment history but also on financial characteristics. Financial characteristics can be extracted from pre-filing financial statements submitted to the court. These characteristics can be used for rough screening purposes when assessing viability. First, it is important to pay attention to the equity ratio of the firm. The higher this ratio is prior to reorganization, the higher is the likelihood of successful debt restructuring. Second, profitability, in terms of return on investment ratio, plays an important role. The higher the pre-filing profitability, the higher is the likelihood of successful business restructuring. This kind of financial analysis of viability is summarized in Figure 3. If both equity ratio and return on investment ratios are low, there is a high likelihood that the firm is unviable and the firm should go bankrupt. In these cases, non-financial information should be used to support viability analysis.

	Equity ratio:	
Return on investment:	Low	Not low
Low	Unviable firm (bankruptcy)	Viable firm if successful business restructuring (reorganization)
Not low	Viable firm if successful debt restructuring (reorganization)	Viable firm

**FIGURE 3. Classification of reorganizing and bankruptcy firms.**

The present study has many limitations, however, they can be taken into account in future studies. First, the sample of the study on reorganization and bankruptcy firms is selective and small. The sample included 34.6% of reorganizing firms and only 13.7% of bankruptcy petition firms reorganizing under FCRA or going bankrupt under FBA in Finland during one year. Very

small (micro) firms and most non-corporations are not represented by the data. Such kinds of firms were not obliged to publish financial statements. Without financial statements, any measurement of viability is inefficient. These kinds of out-of-sample firms may have special characteristics that impair the generalization of the results for all Finnish reorganization and bankruptcy firms. In further studies, these kinds of firms should be included in the data. It is now possible, since the legislation has changed and even very small firms are obliged to publish financial statements. Secondly, it is difficult to draw a cut-off point when classifying firms as viable and unviable. In this study, a simple procedure based on the ROC curve was applied. However, in further studies more accurate methods should be developed to assess the number of viable firms. Third, the *ex ante* data do not make it possible to take account of potential pre-filing reorganization or bankruptcy petitions which are filed during the event period. However, this is a situation faced by decision makers planning reorganization or bankruptcy on a horizon of one year. ■

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**APPENDICES****APPENDIX 1. Descriptive statistics of the sample.****PANEL 1. Industrial classification of the firms.**

	Percentage:		
	Viable firms	Reorganizing firms	Bankruptcy firms
Agriculture, hunting and forestry	1.93	2.75	1.21
Fishing	0.16	0.00	0.00
Mining and quarrying	0.38	0.00	0.00
Manufacturing	14.80	32.11	16.36
Electricity, gas and water supply	0.98	0.00	0.00
Construction	11.84	10.09	23.94
Wholesale and retail trade	22.73	19.27	17.58
Hotels and restaurants	3.54	3.67	7.58
Transport, storage and communication	6.39	9.17	7.27
Financial intermediation	2.35	0.00	0.91
Real estate, renting and business activities	27.99	22.02	20.91
Education	0.88	0.00	0.91
Health and social work	2.84	0.00	0.61
Total	100.00	100.00	100.00
Number of firms	63177	109	330

**PANEL 2. Descriptive variables.**

Variable:	Viable firms:		Reorganizing firms:		Bankruptcy firms:	
	Mean	Median	Mean	Median	Mean	Median
Age in years	14.14	11.25	10.73	8.13	11.32	8.50
Net sales in EURO	3800738.30	269419.00	996654.23	461257.00	1435342.22	464538.00
Total assets in EURO	4712690.08	175418.50	749487.39	264282.50	849014.35	277460.00



**APPENDIX 2. Descriptive statistics of independent variables for the estimation sample (reorganization probability).**

Variable	Viable firms (N = 47143):			Reorganizing firms (N = 81):			Comparison:	
	Mean	Median	Standard deviation	Mean	Median	Standard deviation	F-statistic	p-value
Prior bankruptcy dummy	0.0000	0.0000	0.0046	0.0488	0.0000	0.2167		0.0000
Industry propensity for bankruptcy (%)	0.5321	0.4000	0.4848	0.6890	0.5500	0.4957	8.5804	0.0034
Log. age in months	4.8830	4.9273	0.7397	4.6025	4.6199	0.7440	11.7694	0.0006
Log. number of members on board	1.3630	1.3863	0.3168	1.3183	1.3863	0.2671	1.6257	0.2023
Number of resigned board members (%)	1.4158	0.0000	6.5559	3.1025	0.0000	11.0802	5.4011	0.0201
Log. number of board member personal defaults	0.0423	0.0000	0.1907	0.1394	0.0000	0.3715	21.1413	0.0000
Log. number of board member links to bankrupt firms	0.0279	0.0000	0.1524	0.1373	0.0000	0.3507	41.9402	0.0000
Corporation dummy	0.0083	0.0000	0.0909	0.0244	0.0000	0.1552	2.5436	0.1107
Modified audit report dummy	0.1431	0.0000	0.3502	0.3415	0.0000	0.4771	26.2383	0.0000
Length of last accounting period (months)	12.0127	12.0000	0.9580	12.0854	12.0000	1.2492	0.4706	0.4927
Months to the date of last financial statements	13.7870	11.0000	4.7332	14.8415	12.0000	5.2387	4.0613	0.0439
Log. number of payment defaults	0.0058	0.0000	0.0768	0.3599	0.0000	0.6163	1568.6983	0.0000
Log. number of delays in payment	0.0300	0.0000	0.1641	0.8496	0.8959	0.7440	1975.8203	0.0000
Log. number of positive payment signals	1.1264	0.6931	1.2480	0.8930	0.6931	1.0698	2.8647	0.0905
Log. net sales	11.9391	12.4174	3.3256	13.2276	13.6236	2.6504	12.2952	0.0005
Equity ratio (%)	47.0035	49.3000	36.1924	3.6878	7.3500	35.4866	117.2580	0.0000
Traditional cash flow to sales (%)	9.7417	8.1000	25.4754	-0.9099	1.8000	19.3397	14.1456	0.0002
Quick ratio	3.5802	1.3000	7.9789	0.8878	0.5000	1.5793	9.3358	0.0022
Return on investment ratio (%)	19.3185	14.5000	37.5865	-1.4622	3.4500	38.0407	25.0206	0.0000

**APPENDIX 3. Descriptive statistics of independent variables for the estimation sample (bankruptcy probability).**

Variable	Viable firms (N=47143):			Bankruptcy firms (N=244):			Comparison:	
	Mean	Median	Standard deviation	Mean	Median	Standard deviation	F-statistic	p-value
Prior reorganization dummy	0.0021	0.0000	0.0458	0.1025	0.0000	0.3039	955.6288	0.0000
Industry propensity for bankruptcy (%)	0.5321	0.4000	0.4848	0.7270	0.6000	0.4363	39.3066	0.0000
Log. age in months	4.8830	4.9273	0.7397	4.5061	4.5433	0.6570	63.1014	0.0000
Log. number of members on board	1.3630	1.3863	0.3168	1.1676	1.0986	0.2232	92.5125	0.0000
Number of resigned board members (%)	1.4158	0.0000	6.5559	5.3483	0.0000	15.3738	85.3726	0.0000
Log. number of board member personal defaults	0.0423	0.0000	0.1907	0.2248	0.0000	0.4591	217.0877	0.0000
Log. number of board member links to bankrupt firms	0.0279	0.0000	0.1524	0.1393	0.0000	0.3565	126.8089	0.0000
Corporation dummy	0.0083	0.0000	0.0909	0.0123	0.0000	0.1104	0.4590	0.4981
Modified audit report dummy	0.1431	0.0000	0.3502	0.4262	0.0000	0.4955	157.9245	0.0000
Length of last accounting period (months)	12.0127	12.0000	0.9580	12.1148	12.0000	1.3128	2.7434	0.0977
Months to the date of last financial statements	13.7870	11.0000	4.7332	15.2336	13.0000	5.2859	22.6464	0.0000
Log. number of payment defaults	0.0058	0.0000	0.0768	0.5318	0.0000	0.7535	7646.2567	0.0000
Log. number of delays in payment	0.0300	0.0000	0.1641	0.6863	0.6931	0.6238	3632.3756	0.0000
Log. number of positive payment signals	1.1264	0.6931	1.2480	0.5284	0.0000	0.8568	55.8822	0.0000
Log. net sales	11.9391	12.4174	3.3256	12.2573	12.5258	2.3236	2.2281	0.1355
Equity ratio (%)	47.0035	49.3000	36.1924	7.4590	10.1000	39.8680	289.4732	0.0000
Traditional cash flow to sales (%)	9.7417	8.1000	25.4754	2.5220	3.4000	18.1738	18.9039	0.0000
Quick ratio	3.5802	1.3000	7.9789	1.1160	0.6000	3.4668	23.2490	0.0000
Return on investment ratio (%)	19.3185	14.5000	37.5865	6.9561	7.2000	43.5787	26.2133	0.0000