Master Thesis in Accounting and Financial Management

Stockholm School of Economics

Decision Makers Making Bankruptcy Decisions

An empirical analysis on how CEOs and directors with past bankruptcy experience affect the likelihood of future bankruptcy in Swedish private firms

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Abstract

We investigate the impact of CEOs' and directors' past professional bankruptcy experience on future corporate performance in the context of Swedish private sector. The bankruptcy prediction models (Altman, 1968; Ohlson, 1980) and the upper echelons theory (Hambrick & Mason, 1984) underpin this research. We hypothesize that appointing CEOs and directors with prior bankruptcy involvements will increase the likelihood of bankruptcy of the firm they subsequently join in. Empirical results identify a significantly positive association between bankruptcy experience of CEOs and directors, and bankruptcy of future firms, which supports our hypotheses. Furthermore, we find that incorporating the information on CEOs' and directors' previous bankruptcy involvements can improve the predictive power and classification performance of bankruptcy forecasting models (Altman, 1968; Ohlson, 1980). Moreover, the significant outcomes that individuals with bankruptcy experiences will increase the future bankruptcy probability shed light to future behaviours in Swedish private firms, warning both debtholders and investors to take past professional experiences of CEOs and directors into consideration when making decisions.

Keywords: Bankruptcy Prediction, Managerial Overconfidence, Reputation Cost, Corporate Governance

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1 Introduction

Corporate bankruptcies can result in significant costs and economic inefficiency. The direct costs range from 11% to 17% of firm value up to three years prior to bankruptcy. In some cases, they even exceed 20% of the value of the firm (Altman, 1984). In light of indirect costs, firms usually fail to maintain the relationships with primary non-financial stakeholders after bankruptcy. Such failure will further render the firms to lose valuable resources that can generate sustainable competitive advantage and increase shareholder value (James, 2016).

Given negative consequences of corporate bankruptcy, scholars have conducted great efforts to explore bankruptcy predictability. The most broadly accepted bankruptcy prediction models are the accounting-information-based bankruptcy forecasting models. Among previous studies, two pioneering works are Z Score model (Altman, 1968) and O Score model (Ohlson, 1980), which are often used by empirical accounting researchers as indicators of financial distress (Wu & Gray, 2010).

Recent research also looks into additional factors that can potentially enhance the predictive power of these models. Some scholars investigate the effect of individual managers and directors on corporate financial distress (for example, Kallunki & Pyykkö, 2013; Ivanova & Pündrich, 2017). Their fundamental perception originates from the upper echelons theory (Hambrick & Mason, 1984). The main idea of the upper echelons theory is to explore how organizational outcomes, such as strategic choices and performance levels, are predicted by managerial background characteristics. As an open discussion, the authors propose a number of hypotheses on the relationship between the managerial traits and organizational performance. Based on Hambrick and Mason's work (1984), many researchers extend the upper echelons theory significantly by analyzing different background characteristics. Traits such as gender, education background, and past experience etc., are reported to be efficient predictors of corporate performance (Krishnan & Park, 2005; Custdio & Metzger, 2012; Dittmar & Duchin, 2016; Ivanova & Pündrich, 2017, etc.).

This paper intends to investigate whether appointing CEOs and directors with past professional bankruptcy experience will increase the probability of bankruptcy of the firm they subsequently join in. We incorporate the information on CEOs' and directors' previous bankruptcy exposures into the accounting-information-based prediction models (Altman, 1968; Ohlson, 1980). Thereby, we compare the predictive power of models, both with and without such information. We build on the evidence provided by Kallunki and Pyykkö (2013) who document that appointing CEOs and directors with past personal payment default entries is positively

associated with the likelihood of financial distress of the successive firm. But, compared with personal experience, CEOs' and directors' professional career is more directly relevant to the future corporate performance. Thus, we intend to focus on professional bankruptcy experience instead of personal experience.

We hypothesize that appointing CEOs and directors with past professional bankruptcy experience is positively associated with the likelihood of bankruptcy of the firm they join in subsequently. Two distinct effects of previous experience are taken into account to develop the hypotheses, i.e., the managerial overconfidence mechanism and reputation cost mechanism. On one hand, managerial overconfidence suggests that CEOs and directors tend to overestimate their competence and underestimate business risks in the decision-making process (Ben-David et al., 2007; Gervais et al., 2003; Malmendier & Tate, 2005; Doukas & Petmezas, 2007; etc.). Thus, overconfident managers and directors are likely to make more risk-taking decisions such as investment distortions and imprudent acquisitions (Malmendier & Tate, 2005; Malmendier & Tate, 2008), which will further affect the corporate performance. On the other hand, past bankruptcy experience impairs CEOs' and directors' reputation (Schoar, 2007; Eckbo, et al., 2016; Ivanova & Pündrich, 2017). Such reputation loss will either concern stakeholders such as creditors and investors, or CEOs and directors themselves, leading to an unfavorable business environment (Ivanova & Pündrich, 2017) or incentives of CEOs and directors to make decisions against firm value (Eckbo, et al., 2016).

This paper is conducted in the context of Swedish private limited liability firms. To the best of our knowledge, this is the first work to investigate how CEOs' and directors' professional bankruptcy experiences affect the probability of bankruptcy in the setting of Swedish private sector. According to Kallunki and Pyykkö (2013), the lack of public scrutiny and the significant ownership of CEOs and directors in private firms allow room for speculations. Additionally, to date, the majority of academic studies focus on public firms where information is accessible. Hence, our research can fill this academic gap in the field of bankruptcy prediction.

The empirical results support our hypotheses developed in Section 2.5. First, appointing CEOs and directors with past professional bankruptcy experience increases the likelihood of bankruptcy of the subsequent firm. Therein, we note that the proportion of directors with previous bankruptcy involvements on the board displays a stronger relationship with future bankruptcy than appointing such CEOs in the firm. Second, we find that incorporating the information on CEOs' and directors' past bankruptcy experience can enhance the predictive power and classification performance of the original Z Score (Altman, 1968) and O Score

model (Ohlson, 1980). By applying the likelihood ratio test, we observe that the adjusted bankruptcy forecasting models with the information on the proportion of directors with past bankruptcy exposures on the board perform best. The ROC curves confirm the superiority of the adjusted bankruptcy prediction models to the original ones. Besides, the results of bankruptcy-score-reclassification analysis and ROC curves also indicate that in general, O score models outperform the Z score models. Furthermore, we conduct robustness check to test the results, proving that the conclusions hold under different scenarios..

Our research contributes to the literature in the following aspects. First, this paper supports the upper echelons theory (Hambrick & Mason, 1984). The upper echelons theory proposes to explore and predict organizational outcomes by analyzing characteristics of influential individuals in the organizations. We contribute to this theory by identifying the negative impact of CEOs' and directors' past bankruptcy experience on the probability of bankruptcy of the future firms. Additionally, our research establishes that past professional bankruptcy experience can be used as a proxy for executives and directors' managerial traits to predict organizational outcomes. Second, this study enhances the predictive power and accuracy of the bankruptcy forecasting models (Altman, 1968; Ohlson, 1980) by including the information on CEOs' and directors' past professional bankruptcy experience in the estimation. Furthermore, these two aspects also imply that relevant decision-makers, such as investors or creditors, need to take into account the past professional experience of executives and directors in the firm for the sake of underlying bankruptcy risks. Lastly, to the best of our knowledge, this study is the first to investigate whether appointing CEOs and directors with past professional bankruptcy experience increases the likelihood of bankruptcy of the subsequent firm in the context of Swedish private sector. Thus, we also fill the academic gap in this field.

The remaining parts of the paper proceed as follows: Section (2) presents a relevant literature review and proposes the hypotheses. Section (3) illustrates the process of data selection and demonstrates the methodology. Section (4) describes preliminary analysis and empirical results of the study. Section (5) discusses the findings and Section (6) concludes the findings and identify limitations.

2 Literature review

This paper reviews two streams of literature to explore the research question, i.e., whether appointing CEOs and directors with previous bankruptcy experience increases the likelihood of bankruptcy of the subsequent firm. Figure 1 depicts the theoretical framework of this study. In general, the literature on bankruptcy prediction models and that on the upper echelons theory underpin this paper. First, we retrospect the development of bankruptcy prediction models. Then, we investigate the history and dynamics of the upper echelons theory. Specifically, two respects, i.e., demographic characteristics and personal traits, and previous experience, are examined. As is illustrated in Figure 1, by focusing on past bankruptcy experience as a proxy for psychological dimensions, we identify two distinct effects of bankruptcy experience, namely, managerial overconfidence and reputation cost. Lastly, we build on this theoretical framework to generate the hypotheses for this research.

Section 2.1 presents the literature on bankruptcy prediction models, including the Z Score (Altman, 1968) and O Score model (Ohlson, 1980). Based on prior studies, we can step further to investigate the role of information such as executives and directors' past bankruptcy involvements in predicting bankruptcy.

In Section 2.2, the upper echelons theory is demonstrated. We examine the upper echelons theory from two perspectives, as is displayed in Figure 1. First, extensions of this theory on various demographic characteristics are reviewed. Then, we investigate how observable characteristics such as experience are used as proxies for unobservable psychological traits and behavioral biases.

In Section 2.3, we focus on the effect of bankruptcy experience in particular. Executives and directors' past professional experience seems to be relevant to corporate outcomes, especially negative ones such as bankruptcy events. However, to the best of our knowledge, this area has not received much attention yet. Thus, we attempt to analyze the relationship between executives' and directors' professional experience and corporate bankruptcy to fill this academic gap.

Last but not least, in Section 2.4, we introduce two explanations for the potential impact of bankruptcy experience on CEOs and directors. On one hand, past negative events can be observable consequences of executives' and directors' psychological traits and behavioral biases. To illustrate, CEOs and directors with managerial overconfidence prefer risk-taking decisions, which will further raise the firm's overall risks and increase the likelihood of

bankruptcy of the firm. Such behavioral bias can not only cause CEOs' and directors' previous failures in their professional careers, but also impair the performance of the firm they are involved in subsequently. On the other hand, CEOs and board members are also likely to be punished due to involvements in adverse issues such as bankruptcies and scandals, etc., even if sometimes the events are out of their control (Eckbo et al., 2016; Ivanova & Pündrich, 2017). Such punishments may bring about trouble in their future professional career, or incentivize them to take actions against the firm value, such as hiding bankruptcy risk from shareholders, which will also undermine the outcome of the future firm. These two mechanisms suggest that the past bankruptcy experience of CEOs and directors can increase the likelihood of bankruptcy of the firms they participate in subsequently, which enables us to develop the hypotheses in Section 2.5.

Figure 1 – *The Theoretical Framework*

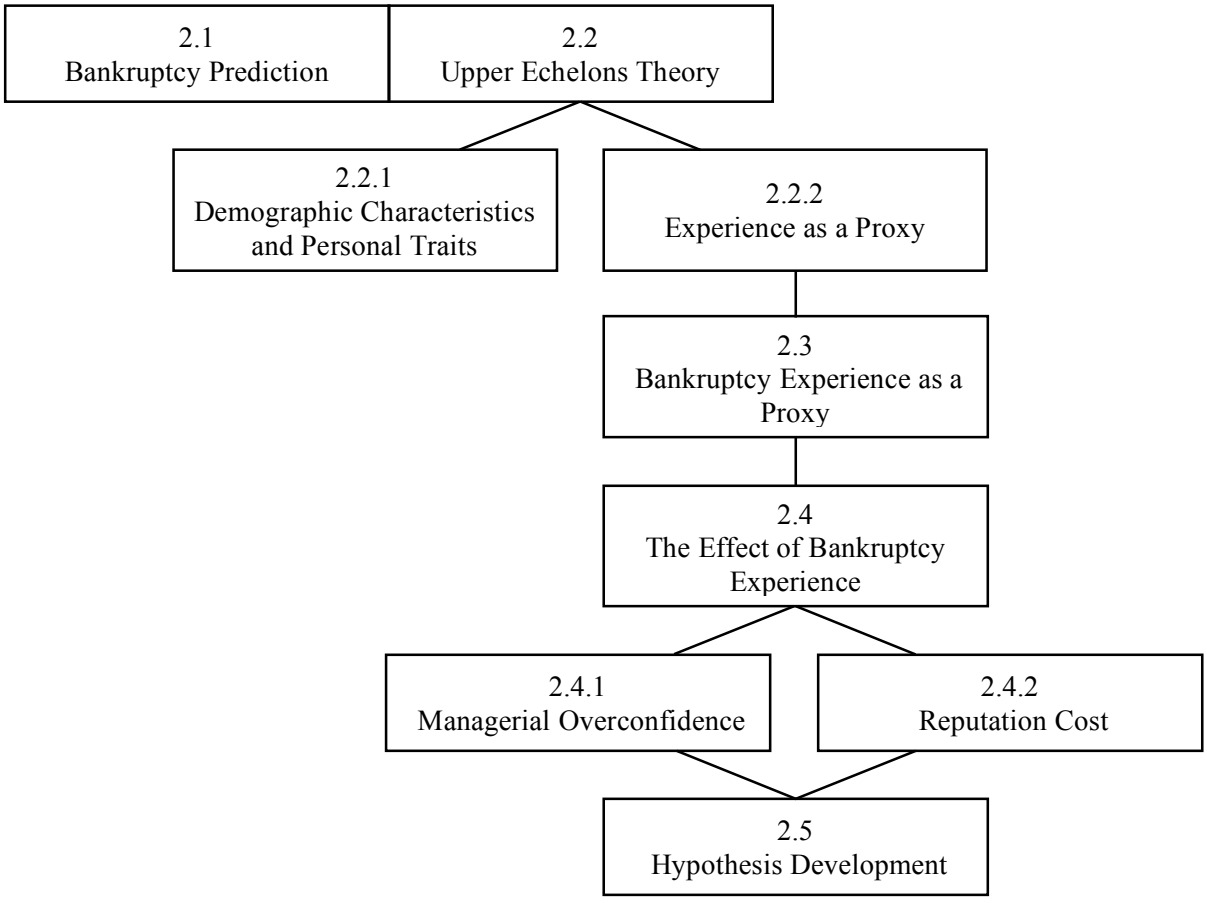

Figure 1 presents the Theoretical Framework of this paper.

2.1 Bankruptcy prediction

Bankruptcy prediction models based on accounting information are broadly accepted. One pioneering work in this field is Altman's (1968) model, commonly referred to as the Z Score model. Altman (1968) introduces an innovative bankruptcy forecasting model based on a multiple discriminant statistical methodology. The author incorporates five variables, i.e., variables measuring liquidity, profitability, productivity, market value and capital turnover, into a regression model to estimate an individual score for each firm. The score, precisely Z score, can be used to assess the probability of bankruptcy of the firm. The most significant contributions of Altman's work (1968) lie in its originality and extendibility. The paper provides scholars with a new method and benchmark for bankruptcy prediction and enables them to enhance the predictive power of the model. From then on, numerous research has been conducted to update and adjust the model (Altman et al., 1977; Altman & Narayanan, 1997; etc.). Besides, the classification performance of the Z Score model has also been broadly acknowledged (for example, Altman et al., 2017).

Another representative work is Ohlson's model (1980), known as O Score model. Ohlson (1980) devises the model for bankruptcy prediction by utilizing conditional logit analysis. The author finds that four basic factors play a statistically significant role in affecting the probability of bankruptcy (within one year), i.e., the size of the company, financial structure, performance and current liquidity. Ohlson (1980) also proposes the incorporation of non-financial information in the bankruptcy prediction models, which the author cannot accomplish due to data limitations.

These two kinds of models, i.e., multivariate discriminant models (Altman, 1968) and logit models (Ohlson, 1980), have enormous impacts in the field of bankruptcy prediction. From then on, many papers focus on additional indicators for bankruptcy prediction such as various market factors and firm characteristics to enhance the predictive power of the models. Altman et al. (1977) propose an adjusted Z Score model, referred to as ZETA model. This updated model includes seven variables regarding return on assets, stability of earnings, debt service (interest coverage ratio), cumulative profitability, liquidity, capitalization and size. Empirical evidence shows that the ZETA model significantly outperforms the original one and has higher forecasting accuracy. Apart from financial ratios, scholars also look into other non-financial factors. Liang et al. (2016) investigate the role of corporate governance indicators as input variables in the bankruptcy prediction. This paper identifies five distinct categories of corporate governance indicators, i.e., board structure, ownership structure, cash flow rights, key person retained, and others (e.g., number of times financial forecast published in a year, and number

of times financial report restated in a year). The authors conclude that the predictive power of bankruptcy forecasting models will be enormously improved by incorporating both financial ratios and corporate governance indicators. Furthermore, Kallunki and Pyykkö (2013) examine whether including CEOs' and directors' past personal defaulting experience into Z Score model (Altman, 1968) and O Score model (Ohlson, 1980) can enhance the predictive power of the models. The empirical results indicate that incorporating such information can significantly improve the performance of the models.

Additionally, numerous bankruptcy prediction models based on various modelling approaches have been developed. For instance, Zmijewski (1984) adopts a probit approach which also draws on accounting information but uses a different set of independent variables from Ohlson's model (1980). Shumway (2001) devises a discrete-time hazard model to predict a firm's bankruptcy using both accounting and market variables. More recently, Hillegeist et al. (2004) develop a BSM-Prob bankruptcy prediction model based on the Black-Scholes-Merton option pricing model (Wu & Gray, 2010). Furthermore, Bellovary et al. (2007) review the bankruptcy prediction studies since 1930. The paper highlights Altman's (1968) work and identifies its significance for facilitating bankruptcy prediction studies. By exploring 165 bankruptcy prediction studies since 1965, the authors trace and discover the development of prevailing prediction models, from the discriminant analysis in the 1960s and 1970s to the logit analysis and neural networks in the 1980s and 1990s.

2.2 Upper echelons theory

Scholars also explore non-financial factors such as managerial traits to evaluate and forecast the companies' performance. This perception derives from the upper echelons theory (Hambrick & Mason, 1984), which investigates the relation between managerial characteristics and corporate outcomes.

Hambrick and Mason (1984) argue that organizational outcomes can be viewed as "reflections of the values and cognitive bases of powerful actors in the organization" (p. 193). The concept of bounded rationality underpins this theory. Figure 2 exhibits the psychological process of strategic choice under conditions of bounded rationality. Powerful individuals in corporations, i.e., top managers and directors, perceive information (or stimuli) both inside and outside the firm to make strategic decisions. However, they are likely to filter and interpret the information based on their own cognitive base and values without comprehending the overall issue. As is demonstrated in Figure 2, managers' and directors' field of vision is confined. It implies that

they tend to omit some information when facing complex situations. Then, they selectively perceive messages based on the field of vision, which will further exclude some other information. Lastly, executives and directors interpret the information that they eventually receive based on their psychological traits, which is likely to lead to distortions. Thus, managerial perceptions of managers and directors derive from the abovementioned perceptual process, and will hence contribute to generating strategic decisions, which directly affect the corporate outcomes.

Figure 2 – *Strategic Choice Under Conditions of Bounded Rationality*[1]

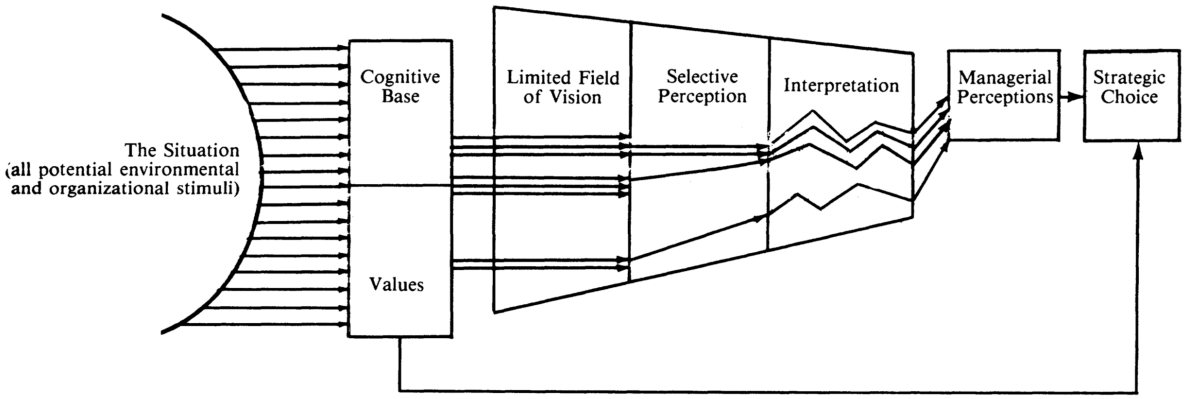

Figure 2 presents the framework of Bounded Rationality based on Hambrick and Mason (1984).

By reviewing and synthesizing relevant previous studies, the authors develop a framework to predict organizational outcomes, through both psychological and observable characteristics of the top management team. Figure 3 summarizes the general framework of the upper echelons theory. The framework further elaborates the relationship between the upper echelons characteristics, strategic choices and corporate performance. The procedure from the objective situation to upper echelons characteristics briefly illustrates the perceptual process in Figure 2. Meanwhile, Figure 3 indicates that the upper echelon characteristics are "determinants of strategic choices and, through these choices, of organizational performance" (Hambrick & Mason, 1984, p. 197).

[1] The framework of Bounded Rationality originates from Hambrick and Mason (1984).

Figure 3 – *An Upper Echelons Perspectives of Organizations*[2]

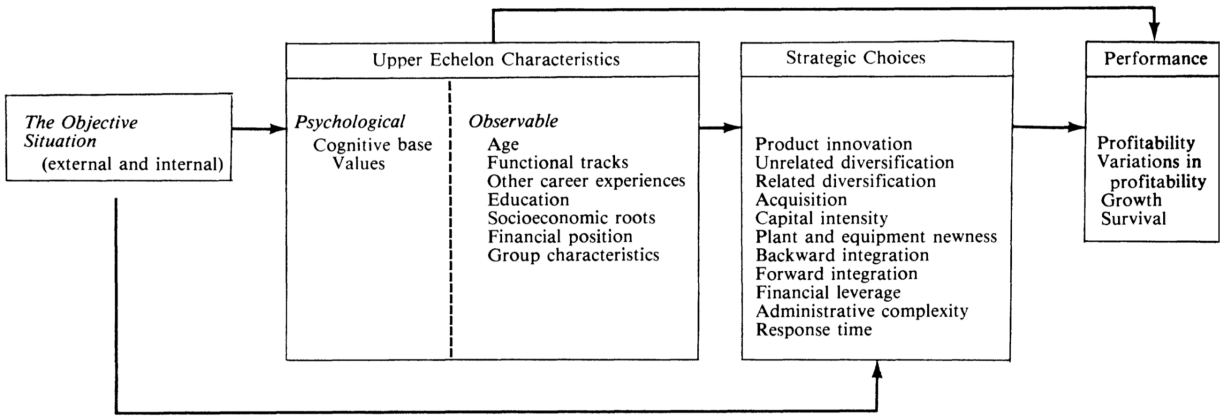

Figure 3 presents the Upper Echelon Perspective of Organizations based on Hambrick and Mason (1984).

Additionally, the authors develop many important propositions regarding demographic traits, industrial characteristics, compensation or ownership and composition of management, etc. For instance, the authors argue that firms with young managers will be more inclined to pursue risky strategies than will firms with older managers, as the latter have less physical and mental stamina and prefer stability and safety rather than novelty. Consequently, this paper underpins and enlightens a bunch of related studies in the future which will be demonstrated in the following sections.

2.2.1 Demographic characteristics and personal traits

Based on Hambrick and Mason's work (1984), many researchers empirically test the upper echelons theory by analyzing different background characteristics such as gender, age, educational background and personal traits, etc. For example, Krishnan and Park (2005) focus on the gender of top management teams. The paper holds that the proportion of female executives in top management teams is positively associated with organizational outcomes. Faccio et al. (2016) conclude that female executives prefer more conservative strategies, whereas male managers tend to be riskier. Plöckinger et al. (2016) review 60 studies to analyze the impact of top management executives on the firm's financial reporting decisions, especially on disclosure decisions. Evidence shows that female executives are more risk-averse than their male counterparts and prefer to choose conservative financial accounting policies. Other demographic characteristics of top managers are also explored. Serfling (2014) argues that there

[2] The Upper Echelon Perspective of Organizations originates from Hambrick and Mason (1984).

is a negative association between CEOs' age and corporate risk-taking behavior. The paper states that older CEOs tend to implement less risky investment policies such as less R&D, more diversified acquisitions and lower operating leverage. Furthermore, Custodio and Metzger (2012) report that CEOs' financial expertise can play a positive role in financial policies and corporate performance.

Additionally, many researchers document that personal traits such as personality and behavioral bias of top executives and directors exert an enormous impact on corporate outcomes. Stumpf and Dunbar (1991) indicate that individuals with different personalities have different preferences and biases for decision making. Based on Jungian (1923) personality theory, the authors examine how different cognitive styles of top executives are suggestive of corresponding patterns of action, and thus, affect their strategic decisions. Plöckinger et al. (2016) find that overconfident top managers tend to employ more risk-taking accounting policies, which may lead to accounting manipulation and earnings management. Hackbarth (2008) investigates how managerial bias influences the firm's financial policy and the firm's value based on a trade-off model of capital structure. The author assumes that managers are rational in all respects, except for how they perceive their firm's growth and risk, i.e., growth perception bias and risk perception bias. The paper establishes that executives' managerial characteristics affect firm's financial decisions. Furthermore, the degree of managerial bias matters in decision making. The author argues that mildly biased managers make capital structure decisions that are more in the interest of shareholders, whereas extreme managerial biases are detrimental to the firm.

2.2.2 Prior experience as proxies

Hambrick and Mason (1984) emphasize "background characteristics, rather than psychological dimensions" (p. 196), since such observable characteristics are convenient to measure, and have no "close psychological analogs" (p. 196). Apart from demographic background characteristics, scholars also focus on past experience of top executives and directors, especially professional experience, which is found to be an effective proxy for the cognitive base and the behavioral bias in the decision-making process.

Benmelech and Frydman (2015) document that CEOs with military experience tend to make conservative decisions, such as lower investment and R&D, and lower involvement in the fraud. Bernile and Rau (2017) indicate that CEOs who experience fatal disasters without extremely negative consequences tend to be risky and aggressive, whereas those who have disastrous

experience and witness the destructive downsides prefer conservative actions. Besides, Cain and McKeon (2016) investigate how CEOs' personal risk taking affects corporate risk. The authors use possessing private pilot licenses as an agent for personal risk preference. Thereby, the paper reports that there is a positive association between personal and corporate risk taking. Interestingly, the paper also finds that the acquisition activities led by CEOs who have private pilot licenses significantly increase the companies' value. It suggests that in some cases, risk-taking decisions could be beneficial for corporate performance. Additionally, Kallunki and Pyykkö (2013) analyze the impact of personal defaulting experience of CEOs and directors on the probability of financial distress of the firm in the Finnish setting. The authors use CEOs' and directors' past personal payment default entries as a proxy for managerial overconfidence to study its effects on future corporate performance. Empirical evidence in this paper shows that appointing CEOs and directors with past personal defaulting experience can increase the likelihood of financial distress of the subsequent firm.

However, many previous studies focus on early-life and personal experience of CEOs and directors, whereas only a few intend to explore professional experience. Actually, past professional experience of CEOs and directors can be a field of interest, as the professional experience are more directly related to corporate performance. Dittmar and Duchin (2015) argue that they are "first to study the role of more recent professional experiences throughout the manager's career" (p. 30). The paper indicates that past distress experience of CEOs is associated with conservatism. Similarly, Schoar (2007) argues that CEOs' early career experience seems to affect their managerial traits in the long run. In particular, executives who start their career in recession and eventually become a CEO prefer more conservative management than those who start their career in boom. Gow et al. (2016) suggest that directors who are ever involved in firms with adverse events are likely to be incentivized to hide such information from stakeholders.

Following the prior studies, past experiences, especially professional ones, are documented to be effective agents for psychological dimensions of executives and directors to predict strategic decisions and corporate outcomes. Thus, the abovementioned literature can underpin our approach to using previous professional experience as a proxy to investigate the impact on organizational performance.

2.3 Bankruptcy experience

In this paper, we attempt to focus on CEOs' and directors' past bankruptcy involvements, the extremely negative situation for professional experience. Some prior studies investigate how past bankruptcy experience of CEOs and directors affect corporate performance, which provide support for this paper. For instance, Tobback et al. (2017) argue that if the certain firm appoints executives or directors who are involved in other bankrupt firms, it will have a higher probability of bankruptcy. Besides, Ivanova and Pündrich (2017) examine how previous bankruptcy involvements of top executives and directors affect the firm's financial policies, especially the design of public debt contracts. The authors establish that such negative experience will lead to higher credit spread and lower bond size of the firm. Similarly, Dittmar and Duchin (2015) document that previous distress experience is associated with conservatism. CEOs with past distress involvements tend to conduct conservative policies, such as lower leverage, more cash and fewer capital expenditures.

Additionally, we also take into account how past bankruptcy experience influences CEOs and directors, and hence affects corporate outcomes. In the next section, this issue will be discussed from two distinct perspectives, i.e., the managerial overconfidence mechanism and reputation cost mechanism.

2.4 Effects of bankruptcy experience

Prior research investigates bankruptcy events from many distinct elements such as causes, consequences and people involved, etc. For example, Kallunki and Pyykkö (2013) attribute past bankruptcy experience to behavioral consistency, indicating that CEOs' and directors' personal risk taking will be consistent with corporate risk taking. Ivanova and Pündrich (2017) develop two different mechanisms, i.e., "reputation mechanism" and "hot-stove mechanism", to explain the effects of bankruptcy experience. Inspired by prior studies, we intend to focus on the potential cause and consequence of firm bankruptcy, the two mechanisms referred to as the managerial overconfidence mechanism and the reputation cost mechanism respectively in the paper.

Figure 4 – *Two Mechanisms for the Effects of Bankruptcy Experience*

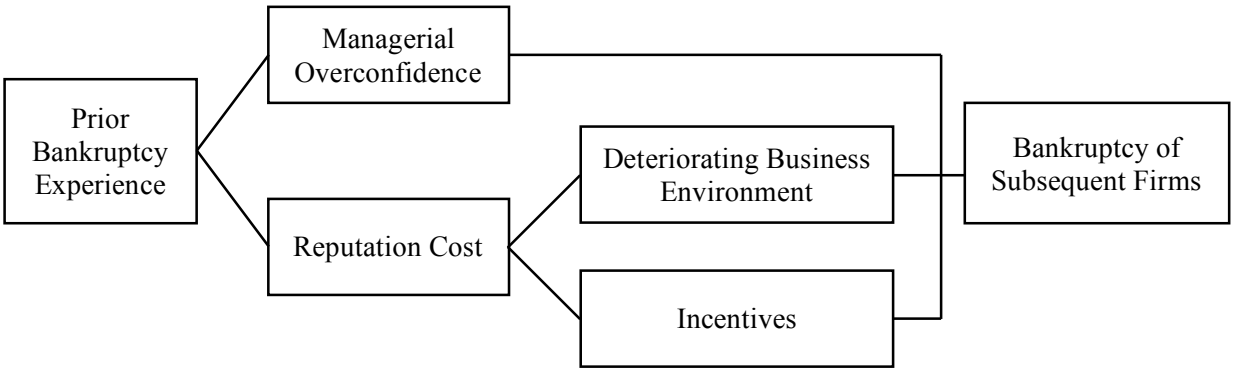

Figure 4 illustrates the two mechanisms for the effects of bankruptcy experience.

2.4.1 Managerial overconfidence mechanism

The managerial overconfidence mechanism indicates that the past bankruptcy experience can be considered as the consequence of CEOs' and directors' innate risk-taking styles. Hambrick and Mason (1984) suggest viewing organizational outcomes as "reflections of the values and cognitive bases of powerful actors in the organization" (p. 2). Numerous researchers explore the impact of various background characteristics on corporate performance. Therein, managerial overconfidence is the field of great interest, which is also the pertinent area to our research question. Overconfident executives and directors tend to overestimate their abilities and underestimate business risks in the decision-making process (Ben-David et al., 2007; Gervais et al., 2003; Malmendier & Tate, 2005; Doukas & Petmezas, 2007; etc.). Thus, it is likely to lead to risk-taking management, which will further affect corporate performance.

Malmendier and Tate (2005) report that there is a significant positive association between managerial overconfidence and investment cash flow. Besides, the paper argues that managerial overconfidence can be a potential explanation for "corporate investment distortions" (p. 2661). In particular, overconfident managers prefer internal funding to external financing, since they tend to overestimate the return of the investment projects. Consequently, it implies that overconfident executives are likely to overinvest when they have sufficient internal funding, but to underinvest when they need external financing (p. 2661). Ben-David et al. (2007) document that managerial overconfidence leads to a lower discount rate for valuing cash flow. Firms with overconfident CFOs tend to invest more, engage in more acquisitions and have more long-term debts. Additionally, Hackbarth (2008) finds that managerial overconfidence is

positively associated with leverage and new issue of debt. Malmendier and Tate (2008) conclude that overconfident CEOs are more likely to undertake mergers and acquisitions that are not expected to create value than their rational counterparts. Similarly, Doukas and Petmezas (2007) establish that overconfident managers tend to generate lower stock returns than rational managers and they are associated with poor long-term performance.

Following prior studies, we argue that managerial overconfidence of CEOs and directors can be a potential explanation for their past bankruptcy involvements. To illustrate, overconfident CEOs and directors tend to make risk-taking decisions due to overestimation of abilities and underestimation of risks (Ben-David et al., 2007; Gervais et al., 2003; Malmendier & Tate, 2005; Doukas & Petmezas, 2007; etc.). The risk-taking management will further affect organizational performance, or even lead to financial distress. It suggests that overconfident decision makers such as CEOs and directors themselves may be the one who should be blamed for past bankruptcy events. When they participate in the next firm, their managerial overconfidence will remain.[3] Hence, we infer that CEOs' and directors' managerial overconfidence and risk-taking manner will continue affecting the firm they subsequently join in, which is likely to increase the probability of bankruptcy of the firm.

2.4.2 Reputation cost mechanism

The reputation cost mechanism implies that involvements in firms with adverse events, such as bankruptcy, earnings management, etc., cause great reputation loss for executives and directors. It will hence lead to difficulties in their future careers and undermine the business situation of the subsequent firm. Besides, we speculate that enormous reputation cost might also incentivize managers and directors to make decisions against firm value, such as hiding crucial information from shareholders.

It is broadly acknowledged that involvements in bankruptcy events can be costly for managers and directors. Eckbo et al., (2016) argue that CEOs suffer significant compensation losses because of bankruptcy involvements. Empirical evidence shows that CEOs who leave executive labor market after bankruptcies suffer a substantial compensation loss with a median present value until age 65 of $7 million, which equals to five times pre-departure compensation (p. 228). Despite the great wealth loss, reputation loss is another important consideration, as bankruptcy

[3] The psychological concept of "coherence" underpins this argument. Coherence refers to "homotypic" continuity – continuity of similar behaviors or phenotypic attributes over time (Caspi et al., 1990, p. 307). Kagan (1969) argues that homotypic continuities are likely to be found after one's psychological organization is almost complete. Costa and McCrae (1988) examine personality in adulthood based on cross-sectional and longitudinal analyses. Similarly, evidence in this paper supports the stability of personalities and individual differences.

issues are likely to be attributed to managers' and directors' inability to deal with distress. Thereby, we propose that such reputation loss can cause concerns from both stakeholders, and executives and directors themselves.

On one hand, stakeholders such as creditors and investors will doubt the firms' capability to cope with distress, since past bankruptcy exposures tend to signify CEOs' and directors' managerial inability for them. For instance, Tobback et al. (2017) argue that the competence of managers and directors is often measured by their business history, i.e., their professional careers. Due to concern about capability, banks will be reluctant to grant a loan to firms which appoint executives or directors with past bankruptcy involvements. Besides, Schoar (2007) reports that starting career in a good economic condition will speed up the executives' promotion to the CEO position. The paper concludes that managers who start career in recession are likely to be punished for the downsides even if it is out of their control, whereas those who start in boom "seem to be rewarded for the overall performance of the economy" (p. 3). Similarly, Ivanova and Pündrich (2017) document that past bankruptcy experience can impair the reputation of both CEOs and directors, since such failures are likely to be attributed to their incapability to address adverse issues. Bondholders will be concerned that firms appoint executives and directors who have previous bankruptcy experience, given that they can only get access to publicly available information, namely the past professional experience of CEOs and directors. Thus, bondholders are likely to take actions to reduce potential risks, which will hence lead to higher credit spread and lower bond size of the firm.

On the other hand, executives and directors may also consider the potential loss that involvements in negative events will bring to them. As is stated in Eckbo et al., (2016), the vast costs are likely to "incentivize CEOs to hedge against bankruptcy risk at the expense of shareholder value" (p. 210). Furthermore, Gow et al. (2016) argue that if directors were ever involved in firms which encountered adverse events such as accounting restatements, securities litigation, or bankruptcy during their tenure, they could be discouraged from disclosing such directorships due to reputation concerns. The authors conclude that the potential loss from bankruptcy experiences can exert an adverse effect on decision making, which will further affect corporate outcomes.

Consequently, according to the abovementioned literature, a bankruptcy event will not only affect the firm itself, but also influence related participants, i.e., CEOs and directors. Significant reputation cost may either deteriorate the future business environment, or cause incentives for executives and directors to make adverse decisions, which will hence lead to a higher likelihood

of bankruptcy of the subsequent firms.

2.5 Hypothesis development

From discussions above, we infer that past bankruptcy experience of CEOs and directors is positively related to the likelihood of bankruptcy of the firm they participate in later. The positive association can be explained by two mechanisms. According to the managerial overconfidence mechanism, the firm bankruptcy is attributed to executives' and directors' personal behavioral bias. Overconfident CEOs and directors tend to implement risk-taking decisions, which are likely to increase the likelihood of bankruptcy of the firm. As for the reputation cost mechanism, the bankruptcy event impairs executives' and directors' reputation and worsens the business environment of the future firm. Furthermore, CEOs and directors may be incentivized to act against shareholders' interest due to reputation concern. Thereby, it will also lead to higher probability of bankruptcy of the firm.

Consequently, these arguments can underpin the following three hypotheses:

Hypothesis 1: A CEO's past bankruptcy experience is positively associated with the likelihood of the future bankruptcy of the firm.

Hypothesis 2: The proportion of directors with past bankruptcy experience on the board is positively associated with the likelihood of the future bankruptcy of the firm.

Hypothesis 3: Appointing a CEO and at least one director with past bankruptcy experience on the board is positively associated with the likelihood of the future bankruptcy of the firm.

3 Data and methodology

Based on our research question and reviewed literature, three hypotheses are developed in Section 2. Section 3 presents our research design and methodology. The data source are explained in Section 3.1. Assumptions and data selection methodologies for three explanatory variables are illustrated in Section 3.2. In Section 3.3, dependent variable and other accounting-based independent variables are shown, together with two original models and twelve adjusted models.

3.1 Data sources

Three hypotheses are tested on a large sample of Swedish private firms, which is obtained from Serrano and a complemented top executives' database. The Serrano database includes comprehensive historical financial information (from 1997 to 2017) of most legal forms in the Swedish business environment and contains financial statement data from the *Swedish Companies Registration Office (Bolagsverket)*, general company data from *Statistics Sweden (SCB)*, bankruptcy information from the *Swedish Companies Registration Office*, and group data from *Bisnodes group register*. All information is linked by unique organization number and fiscal year thus merging into Serrano. The other database includes top executives' personal information such as name, birth year, gender, and professional records such as tenures, titles, starting and ending dates, firms' names and organization numbers (from 1993 to 2016). By linking the distinct organization numbers, we are able to combine top executives' and directors' information with firms, in order to depict the composition of top management team in each firm every year.

3.2 Research design and sample selection

Firms in our sample have binary outcomes, bankruptcy or no distress. When a firm is unable to pay its debts, either a creditor or a firm itself can initiate the bankruptcy procedure, according to Swedish Bankruptcy Act (1987:672) Section 2. Thorburn (2000) finds that "all bankruptcy filings (in Sweden) are resolved through a public auction … in which the firm is either liquidated piecemeal (25%, p. 339) or survives as a going concern (75%, p. 339)", showing that the majority of firms can still find ways to exist even though after bankruptcy filings, however, a bankruptcy declaration implies a firm "fail(s) to take a certain measure and thereby present(s) a risk to the rights of the creditor" (Swedish Bankruptcy Act (1987:672) Section 10a). Therefore, it is reasonable to regard bankruptcy declaration as an important timing indicator to separate

firms in our sample and classify them into two different groups – non-distressed group and bankrupt group.

3.2.1 IBE individuals

First of all, we pinpoint each CEO and director with initial bankruptcy experience (IBE) and mark their bankruptcy experience starting point (BESP). Since the personal reputation is easily ruined after those adverse consequences as discussed in Section 2.4.2, we expand CEOs' and directors' IBE happening in both private and public firms.[4] As for legal forms, we use limited liability consistently - both when selecting top managers with IBE and firms they subsequently join in[5]. Additionally, deputy CEOs and deputy directors are excluded from our sample because they participate and devote less to the corporate decision-making process. They appear and make decisions only when CEO and directors' tenure come to a halt which happens only in extraordinary circumstance. Our research question also requires the selected CEO/board member must play an important role in the firm management. Therefore, we only include both internal and external CEOs, both internal and external directors and chairpersons in the final sample.

Moreover, we set a two-year limit prior to the firm's bankruptcy filing date. This time span represents the period during which we assume that CEOs and directors can have influence on the corporate outcomes. In other words, if the certain CEO/director serves in the *first* firm during the two-year period prior to bankruptcy, it will be considered as their primary bankruptcy experience (IBE).

Previous studies select different timespans as limitation, such as up to three years (Tinoco & Wilson, 2013; Tobback et al, 2017), five years (Kallunki & Pyykkö, 2013; Ivanova & Pündrich, 2017) and three to ten years (Reisz & Perlich, 2004) based on different assumptions, but we believe two years is assumed to be more reasonable given the short lifespan of private firms in our setting. Two-year limitation originates from Swedish Restructuring and Insolvency analysis[6]. It says payments of debts in the period beginning three months (two years for

[4] One may say that the research range of this paper is limited in *private* firms, then it is consistent to target individuals serving in *private* firms only. However, we think that such negative experiences – regardless of being in a listed or non-listed firm – will leave an indelible record on CEO and directors' professional history. From reputation cost perspective, taking public firms' experiences into consideration also strengthen the linkage between personal professional experience and firms' future in our previous hypotheses.

[5] Because different legislations will regulate different responsibilities and supervision mechanisms to top managers in other legal forms, which will bring a noise in our research especially when exploring the impact from CEO's participation and director's composition to firm's future.

[6] The information is collected from the website:

affiliated companies) before the day before the petition for bankruptcy was filed (the 'limitation date') and that have been made by non-customary means, prematurely or that are of sums that have caused a substantial deterioration in the financial position of the debtor. If CEOs and directors made some abnormal payment decisions, such as paying for themselves, or borrowing extraordinarily, within two years prior to limitation date or bankruptcy filing day, which could deteriorate the firm's situation, those payments can be annulled and return to the company. Hence, the two-year span can be regarded as a protection period for the company to limit the risky decisions from top managers. In other words, CEOs and directors should take responsibility for decisions they make during these two years, otherwise the court can annul any payments if these payment decisions "caused a substantial deterioration in the financial position of the debtor". Although longer timespan is prevalent among bankruptcy prediction papers, we think shorter period can better capture those top executives' normal actions and explore the further relationship between negative organizational outcome and IBE individuals.

Lastly, we define bankruptcy experience starting point (BESP) based on the IBE individuals and the two-year limitation, illustrated in the Figure 5. BESP is the earlier date of company's bankruptcy declaration date or top executive tenure ending date. As shown in Figure 5, if the Firm A declared bankruptcy at the end of 2008, CEO, Director A, Director C were involved in Firm A during the two-year period (2007-2008), so they are targeted and marked as the IBE CEO or IBE directors. CEO's BESP is at the end of 2007, while Director A and Director C's BESP are at bankruptcy declaration day.

As shown in Table 1A, after three steps, 142,606 individuals with IBE and their BESP are identified. Specifically, more than 80% of IBE individuals have been employed in the first bankrupt firm more than one year before the bankruptcy declaration.

https://gettingthedealthrough.com/area/35/jurisdiction/10/restructuring-insolvency-european-union/

Figure 5 – *BESP Illustration*

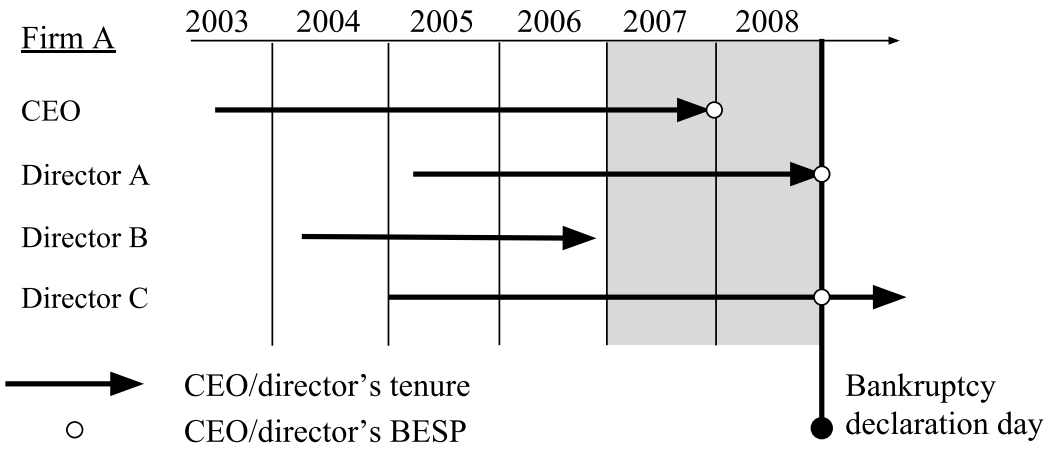

Figure 5 illustrates the mechanism of selection IBE (initial bankruptcy experience) individuals and their BESP (bankruptcy experience starting point). CEO, Director A, Director B and Director C are four top executives employed by Firm A during 2003-2008. Firm A declared its bankruptcy at the end of 2008, so according to two-year limitation, 2007-2008 is the period during which anyone involved will be regarded as IBE individuals (assuming that Firm A is the first bankrupt firm in their careers). Apparently, Director B's employment terminates before 2007, so he should not be responsible for Firm A's bankruptcy according to our assumption. CEO, Director A and Director C involved in Firm A during 2007-2008, so they are marked as IBE CEO or IBE directors. Among them, CEO and Director A ended their tenure before or at bankruptcy declaration day, so their BESP should be the day they left Firm A. Director C left after Firm A declared bankruptcy, so the bankruptcy declaration day is regarded as his/her BESP.

Table 1A – *Sample Selection (all IBE Individuals)*

Steps	Distinct individuals
Original database	889,285
Less: Individuals who did not work in either limited liability or bankrupt firms before	559,092
Less: Individuals whose initial bankruptcy experience as deputy executives	120,924
Less: Individuals whose first bankrupt experiences exceed the two-year limitation	66,663
Distinct individuals with Initial Bankruptcy Experience (IBE) and their Bankruptcy Experience Starting Points (BESPs)	**142,606**

Note: Steps in Table 1A are consistent with Section 3.2.1. See Table 1B and Table 1C in Section 3.2.2 and 3.2.3.

3.2.2 Subsequent experiences

After identifying 142,606 IBE individuals with BESPs, we focus on their subsequent experiences. As shown in Table 1B, 72,946 IBE individuals' 711,291 subsequent experiences meet the requirements of (1) joining in the firm after BESP and (2) serving as a non-deputy director or CEO, which is consistent with the criteria in Section 3.2.1.

We assume that an IBE individual takes time to "infect" the next firm by his/her continuous involvement with managerial confidence. Generally, we believe one year is the minimum gap between IBE individuals' BESP and the year of their subsequent experience, before any effect can be reflected. This minimum gap is also supported by several previous papers (Kallunki & Pyykkö, 2013; Tobback et al, 2017; Cenciarelli et al, 2018). If the timespan between one's next experience starting point and the release day of financial report in that firm is too short, firm's financial report for last fiscal year may have not captured those individual's involvement sufficiently thus is not able to reflect in numbers.[7] In order to have better reflection in the financial information, therefore, one-year gap is set as the "infectious period" to sort out the subsequent experiences after it. Considering the financial statements are usually released three to six months after year end, the "infectious period" is actually longer than one year.

The detailed method of setting "infectious period" is demonstrated in the Figure 6. For example, the CEO or director stayed in company A till the end of 2003 and afterwards he/she entered into company C, D and B (chronologically). After 2004, or the infectious period, we assume his/her involvement has already affected the company, then Company B, Company C and D's subsequent firm-year observations, i.e. C-2005, D-2005, D-2006 and B-2009 are included in the final sample.

As shown in Table 1B, 65,768 distinct IBE individuals with 637,513 firm-year experiences are selected (from 1997 to 2016).

[7] Although we assume BESP at the year-end as illustrated in Figure 5, in fact, the tenure can end at any time during the year, so does the next experience starting point.

Figure 6 – *"Infectious period" Illustration*

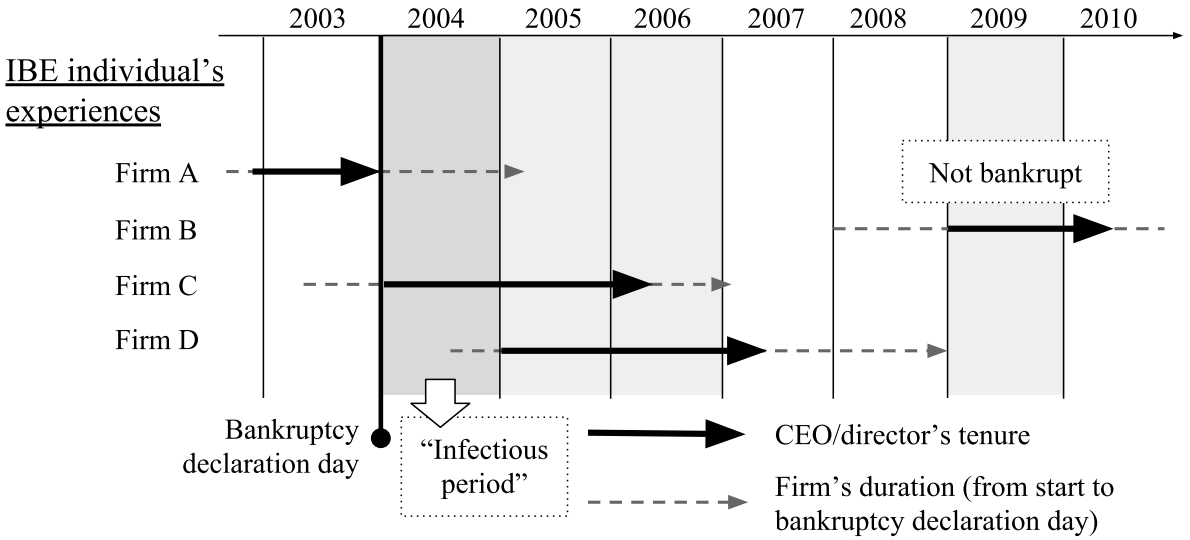

Figure 6 illustrates the mechanism of how "infectious period" works and affects an IBE individual's subsequent experiences. The IBE individual started his/her career in Firm A but unfortunately Firm A declared bankruptcy at the end of 2003. According to criteria in Section 3.2.1, he/she should be regarded as IBE individual because he/she joined in the Firm A within two years prior to bankruptcy declaration day. But not all his/her subsequent experiences should be taken into consideration due to the existence of "infectious period" – one year after bankruptcy declaration day. In Figure 6, although this IBE individual served in Firm C after his/her IBE, this firm-year observation is not counted in the final sample since it is during the "infectious period". So we only take observations after 2004, i.e. Firm C-2005, Firm D-2005, Firm D-2006 and Firm B-2009 into the final sample.

Table 1B – *Sample Selection (subsequent experiences)*

Steps	Distinct individuals	Distinct firms	Individual-firm-year observations
Distinct IBE individuals from Panel A	**142,606**	516,708	1,254,393
Less: All subsequent experience happening before BESP, or being as deputy executives	69,660	87,832	543,102
Subtotal	*72,946*	*428,876*	*711,291*
Less: One-year gap ("infectious period")	7,178	23,379	73,778
IBE individuals and their subsequent experiences	**65,768**	**405,497**	**637,513**

Note: Steps in Table 1B are consistent with Section 3.2.2. See Table 1A and Table 1C in Section 3.2.1 and 3.2.3.

3.2.3 Selected firms with these IBE individuals

Although we select IBE individuals from both private and public firms, to explore how firms' future is affected by their behaviors, we only target on private limited liability firms. To ensure the pure relationship between top executives and private firms, we also exclude 1,096 firms that ever become public within firm's duration. Additionally, industry classification is used as a limitation for the database. We exclude two major industries, i.e. financial service (SNI code 64190 - 68320) and renting & leasing (SNI code 77110 - 77400) as other papers did. Besides, the industry code of a firm sometimes changes due to business model transformation, or firms with complicated business models have several industry codes. To simplify, we choose the major industry code for each company which can represent the business and operation of the firm best. Lastly, we drop out the observation if its industry information is missing. 689,967 out of 1,240,164 firms are selected, shown in Table 1C.

Firm size is another filtering criterion. Swedish corporation law (*Aktiebolagslag (2005:551)*) regulates small firms meet none of the following conditions: No fewer than 3 employees, net sales no more than 3 million kronor and total assets no more than 1.5 million kronor. Considering bankruptcy events in larger firms will have greater influence in both stakeholders and macro economy, we exclude very small firms by applying two requirements (net sales and total assets) from Swedish corporation law to benchmark remaining 689,967 firms, except the first requirement due to the high employee turnover in real business. [8] After selecting all necessary IBE individuals' and related accounting ratios' information to build the models, 102,456 distinct firms are remained after this step.

[8] We think that firms are never "large" before implies they may have immature business models rather than the involvement of CEO and directors in these firms, thus being exposed to market risks and leading to firms' unsuccessful development. So we exclude those small firms provided that their sales and total assets that never reach the minimum requirements at least one year.

Table 1C – *Sample Selection (firms with IBE individuals)*

Steps	Distinct firms	Firm-year observations
Original database	1,240,164	
Less: Firms that are not limited liability, or ever listed before, financial service or real estate, or no industry code.	550,197	
Subtotal	*689,967*	
Less: Firms that never 'large' before, or lacking necessary accounting information	476,492	
Less: Firms without CEO, director etc information (merged with Table 1B)	110,648	
Subtotal	*102,456*	*891,074*
All firms – $BANKRUPTCY_{it+2}$ = 1 (1999-2014) for two years prior to bankruptcy declaration year (2001-2016)	**94,903**	**747,481**

Note: Steps in Table 1C are consistent with Section 3.2.3. See Table 1A and Table 1B in Section 3.2.1 and 3.2.2.

3.3 Models, variable definitions and methodology

Z Score (1968) and O Score (1980) models are used to predict bankruptcy in this paper. Three explanatory variables – $BANKR\_CEO_{it}$, $BANKR\_DIR_{it}$, $BANKR\_CEO\_DIR\_DUAL_{it}$ – are generated from three hypotheses. To compare which explanatory variable(s) is(are) statistically and economically significant to bankruptcy prediction, Model Z1 is set as the original Altman's Z Score model (1968) and Model O1 as the original O Score model (Ohlson, 1980). We also replace the variable concerning market value of equity with that concerning book value considering the context of the research question. (for example, Altman, 2000; Altman & Saunders, 1997). Z2-Z4/O2-O4 comprise each of all three explanatory variables. $BANKR\_DIR_{it}$ and either of the remaining two are included in Z5 and Z6/O5 and O6. Z7/O7 incorporates all variables. Considering the binary outcome (either bankruptcy or no distress), and the explanatory variables of the bankruptcy prediction equation are neither linear nor normally distributed (Ohlson 1980), logistic regression is used to predict the probabilities of bankruptcy after two years.

In order to explore the universality of these models, we select all firm-year observations two years prior to the bankruptcy declaration as "bankrupt firms". As stated above, the two-year

time span before bankruptcy represents a protection period for a certain firm. During the period, executives and directors must take responsibility for every decision they make. Meanwhile, after inspecting the financial data in the final sample, we note that in general, all financial ratios of bankrupt firms present fluctuation in two years before bankruptcy filing, which signifies a deteriorating performance and can support the method of using two-year period. Considering the latest financial information is from 2016, we can only select 2014 and older years as sample, so our sample comprises of 747,481 firm-year observations with 94,903 distinct firms. Out of these observations, 10,369 are filing for bankruptcy in year *t+2* and 737,112 have no filings in year *t+2*.

Models are listed below:

Model Z1:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 WC\_TA_{it} + \beta_2 RE\_TA_{it} + \beta_3 EBIT\_TA_{it} + \beta_4 BV\_TL_{it} + \beta_5 SALES\_TA_{it}$$

Model Z2:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 WC\_TA_{it} + \beta_3 RE\_TA_{it} + \beta_4 EBIT\_TA_{it} + \beta_5 BV\_TL_{it} + \beta_6 SALES\_TA_{it}$$

Model Z3:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_DIR_{it} + \beta_2 WC\_TA_{it} + \beta_3 RE\_TA_{it} + \beta_4 EBIT\_TA_{it} + \beta_5 BV\_TL_{it} + \beta_6 SALES\_TA_{it}$$

Model Z4:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_2 WC\_TA_{it} + \beta_3 RE\_TA_{it} + \beta_4 EBIT\_TA_{it} + \beta_5 BV\_TL_{it} + \beta_6 SALES\_TA_{it}$$

Model Z5:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 BANKR\_DIR_{it} + \beta_3 WC\_TA_{it} + \beta_4 RE\_TA_{it} + \beta_5 EBIT\_TA_{it} + \beta_6 BV\_TL_{it} + \beta_7 SALES\_TA_{it}$$

Model Z6:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_DIR_{it} + \beta_2 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_3 WC\_TA_{it} + \beta_4 RE\_TA_{it} + \beta_5 EBIT\_TA_{it} + \beta_6 BV\_TL_{it} + \beta_7 SALES\_TA_{it}$$

Model Z7:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 BANKR\_DIR_{it} + \beta_3 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_4 WC\_TA_{it} + \beta_5 RE\_TA_{it} + \beta_6 EBIT\_TA_{it} + \beta_7 BV\_TL_{it} + \beta_8 SALES\_TA_{it}$$

Model O1:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 SIZE_{it} + \beta_2 TL\_TA_{it} + \beta_3 WC\_TA_{it} + \beta_4 CL\_CA_{it} + \beta_5 OENEG_{it} + \beta_6 NI\_TA_{it} + \beta_7 FFO\_TL_{it} + \beta_8 NITWO_{it} + \beta_9 CHIN_{it}$$

Model O2:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 SIZE_{it} + \beta_3 TL\_TA_{it} + \beta_4 WC\_TA_{it} + \beta_5 CL\_CA_{it} + \beta_6 OENEG_{it} + \beta_7 NI\_TA_{it} + \beta_8 FFO\_TL_{it} + \beta_9 NITWO_{it} + \beta_{10} CHIN_{it}$$

Model O3:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_DIR_{it} + \beta_2 SIZE_{it} + \beta_3 TL\_TA_{it} + \beta_4 WC\_TA_{it} + \beta_5 CL\_CA_{it} + \beta_6 OENEG_{it} + \beta_7 NI\_TA_{it} + \beta_8 FFO\_TL_{it} + \beta_9 NITWO_{it} + \beta_{10} CHIN_{it}$$

Model O4:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_2 SIZE_{it} + \beta_3 TL\_TA_{it} + \beta_4 WC\_TA_{it} + \beta_5 CL\_CA_{it} + \beta_6 OENEG_{it} + \beta_7 NI\_TA_{it} + \beta_8 FFO\_TL_{it} + \beta_9 NITWO_{it} + \beta_{10} CHIN_{it}$$

Model O5:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 BANKR\_DIR_{it} + \beta_3 SIZE_{it} + \beta_4 TL\_TA_{it} + \beta_5 WC\_TA_{it} + \beta_6 CL\_CA_{it} + \beta_7 OENEG_{it} + \beta_8 NI\_TA_{it} + \beta_9 FFO\_TL_{it} + \beta_{10} NITWO_{it} + \beta_{11} CHIN_{it}$$

Model O6:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_DIR_{it} + \beta_2 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_3 SIZE_{it} + \beta_4 TL\_TA_{it} + \beta_5 WC\_TA_{it} + \beta_6 CL\_CA_{it} + \beta_7 OENEG_{it} + \beta_8 NI\_TA_{it} + \beta_9 FFO\_TL_{it} + \beta_{10} NITWO_{it} + \beta_{11} CHIN_{it}$$

Model O7:

$$logit\big(P(BANKRUPTCY_{it+2}=1|BANKRUPTCY_{it})\big) = \alpha_0 + \beta_1 BANKR\_CEO_{it} + \beta_2 BANKR\_DIR_{it} + \beta_3 BANKR\_CEO\_DIR\_DUAL_{it} + \beta_4 SIZE_{it} + \beta_5 TL\_TA_{it} + \beta_6 WC\_TA_{it} + \beta_7 CL\_CA_{it} + \beta_8 OENEG_{it} + \beta_9 NI\_TA_{it} + \beta_{10} FFO\_TL_{it} + \beta_{11} NITWO_{it} + \beta_{12} CHIN_{it}$$

To illustrate, $BANKRUPTCY_{it+2}$ is the indicator variable for firms' bankruptcy filing record. It equals to one if firm *i* has a bankruptcy filing in year *t+2*, otherwise it is zero. In other words, we predict bankruptcy in year *t+2* by the financial ratios and the information on CEOs' and directors' past bankruptcy experience in year *t.* $BANKR\_CEO_{it}$ is an indicator variable to represent whether firm *i* appoints an IBE CEO. If, firm *i* has an IBE CEO in year *t,* it will be one, otherwise it is zero. $BANKR\_DIR_{it}$ refers to the proportion of IBE directors to non-deputy

directors in the board of firm *i* in year *t*. $BANKR\_CEO\_DIR\_DUAL_{it}$ is an indicator variable to represent whether firm *i* appoints an IBE CEO and at least one IBE director on the board. If firm *i* has both an IBE CEO and at least one IBE director on the board in year *t,* it equals to one, otherwise it is zero. WC_TA_{it} is the working capital divided by total assets of firm *i* in year *t*. RE_TA_{it} is the retained earnings (or accumulated profit or loss) divided by total assets of firm *i* in year *t*. $EBIT\_TA_{it}$ is the earnings before interest and taxes (or the operating profit/loss) divided by total assets of firm *i* in year *t*. BV_TL_{it} is the book value of equity divided by total liabilities of firm *i* in year *t*. $SALES\_TA_{it}$ is the net sales divided by total assets of firm *i* in year *t*. $SIZE_{it}$ is the ln(Total Assets/GDP price-level index) of firm *i* in year *t*. Total assets are measured in SEK. GDP price-level index is based on "the year prior to the year of the balance sheet date" (Ohlson, 1980, p. 118). TL_TA_{it} is the total liabilities divided by total assets of firm *i* in year *t*. CL_CA_{it} is the current liabilities divided by current assets of firm *i* in year *t*. $OENEG_{it}$ is an indicator variable to capture the liability information. If the total liabilities are larger than total assets of firm *i* in year *t,* it will be one, otherwise it is zero. NI_TA_{it} is the net income (or profit/loss for the year) divided by total assets of firm *i* in year *t*. FFO_TL_{it} is the funds from operations, i.e. EBITDA minus net interest expense and current tax expense divided by total liabilities of firm *i* in year *t*. $NITWO_{it}$ is an indicator variable to demonstrate the cumulative net income of firm *i*. If the cumulative net income over the past two years of firm *i* in year t is negative, it will be one, otherwise it is zero. $CHIN_{it}$ is an indicator intended to measure the change in net income. It is displayed as $[(NI_t - NI_{t-1}) / (|NI_t| + |NI_{t-1}|)]$ of firm *i* in year *t*.[9]

3.4 Data quality check

A careful check has been done on the original databases by randomly selecting firms and comparing these firms' accounting information and top managers' tenure details with online financial reports from Retriever[10]. We then winsorize all accounting-based variables at 1st and 99th percentile to limit the impact from extreme values and outliers.

[9] All definitions of variables are listed in Table 12 in appendix.
[10] We inspect the data quality with the help of Retriever Business: https://www.retriever-info.com

4 Analysis

In this section, we analyze the seventeen variables and the fourteen models generated in Section 3. Specifically, we examine the descriptive summary of each variable in Section 4.1 and correlationship in Section 4.2. In Section 4.3, the effect from variables in fourteen models are explored, in statistical way. To evaluate the effectiveness of models (in economic way), we use three tests in Section 4.4. To prove the findings still can be hold in different scenarios, Section 4.5 illustrates four different ways of robustness check.

4.1 Descriptive statistics

Table 2 presents the descriptive statistics of all seventeen variables used in fourteen models. The mean of the dependent variable - $BANKRUPTCY_{it+2}$ - is 0.014 and median is 0, which means firms that declare bankruptcy account for 1.4%. The mean of $BANKR\_DIR_{it}$ is 0.198, showing on average one fifth of (non-deputy) directors in board are with negative professional experiences before. The other two explanatory variables - $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ - display similar average and standard deviation. All these three non-accounting explanatory variables range from 0 to 1, and their medians are all 0. It means that most of firms in the sample did not employ CEO/directors who had bankruptcy experience previously. The accounting-based variables before winsorization show larger maximums, but most of extreme values are enlarged by very small denominators, which means they did not provide much useful economical information for bankruptcy prediction. Therefore, after winsorizing all accounting-based variables at 1st percentile and 99th percentile, we compare the outcome with other papers and find all information in Table 2 displays similar distribution.

Table 3 reports the comparison of all seventeen variables' mean under bankrupt and non-distressed scenarios. We also apply a *t*-test to examine (1) whether the means in two scenarios are different and (2) whether the differences of means between two situations are significant.

All variables are significantly different at the 0.001 level. Specifically, all three explanatory variables - $BANKR\_CEO_{it}$, $BANKR\_DIR_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ - in bankrupt companies are significantly higher than those in healthy firms, implying that such negative professional experiences are positively related to the bankruptcy probabilities after two years, and that bankrupt firms are more likely to have both CEOs and at least one board member who have past bankruptcy exposures, which is supported by Figure 7 as well.

Table 2 – *Descriptive Statistics Summary*

Variable (Observations: 747481)	Mean	Median	SD	Min	Max
(1) $BANKRUPTCY_{it+2}$	0.014	0.000	0.117	0.000	1.000
(2) $BANKR\_CEO_{it}$	0.087	0.000	0.282	0.000	1.000
(3) $BANKR\_DIR_{it}$	0.198	0.000	0.333	0.000	1.000
(4) $BANKR\_CEO\_DIR\_DUAL_{it}$	0.082	0.000	0.274	0.000	1.000
(5) WC_TA_{it}	0.241	0.236	0.345	–0.962	0.978
(6) RE_TA_{it}	0.114	0.105	0.435	–2.923	0.959
(7) $EBIT\_TA_{it}$	0.051	0.058	0.249	–1.214	0.697
(8) BV_TL_{it}	2.974	0.546	10.921	–0.588	89.545
(9) $SALES\_TA_{it}$	2.168	1.849	1.861	0.000	10.222
(10) $SIZE_{it}$	15.156	14.958	1.735	11.065	20.266
(11) TL_TA_{it}	0.633	0.647	0.344	0.011	2.374
(12) CL_CA_{it}	0.937	0.662	1.440	0.010	11.889
(13) NI_TA_{it}	0.022	0.032	0.229	–1.288	0.614
(14) FFO_TL_{it}	0.250	0.127	0.885	–2.964	5.846
(15) $NITWO_{it}$	0.258	0.000	0.437	0.000	1.000
(16) $OENEG_{it}$	0.044	0.000	0.206	0.000	1.000
(17) $CHIN_{it}$	0.011	0.024	0.641	–1.000	1.000

Table 2 presents the descriptive statistics summary of all seventeen variables used in this paper, in the full sample (747,481). All accounting-based variables, i.e. variable (5) - (17) are winsorized at 1st percentile and 99th percentile level. The definitions of all variables are listed in Table 12 in appendix.

Figure 7 – *The Proportion of Bankrupt Firms to All Selected Firms, Grouped By* $BANKR\_DIR_{it}$

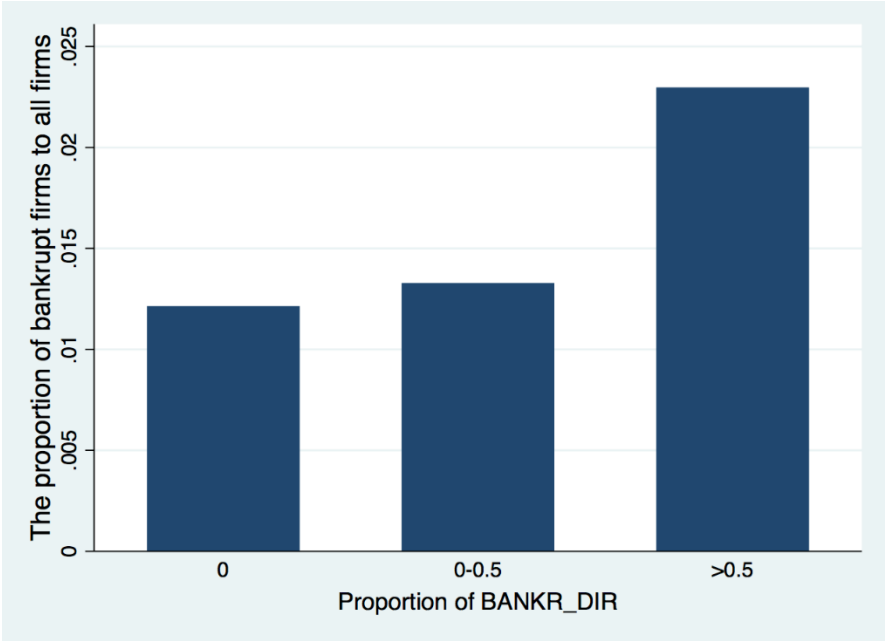

Figure 7 presents the relationship between the proportion of IBE directors in the non-deputy board and the proportion of bankruptcy cases among all firms. When firms have no more than half of non-deputy IBE directors, only 1.25% of the total firms will declare bankruptcy in year *t+2*. When firms have more than half of non-deputy IBE directors, the rate of bankruptcy declaration cases happening among all selected firms doubles, which proves the linkage between $BANKR\_DIR_{it}$ and future bankruptcy.

Divided into three groups (0 means no bankruptcy experience director in the board, while 0-0.5 and >0.5 means less than half and more than half of directors had bankruptcy experience before), the proportion of bankrupt firms increases when more such directors involved in the board. Companies with no IBE directors in board have similar low outcomes (around 0.0125) with companies having up to half of such directors in the board, while firms are more likely (around 0.023) to declare bankruptcy if more than half of directors are IBE directors.

Table 3 – *Characteristics of the Bankrupt And Non-distressed Firms*

Variable	BANKRUPTCY (Observations = 10369)	NONDISTRESSED (Observations = 737112)
(1) $BANKRUPTCY_{it+2}$	1.000	0.000
(2) $BANKR\_CEO_{it}$	0.117^{***}	0.086^{***}
(3) $BANKR\_DIR_{it}$	0.290^{***}	0.197^{***}
(4) $BANKR\_CEO\_DIR\_DUAL_{it}$	0.110^{***}	0.081^{***}
(5) WC_TA_{it}	0.034^{***}	0.244^{***}
(6) RE_TA_{it}	-0.056^{***}	0.117^{***}
(7) $EBIT\_TA_{it}$	-0.086^{***}	0.053^{***}
(8) BV_TL_{it}	0.758^{***}	3.006^{***}
(9) $SALES\_TA_{it}$	2.497^{***}	2.163^{***}
(10) $SIZE_{it}$	14.715^{***}	15.162^{***}
(11) TL_TA_{it}	0.940^{***}	0.628^{***}
(12) CL_CA_{it}	1.401^{***}	0.931^{***}
(13) NI_TA_{it}	-0.127^{***}	0.024^{***}
(14) FFO_TL_{it}	-0.039^{***}	0.254^{***}
(15) $NITWO_{it}$	0.478^{***}	0.255^{***}
(16) $OENEG_{it}$	0.228^{***}	0.042^{***}
(17) $CHIN_{it}$	-0.145^{***}	0.014^{***}

Table 3 presents the mean of 17 variables under two different scenarios. The definitions of all variables are listed in Table 12 in appendix.
*** denotes significance level at the 0.001.

Other financial ratios in Table 3 present various outcomes, and with the exception of $SALES\_TA_{it}$, they are all consistent with Kallunki and Pyykkö (2013) and our expectation in terms of growth, profitability and liquidity. For instance, healthy firms usually are managed more efficiently, thus have more working capital, EBIT and retained earnings. Accordingly, they grow rapidly or steadily, depending on being at different stages of the business cycle. Meanwhile, the size of liabilities is well controlled so appear to be smaller than firms that bankrupted two years later. Therefore, as we expected, profitability-related ratios (RE_TA_{it}, $EBIT\_TA_{it}$, NI_TA_{it}) and growth-related ratios (WC_TA_{it}, $SIZE_{it}$, FFO_TL_{it}, BV_TL_{it}) illustrated in Table 3 are higher or positive, while liquidity-related ratios (TL_TA_{it}, CL_CA_{it}) and other

indicators ($NITWO_{it}$, $OENEG_{it}$, $CHIN_{it}$) demonstrate lower or close to zero in healthy firms. The only exception is $SALES\_TA_{it}$. Contrary to our expectation that assets in healthy firms are utilized more effectively, instead, this ratio is higher in distressed firms than in healthy firms. Kallunki and Pyykkö (2013) infer that book equity and total assets probably decline sharply for distressed firms, thus increasing their sales-to-total-assets ratio. We also get support from Fairfield & Yohn (2001) that $SALES\_TA_{it}$ is in part the product of a firm's operating strategy only, so it makes no contribution to bankruptcy prediction.

4.2 Correlation analysis

Table 4 presents the outcomes from Pearson correlation and Spearman correlation between each variable, combining with *t*-test to identify the significance. The results show that $BANKR\_CEO_{it}$ is positively associated with $BANKR\_DIR_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$, both at the significant level of 0.05. It implies that the firm which appoints a CEO with past professional bankruptcy experience is more likely to have directors with similar experience on board. However, we also notice that the correlation coefficients between $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ in both Pearson and Spearman are close to 1 (0.967 in both correlations). Based on similar characteristics for these two independent variables having already displayed in Table 2, a close-to-one correlation coefficient indicates multicollinearity which will exacerbate the prediction from our estimated models. Other accounting ratios exhibit resemblances in correlations with all three explanatory variables with varying degrees, but are higher correlated with $BANKR\_DIR_{it}$.

Table 4 – *Pearson/Spearman Correlation Matrix*

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*
(1) $BANKRUPTCY_{it+2}$		0.013*	0.026*	0.012*	-0.064*	-0.062*	-0.070*	-0.103*	0.016*	-0.028*	0.103*	0.068*	-0.082*	-0.084*	0.060*	0.106*	-0.029*
(2) $BANKR\_CEO_{it}$	0.013*		0.394*	0.967*	-0.024*	-0.004*	-0.050*	-0.011*	-0.042*	0.093*	0.011*	0.016*	-0.039*	-0.046*	0.045*	0.005*	-0.001
(3) $BANKR\_DIR_{it}$	0.033*	0.363*		0.419*	-0.028*	-0.007*	-0.071*	-0.013*	-0.081*	0.072*	0.013*	0.019*	-0.055*	-0.066*	0.068*	0.022*	0.001
(4) $BANKR\_CEO\_DIR\_DUAL_{it}$	0.012*	0.967*	0.385*		-0.022*	-0.003*	-0.045*	-0.009*	-0.042*	0.083*	0.009*	0.013*	-0.035*	-0.042*	0.042*	0.006*	-0.001
(5) WC_TA_{it}	-0.071*	-0.024*	-0.028*	-0.022*		0.400*	0.197*	0.623*	-0.057*	-0.113*	-0.624*	-0.930*	0.285*	0.271*	-0.169*	-0.250*	0.023*
(6) RE_TA_{it}	-0.046*	-0.009*	-0.037*	-0.009*	0.374*		-0.019*	0.625*	-0.147*	0.134*	-0.626*	-0.439*	0.060*	0.175*	-0.307*	-0.277*	-0.216*
(7) $EBIT\_TA_{it}$	-0.065*	-0.040*	-0.041*	-0.036*	0.205*	0.067*		0.215*	0.241*	0.053*	-0.214*	-0.146*	0.817*	0.684*	-0.309*	-0.171*	0.364*
(8) BV_TL_{it}	-0.024*	0.008*	0.022*	0.009*	0.305*	0.198*	-0.028*		-0.268*	-0.012*	-0.999*	-0.670*	0.367*	0.498*	-0.250*	-0.356*	0.018*
(9) $SALES\_TA_{it}$	0.021*	-0.037*	-0.065*	-0.037*	-0.103*	-0.120*	0.081*	-0.209*		-0.131*	0.269*	0.185*	0.138*	0.043*	-0.098*	0.049*	0.031*
(10) $SIZE_{it}$	-0.030*	0.089*	-0.042*	0.078*	-0.085*	0.223*	0.105*	-0.035*	-0.153*		0.013*	0.059*	0.053*	0.046*	-0.121*	-0.161*	-0.004*
(11) TL_TA_{it}	0.106*	0.011*	0.029*	0.010*	-0.667*	-0.614*	-0.249*	-0.403*	0.254*	-0.069*		0.672*	-0.366*	-0.497*	0.250*	0.356*	-0.018*
(12) CL_CA_{it}	0.038*	0.018*	0.043*	0.017*	-0.613*	-0.302*	-0.156*	-0.124*	-0.054*	-0.004*	0.388*		-0.250*	-0.291*	0.153*	0.235*	-0.014*
(13) NI_TA_{it}	-0.077*	-0.031*	-0.033*	-0.028*	0.257*	0.103*	0.827*	0.045*	0.020*	0.126*	-0.339*	-0.186*		0.861*	-0.318*	-0.197*	0.446*
(14) FFO_TL_{it}	-0.039*	-0.015*	-0.007*	-0.013*	0.209*	0.049*	0.405*	0.329*	-0.061*	0.050*	-0.298*	-0.103*	0.576*		-0.319*	-0.205*	0.346*
(15) $NITWO_{it}$	0.060*	0.045*	0.060*	0.042*	-0.181*	-0.254*	-0.289*	0.002*	-0.049*	-0.117*	0.255*	0.148*	-0.291*	-0.159*		0.248*	0.274*
(16) $OENEG_{it}$	0.106*	0.005*	0.041*	0.006*	-0.354*	-0.457*	-0.240*	-0.064*	0.097*	-0.170*	0.576*	0.262*	-0.297*	-0.090*	0.248*		-0.022*
(17) $CHIN_{it}$	-0.029*	-0.001	0.003*	-0.001	0.020*	-0.156*	0.285*	-0.010*	0.020*	-0.003*	-0.008*	-0.009*	0.304*	0.211*	0.279*	-0.023*	

Table 4 reports Pearson/Spearman correlation coefficients matrix calculated on the final sample (747,481 firm-year observations from 94,903 distinct firms over 1999-2014. See sample selection in Table 1). Lower-triangular cells report Pearson's correlation coefficients, while upper-triangular cells are Spearman's rank correlation. Variable (1) is the independent variable $BANKRUPTCY_{it+2}$, variable (2) - (4) are three explanatory variables derived from our hypotheses, and variable (5)-(17) are accounting-based variables composed of our models and are winsorized at 1st percentile and 99th percentile. The definitions of all variables are listed in Table 12 in appendix.
* denotes significance at 0.05 level.

4.3 Multivariate analysis

In Table 5 and Table 6, the number of observations, the intercepts and coefficients of each original Z Score/O Score model and other six adjusted models are demonstrated.

In Table 5 each of all three explanatory variables' coefficients are positively correlated with future bankruptcy at the significant level of 0.001 when only one explanatory variable is added in the models (Z2-Z4), which indicates consistencies with our hypotheses 1, 2 and 3 in Section 2.5 that all three explanatory variables are positively associated with the bankruptcy probability. The coefficient of $BANKR\_DIR_{it}$ is more than two times of $BANKR\_CEO_{it}$ or $BANKR\_CEO\_DIR\_DUAL_{it}$, suggesting a stronger relationship between the percentage of IBE directors and future bankruptcy, than between IBE CEO or duality and future bankruptcy. However, when $BANKR\_DIR_{it}$ is added with either of $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$, or both of them, into the models (Z5-Z7), neither $BANKR\_CEO_{it}$ nor $BANKR\_CEO\_DIR\_DUAL_{it}$ becomes significant at the 0.05 level. Although the coefficients of $BANKR\_DIR_{it}$ remain constant among four models (Z4-Z7), just below 0.65, the coefficients of $BANKR\_CEO_{it}$ decline and become insignificant in model Z5 and Z7.

One may say both CEO and directors with those negative experiences should generate "negative synergy" which leads to larger coefficients for both variables, we think one possible explanation towards the largely declined but still positive effect from $BANKR\_CEO_{it}$ is "there is less incremental benefit from a marginal increase in (CEO's) monitoring activity where CEO interests are already well aligned with shareholder interests (Westphal, 1999, p. 12)". In other words, a CEO will not achieve more if his/her interests are aligned with interests of the board of directors who represent shareholders' interests. A CEO will also avoid investing more if there is nothing he/she can earn from the firm administration. So the convergence of CEO (no matter with or without previous bankruptcy experience) and directors' intentions to some extent weakens CEO's power on decision-making and companies' outcome, especially when the $BANKR\_DIR_{it}$ is composed by all non-deputy directors whose reputations are fragile ($BANKR\_DIR_{it} = 1$), are thought to engage in contributing more strategies and to exert more control over CEO. That is the reason why a sharp decrease in coefficients of $BANKR\_CEO_{it}$ when $BANKR\_DIR_{it}$ joined in.

Table 5 – *Original Z Score And Adjusted Z score Models Comparison*

Variable	Z1	Z2	Z3	Z4	Z5	Z6	Z7
Intercept	–4.149*** (–260.526)	–4.181*** (–254.364)	–4.323*** (–242.016)	–4.180*** (–254.765)	–4.323*** (–241.364)	–4.323*** (–241.585)	–4.325*** (–241.043)
$BANKR\_CEO_{it}$		0.274*** (8.777)			0.004 (0.114)		0.207 (1.628)
$BANKR\_DIR_{it}$			0.644*** (24.957)		0.643*** (23.381)	0.647*** (23.364)	0.649*** (23.412)
$BANKR\_CEO\_DIR\_DUAL_{it}$				0.286*** (8.943)		–0.010 (–0.281)	–0.217 (–1.645)
WC_TA_{it}	–1.029*** (–32.823)	–1.026*** (–32.724)	–0.997*** (–31.913)	–1.026*** (–32.720)	–0.997*** (–31.912)	–0.997*** (–31.912)	–0.997*** (–31.908)
RE_TA_{it}	–0.026 (–1.497)	–0.026 (–1.507)	–0.008 (–0.446)	–0.026 (–1.489)	–0.008 (–0.448)	–0.008 (–0.442)	–0.008 (–0.450)
$EBIT\_TA_{it}$	–1.021*** (–34.727)	–1.012*** (–34.428)	–1.005*** (–34.328)	–1.013*** (–34.459)	–1.005*** (–34.313)	–1.005*** (–34.325)	–1.004*** (–34.294)
BV_TL_{it}	–0.050*** (–10.648)	–0.050*** (–10.657)	–0.052*** (–10.901)	–0.050*** (–10.664)	–0.052*** (–10.901)	–0.052*** (–10.902)	–0.052*** (–10.899)
$SALES\_TA_{it}$	0.045*** (10.000)	0.047*** (10.385)	0.053*** (11.657)	0.047*** (10.387)	0.053*** (11.656)	0.053*** (11.649)	0.053*** (11.664)
Observations	747481	747481	747481	747481	747481	747481	747481
Log likelihood	–52176.34	–52140.26	–51888.99	–52139.02	–51888.99	–51888.95	–51887.71

Table 5 presents the intercepts of each model and coefficients of each variables for seven Z score models. Z1 is Altman's Z Score model (1968), while Z2-Z7 are adjusted Z score models illustrated in Section 3.3. The definitions of all variables are listed in Table 12 in appendix. Z statistics are presented in parentheses. *** denotes significance level at the 0.001, ** at the 0.01 and * at the 0.05.

Similarly, in Table 6, significant correlations are found between each of $BANKR\_CEO_{it}$, $BANKR\_DIR_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ and other nine accounting variables (O2-O4), which supports the same hypotheses 1, 2 and 3. As for the model O5, we discover the similar declined effect, which attributed to the suppressing power from directors to CEO.

But not all coefficients in both Table 5 and Table 6 are similar. In model Z6 and model O6, $BANKR\_CEO\_DIR\_DUAL_{it}$ presents insignificantly opposite effects when used to predict bankruptcy in year $t+2$. Statistical insignificance means that mean effect is not significantly different from 0, so the effect is trivial. But the similar large decrease between single

$BANKR\_CEO\_DIR\_DUAL_{it}$ in the model Z5/O5 and both $BANKR\_CEO\_DIR\_DUAL_{it}$ and $BANKR\_DIR_{it}$ in the model Z6/O6 could be attributed to the consequence from $BANKR\_CEO_{it}$ as explained before.

The majority of remaining accounting variables in each model in Table 5 and Table 6 demonstrate statistical and economical significance in predicting bankruptcy, and yield the predicted signs. In Table 5, the effects derived from WC_TA_{it} and $EBIT\_TA_{it}$ are larger than –1, which supports our expectation that distressed companies have presented worse working capital management and performance since two years before the bankruptcy declaration. $SALES\_TA_{it}$ is significantly positive with bankruptcy probabilities, but it only represents corporates' business strategies and have less connection to the outcome. In Table 6, all accounting-related variables present highly significance and the largest slope which close to 1 is from TL_TA_{it}.

Table 6 – *Original O Score and Adjusted O score Models Comparison*

Variable	O1	O2	O3	O4	O5	O6	O7
Intercept	–4.464***	–4.417***	–4.675***	–4.426***	–4.665***	–4.670***	–4.662***
	(–42.993)	(–42.471)	(–44.648)	(–42.573)	(–44.371)	(–44.439)	(–44.337)
$BANKR\_CEO_{it}$		0.271***			0.035		0.240
		(8.596)			(1.032)		(1.879)
$BANKR\_DIR_{it}$			0.545***		0.535***	0.539***	0.541***
			(21.086)		(19.298)	(19.308)	(19.365)
$BANKR\_CEO\_DIR\_DUAL_{it}$				0.277***		0.021	–0.219
				(8.603)		(0.601)	(–1.656)
WC_TA_{it}	–0.508***	–0.509***	–0.508***	–0.509***	–0.508***	–0.508***	–0.508***
	(–12.764)	(–12.819)	(–12.825)	(–12.818)	(–12.831)	(–12.828)	(–12.831)
$SIZE_{it}$	–0.041***	–0.046***	–0.034***	–0.045***	–0.035***	–0.035***	–0.035***
	(–6.755)	(–7.461)	(–5.609)	(–7.367)	(–5.688)	(–5.641)	(–5.725)
TL_TA_{it}	0.953***	0.949***	0.938***	0.949***	0.938***	0.938***	0.937***
	(25.408)	(25.333)	(25.120)	(25.346)	(25.115)	(25.118)	(25.105)
CL_CA_{it}	–0.102***	–0.103***	–0.107***	–0.103***	–0.107***	–0.107***	–0.107***
	(–13.886)	(–14.041)	(–14.487)	(–14.033)	(–14.495)	(–14.491)	(–14.502)
NI_TA_{it}	0.140***	0.143***	0.116**	0.142***	0.117**	0.116**	0.117**
	(3.335)	(3.416)	(2.771)	(3.394)	(2.791)	(2.781)	(2.799)
FFO_TL_{it}	–0.231***	–0.228***	–0.222***	–0.228***	–0.222***	–0.222***	–0.222***
	(–10.915)	(–10.826)	(–10.644)	(–10.828)	(–10.638)	(–10.640)	(–10.636)
$NITWO_{it}$	0.696***	0.688***	0.680***	0.689***	0.680***	0.680***	0.679***
	(29.052)	(28.744)	(28.420)	(28.782)	(28.387)	(28.402)	(28.360)
$OENEG_{it}$	0.375***	0.377***	0.368***	0.376***	0.368***	0.368***	0.369***
	(8.905)	(8.938)	(8.706)	(8.916)	(8.714)	(8.709)	(8.725)
$CHIN_{it}$	–0.459***	–0.458***	–0.455***	–0.458***	–0.455***	–0.455***	–0.455***
	(–27.149)	(–27.081)	(–26.900)	(–27.085)	(–26.896)	(–26.898)	(–26.892)
Observations	747481	747481	747481	747481	747481	747481	747481
Log likelihood	–50604.69	–50569.98	–50396.22	–50570.02	–50395.69	–50396.04	–50394.39

Table 6 presents the intercepts of each model and coefficients of each variables for seven O score models. O1 is Ohlson's O Score model (1980), while O2-O7 are adjusted O score models illustrated in Section 3.3. The definitions of all variables are listed in Table 12 in appendix. Z statistics are presented in parentheses. *** denotes significance level at the 0.001, ** at the 0.01 and * at the 0.05.

4.4 Model evaluation

4.4.1 Likelihood ratio test

To compare which model captures more relative information thus predicting bankruptcy better, we use likelihood ratio test[11]. Table 7 provides a detailed comparison showing the impact (likelihood ratio chi-squared ($\chi 2$), p-value and degrees of freedom) from models with more variables to models with fewer variables.

From the highest chi-squared value and lowest p-value, the result of likelihood ratio test indicates that Z3 and O3 are the best models in Panel A and Panel B respectively, due to the lowest chi-squared ($\chi 2$) value and the highest probabilities. Other models like Z5-Z7/O5-O7 perform well, too. The chi-squared ($\chi 2$) value implies that models that include $BANKR\_DIR_{it}$ only enhances the predictive power the most, although three explanatory variables ($BANKR\_CEO_{it}$, $BANKR\_DIR_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$) are added. One reason could be the multicollinearity between $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$. The outcome of likelihood ratio tests proves that three explanatory variables help enhance the predictive power of original models.

4.4.2 Bankruptcy-score-reclassification and total-sample prediction

From the likelihood ratio test we identify the best model, in a statistical way. But we also need to examine the usefulness in economic environment. After coefficients and intercept are regressed from each model, scores can be easily calculated from linear function, i.e. the right-side of the logit function ($Score = \alpha + \beta_1 * X_1 + \beta_2 * X_2 + \cdots + \beta_n * X_n$, where X_n is variables and α, β_n are intercept and coefficients). Usually, the differences among scores generated from linear function is not manifest to attach an economic meaning on. So, a reclassification on probability based on scores from each model can enlarge the differences but remain each group's economic meaning, thus providing better estimation.

After using in-sample to obtain intercepts and coefficients, and then predicting out-of-sample, a cut-off percentage is applied to separate out-of-sample into two groups. Though most of the previous papers use 5% as the cutoff percentage, considering the bankruptcy rate in Sweden

[11] Parallel to the F-test in least-squares regression, log likelihood is a good indicator to compare the goodness-of-fit of logistic regression models. Although shown at the bottom of Table 5 and Table 6, log likelihood is only useful when two nested models are compared.

Table 7 – *Likelihood Ratio Test*

Panel A: Z score models

Model	Z1	Z2	Z3	Z4	Z5	Z6
Z2	72.16*** (1)					
Z3	574.69*** (1)	–				
Z4	74.63*** (1)	–	–			
Z5	574.70*** (2)	502.54*** (1)	0.01 (1)	500.07*** (1)		
Z6	574.77*** (2)	502.61*** (1)	0.08 (1)	500.14*** (1)	–	
Z7	577.25*** (3)	505.09*** (2)	2.57 (2)	502.62*** (2)	2.55 (1)	2.49 (1)

Table 7 Panel A reports the outcome from likelihood ratio test within seven Z score models (See models in Section 3.3). Values are from chi-squared (χ2) and always present the impact from models listed in row to models listed in column (e.g. 72.16 means the impact from model Z2 to model Z1), and degrees of freedom are in parentheses. – means no outcome due to the same degrees of freedom (likelihood ratio test can only be applied within the nested models).
*** denotes significance is at 0.001 level, ** at 0.01 level and * at 0.1 level.

Panel B: O score models

Model	O1	O2	O3	O4	O5	O6
O2	69.43*** (1)					
O3	416.95*** (1)	–				
O4	69.34*** (1)	–	–			
O5	418.01*** (2)	348.58*** (1)	1.06 (1)	348.66*** (1)		
O6	417.31*** (2)	347.88*** (1)	0.36 (1)	347.97*** (1)	–	
O7	420.60*** (3)	351.17*** (2)	3.65 (2)	351.25*** (2)	2.59 (1)	3.29* (1)

Table 7 Panel B reports the outcome from likelihood ratio test within seven O score models (See models in Section 3.3). Values are from chi-squared (χ2) and always present the impact from models listed in row to models listed in column (e.g. 69.43 means the impact from model O2 to model O1), and degrees of freedom are in parentheses. – means no outcome due to the same degrees of freedom (likelihood ratio test can only be applied within the nested models).
*** denotes significance is at 0.001 level, ** at 0.01 level and * at 0.1 level.

has been constantly low during the sample period, we use 1% instead as the cut-off percentage of the score distribution, i.e.

$$Probability\ (BANKRUPTCY_{it+2}) = \begin{cases} 1, if\ score \leq 1\%\ of\ distribution \\ 0, if\ score > 1\%\ of\ distribution \end{cases}$$

Table 8 reports the descriptive summary of fourteen models in terms of status two years later, using bankruptcy-score-reclassification. In both Panel A and Panel B, the mean probabilities of all models are different between the two statuses, because gaps between two statuses are enlarged by five to six times through redefining the probability according to 1% cut-off

percentage and are significant at 0.001 level through *t*-test (e.g. average probability calculated through model Z3 is 0.94% in non-distressed firms and 5.22% in bankrupt firms, so the gap is enlarged by 5.5 times). The larger gap implies that more companies which declare bankruptcy after two years are divided into the correct group, consequently, models in Panel B perform better than those in Panel A. The median for both panel is 0, showing the majority companies are not at risk of bankruptcy two years later. 1st percentile and 99th percentile is both 0 for non-distressed companies, which means rather low bankruptcy rate happening in our sample setting. Corresponding to the findings in Table 7, the models with better performance in likelihood ratio test also have larger mean gap between two statuses, which supports our hypotheses 1, 2 and 3.

Total-sample prediction is conducted and illustrated in Table 9. We sort 747,481 firm-year observations by scores from fourteen models ascendingly, then group them into 10 equal size groups. Group 1 embodies firms with the lowest bankrupt risk while group 10 the highest. According to Pencina et al. (2008), any 'upward' movement in categories for event subjects (i.e. those with the event) implies improved classification, and any 'downward movement' indicates worse reclassification. The number of firms declaring bankruptcy in year *t+2* is larger than those in other bankruptcy prediction model papers. In those papers, group 1 sometimes has no firm under some models. However, in our case, 10,369 firm-year observations have declared bankruptcy in year *t+2*, out of total 747,481 firm-year observations. Considering the large sample size, group 1 probably includes more firms than in other papers with smaller sample size. So, instead, we will explore whether the distribution of 10,369 observations goes up when risk increases, i.e. whether the number of observations increase largely when risk level (group number) becomes large.

O score models (O1-O7) predict fewer observations (–40) in group 1 and more in group 10 (+700), compared with Z score models, proving their better predictive power. Higher risk groups (group 8, 9, 10) contain almost 70% of all bankruptcy-to-be-declared firms from O score models, but only 60% are correctly forecast from Z score models. Meanwhile, at most 10% of firms are allocated to lower-risk groups (group 1, 2, 3) from Z score models, while only 7% go to the same groups from O score models. Similarly, O7, O5, O6, O3 are the four best performance models. These conclusions are also consistent with findings reported in other papers mentioned before, but they have better percentage of allocation due to the smaller sample size.

Table 8 – *Descriptive Statistics Summary Using Bankruptcy-Score-Reclassification method*

Panel A: Z Score model and adjusted Z score models

Model	Status	Mean	Median	SD	1st Percentile	99th Percentile
Z1-Probability	Non-distressed	0.948% +	0.00%	9.70%	0.00%	0.00%
	Bankrupt	4.613% +	0.00%	21.00%	0.00%	100.00%
Z2-Probability	Non-distressed	0.900% +	0.00%	9.70%	0.00%	0.00%
	Bankrupt	4.600% +	0.00%	20.90%	0.00%	100.00%
Z3-Probability	Non-distressed	0.940% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.218% +	0.00%	22.20%	0.00%	100.00%
Z4-Probability	Non-distressed	0.948% +	0.00%	9.70%	0.00%	0.00%
	Bankrupt	4.613% +	0.00%	21.00%	0.00%	100.00%
Z5-Probability	Non-distressed	0.939% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.237% +	0.00%	22.30%	0.00%	100.00%
Z6-Probability	Non-distressed	0.939% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.256% +	0.00%	22.30%	0.00%	100.00%
Z7-Probability	Non-distressed	0.939% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.256% +	0.00%	22.30%	0.00%	100.00%

Table 8 Panel A presents the descriptive statistics summary of probability under two scenarios after Bankruptcy-score-reclassification. See more details about the methodology in Section 4.4.2. Z1-Probability is the probability following Bankruptcy-score-reclassification based on Altman's Z Score model (1968). Z2-Probability – Z7-Probability are probabilities following Bankruptcy-score-reclassification based on adjusted Z score models (Z2-Z7). All models are illustrated in Section 3.3.
+ denotes significance level at the 0.001 level.

Panel B: O Score model and adjusted O score models

Model	Status	Mean	Median	SD	1st Percentile	99th Percentile
O1-Probability	Non-distressed	0.934% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.615% +	0.00%	23.00%	0.00%	100.00%
O2-Probability	Non-distressed	0.935% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.521% +	0.00%	22.80%	0.00%	100.00%
O3-Probability	Non-distressed	0.925% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	6.220% +	0.00%	24.20%	0.00%	100.00%
O4-Probability	Non-distressed	0.935% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	5.540% +	0.00%	22.90%	0.00%	100.00%
O5-Probability	Non-distressed	0.925% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	6.220% +	0.00%	24.20%	0.00%	100.00%
O6-Probability	Non-distressed	0.925% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	6.239% +	0.00%	24.20%	0.00%	100.00%
O7-Probability	Non-distressed	0.925% +	0.00%	9.60%	0.00%	0.00%
	Bankrupt	6.239% +	0.00%	24.20%	0.00%	100.00%

Table 8 Panel B presents the descriptive statistics summary of probability under two scenarios after Bankruptcy-score-reclassification. See more details about the methodology in Section 4.4.2. O1-Probability is the probability following Bankruptcy-score-reclassification based on Ohlson's O Score model (1980). O2-Probability – O7-Probability are probabilities following Bankruptcy-score-reclassification based on adjusted O score models (O2-O7). All models are illustrated in Section 3.3.
+ denotes significance level at the 0.001 level.

Table 9 – *Total-Sample Prediction Test: # of Actual Bankruptcy Declaration Firms*

Panel A: Z Score model and adjusted Z score models

Model	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**
Group	count	count	count	count	count	count	count
1 (Low risk)	268	271	245	272	245	245	245
2	327	325	309	326	309	307	307
3	425	413	387	409	388	388	388
4	523	525	509	524	506	508	506
5	682	691	713	699	713	714	708
6	886	872	806	872	805	803	812
7	1041	1042	1071	1038	1071	1081	1078
8	1260	1271	1373	1270	1376	1359	1362
9	1851	1863	1770	1866	1769	1782	1785
10 (High risk)	3106	3096	3186	3093	3187	3182	3178
Total	10369	10369	10369	10369	10369	10369	10369
8+9+10 / total	60%	60%	61%	60%	61%	61%	61%
1+2+3 / total	10%	10%	9%	10%	9%	9%	9%

Table 9 Panel A reports the number of actual future bankruptcy filings in the groups of predicted bankruptcy probabilities. Z1-Probability is the probability following Bankruptcy-score-reclassification based on Altman's Z Score model (1968). Z2-Probability – Z7-Probability are probabilities following Bankruptcy-score-reclassification based on adjusted Z score models (Z2-Z7). All models are illustrated in Section 3.3. Percentage from 8+9+10/total is the percentage of total number of firms in group 8,9,10 divided by total bankruptcy declaration firms (10,369). Percentage from 1+2+3/total is the percentage of total number of firms in group 1,2,3 divided by total bankruptcy declaration firms (10,369).

Panel B: O Score model and adjusted O score models

Model	O1	O2	O3	O4	O5	O6	O7
Group	count	count	count	count	count	count	count
1 (Low risk)	208	206	205	207	204	205	203
2	212	210	208	210	209	209	209
3	299	279	251	279	254	251	252
4	402	407	391	409	387	390	386
5	502	509	486	514	483	484	484
6	679	672	736	670	730	729	731
7	951	963	877	960	894	893	893
8	1367	1379	1404	1361	1405	1403	1408
9	2031	1985	1962	1997	1949	1954	1948
10 (High risk)	3718	3759	3849	3762	3854	3851	3855
Total	10369	10369	10369	10369	10369	10369	10369
8+9+10 / total	69%	69%	70%	69%	70%	70%	70%
1+2+3 / total	7%	7%	6%	7%	6%	6%	6%

Table 9 Panel B reports the number of actual future bankruptcy filings in the groups of predicted bankruptcy probabilities. O1-Probability is the probability following Bankruptcy-score-reclassification based on Ohlson's O Score model (1980). O2-Probability – O7-Probability are probabilities following Bankruptcy-score-reclassification based on adjusted O score models (O2-O7). All models are illustrated in Section 3.3. Percentage from 8+9+10/total is the percentage of total number of firms in group 8,9,10 divided by total bankruptcy declaration firms (10,369). Percentage from 1+2+3/total is the percentage of total number of firms in group 1,2,3 divided by total bankruptcy declaration firms (10,369).

4.4.3 ROC curve and AUC

To add a credibility of our conclusions, we apply an additional test - area under the receiver operating characteristic (ROC) curve (AUC) - to capture the discrimination. AUC varies from 0.5 (no apparent accuracy) to 1.0 (perfect accuracy) as the ROC curve moves towards the left and top boundaries of the ROC graph. If the sample is infinite and outcomes are continuous, the AUC and the probability of a correct ranking are equal. (Hanley & McNeil, 1982, p. 31)

Figure 8[12] is the ROC curve generated from model O3. Area under ROC curve (0.7618) indicates the accuracy of estimation from model O3, compared with the 45-degree straight reference line which represents a random classification model (0.5). The larger area under ROC curve, the better estimation the model can provide. Another advantage of using area under ROC curve is it can help us make better decision as well as balance between sensitivity (correct classification in bankrupt firms) and specificity (correct classification in non-distressed firms). Better models have curves increasing more highly at first because of the better predictive power, but the increase slow down due to the wrong classification number grows. Through the area under the curve (AUC) it is more clear to understand the correct prediction probability in each model.

Table 10 illustrates all models' AUC. All models perform better than random classification because their AUCs are larger than 0.5. Specifically, it proves that in Panel B, O Score models and adjusted O score models in general perform better than counterparts in Panel A, by 5% on average. Models with $BANKR\_DIR_{it}$ predict with higher accuracy, in both Panel A and Panel B. One may say the increased percentage is not high enough, however, even 1% in our sample which stands for 7,000 firms being correctly predicted implies a powerful economic enhancement. These results support the results reported in the tables discussed before.

[12] See Figure 8 in Appendix.

Table 10 – *AUC Comparison*

Panel A: Z Score model and adjusted Z score models

Model	Z1	Z2	Z3	Z4	Z5	Z6	Z7
Area under ROC curve (AUC)	0.7097	0.7103	0.7167	0.7104	0.7167	0.7167	0.7167
Number of observations	747481	747481	747481	747481	747481	747481	747481

Table 10 Panel A reports the area under ROC curve (AUC) for Z score models based on the final sample size (747,481). More explanation on ROC curve and AUC, see Figure 8 and note in appendix.

Panel B: O Score model and adjusted O score models

Model	O1	O2	O3	O4	O5	O6	O7
Area under ROC curve (AUC)	0.7571	0.7580	0.7618	0.7579	0.7618	0.7618	0.7619
Number of observations	747481	747481	747481	747481	747481	747481	747481

Table 10 Panel B reports the area under ROC curve (AUC) for O score models based on the final sample size (747,481). More explanation on ROC curve and AUC, see Figure 8 and note in appendix.

4.5 Robustness checks and additional analyses

4.5.1 Marginal effect analysis

We evaluate the marginal improvements in Z score models and O score models when three explanatory variables are added in, following the methodology outlined by Kallunki and Pyykkö's (2013). With binary independent variables, marginal effects measure discrete change, i.e. how do predicted probabilities change as the binary independent variables ($BANKR\_CEO_{it}$, $BANKR\_CEO\_DIR\_DUAL_{it}$) or continuous independent variable ($BANKR\_DIR_{it}$) changes from 0 to 1. In each model we repeatedly set each of the explanatory variable as either zero or one while keeping other accounting-based variables at average, then generate marginal probabilities respectively. Table 11 in the appendix presents the outcomes. The largest marginal probability is 2.19% in model Z7 when $BANKR\_CEO_{it} = 1$ and $BANKR\_DIR_{it} = 1$, which means when both CEO and all non-deputy directors have negative professional experiences, the predicted probability of bankruptcy in two years is 2.19% greater than all variables are set to 0. $BANKR\_DIR_{it}$ contributes the highest marginal increase in the models when $BANKR\_DIR_{it} = 1$, which is consistent with our finding in Table 5 and Table 6. All marginal effects are statistically significant. Moreover, the multicollinearity (Section 4.5.4) between $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ decreases the effectiveness of the model, seen from smaller percentages generated when both $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ are equal to 1.

4.5.2 Macroeconomic environment

Another important factor is from macro environment. An enterprise, which has a high systematic risk corresponding to macroeconomic conditions, e.g., growth of industrial production, inflation, changes in interest rates, and changes in money supply (M2), may be exposed to the possibility of financial distress (Tirapat & Nittayagasetwat, 1999). However, it is difficult to analyze how macroeconomic environment exerts impact on firms in a firm-year pooled database. So we separate four years' observations and analyze them individually by year. Taking the financial crisis happening in 2008 into consideration, we select 2007, 2009, and the latest two years 2012 and 2014.[13] Our expectation is that performances of different models can be affected by macroeconomic factors, but whether three hypotheses can be still supported in

[13] For 2007, 2009, 2012 and 2014: GDP is 3,297 billion SEK, 3,289 billion SEK, 3,685 billion SEK and 3,937 billion SEK respectively. GDP growth rate is 6%, –3%, 1% and 4% respectively. Average yearly interest rate is 3.46%, 0.65%, 1.46% and 0.46% respectively.

individual years is not sure. So we use each of four years to run fourteen models, and draw several interesting findings from untabulated outcomes. Overall, our models with three explanatory variables still perform better, which means three hypotheses are supported regardless of macroeconomic factors, even though macroeconomic factors do have an impact on the magnitude of explanatory variables and some accounting-based variables.

First of all, we find that models Z5-Z7/O5-O7 and Z3/O3 which include $BANKR\_DIR_{it}$ perform better (through untabulated likelihood ratio test), which is consistent with the outcomes found previously. Second, consistent with conclusions from previous pooled data, $BANKR\_DIR_{it}$ displays highest statistical significance in the models compared with other two explanatory variables. In particular, the coefficients are highest in 2007, then decrease in 2009 and slowly increase in 2012 and 2014. The coefficients of $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ also show decrease at year 2009 with less magnitude. We find the coefficients are correlated with GDP growth rate, so one possible explanation is during 'bad times' such as financial crisis, macro factors have more straightforward impacts on firm's bankruptcy. However, the directors' and top executives' past negative experience still have impact on firms' future, though the magnitudes is weakened by the surrounding economic factors.

As for other accounting ratios, we compare Z score models and O score models with single years and with all years. Among Z score models, RE_TA_{it} becomes significantly negative in 2009 while in other single years and models it is insignificant. It implies that during downward economic cycle, firms have worse financial situation are prone to bankruptcy, while in other stages of economic cycle bankruptcy is more likely attributed to unproductive strategy or lacking monitoring from top executives. Accordingly, in each of seven O score models, $NITWO_{it}$ also has the highest and statistically significant coefficients, which proves that macroeconomic environment has an impact on the accounting ratios, thus affect the outcomes from individual years.

4.5.3 Consolidated and individual firms

Our sample size after several filtering criteria has 747,781 firm-year observations (Table 1C), including both consolidated-firm-year observations (40,987) and single-firm-year observations (706,494). Since consolidated corporations usually break down group structure into separate legal entities and exist in individual form several years before bankruptcy declaration, we suppose the consolidated firms and individual firms are different in terms of financial information magnitude. In this part we explore the difference in terms of 16 variables between

consolidated and individual firms, by calculating yearly average value of 16 variables, up to 16 years prior to either the bankruptcy declaration years for bankrupt firms, or the end of existing fiscal year for non-distressed firms.

For three explanatory variables, the mean of $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ is two times higher in consolidated firms than in individual firms, and shows no difference in either healthy or distressed firms until two years prior to bankruptcy declaration years for bankrupt firms, or the end of existing fiscal year. Both variables present larger mean from two years prior to bankruptcy declaration, which is consistent with what we find in final sample. For $BANKR\_DIR_{it}$, it does not display large difference. Among 13 accounting-based variables, consolidated firms usually have larger economies of scale, therefore, variables with retained earnings, EBIT and size are larger on average. But it is more difficult for consolidated firms to maintain increased growth, so the mean of growth-related variables is smaller than single firms. Additionally, large firms present more steady changes in non-distressed firms among those 16 years. Conversely, for consolidated firms eventually go bankruptcy, the 16-year changes present more dramatically fluctuations since it is impossible to pursue a turnaround as flexible as individual and smaller-size firms do, in the economic environment. Overall, although consolidated firms perform differently in magnitude as individual firms do, due to same-direction fluctuations in most variables, the performance of the combined database show consistency with both consolidated and individual firms, which lays a reliable foundation for our analysis.

4.5.4 Multicollinearity

We examine and prove $BANKR\_CEO_{it}$ and $BANKR\_CEO\_DIR\_DUAL_{it}$ are multicollinear. If multicollinearity exists, the coefficients of these two variables can be summed up, and the combined variable can be replaced by the role of $BANKR\_CEO\_DIR\_DUAL_{it}$ only since it contains more factors. To prove, in model Z7 (See Table 5), –0.010 as the coefficient of $BANKR\_CEO\_DIR\_DUAL_{it}$ can be obtained by adding up 0.207 for $BANKR\_CEO_{it}$ and –0.217 for $BANKR\_CEO\_DIR\_DUAL_{it}$. So does in model O7 (See Table 6) where 0.021 = 0.240 + (–0.219). $BANKR\_CEO_{it}$ becomes the decisive factor for the $BANKR\_CEO\_DIR\_DUAL_{it}$. Since the $BANKR\_CEO\_DIR\_DUAL_{it}$ includes both effects from IBE CEO and IBE directors, the merged effect eventually reflects in the $BANKR\_CEO\_DIR\_DUAL_{it}$ only, thus model Z7/O7 is actually same with model Z6/O6. As we find in previous sections, multicollinearity does affect the outcome of our models by weakening both variables' impact to overall effect, but not affect the performance of $BANKR\_DIR_{it}$.

5 Discussion

To answer the research question, i.e., whether appointing CEOs and directors with previous bankruptcy experience increases the likelihood of bankruptcy of the subsequent firm, three hypotheses are proposed:

Hypothesis 1: A CEO's past bankruptcy experience is positively associated with the likelihood of the future bankruptcy of the firm.

Hypothesis 2: The proportion of directors with past bankruptcy experience on the board is positively associated with the likelihood of the future bankruptcy of the firm.

Hypothesis 3: Appointing a CEO and at least one director with past bankruptcy experience on the board is positively associated with the likelihood of the future bankruptcy of the firm.

Three explanatory variables are generated from each hypotheses and incorporated into Z Score and O Score models. We test three hypotheses on a large sample of Swedish limited liability private firms, and find that all statistical results and significant improvements provide support to the three hypotheses. In general, Swedish private limited liability firms which declared bankruptcy two years later have more IBE CEOs and higher proportion of IBE directors, and present worse profitability, liquidity and growth. Particularly, more IBE directors on the board increase the highest probability of bankruptcy two years later. As for models, O score models capture more information so have better predictions. Our adjusted O score models with IBE information can be easily adopted by debtholders and investors to evaluate the firms' health status after two years.

Different from IBE individuals who had served in both private and public bankrupt firms, only private firms are selected as our research objects. On one hand, private firms are not as exposed to public scrutiny as their listed counterparts. On the other hand, CEOs and directors play a more significant role in private firms by owning substantial parts of the companies compared with their counterparts in public firms. CEOs and directors can either improve the corporate governance due to less agency cost, or impair the situation due to abuse of funds. However, from our statistical outcomes, we find that such IBE individuals will only impair the subsequent firms, which can be explained by both managerial overconfidence and reputation cost mechanisms.

The positive effect of bankruptcy experience on future bankruptcy declaration can be explained by managerial overconfidence. Top executives and directors with managerial overconfidence

are prone to make risky decisions, which increases the probability of bankruptcy in the firms they subsequently join in. This could be driven either by overestimating their ability to predict the future or by underestimating the volatility of random events. Therefore, IBE individuals usually make riskier decisions such as overborrowing or overconfident strategic plans which will not achieve the desired outcomes and lead to distress eventually. It is supported by higher leverage and lower profits or retained earnings appearing in financial reports from bankruptcy firms, compared with financial situations in non-distressed firms. Although private limited liability firms are deemed to have more flexibility in a turnaround, an IBE individual who has managerial confidence will hardly change his/her mind on sticking to the previous strategies until it is too late. Hence, significantly positive linkages are found between IBE individuals and bankruptcy in the future.

Those who have bankruptcy declaration experiences also have to undertake reputation loss, which is referred to the reputation cost mechanism. Though unavoidable loss happened in IBE individuals' career, statistical results prove that the managerial decisions in subsequent firms made by those individuals are still risky (higher leverage and lower accumulated profit) and probably lead to bankruptcy in the future. We argue that CEOs and directors with past bankruptcy involvements may concern about their reputation due to potential loss. Thus, such CEOs and directors attempt to conduct beneficial decisions and policies to fix their reputation. But meanwhile, their inherent biases, i.e., managerial overconfidence, still exist and cannot be changed easily, which will continue affecting the decision-making process either consciously or unconsciously. Therefore, it is reasonable to argue that overconficent CEOs and directors will still be prone to risky decisions, even though they intend to redeem their reputation.

Moreover, more directors with such negative experiences in board have saliently stronger relationship with the bankruptcy declaration two years later. We think it can be explained by CEO's decreased involvement in management. Boards can extend their involvement beyond monitoring to the provision of ongoing advice and counsel on strategic issues (Westphal, 1999, p. 9). Instead of analyzing the impact from individual IBE directors towards firms' future, we regard directors in board as a whole, and find that under reputation cost mechanism, higher density of IBE directors in the board will probably create a "cluster effect" – they will not only monitor CEO's behaviors, but also highly participate in the decision-making process, in order to quickly increase shareholders' value or achieve investors' financial targets. From managerial overconfidence's point of view, active involvements from high proportion of directors probably increase the riskier decisions linking to future bankruptcy. Unavoidably, CEO's involvement

in decision-making process is directly replaced, especially when both parties have the same targets.

All three hypotheses are supported by robustness checks. IBE individuals and IBE duality present similar trends as they performed in the final sample (747,481), but the proportion of directors is positively correlated with possibility of future bankruptcy declaration receives the most support from robust tests.

6 Conclusion

6.1 Conclusion

In this paper, we attempt to explore the impact of CEOs' and directors' past professional experience on the future corporate outcomes. Specifically, we hypothesize that appointing CEOs and directors with previous bankruptcy experience is positively associated with the likelihood of the bankruptcy of the firm they join in subsequently. Our hypotheses draw on the upper echelons theory (Hambrick & Mason, 1984). The upper echelons theory indicates that organizational outcomes can be regarded as the reflections of executives' and directors' psychological dimensions in the organization. Prior studies justify using observable characteristics such as previous experience, especially past bankruptcy experience, as proxies for cognitive elements to examine the effect of CEOs and directors on corporate performance. Furthermore, we introduce two distinct effects of prior bankruptcy exposures on executives and directors to generate the hypotheses. On one hand, CEOs' and directors' innate managerial overconfidence will not only account for the past adverse experience, but also affect the outcomes of the future firms. On the other hand, past bankruptcy involvements are likely to undermine the reputation of CEOs and directors, which may hence lead to deteriorating business environment and executives' and directors' incentives. Both aspects imply that CEOs' and directors' past bankruptcy experience will increase the probability of the bankruptcy of the future firm.

Given the context of the research question, we select Swedish private limited liability, non-financial and "not small" firms. Thereby, 747,481 firm-year observations with 94,903 distinct firms from 1999 to 2014 are used to test our hypotheses, including 10,369 filings for bankruptcy in year *t+2* and 737,112 non-bankrupt records in year *t+2*. By adding three explanatory variables to Altman's (1968) and Ohlson's (1980) model, we estimate and compare the intercepts and coefficients of both original and adjusted bankruptcy prediction models. Additional tests such as likelihood ratio test, bankruptcy-score-reclassification, out-of-sample prediction and ROC curve are applied to investigate the performance of fourteen different bankruptcy predicting models.

Empirical results indicate that CEOs' and directors' past bankruptcy experience are positively associated with the probability of bankruptcy of the firm they join in subsequently, which supports the hypotheses developed in Section 2.5. In particular, the proportion of directors with previous bankruptcy exposures on the board is the best predictor of future bankruptcy among

the three explanatory variables. Additionally, we find that incorporating the information on CEOs' and directors' past professional bankruptcy experience can enhance the predictive power of the bankruptcy forecasting models (Altman, 1968; Ohlson, 1980). Specifically, the results in the likelihood ratio test suggest that the bankruptcy prediction models containing the proportion of directors with previous bankruptcy involvements on the board, i.e., Z3 and O3 models, perform best, as indicated by the lowest chi-squared ($\chi 2$) value. Besides, bankruptcy-score-reclassification test implies that in general, O score models (O1 – O7) have a better classification performance than Z score models (Z1 – Z7), as O score model allocate 70% bankrupt firms into the high risk group, while Z score models predict only 60% on average. The ROC curves and comparisons of AUC present the similar implications. Furthermore, the significantly positive association between CEOs' and directors' past bankruptcy experience and future bankruptcy risk supports the arguments of both managerial overconfidence mechanism and reputation cost mechanism.

6.2 Contribution

This research contributes to the literature in the following respects. First, this paper provides insights into the underlying risks of appointing CEOs and directors with past adverse professional involvements. On one hand, our research is consistent the upper echelons theory (Hambrick & Mason, 1984). The upper echelons theory indicates that organizational outcomes can be predict by the psychological traits of powerful individuals in the organization, and establishes that observable characteristics can be used as agents to explore this issue. We propose and test the effect of prior bankruptcy experience on future bankruptcy risk. Besides, this paper validates past professional bankruptcy experience as a proxy for managerial characteristics to predict organizational outcomes. On the other hand, empirical results in this paper suggest that including the information on CEOs' and directors' past professional experience can enhance the predictive power and classification performance of bankruptcy forecasting models (Altman, 1968; Ohlson, 1980). Therein, we note that the proportion of such directors on the board contributes the most to updating the models. Both aspects imply that relevant decision makers, such as investors or creditors, need to take into account the past professional experience of company executives and directors to avoid potential bankruptcy risks.

Additionally, the majority of existing studies focus on public firms where information is accessible to date. To the best of our knowledge, this study is the first to investigate whether the appointment of CEOs and directors with past professional bankruptcy experience increases

the likelihood of bankruptcy in the setting of Swedish private sector. Therefore, this paper also contributes to the literature by filling the academic gap in this field.

6.3 Limitation

This paper focuses on the cumulative effect from IBE individuals on the outcomes of the firms they subsequent join in, so identifying the initial bankruptcy experience (IBE) and bankruptcy experience starting point (BESP) of each person are essential to the outcome. However, we find that IBE and BESP in our setting are sensitive to the data accuracy, thus unavoidably limiting interpretation and application of our research findings.

Firstly, we believe the timespan of all top executives' and directors' experiences may affect determining the BESP. The complemented top executives' database mentioned in Section 3.1 include 5 million observations, ranging from 1993 to 2016. Due to the short timespan of database, we believe a few individuals who had IBE earlier than 1993 are not marked as IBE individuals in our final sample because they never had a bankruptcy experience over 24 years. Some may be marked as IBE individuals after 1993 but their BESPs might not be accurate. So the number of IBE individuals may be underestimated thus affecting both bankrupt and non-distressed firms.

Another limitation comes from the coverage of individual's experiences. Although a careful check has been done to ensure none of 5 million observations is duplicated and to ensure top executives' and directors' information are correct through sampling, we cannot conduct a full check on the correctness of each piece of information due to the large sample size. So we believe the absence of completed executive and board information in some firms may exist. Because of the absence, the composition of board of directors might not be accurate. This limitation can either overestimate or underestimate the effect from the board of directors towards both bankrupt and non-distressed firms.

Additionally, the research design leaves room for reverse causality. The emipirical evidence presents a significantly positive association between past bankruptcy experience of CEOs and directors, and future bankruptcy risk. Besides, the paper provides two potential explanations for how past experience affects the future, i.e., managerial overconfidence mechanism and reputation cost mechanism. However, the direction of causality can also be reverse. To illustrate, one may also argue that such positive relation indicates that it is risk-taking firms or those in poor financial condition that tend to seek managers and directors with risk-taking management to pursue lucrative but risky strategies, or to survive the upcoming distress. Past failure

experience can be regarded as a proxy for risk-taking manner. Thus, the research design of this paper cannot provide more support for the direction of causality, which deserves attention from future research.

6.4 Areas for future research

Interesting findings from this paper help fill the gap that no previous paper has examined how individuals with previous bankruptcy experience affect the subsequent firms' future with regards to bankruptcy probability and performance. But findings are sensitive to assumptions so future research can explore whether the results are sensitive to moderating some of the assumptions, at least from three aspects.

Firstly, we think the criteria of selection IBE individuals and their BESPs can be redefined based on different assumptions. Assumptions used in Section 3.2 are for narrowing the scope and ensuring the consistency, so the findings of this study are only limited to these assumptions (e.g., two-year limitation and one-year "infectious period"). Generally speaking, our assumptions are related to legislative aspects, so further research can test other assumptions such as loan maturity (du Jardin, 2017), and examine the linkage between these assumptions and outcomes. Besides, further research can expand the range of the complemented top executives' database to enhance the reliability of three explanatory variables.

Secondly, we suggest a more detailed classificaion in the board of directors to explore the possible outcomes. We assume that all directors have same impact to the outcome of firms regardless of any managerial or personal traits, so further research can investigate whether these traits such as external or internal directors have different impact on firms' furture. Baysinger and Butler (1985) suggested that outside directors serve primarily to exercise control and that inside directors are the main source of advice on strategic issues. Together with other personal traits (upper echelons theory), further research can explore whether our findings still hold in the same setting.

Besides, emipirical evidence indicates a positive association between past bankruptcy experience of CEOs and directors, and future bankruptcy probability, while future studies can look into the causality, i.e., whether it is the case that IBE CEOs and directors increase the future bankruptcy risk, or that risk-seeking firms search for risk-taking managers and directors. Apart from quantitative methods, qualitative approaches such as questionaires and interviews, can be combined to explore the reality and the causality throughly.

Lastly, empirical results in this paper support that CEOs' and directors' past bankruptcy experience exerts negative impacts on corporate performance of the future firm. We introduce two distinct mechanisms to illustrate how bankruptcy experience affects CEOs and directors, and hence influences corporate outcomes, i.e., managerial overconfidence mechanism and reputation cost mechanism. Future research could step further to explore the effects of previous bankruptcy experience on executives and directors. Specifically, subsequent scholars could investigate which mechanism dominates in this issue. Besides, more potential mechanisms are open to discussions.

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Appendix:

Figure 8 – *ROC Curve and AUC*

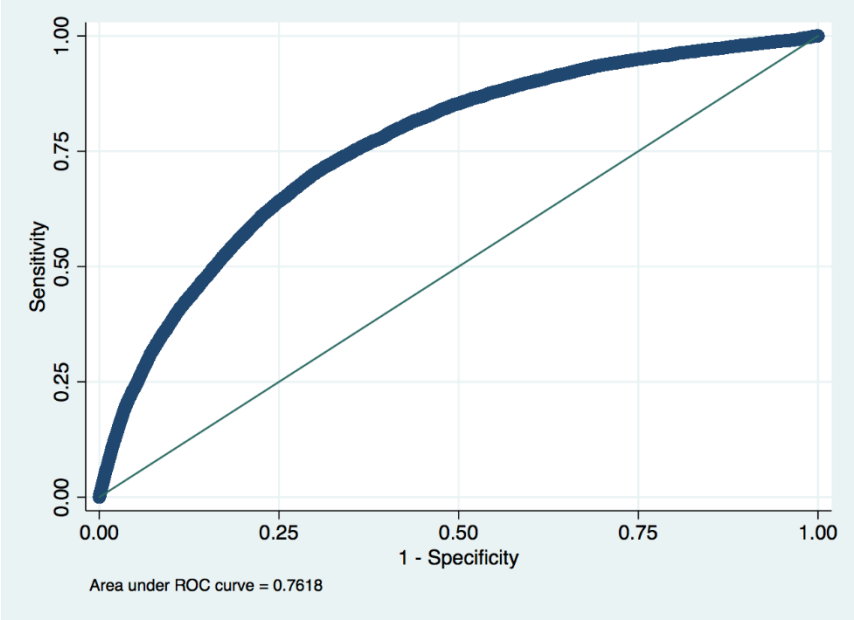

Figure 8 is exported from Stata. It illustrates the area under ROC curve from our model O3 (0.7618) and the 45-degree straight reference line from random selection model. The y-axis stands for sensitivity while x-axis for 1–specificity. Sensitivity measures the proportion of $BANKRUPTCY_{it+2} = 1$ that are correctly identified as bankrupt firms which actually will declare bankruptcy in year $t+2$, while specificity measures the proportion of $BANKRUPTCY_{it+2} = 0$ that are correctly identified as non-distressed firms. So y-axis, i.e. sensitivity here represents 1 - Type I classification error, and x-axis, i.e. 1–specificity equals to Type II classification error. In bankruptcy setting, the Type II classification error, for example falsely classifying a high-risk firm as non-distressed firm, is costlier than incorrectly classifying a healthy firm into distressed group. The more ROC curve bends to the upper left of the graph (higher sensitivity and lower 1–specificity), the better the predicted model will be. Therefore, using area under ROC curve can help us make better decision when classifications ignore the trade-offs between sensitivity and specificity.

Table 11 – *Marginal Effect Analysis*

Model	Margin – Z score models	Model	Margin – O score models	*(1)*	*(2)*	*(3)*
Z1	1.10%	O1	1.03%	X	X	X
Z2	1.07%	O2	1.00%	0	X	X
	1.40%		1.31%	1	X	X
Z3	0.94%	O3	0.91%	X	0	X
	1.78%		1.56%	X	1	X
Z4	1.07%	O4	1.00%	X	X	0
	1.41%		1.32%	X	X	1
Z5	0.94%	O5	0.91%	0	0	X
	1.78%		1.54%	0	1	X
	0.94%		0.94%	1	0	X
	1.78%		1.59%	1	1	X
Z6	0.94%	O6	0.91%	X	0	0
	0.93%		0.93%	X	0	1
	1.78%		1.54%	X	1	0
	1.77%		1.58%	X	1	1
Z7	0.94%	O7	0.91%	0	0	0
	0.76%		0.73%	0	0	1
	1.44%		1.25%	0	1	1
	1.78%		1.55%	0	1	0
	1.15%		1.15%	1	0	0
	0.93%		0.92%	1	0	1
	2.19%		1.96%	1	1	0
	1.77%		1.58%	1	1	1

Table 11 examines the marginal effect of each model when setting three explanatory variables (see definitions in Table 12 in appendix) accordingly as 1 or 0.
(1) represents $BANKR\_CEO_{it}$, *(2)* represents $BANKR\_DIR_{it}$, *(3)* represents $BANKR\_CEO\_DIR\_DUAL_{it}$. X means no such variable existing in the model, while 1 or 0 indicates that three explanatory variables are set as 1 (maximum) or 0 (minimum) accordingly.

Table 12 – *Variables Description*

Variable Name	Variable Description
	Dependent variable
$BANKRUPTCY_{it+2}$	An indicator variable for firms' bankruptcy filing record. It equals to one if firm *i* has a bankruptcy filing in the year *t+2*, otherwise it is zero.
	Explanatory variables
$BANKR\_CEO_{it}$	An indicator variable to represent whether firm *i* appoints an IBE CEO. If firm *i* has an IBE CEO in year *t,* it will be one, otherwise it is zero.
$BANKR\_DIR_{it}$	A variable to represent the proportion of IBE directors on the board of firm *i* in year *t*, i.e. IBE directors / total non-deputy directors.
$BANKR\_CEO\_DIR\_DUAL_{it}$	An indicator variable to represent whether firm *i* appoints an IBE CEO and at least one IBE director on the board. If firm *i* has both an IBE CEO and at least one IBE director on the board in year *t,* it equals to one, otherwise it is zero.
	Independent variables
WC_TA_{it}	The ratio of working capital divided by total assets of firm *i* in year *t.*
RE_TA_{it}	The ratio of retained earnings (or accumulated profit or loss) divided by total assets of firm *i* in year *t.*
$EBIT\_TA_{it}$	The ratio of earnings before interest and taxes (or the operating profit/loss) divided by total assets of firm *i* in year *t.*
BV_TL_{it}	The ratio of book value of equity divided by total liabilities of firm *i* in year *t.*
$SALES\_TA_{it}$	The ratio of net sales divided by total assets of firm *i* in year *t.*
$SIZE_{it}$	The variable calculated as *ln*(Total Assets/GDP price-level index) of firm *i* in year *t.* Total assets are measured in SEK. GDP price-level index is based on the year prior to the year of the balance sheet date.
TL_TA_{it}	The ratio of total liabilities divided by total assets of firm *i* in year *t.*
CL_CA_{it}	The ratio of current liabilities divided by current assets of firm *i* in year *t.*
$OENEG_{it}$	An indicator variable to capture the liability information. If the total liabilities are larger than total assets of firm *i* in year *t,* it will be one, otherwise it is zero.
NI_TA_{it}	The ratio of net income (or profit/loss for the year) divided by total assets of firm *i* in year *t.*
FFO_TL_{it}	The ratio of funds from operations, i.e. EBITDA, minus net interest expense and current tax expense, divided by total liabilities of firm *i* in year *t.*
$NITWO_{it}$	An indicator variable to demonstrate the cumulative net income of firm *i*. If the cumulative net income over the past two years of firm *i* in year t is negative, it will be one, otherwise it is zero.
$CHIN_{it}$	An indicator intended to measure the change in net income. It is calculated as $[(NI_t - NI_{t-1})/(\|NI_t\| + \|NI_{t-1}\|)]$ of firm *i* in year *t.*